

axiomTM



The 30 Year Horizon

<i>Manuel Bronstein</i>	<i>William Burge</i>	<i>Timothy Daly</i>
<i>James Davenport</i>	<i>Michael Dewar</i>	<i>Martin Dunstan</i>
<i>Albrecht Fortenbacher</i>	<i>Patrizia Gianni</i>	<i>Johannes Grabmeier</i>
<i>Jocelyn Guidry</i>	<i>Richard Jenks</i>	<i>Larry Lambe</i>
<i>Michael Monagan</i>	<i>Scott Morrison</i>	<i>William Sit</i>
<i>Jonathan Steinbach</i>	<i>Robert Sutor</i>	<i>Barry Trager</i>
<i>Stephen Watt</i>	<i>Jim Wen</i>	<i>Clifton Williamson</i>

Volume 5: Axiom Interpreter

Contents

1	Credits	1
1.0.1	defvar \$credits	1
2	The Interpreter	5
3	The Fundamental Data Structures	7
3.1	The global variables	7
3.1.1	defvar \$current-directory	7
3.1.2	defvar \$current-directory	7
3.1.3	defvar \$defaultMsgDatabaseName	8
3.1.4	defvar \$defaultMsgDatabaseName	8
3.1.5	defvar \$directory-list	8
3.1.6	defvar \$directory-list	8
3.1.7	defvar \$InitialModemapFrame	9
3.1.8	defvar \$InitialModemapFrame	9
3.1.9	defvar \$library-directory-list	9
3.1.10	defvar \$library-directory-list	9
3.1.11	defvar \$msgDatabaseName	9
3.1.12	defvar \$msgDatabaseName	10
3.1.13	defvar \$openServerIfTrue	10
3.1.14	defvar \$openServerIfTrue	10
3.1.15	defvar \$relative-directory-list	10
3.1.16	defvar \$relative-directory-list	11
3.1.17	defvar \$relative-library-directory-list	11
3.1.18	defvar \$relative-library-directory-list	11
3.1.19	defvar \$spadroot	11
3.1.20	defvar \$spadroot	12
3.1.21	defvar \$SpadServer	12
3.1.22	defvar \$SpadServer	12
3.1.23	defvar \$SpadServerName	12
3.1.24	defvar \$SpadServerName	13

4	Starting Axiom	15
4.1	Variables Used	15
4.2	Data Structures	15
4.3	Functions	15
4.3.1	Set the restart hook	15
4.3.2	restart function (The restart function)	16
4.3.3	defun Non-interactive restarts	18
4.3.4	defun The startup banner messages	19
4.3.5	defun Make a vector of filler characters	20
4.3.6	Starts the interpreter but do not read in profiles	20
4.3.7	defvar \$quitTag	20
4.3.8	defun runspad	21
4.3.9	defun Reset the stack limits	21
5	Handling Terminal Input	23
5.1	Streams	23
5.1.1	defvar \$curinstream	23
5.1.2	defvar \$curoutstream	23
5.1.3	defvar \$errorinstream	23
5.1.4	defvar \$erroroutstream	24
5.1.5	defvar \$*eof*	24
5.1.6	defvar \$*whitespace*	24
5.1.7	defvar \$InteractiveMode	24
5.1.8	defvar \$boot	25
5.1.9	Top-level read-parse-eval-print loop	25
5.1.10	defun ncIntLoop	25
5.1.11	defvar \$intTopLevel	26
5.1.12	defvar \$intRestart	26
5.1.13	defun intloop	26
5.1.14	defvar \$ncMsgList	27
5.1.15	defun SpadInterpretStream	27
5.1.16	defvar \$promptMsg	28
5.1.17	defun GCL cmpnote function	28
5.1.18	defvar \$newcompErrorCount	28
5.1.19	defvar \$nopus	28
5.2	The Read-Eval-Print Loop	30
5.2.1	defun intloopReadConsole	30
5.3	Helper Functions	31
5.3.1	Get the value of an environment variable	31
5.3.2	defvar \$intCoerceFailure	32
5.3.3	defvar \$intSpadReader	32
5.3.4	defun InterpExecuteSpadSystemCommand	32
5.3.5	defun ExecuteInterpSystemCommand	33
5.3.6	defun Handle Synonyms	33
5.3.7	defun Synonym File Reader	33
5.3.8	defun init-memory-config	34

5.3.9	Set spadroot to be the AXIOM shell variable	35
5.3.10	Does the string start with this prefix?	36
5.3.11	defun Interpret a line of lisp code	36
5.3.12	Get the current directory	36
5.3.13	Prepend the absolute path to a filename	36
5.3.14	Make the initial modemap frame	37
5.3.15	defun nloopEscaped	37
5.3.16	defun intloopProcessString	37
5.3.17	defun nloopParse	38
5.3.18	defun next	38
5.3.19	defun next1	38
5.3.20	defun incString	39
5.3.21	Call the garbage collector	39
5.3.22	defun reroot	40
5.3.23	defun setCurrentLine	41
5.3.24	Show the Axiom prompt	42
5.3.25	defvar \$frameAlist	43
5.3.26	defvar \$frameNumber	43
5.3.27	defvar \$currentFrameNum	43
5.3.28	defvar \$EndServerSession	43
5.3.29	defvar \$NeedToSignalSessionManager	44
5.3.30	defvar \$sockBufferLength	44
5.3.31	READ-LINE in an Axiom server system	44
5.3.32	defun protectedEVAL	47
5.3.33	defvar \$QuietCommand	47
5.3.34	defun executeQuietCommand	47
5.3.35	defun parseAndInterpret	48
5.3.36	defun parseFromString	48
5.3.37	defvar \$interpOnly	49
5.3.38	defvar \$miniVectorNames	49
5.3.39	defvar \$domPvar	49
5.3.40	defun processInteractive	49
5.3.41	defvar \$ProcessInteractiveValue	52
5.3.42	defvar \$HTCompanionWindowID	52
5.3.43	defun processInteractive1	52
5.3.44	defun interpretTopLevel	53
5.3.45	defvar \$genValue	53
5.3.46	defun Type analyzes and evaluates expression x, returns object	54
5.3.47	defun Dispatcher for the type analysis routines	54
5.3.48	defun interpret2	55
5.3.49	defun Result Output Printing	56
5.3.50	defun printStatisticsSummary	57
5.3.51	defun printStorage	58
5.3.52	defun printTypeAndTime	58
5.3.53	defun printTypeAndTimeNormal	59
5.3.54	defun printTypeAndTimeSaturn	60

5.3.55	defun printAsTeX	61
5.3.56	defun sameUnionBranch	61
5.3.57	defun msgText	61
5.3.58	defun Right-justify the Type output	62
5.3.59	defun Destructively fix quotes in strings	62
5.3.60	Include a file into the stream	63
5.3.61	defun intloopInclude0	63
5.3.62	defun intloopProcess	64
5.3.63	defun intloopSpadProcess	64
5.3.64	defun intloopSpadProcess,interp	65
5.3.65	defun phParse	66
5.3.66	defun phIntReportMsgs	66
5.3.67	defun phInterpret	67
5.3.68	defun intInterpretPform	67
5.3.69	defun zeroOneTran	68
5.3.70	defun ncConversationPhase	68
5.3.71	defun ncConversationPhase,wrapup	68
5.3.72	defun ncError	69
5.3.73	defun intloopEchoParse	69
5.3.74	defun nclloopPrintLines	70
5.3.75	defun mkLineList	70
5.3.76	defun nonBlank	71
5.3.77	defun nclloopDQlines	71
5.3.78	defun poGlobalLinePosn	72
5.3.79	defun streamChop	72
5.3.80	defun nclloopInclude0	73
5.3.81	defun incStream	73
5.3.82	defun incRenumber	74
5.3.83	defun incZip	74
5.3.84	defun incZip1	74
5.3.85	defun incIgen	75
5.3.86	defun incIgen1	75
5.3.87	defun incRenumberLine	75
5.3.88	defun incRenumberItem	76
5.3.89	defun incHandleMessage	76
5.3.90	defun incLude	76
5.3.91	defmacro Rest	77
5.3.92	defvar \$Top	77
5.3.93	defvar \$IfSkipToEnd	77
5.3.94	defvar \$IfKeepPart	77
5.3.95	defvar \$IfSkipPart	78
5.3.96	defvar \$ElseifSkipToEnd	78
5.3.97	defvar \$ElseifKeepPart	78
5.3.98	defvar \$ElseifSkipPart	78
5.3.99	defvar \$ElseSkipToEnd	78
5.3.100	defvar \$ElseKeepPart	79

5.3.101 defvar \$Top?	79
5.3.102 defvar \$If?	79
5.3.103 defvar \$Elseif?	79
5.3.104 defvar \$Else?	80
5.3.105 defvar \$SkipEnd?	80
5.3.106 defvar \$KeepPart?	80
5.3.107 defvar \$SkipPart?	81
5.3.108 defvar \$Skipping?	81
5.3.109 defun incLude1	81
5.3.110 defun xlPrematureEOF	86
5.3.111 defun xlMsg	86
5.3.112 defun xlOK	86
5.3.113 defun xlOK1	86
5.3.114 defun incAppend	87
5.3.115 defun incAppend1	87
5.3.116 defun incLine	87
5.3.117 defun incLine1	88
5.3.118 defun inclmsgPrematureEOF	88
5.3.119 defun theorigin	88
5.3.120 defun porigin	88
5.3.121 defun ifCond	89
5.3.122 defun xlSkip	89
5.3.123 defun xlSay	89
5.3.124 defun inclmsgSay	90
5.3.125 defun theid	90
5.3.126 defun xlNoSuchFile	90
5.3.127 defun inclmsgNoSuchFile	91
5.3.128 defun thefname	91
5.3.129 defun pfname	91
5.3.130 defun xlCannotRead	91
5.3.131 defun inclmsgCannotRead	92
5.3.132 defun xlFileCycle	92
5.3.133 defun inclmsgFileCycle	92
5.3.134 defun xlConActive	93
5.3.135 defun inclmsgConActive	93
5.3.136 defun xlConStill	94
5.3.137 defun inclmsgConStill	94
5.3.138 defun xlConsole	94
5.3.139 defun inclmsgConsole	94
5.3.140 defun xlSkippingFin	95
5.3.141 defun inclmsgFinSkipped	95
5.3.142 defun xlPrematureFin	95
5.3.143 defun inclmsgPrematureFin	95
5.3.144 defun assertCond	96
5.3.145 defun xlIfSyntax	96
5.3.146 defun inclmsgIfSyntax	97

5.3.147 defun xIfBug	97
5.3.148 defun inclmsgIfBug	97
5.3.149 defun xlCmdBug	98
5.3.150 defun inclmsgCmdBug	98
5.3.151 defvar \$incCommands	98
5.3.152 defvar \$pfMacros	98
5.3.153 defun incClassify	99
5.3.154 defun incCommand?	100
5.3.155 defun incPrefix?	100
5.3.156 defun incCommandTail	101
5.3.157 defun incDrop	101
5.3.158 defun inclFname	102
5.3.159 defun incFileInput	102
5.3.160 defun incConsoleInput	102
5.3.161 defun incNConsoles	103
5.3.162 defun incActive?	103
5.3.163 defun incRgen	103
5.3.164 defun Delay	103
5.3.165 defvar \$StreamNil	104
5.3.166 defvar \$StreamNil	104
5.3.167 defun incRgen1	104
6 The Token Scanner	105
6.0.168 defvar \$SPACE	105
6.0.169 defvar \$ESCAPE	105
6.0.170 defvar \$STRINGCHAR	105
6.0.171 defvar \$PLUSCOMMENT	106
6.0.172 defvar \$MINUSCOMMENT	106
6.0.173 defvar \$RADIXCHAR	106
6.0.174 defvar \$DOT	106
6.0.175 defvar \$EXPONENT1	107
6.0.176 defvar \$EXPONENT2	107
6.0.177 defvar \$CLOSEPAREN	107
6.0.178 defvar \$QUESTION	107
6.0.179 defvar \$scanKeyWords	108
6.0.180 defvar \$infgeneric	110
6.0.181 defun lineoftoks	111
6.0.182 defun nextline	112
6.0.183 defun scanIgnoreLine	113
6.0.184 defun constoken	113
6.0.185 defun scanToken	114
6.0.186 defun lfId	115
6.0.187 defun startsComment?	115
6.0.188 defun scanComment	116
6.0.189 defun lfcomment	116
6.0.190 defun startsNegComment?	117

6.0.191 defun scanNegComment	117
6.0.192 defun lfnegcomment	118
6.0.193 defun punctuation?	118
6.0.194 defun scanPunct	118
6.0.195 defun subMatch	119
6.0.196 defun substringMatch	119
6.0.197 defun scanKeyTr	120
6.0.198 defun keyword	121
6.0.199 defun keyword?	121
6.0.200 defun scanPossFloat	121
6.0.201 defun digit?	122
6.0.202 defun lfkey	122
6.0.203 defun spleI	122
6.0.204 defun spleI1	122
6.0.205 defun scanEsc	123
6.0.206 defvar \$scanCloser	125
6.0.207 defun scanCloser?	125
6.0.208 defun scanWord	126
6.0.209 defun scanExponent	126
6.0.210 defun lffloat	127
6.0.211 defmacro idChar?	128
6.0.212 defun scanW	128
6.0.213 defun posend	129
6.0.214 defun scanSpace	129
6.0.215 defun lfspace	130
6.0.216 defun scanString	130
6.0.217 defun lfstring	130
6.0.218 defun scanS	131
6.0.219 defun scanTransform	132
6.0.220 defun scanNumber	132
6.0.221 defun rdigit?	133
6.0.222 defun lfinteger	133
6.0.223 defun lfrinteger	134
6.0.224 defun scanCheckRadix	134
6.0.225 defun scanEscape	135
6.0.226 defun scanError	135
6.0.227 defun lfferror	135
6.0.228 defvar \$scanKeyTable	136
6.0.229 defun scanKeyTableCons	136
6.0.230 defvar \$scanDict	137
6.0.231 defun scanDictCons	137
6.0.232 defun scanInsert	138
6.0.233 defvar \$scanPun	139
6.0.234 defun scanPunCons	139

7 Input Stream Parser	141
7.0.235 defun Input Stream Parser	141
7.0.236 defun npItem	142
7.0.237 defun npItem1	142
7.0.238 defun npFirstTok	143
7.0.239 defun Push one item onto \$stack	143
7.0.240 defun Pop one item off \$stack	144
7.0.241 defun Pop the second item off \$stack	144
7.0.242 defun Pop the third item off \$stack	144
7.0.243 defun npQualDef	145
7.0.244 defun Advance over a keyword	145
7.0.245 defun Advance the input stream	145
7.0.246 defun npComma	146
7.0.247 defun npTuple	146
7.0.248 defun npCommaBackSet	146
7.0.249 defun npQualifiedDefinition	147
7.0.250 defun npQualified	147
7.0.251 defun npDefinitionOrStatement	147
7.0.252 defun npBackTrack	148
7.0.253 defun npGives	148
7.0.254 defun npLambda	148
7.0.255 defun npType	149
7.0.256 defun npMatch	150
7.0.257 defun npSuch	150
7.0.258 defun npWith	150
7.0.259 defun npCompMissing	151
7.0.260 defun npMissing	151
7.0.261 defun npRestore	152
7.0.262 defun Peek for keyword s, no advance of token stream	152
7.0.263 defun npCategoryL	152
7.0.264 defun npCategory	153
7.0.265 defun npSCategory	153
7.0.266 defun npSignature	154
7.0.267 defun npSigItemList	154
7.0.268 defun npListing	155
7.0.269 defun Always produces a list, fn is applied to it	155
7.0.270 defun npSigItem	156
7.0.271 defun npTypeVariable	156
7.0.272 defun npSignatureDefinee	156
7.0.273 defun npTypeVariablelist	157
7.0.274 defun npSigDecl	157
7.0.275 defun npPrimary	157
7.0.276 defun npPrimary2	158
7.0.277 defun npADD	158
7.0.278 defun npAdd	159
7.0.279 defun npAtom2	159

7.0.280 defun npInfixOperator	160
7.0.281 defun npInfixOp	161
7.0.282 defun npPrefixColon	161
7.0.283 defun npApplication	162
7.0.284 defun npDotted	162
7.0.285 defun npAnyNo	162
7.0.286 defun npSelector	163
7.0.287 defun npApplication2	163
7.0.288 defun npPrimary1	164
7.0.289 defun npMacro	164
7.0.290 defun npMdef	164
7.0.291 defun npMDEF	165
7.0.292 defun npMDEFinition	165
7.0.293 defun npFix	166
7.0.294 defun npLet	166
7.0.295 defun npLetQualified	166
7.0.296 defun npDefinition	167
7.0.297 defun npDefinitionItem	167
7.0.298 defun npTyping	168
7.0.299 defun npDefaultItemList	168
7.0.300 defun npSDefaultItem	169
7.0.301 defun npDefaultItem	169
7.0.302 defun npDefaultDecl	170
7.0.303 defun npStatement	170
7.0.304 defun npExport	171
7.0.305 defun npLocalItemList	171
7.0.306 defun npSLocalItem	172
7.0.307 defun npLocalItem	172
7.0.308 defun npLocalDecl	172
7.0.309 defun npLocal	173
7.0.310 defun npFree	173
7.0.311 defun npInline	174
7.0.312 defun npIterate	174
7.0.313 defun npBreak	174
7.0.314 defun npLoop	175
7.0.315 defun npIterators	175
7.0.316 defun npIterator	176
7.0.317 defun npSuchThat	176
7.0.318 defun Apply argument 0 or more times	177
7.0.319 defun npWhile	177
7.0.320 defun npForIn	177
7.0.321 defun npReturn	178
7.0.322 defun npVoid	179
7.0.323 defun npExpress	179
7.0.324 defun npExpress1	179
7.0.325 defun npConditionalStatement	180

7.0.326 defun npImport	180
7.0.327 defun npQualTypelist	180
7.0.328 defun npSQualTypelist	181
7.0.329 defun npQualType	181
7.0.330 defun npAndOr	181
7.0.331 defun npEncAp	182
7.0.332 defun npEncl	182
7.0.333 defun npAtom1	183
7.0.334 defun npPDefinition	183
7.0.335 defun npDollar	183
7.0.336 defun npConstTok	184
7.0.337 defun npBDefinition	185
7.0.338 defun npBracketed	185
7.0.339 defun npParened	185
7.0.340 defun npBracked	186
7.0.341 defun npBraced	186
7.0.342 defun npAngleBared	186
7.0.343 defun npDefn	187
7.0.344 defun npDef	187
7.0.345 defun npBPileDefinition	188
7.0.346 defun npPileBracketed	188
7.0.347 defun npPileDefinitionlist	189
7.0.348 defun npListAndRecover	189
7.0.349 defun npRecoverTrap	190
7.0.350 defun npMoveTo	191
7.0.351 defun syIgnoredFromTo	191
7.0.352 defun syGeneralErrorHere	192
7.0.353 defun sySpecificErrorHere	192
7.0.354 defun sySpecificErrorAtToken	192
7.0.355 defun npDefinitionlist	193
7.0.356 defun npSemiListing	193
7.0.357 defun npSemiBackSet	193
7.0.358 defun npRule	193
7.0.359 defun npSingleRule	194
7.0.360 defun npDefTail	194
7.0.361 defun npDefaultValue	194
7.0.362 defun npWConditional	195
7.0.363 defun npConditional	195
7.0.364 defun npElse	196
7.0.365 defun npBacksetElse	197
7.0.366 defun npLogical	197
7.0.367 defun npDisjand	197
7.0.368 defun npDiscrim	197
7.0.369 defun npQuiver	198
7.0.370 defun npRelation	198
7.0.371 defun npSynthetic	198

7.0.372 defun npBy	199
7.0.373 defun	199
7.0.374 defun npSegment	200
7.0.375 defun npArith	200
7.0.376 defun npSum	201
7.0.377 defun npTerm	201
7.0.378 defun npRemainder	201
7.0.379 defun npProduct	202
7.0.380 defun npPower	202
7.0.381 defun npAmpersandFrom	202
7.0.382 defun npFromdom	202
7.0.383 defun npFromdom1	203
7.0.384 defun npAmpersand	204
7.0.385 defun npName	204
7.0.386 defvar \$npPParg	204
7.0.387 defun npId	204
7.0.388 defun npSymbolVariable	205
7.0.389 defun npRightAssoc	206
7.0.390 defun $p \circ p \circ p \circ p = (((p \circ p) \circ p) \circ p)$	206
7.0.391 defun npInfGeneric	207
7.0.392 defun npDDInfKey	208
7.0.393 defun npInfKey	208
7.0.394 defun npPushId	209
7.0.395 defvar \$npPParg	209
7.0.396 defun npPP	209
7.0.397 defun npPPff	210
7.0.398 defun npPPg	210
7.0.399 defun npPPf	211
7.0.400 defun npEnclosed	211
7.0.401 defun npState	212
7.0.402 defun npTrap	212
7.0.403 defun npTrapForm	212
7.0.404 defun npVariable	213
7.0.405 defun npVariablelist	213
7.0.406 defun npVariableName	213
7.0.407 defun npDecl	214
7.0.408 defun npParenthesized	214
7.0.409 defun npParenthesize	215
7.0.410 defun npMissingMate	215
7.0.411 defun npExit	215
7.0.412 defun npPileExit	216
7.0.413 defun npAssign	216
7.0.414 defun npAssignment	217
7.0.415 defun npAssignVariable	217
7.0.416 defun npColon	217
7.0.417 defun npTagged	218

7.0.418	defun npTypedForm1	218
7.0.419	defun npTypified	218
7.0.420	defun npTypeStyle	219
7.0.421	defun npPretend	219
7.0.422	defun npColonQuery	219
7.0.423	defun npCoerceTo	220
7.0.424	defun npTypedForm	220
7.0.425	defun npRestrict	220
7.0.426	defun npListofFun	221
7.1	Macro handling	221
7.1.1	defun phMacro	221
7.1.2	defun macroExpanded	222
7.1.3	defun macExpand	222
7.1.4	defun macApplication	223
7.1.5	defun mac0MLambdaApply	223
7.1.6	defun mac0ExpandBody	224
7.1.7	defun mac0InfiniteExpansion	225
7.1.8	defun mac0InfiniteExpansion,name	226
7.1.9	defun mac0GetName	226
7.1.10	defun macId	227
7.1.11	defun mac0Get	228
7.1.12	defun macWhere	228
7.1.13	defun macWhere,mac	228
7.1.14	defun macLambda	228
7.1.15	defun macLambda,mac	229
7.1.16	defun Add appropriate definition the a Macro pform	229
7.1.17	defun Add a macro to the global pfMacros list	230
7.1.18	defun macSubstituteOuter	230
7.1.19	defun mac0SubstituteOuter	231
7.1.20	defun macLambdaParameterHandling	231
7.1.21	defun macSubstituteId	232
8	Pftrees	233
8.1	Abstract Syntax Trees Overview	233
8.2	Structure handlers	235
8.2.1	defun pfGlobalLinePosn	235
8.2.2	defun pfCharPosn	235
8.2.3	defun pfLinePosn	235
8.2.4	defun pfFileName	236
8.2.5	defun pfCopyWithPos	236
8.2.6	defun pfMapParts	236
8.2.7	defun pf0ApplicationArgs	237
8.2.8	defun pf0FlattenSyntacticTuple	237
8.2.9	defun pfSourcePosition	238
8.2.10	defun Convert a Sequence node to a list	238
8.2.11	defun pfSpread	239

8.2.12	defun Deconstruct nodes to lists	239
8.2.13	defun pfCheckMacroOut	240
8.2.14	defun pfCheckArg	241
8.2.15	defun pfCheckId	241
8.2.16	defun pfFlattenApp	241
8.2.17	defun pfCollect1?	242
8.2.18	defun pfCollectVariable1	242
8.2.19	defun pfPushMacroBody	243
8.2.20	defun pfSourceStok	243
8.2.21	defun pfTransformArg	244
8.2.22	defun pfTaggedToTyped1	244
8.2.23	defun pfSuch	244
8.3	Special Nodes	245
8.3.1	defun Create a Listof node	245
8.3.2	defun pfNothing	245
8.3.3	defun Is this a Nothing node?	245
8.4	Leaves	246
8.4.1	defun Create a Document node	246
8.4.2	defun Construct an Id node	246
8.4.3	defun Is this an Id node?	246
8.4.4	defun Construct an Id leaf node	246
8.4.5	defun Return the Id part	247
8.4.6	defun Construct a Leaf node	247
8.4.7	defun Is this a leaf node?	247
8.4.8	defun Return the token position of a leaf node	248
8.4.9	defun Return the Leaf Token	248
8.4.10	defun Is this a Literal node?	248
8.4.11	defun Create a LiteralClass node	248
8.4.12	defun Return the LiteralString	249
8.4.13	defun Return the parts of a tree node	249
8.4.14	defun Return the argument unchanged	249
8.4.15	defun pfPushBody	249
8.4.16	defun An S-expression which people can read.	250
8.4.17	defun Create a human readable S-expression	250
8.4.18	defun Construct a Symbol or Expression node	251
8.4.19	defun Construct a Symbol leaf node	251
8.4.20	defun Is this a Symbol node?	252
8.4.21	defun Return the Symbol part	252
8.5	Trees	252
8.5.1	defun Construct a tree node	252
8.5.2	defun Construct an Add node	252
8.5.3	defun Construct an And node	253
8.5.4	defun pfAttribute	253
8.5.5	defun Return an Application node	253
8.5.6	defun Return the Arg part of an Application node	254
8.5.7	defun Return the Op part of an Application node	254

8.5.8	defun Is this an And node?	254
8.5.9	defun Return the Left part of an And node	254
8.5.10	defun Return the Right part of an And node	255
8.5.11	defun Flatten a list of lists	255
8.5.12	defun Is this an Application node?	255
8.5.13	defun Create an Assign node	255
8.5.14	defun Is this an Assign node?	256
8.5.15	defun Return the parts of an LhsItem of an Assign node	256
8.5.16	defun Return the LhsItem of an Assign node	256
8.5.17	defun Return the RHS of an Assign node	256
8.5.18	defun Construct an application node for a brace	257
8.5.19	defun Construct an Application node for brace-bars	257
8.5.20	defun Construct an Application node for a bracket	257
8.5.21	defun Construct an Application node for bracket-bars	257
8.5.22	defun Create a Break node	258
8.5.23	defun Is this a Break node?	258
8.5.24	defun Return the From part of a Break node	258
8.5.25	defun Construct a Coerceto node	259
8.5.26	defun Is this a CoerceTo node?	259
8.5.27	defun Return the Expression part of a CoerceTo node	259
8.5.28	defun Return the Type part of a CoerceTo node	259
8.5.29	defun Return the Body of a Collect node	260
8.5.30	defun Return the Iterators of a Collect node	260
8.5.31	defun Create a Collect node	260
8.5.32	defun Is this a Collect node?	260
8.5.33	defun pfDefinition	261
8.5.34	defun Return the Lhs of a Definition node	261
8.5.35	defun Return the Rhs of a Definition node	261
8.5.36	defun Is this a Definition node?	261
8.5.37	defun Return the parts of a Definition node	262
8.5.38	defun Create a Do node	262
8.5.39	defun Is this a Do node?	262
8.5.40	defun Return the Body of a Do node	262
8.5.41	defun Construct a Sequence node	263
8.5.42	defun Construct an Exit node	263
8.5.43	defun Is this an Exit node?	263
8.5.44	defun Return the Cond part of an Exit	263
8.5.45	defun Return the Expression part of an Exit	264
8.5.46	defun Create an Export node	264
8.5.47	defun Construct an Expression leaf node	264
8.5.48	defun pfFirst	264
8.5.49	defun Create an Application Fix node	265
8.5.50	defun Create a Free node	265
8.5.51	defun Is this a Free node?	265
8.5.52	defun Return the parts of the Items of a Free node	266
8.5.53	defun Return the Items of a Free node	266

8.5.54	defun Construct a Forin node	266
8.5.55	defun Is this a ForIn node?	266
8.5.56	defun Return all the parts of the LHS of a ForIn node	267
8.5.57	defun Return the LHS part of a ForIn node	267
8.5.58	defun Return the Whole part of a ForIn node	267
8.5.59	defun pfFromDom	267
8.5.60	defun Construct a Fromdom node	268
8.5.61	defun Is this a Fromdom mode?	268
8.5.62	defun Return the What part of a Fromdom node	268
8.5.63	defun Return the Domain part of a Fromdom node	269
8.5.64	defun Construct a Hide node	269
8.5.65	defun pfIf	269
8.5.66	defun Is this an If node?	269
8.5.67	defun Return the Cond part of an If	270
8.5.68	defun Return the Then part of an If	270
8.5.69	defun pfIfThenOnly	270
8.5.70	defun Return the Else part of an If	270
8.5.71	defun Construct an Import node	271
8.5.72	defun Construct an Iterate node	271
8.5.73	defun Is this an Iterate node?	271
8.5.74	defun Handle an infix application	271
8.5.75	defun Create an Inline node	272
8.5.76	defun pfLam	272
8.5.77	defun pfLambda	273
8.5.78	defun Return the Body part of a Lambda node	273
8.5.79	defun Return the Rets part of a Lambda node	273
8.5.80	defun Is this a Lambda node?	273
8.5.81	defun Return the Args part of a Lambda node	274
8.5.82	defun Return the Args of a Lambda Node	274
8.5.83	defun Construct a Local node	274
8.5.84	defun Is this a Local node?	274
8.5.85	defun Return the parts of Items of a Local node	275
8.5.86	defun Return the Items of a Local node	275
8.5.87	defun Construct a Loop node	275
8.5.88	defun pfLoop1	275
8.5.89	defun Is this a Loop node?	276
8.5.90	defun Return the Iterators of a Loop node	276
8.5.91	defun pf0LoopIterators	276
8.5.92	defun pfLp	276
8.5.93	defun Create a Macro node	277
8.5.94	defun Is this a Macro node?	277
8.5.95	defun Return the Lhs of a Macro node	277
8.5.96	defun Return the Rhs of a Macro node	277
8.5.97	defun Construct an MLambda node	278
8.5.98	defun Is this an MLambda node?	278
8.5.99	defun Return the Args of an MLambda	278

8.5.100 defun	Return the parts of an MLambda argument	278
8.5.101 defun	pfMLambdaBody	279
8.5.102 defun	Is this a Not node?	279
8.5.103 defun	Return the Arg part of a Not node	279
8.5.104 defun	Construct a NoValue node	279
8.5.105 defun	Is this a Novalue node?	280
8.5.106 defun	Return the Expr part of a Novalue node	280
8.5.107 defun	Construct an Or node	280
8.5.108 defun	Is this an Or node?	280
8.5.109 defun	Return the Left part of an Or node	281
8.5.110 defun	Return the Right part of an Or node	281
8.5.111 defun	Return the part of a parenthesised expression	281
8.5.112 defun	pfPretend	281
8.5.113 defun	Is this a Pretend node?	282
8.5.114 defun	Return the Expression part of a Pretend node	282
8.5.115 defun	Return the Type part of a Pretend node	282
8.5.116 defun	Construct a QualType node	282
8.5.117 defun	Construct a Restrict node	283
8.5.118 defun	Is this a Restrict node?	283
8.5.119 defun	Return the Expr part of a Restrict node	283
8.5.120 defun	Return the Type part of a Restrict node	283
8.5.121 defun	Construct a RetractTo node	284
8.5.122 defun	Construct a Return node	284
8.5.123 defun	Is this a Return node?	284
8.5.124 defun	Return the Expr part of a Return node	284
8.5.125 defun	pfReturnNoName	285
8.5.126 defun	Construct a ReturnTyped node	285
8.5.127 defun	Construct a Rule node	285
8.5.128 defun	Return the Lhs of a Rule node	286
8.5.129 defun	Return the Rhs of a Rule node	286
8.5.130 defun	Is this a Rule node?	286
8.5.131 defun	pfSecond	286
8.5.132 defun	Construct a Sequence node	287
8.5.133 defun	Return the Args of a Sequence node	287
8.5.134 defun	Is this a Sequence node?	287
8.5.135 defun	Return the parts of the Args of a Sequence node	287
8.5.136 defun	Create a Suchthat node	288
8.5.137 defun	Is this a SuchThat node?	288
8.5.138 defun	Return the Cond part of a SuchThat node	288
8.5.139 defun	Create a Tagged node	288
8.5.140 defun	Is this a Tagged node?	289
8.5.141 defun	Return the Expression portion of a Tagged node	289
8.5.142 defun	Return the Tag of a Tagged node	289
8.5.143 defun	pfTaggedToTyped	289
8.5.144 defun	pfTweakIf	290
8.5.145 defun	Construct a Typed node	290

8.5.146 defun Is this a Typed node?	291
8.5.147 defun Return the Type of a Typed node	291
8.5.148 defun Return the Id of a Typed node	291
8.5.149 defun Construct a Typing node	291
8.5.150 defun Return a Tuple node	292
8.5.151 defun Return a Tuple from a List	292
8.5.152 defun Is this a Tuple node?	292
8.5.153 defun Return the Parts of a Tuple node	293
8.5.154 defun Return the parts of a Tuple	293
8.5.155 defun Return a list from a Sequence node	293
8.5.156 defun The comment is attached to all signatutres	293
8.5.157 defun Construct a WDeclare node	294
8.5.158 defun Construct a Where node	294
8.5.159 defun Is this a Where node?	294
8.5.160 defun Return the parts of the Context of a Where node	295
8.5.161 defun Return the Context of a Where node	295
8.5.162 defun Return the Expr part of a Where node	295
8.5.163 defun Construct a While node	295
8.5.164 defun Is this a While node?	296
8.5.165 defun Return the Cond part of a While node	296
8.5.166 defun Construct a With node	296
8.5.167 defun Create a Wrong node	296
8.5.168 defun Is this a Wrong node?	297
9 Pftree to s-expression translation	299
9.0.169 defun Pftree to s-expression translation	299
9.0.170 defun Pftree to s-expression translation inner function	300
9.0.171 defun Convert a Literal to an S-expression	304
9.0.172 defun Convert a float to an S-expression	305
9.0.173 defun Change an Application node to an S-expression	305
9.0.174 defun Convert a SuchThat node to an S-expression	307
9.0.175 defun pfOp2Sex	308
9.0.176 defun pmDontQuote?	309
9.0.177 defun hasOptArgs?	309
9.0.178 defun Convert a Sequence node to an S-expression	310
9.0.179 defun pfSequence2Sex0	310
9.0.180 defun Convert a loop node to an S-expression	311
9.0.181 defun Change a Collect node to an S-expression	314
9.0.182 defun Convert a Definition node to an S-expression	315
9.0.183 defun Convert a Lambda node to an S-expression	316
9.0.184 defun pfCollectArgTran	317
9.0.185 defun Convert a Lambda node to an S-expression	317
9.0.186 defun Convert a Rule node to an S-expression	318
9.0.187 defun Convert the Lhs of a Rule to an S-expression	318
9.0.188 defun Convert the Rhs of a Rule to an S-expression	319
9.0.189 defun Convert a Rule predicate to an S-expression	319

9.0.190 defun patternVarsOf	321
9.0.191 defun patternVarsOf1	321
9.0.192 defun pvarPredTran	322
9.0.193 defun Convert the Lhs of a Rule node to an S-expression	322
9.0.194 defvar \$dotdot	323
9.0.195 defun Translate ops into internal symbols	323
10 Keyed Message Handling	325
10.0.196 defvar \$cacheMessages	326
10.0.197 defvar \$msgAlist	326
10.0.198 defvar \$msgDatabaseName	326
10.0.199 defvar \$testingErrorPrefix	327
10.0.200 defvar \$texFormatting	327
10.0.201 defvar \$*msghash*	327
10.0.202 defvar \$msgdbPrims	327
10.0.203 defvar \$msgdbPunct	327
10.0.204 defvar \$msgdbNoBlanksBeforeGroup	328
10.0.205 defvar \$msgdbNoBlanksAfterGroup	328
10.0.206 defun Fetch a message from the message database	328
10.0.207 defun Cache messages read from message database	329
10.0.208 defun getKeyedMsg	329
10.0.209 defun Say a message using a keyed lookup	329
10.0.210 defun Handle msg formatting and print to file	330
10.0.211 defun Break a message into words	330
10.0.212 defun Write a msg into spadmsg.listing file	331
10.0.213 defun sayMSG	331
11 Stream Utilities	333
11.0.214 defun npNull	333
11.0.215 defun StreamNull	333
12 Code Piles	335
12.0.216 defun insertpile	335
12.0.217 defun pilePlusComment	336
12.0.218 defun pilePlusComments	336
12.0.219 defun pileTree	337
12.0.220 defun pileColumn	337
12.0.221 defun pileForests	337
12.0.222 defun pileForest	338
12.0.223 defun pileForest1	338
12.0.224 defun eqpileTree	339
12.0.225 defun pileCtree	340
12.0.226 defun pileCforest	340
12.0.227 defun enPile	340
12.0.228 defun firstTokPosn	341
12.0.229 defun lastTokPosn	341

12.0.23	defun separatePiles	341
13	Dequeue Functions	343
13.0.23	defun dqUnit	343
13.0.23	defun dqConcat	343
13.0.23	defun dqAppend	344
13.0.23	defun dqToList	344
14	Message Handling	345
14.1	The Line Object	345
14.1.1	defun Line object creation	345
14.1.2	defun Line element 0; Extra blanks	345
14.1.3	defun Line element 1; String	345
14.1.4	defun Line element 2; Global number	346
14.1.5	defun Line element 2; Set Global number	346
14.1.6	defun Line element 3; Local number	346
14.1.7	defun Line element 4; Place of origin	346
14.1.8	defun Line element 4: Is it a filename?	347
14.1.9	defun Line element 4: Is it a filename?	347
14.1.10	defun Line element 4; Get filename	347
14.2	Messages	347
14.2.1	defun msgCreate	347
14.2.2	defun getMsgPosTagOb	348
14.2.3	defun getMsgKey	348
14.2.4	defun getMsgArgL	349
14.2.5	defun getMsgPrefix	349
14.2.6	defun setMsgPrefix	349
14.2.7	defun getMsgText	349
14.2.8	defun setMsgText	349
14.2.9	defun getMsgPrefix?	350
14.2.10	defun getMsgTag	350
14.2.11	defun getMsgTag?	350
14.2.12	defun line?	351
14.2.13	defun leader?	351
14.2.14	defun toScreen?	351
14.2.15	defun ncSoftError	351
14.2.16	defun ncHardError	352
14.2.17	defun desiredMsg	352
14.2.18	defun processKeyedError	353
14.2.19	defun msgOutputter	353
14.2.20	defun listOutputter	354
14.2.21	defun getStFromMsg	354
14.2.22	defvar \$preLength	355
14.2.23	defun getPreStL	355
14.2.24	defun getPosStL	356
14.2.25	defun ppos	357

14.2.26 defun remFile	357
14.2.27 defun showMsgPos?	357
14.2.28 defvar \$imPrGuys	358
14.2.29 defun msgImPr?	358
14.2.30 defun getMsgCatAttr	358
14.2.31 defun getMsgPos	359
14.2.32 defun getMsgFTTag?	359
14.2.33 defun decideHowMuch	359
14.2.34 defun poNopos?	360
14.2.35 defun poPosImmediate?	360
14.2.36 defun poFileName	360
14.2.37 defun poGetLineObject	361
14.2.38 defun poLinePosn	361
14.2.39 defun listDecideHowMuch	361
14.2.40 defun remLine	362
14.2.41 defun getMsgKey?	362
14.2.42 defun getMsgLitSym	362
14.2.43 defun tabbing	362
14.2.44 defvar \$toWhereGuys	363
14.2.45 defun getMsgToWhere	363
14.2.46 defun toFile?	363
14.2.47 defun alreadyOpened?	363
14.2.48 defun setMsgForcedAttrList	364
14.2.49 defun setMsgForcedAttr	364
14.2.50 defvar \$attrCats	364
14.2.51 defun whichCat	365
14.2.52 defun setMsgCatlessAttr	365
14.2.53 defun putDatabaseStuff	365
14.2.54 defun getMsgInfoFromKey	366
14.2.55 defun setMsgUnforcedAttrList	366
14.2.56 defun setMsgUnforcedAttr	367
14.2.57 defvar \$imPrTagGuys	367
14.2.58 defun initImPr	367
14.2.59 defun initToWhere	368
14.2.60 defun ncBug	368
14.2.61 defun processMsgList	369
14.2.62 defun erMsgSort	369
14.2.63 defun erMsgCompare	370
14.2.64 defun compareposns	370
14.2.65 defun erMsgSep	370
14.2.66 defun makeMsgFromLine	371
14.2.67 defun rep	371
14.2.68 defun getLinePos	372
14.2.69 defun getLineText	372
14.2.70 defun queueUpErrors	372
14.2.71 defun thisPosIsLess	374

14.2.72 defun thisPosIsEqual	374
14.2.73 defun redundant	374
14.2.74 defvar \$repGuys	375
14.2.75 defun msgNoRep?	375
14.2.76 defun sameMsg?	376
14.2.77 defun processChPosesForOneLine	376
14.2.78 defun poCharPosn	377
14.2.79 defun makeLeaderMsg	377
14.2.80 defun posPointers	378
14.2.81 defun getMsgPos2	378
14.2.82 defun insertPos	379
14.2.83 defun putFTText	379
14.2.84 defun From	380
14.2.85 defun To	380
14.2.86 defun FromTo	380
15 The Interpreter Syntax	383
15.1 syntax assignment	383
15.2 syntax blocks	386
15.3 system clef	388
15.4 syntax collection	389
15.5 syntax for	391
15.6 syntax if	395
15.7 syntax iterate	397
15.8 syntax leave	398
15.9 syntax parallel	399
15.10 syntax repeat	402
15.11 syntax suchthat	406
15.12 syntax syntax	407
15.13 syntax while	407
16 Abstract Syntax Trees (ptrees)	411
16.0.1 defun Construct a leaf token	411
16.0.2 defun Return a part of a node	412
16.0.3 defun Compare a part of a node	412
16.0.4 defun pfNoPosition?	412
16.0.5 defun poNoPosition?	413
16.0.6 defun tokType	413
16.0.7 defun tokPart	413
16.0.8 defun tokPosn	413
16.0.9 defun pfNoPosition	414
16.0.10 defun poNoPosition	414

17 Attributed Structures	415
17.0.11 defun ncTag	415
17.0.12 defun ncAlist	415
17.0.13 defun ncEltQ	416
17.0.14 defun ncPutQ	416
18 Function Selection	419
18.0.15 defun ofCategory	419
18.0.16 defun isPartialMode	420
18.0.17 defun hasCaty	420
18.0.18 defun domArg	422
18.0.19 defun domArg2	422
18.0.20 defun hasSig	423
18.0.21 defun hasAtt	424
18.0.22 defun hasSigAnd	425
18.0.23 defun hasSigOr	426
18.0.24 defun hasAttSig	426
18.0.25 defun hasCate1	427
18.0.26 defun hasCatExpression	427
18.0.27 defun unifyStruct	428
18.0.28 defun unifyStructVar	429
18.0.29 defun containsVars	430
18.0.30 defun containsVars1	431
18.0.31 defun hasCaty1	431
18.0.32 defun mkDomPvar	432
18.0.33 defun hasCate	433
18.0.34 defun constructSubst	434
18.0.35 defun hasCateSpecial	434
18.0.36 defun hasCateSpecialNew	435
18.0.37 defun defaultTargetFE	437
18.0.38 defun isEqualOrSubDomain	438
19 System Command Handling	439
19.1 Variables Used	441
19.1.1 defvar \$systemCommands	441
19.1.2 defvar \$syscommands	442
19.1.3 defvar \$noParseCommands	442
19.2 Functions	443
19.2.1 defun handleNoParseCommands	443
19.2.2 defun Handle a top level command	444
19.2.3 defun Split block into option block	445
19.2.4 defun Tokenize a system command	445
19.2.5 defun Handle system commands	446
19.2.6 defun Select commands matching this user level	446
19.2.7 defun No command begins with this string	447
19.2.8 defun No option begins with this string	447

19.2.9 defvar \$oldline	447
19.2.10 defun No command/option begins with this string	447
19.2.11 defun Option not available at this user level	448
19.2.12 defun Command not available at this user level	448
19.2.13 defun Command not available error message	448
19.2.14 defun satisfiesUserLevel	449
19.2.15 defun hasOption	449
19.2.16 defun terminateSystemCommand	450
19.2.17 defun Terminate a system command	450
19.2.18 defun commandAmbiguityError	450
19.2.19 defun getParserMacroNames	451
19.2.20 defun clearParserMacro	451
19.2.21 defun displayMacro	451
19.2.22 defun displayWorkspaceNames	452
19.2.23 defun getWorkspaceNames	453
19.2.24 defun fixObjectForPrinting	454
19.2.25 defun displayProperties,sayFunctionDeps	454
19.2.26 defun displayValue	457
19.2.27 defun displayType	458
19.2.28 defun getAndSay	459
19.2.29 defun displayProperties	459
19.2.30 defun displayParserMacro	462
19.2.31 defun displayCondition	463
19.2.32 defun interpFunctionDepAlists	463
19.2.33 defun displayModemap	464
19.2.34 defun displayMode	464
19.2.35 defun Split into tokens delimited by spaces	465
19.2.36 defun Convert string tokens to their proper type	465
19.2.37 defun Is the argument string an integer?	466
19.2.38 defun Handle parsed system commands	466
19.2.39 defun Parse a system command	467
19.2.40 defun Get first word in a string	467
19.2.41 defun Unabbreviate keywords in commands	467
19.2.42 defun The command is ambiguous error	468
19.2.43 defun Remove the spaces surrounding a string	469
19.2.44 defun Remove the lisp command prefix	469
19.2.45 defun Handle the)lisp command	470
19.2.46 defun The)boot command is no longer supported	470
19.2.47 defun Handle the)system command	470
19.2.48 defun Handle the)synonym command	471
19.2.49 defun Handle the synonym system command	471
19.2.50 defun printSynonyms	472
19.2.51 defun Print a list of each matching synonym	472
19.2.52 defvar \$tokenCommands	473
19.2.53 defvar \$InitialCommandSynonymAlist	474
19.2.54 defun Print the current version information	474

19.2.55 defvar \$CommandSynonymAlist	476
19.2.56 defun nclloopCommand	476
19.2.57 defun nclloopPrefix?	477
19.2.58 defun selectOptionLC	477
19.2.59 defun selectOption	477
20)abbreviations help page Command	479
20.1 abbreviations help page man page	479
20.2 Functions	481
20.2.1 defun abbreviations	481
20.2.2 defun abbreviationsSpad2Cmd	481
20.2.3 defun listConstructorAbbreviations	482
21)boot help page Command	485
21.1 boot help page man page	485
21.2 Functions	486
22)browse help page Command	487
22.1 browse help page man page	487
22.2 Overview	487
22.3 Browsers, MathML, and Fonts	488
22.4 The axServer/multiServ loop	489
22.5 The)browse command	490
22.6 Variables Used	491
22.7 Functions	491
22.8 The server support code	491
23)cd help page Command	493
23.1 cd help page man page	493
23.2 Variables Used	494
23.3 Functions	494
24)clear help page Command	495
24.1 clear help page man page	495
24.2 Variables Used	497
24.2.1 defvar \$clearOptions	497
24.3 Functions	497
24.3.1 defun clear	497
24.3.2 defvar \$clearExcept	497
24.3.3 defun clearSpad2Cmd	498
24.3.4 defun clearCmdSortedCaches	499
24.3.5 defun compiledLookupCheck	499
24.3.6 defvar \$functionTable	500
24.3.7 defun clearCmdCompletely	500
24.3.8 defun clearCmdAll	501
24.3.9 defun clearMacroTable	502

24.3.10 defun clearCmdExcept	502
24.3.11 defun clearCmdParts	503
25)close help page Command	507
25.1 close help page man page	507
25.2 Functions	508
25.2.1 defun queryClients	508
25.2.2 defun close	508
26)compile help page Command	511
26.1 compile help page man page	511
26.2 Functions	513
26.2.1 defvar \$/editfile	513
27)copyright help page Command	515
27.1 copyright help page man page	515
27.2 Functions	520
27.2.1 defun copyright	520
27.2.2 defun trademark	521
28)credits help page Command	523
28.1 credits help page man page	523
28.2 Variables Used	523
28.3 Functions	523
28.3.1 defun credits	523
29)describe help page Command	525
29.1 describe help page man page	525
29.1.1 defvar \$describeOptions	526
29.2 Functions	526
29.2.1 defun Print comment strings from algebra libraries	526
29.2.2 defun describeSpad2Cmd	526
29.2.3 defun cleanline	527
29.2.4 defun flatten	529
30)display help page Command	531
30.1 display help page man page	531
30.1.1 defvar \$displayOptions	533
30.2 Functions	533
30.2.1 defun display	533
30.2.2 displaySpad2Cmd	533
30.2.3 defun abbQuery	534
30.2.4 defun displayOperations	535
30.2.5 defun yesanswer	535
30.2.6 defun displayMacros	536
30.2.7 defun sayExample	537

30.2.8	defun cleanupLine	538
31)edit help page Command	541
31.1	edit help page man page	541
31.2	Functions	542
31.2.1	defun edit	542
31.2.2	defun editSpad2Cmd	542
31.2.3	defun Implement the)edit command	543
31.2.4	defun updateSourceFiles	544
32)fin help page Command	545
32.1	fin help page man page	545
32.1.1	defun Exit from the interpreter to lisp	546
32.2	Functions	546
33)frame help page Command	547
33.1	frame help page man page	547
33.2	Variables Used	549
33.2.1	Primary variables	549
33.2.2	Used variables	550
33.3	Data Structures	550
33.3.1	Frames and the Interpreter Frame Ring	550
33.4	Accessor Functions	550
33.4.1	0th Frame Component – frameName	550
33.4.2	defun frameName	550
33.4.3	1st Frame Component – frameInteractive	551
33.4.4	2nd Frame Component – frameIOIndex	551
33.4.5	3rd Frame Component – frameHiFiAccess	551
33.4.6	4th Frame Component – frameHistList	551
33.4.7	5th Frame Component – frameHistListLen	552
33.4.8	6th Frame Component – frameHistListAct	552
33.4.9	7th Frame Component – frameHistRecord	552
33.4.10	8th Frame Component – frameHistoryTable	552
33.4.11	9th Frame Component – frameExposureData	553
33.5	Functions	553
33.5.1	Initializing the Interpreter Frame Ring	553
33.5.2	Creating a List of all of the Frame Names	554
33.5.3	Get Named Frame Environment (aka Interactive)	554
33.5.4	Create a new, empty Interpreter Frame	554
33.5.5	Collecting up the Environment into a Frame	555
33.5.6	Update from the Current Frame	556
33.5.7	Find a Frame in the Frame Ring by Name	557
33.5.8	Update the Current Interpreter Frame	557
33.5.9	Move to the next Interpreter Frame in Ring	558
33.5.10	Change to the Named Interpreter Frame	558
33.5.11	Move to the previous Interpreter Frame in Ring	559

33.5.12 Add a New Interpreter Frame	559
33.5.13 Close an Interpreter Frame	560
33.5.14 Display the Frame Names	561
33.5.15 Import items from another frame	561
33.5.16 The top level frame command	563
33.5.17 The top level frame command handler	564
33.6 Frame File Messages	565
34)help help page Command	567
34.1 help help page man page	567
34.2 Functions	570
34.2.1 The top level help command	570
34.2.2 The top level help command handler	570
34.2.3 defun newHelpSpad2Cmd	570
35)history help page Command	573
35.1 history help page man page	573
35.2 Initialized history variables	576
35.2.1 defvar \$oldHistoryFileName	576
35.2.2 defvar \$historyFileType	577
35.2.3 defvar \$historyDirectory	577
35.2.4 defvar \$useInternalHistoryTable	577
35.3 Data Structures	577
35.4 Functions	577
35.4.1 defun makeHistFileName	577
35.4.2 defun oldHistFileName	578
35.4.3 defun histFileName	578
35.4.4 defun histInputFileName	578
35.4.5 defun initHist	579
35.4.6 defun initHistList	579
35.4.7 The top level history command	580
35.4.8 The top level history command handler	580
35.4.9 defun setHistoryCore	582
35.4.10 defvar \$underbar	584
35.4.11 defun writeInputLines	585
35.4.12 defun resetInCoreHist	586
35.4.13 defun changeHistListLen	587
35.4.14 defun updateHist	587
35.4.15 defun updateInCoreHist	588
35.4.16 defun putHist	588
35.4.17 defun recordNewValue	589
35.4.18 defun recordNewValue0	589
35.4.19 defun recordOldValue	590
35.4.20 defun recordOldValue0	590
35.4.21 defun undoInCore	590
35.4.22 defun undoChanges	591

35.4.23	defun undoFromFile	592
35.4.24	defun saveHistory	593
35.4.25	defun restoreHistory	595
35.4.26	defun setIOindex	597
35.4.27	defun showInput	597
35.4.28	defun showInOut	598
35.4.29	defun fetchOutput	598
35.4.30	Read the history file using index n	599
35.4.31	Write information of the current step to history file	600
35.4.32	Disable history if an error occurred	601
35.4.33	defun writeHistModesAndValues	601
35.5	Lisplib output transformations	602
35.5.1	defun spadrrwrite0	602
35.5.2	defun Random write to a stream	602
35.5.3	defun spadrrwrite	603
35.5.4	defun spadrrread	603
35.5.5	defun Random read a key from a stream	603
35.5.6	defun unwritable?	604
35.5.7	defun writifyComplain	604
35.5.8	defun safeWritify	604
35.5.9	defun writify,writifyInner	605
35.5.10	defun writify	608
35.5.11	defun spadClosure?	609
35.5.12	defvar \$NonNullStream	609
35.5.13	defvar \$NullStream	609
35.5.14	defun dewritify,dewritifyInner	610
35.5.15	defun dewritify	613
35.5.16	defun ScanOrPairVec,ScanOrInner	613
35.5.17	defun ScanOrPairVec	614
35.5.18	defun gensymInt	614
35.5.19	defun charDigitVal	615
35.5.20	defun histFileErase	615
35.6	History File Messages	616
36)include help page Command	619
36.1	include help page man page	619
36.2	Functions	619
36.2.1	defun ncloopInclude1	619
36.2.2	Returns the first non-blank substring of the given string	620
36.2.3	Open the include file and read it in	620
36.2.4	Return the include filename	620
36.2.5	Return the next token	621
37)library help page Command	623
37.1	library help page man page	623

38)lisp help page Command	625
38.1 lisp help page man page	625
38.2 Functions	626
39)load help page Command	627
39.1 load help page man page	627
39.1.1 defun The)load command (obsolete)	627
40)ltrace help page Command	629
40.1 ltrace help page man page	629
40.1.1 defun The top level)ltrace function	630
40.2 Variables Used	630
40.3 Functions	630
41)pquit help page Command	631
41.1 pquit help page man page	631
41.2 Functions	632
41.2.1 The top level pquit command	632
41.2.2 The top level pquit command handler	632
42)quit help page Command	635
42.1 quit help page man page	635
42.2 Functions	636
42.2.1 The top level quit command	636
42.2.2 The top level quit command handler	636
42.2.3 Leave the Axiom interpreter	637
43)read help page Command	639
43.1 read help page man page	639
43.1.1 defun The)read command	640
43.1.2 defun Implement the)read command	640
43.1.3 defun /read	642
44)regress help page Command	643
44.1 regress help page man page	643
45)savesystem help page Command	647
45.1 savesystem help page man page	647
45.1.1 defun The)savesystem command	648
46)set help page Command	649
46.1 set help page man page	649
46.2 Overview	650
46.3 Variables Used	651
46.4 Functions	651
46.4.1 Initialize the set variables	651
46.4.2 Reset the workspace variables	652

46.4.3	Display the set option information	653
46.4.4	Display the set variable settings	655
46.4.5	Translate options values to t or nil	656
46.4.6	Translate t or nil to option values	657
46.5	The list structure	657
46.6	breakmode	658
46.6.1	defvar \$BreakMode	659
46.7	debug	659
46.8	debug lambda type	660
46.8.1	defvar \$lambdatype	660
46.9	debug dalymode	660
46.9.1	defvar \$dalymode	661
46.10	compile	661
46.11	compile output	662
46.12	Variables Used	662
46.13	Functions	662
46.13.1	The set output command handler	662
46.13.2	Describe the set output library arguments	663
46.13.3	defvar \$output-library	663
46.13.4	Open the output library	664
46.14	compile input	664
46.15	Variables Used	665
46.16	Functions	665
46.16.1	The set input library command handler	665
46.16.2	Describe the set input library arguments	666
46.16.3	Add the input library to the list	666
46.16.4	defvar \$input-libraries	666
46.16.5	Drop an input library from the list	667
46.17	expose	667
46.18	Variables Used	668
46.18.1	defvar \$globalExposureGroupAlist	668
46.18.2	defvar \$localExposureDataDefault	694
46.18.3	defvar \$localExposureData	694
46.19	Functions	694
46.19.1	The top level set expose command handler	694
46.19.2	The top level set expose add command handler	695
46.19.3	Expose a group	696
46.19.4	The top level set expose add constructor handler	698
46.19.5	The top level set expose drop handler	699
46.19.6	The top level set expose drop group handler	700
46.19.7	The top level set expose drop constructor handler	701
46.19.8	Display exposed groups	702
46.19.9	Display exposed constructors	702
46.19.10	Display hidden constructors	703
46.20	functions	703
46.21	functions cache	704

46.22	Variables Used	705
46.22.1	defvar \$cacheAlist	705
46.23	Functions	705
46.23.1	The top level set functions cache handler	705
46.23.2	defvar \$compileDontDefineFunctions	709
46.24	functions recurrence	709
46.24.1	defvar \$compileRecurrence	710
46.25	fortran	710
46.25.1	ints2floats	711
46.25.2	defvar \$fortInts2Floats	712
46.25.3	fortindent	712
46.25.4	defvar \$fortIndent	712
46.25.5	fortlength	713
46.25.6	defvar \$fortLength	713
46.25.7	typedecs	713
46.25.8	defvar \$printFortranDecs	714
46.25.9	defaulttype	714
46.25.10	defvar \$defaultFortranType	715
46.25.11	precision	715
46.25.12	defvar \$fortranPrecision	715
46.25.13	intrinsic	716
46.25.14	defvar \$useIntrinsicFunctions	716
46.25.15	explength	717
46.25.16	defvar \$maximumFortranExpressionLength	717
46.25.17	segment	717
46.25.18	defvar \$fortranSegment	718
46.25.19	optlevel	718
46.25.20	defvar \$fortranOptimizationLevel	718
46.25.21	startindex	719
46.25.22	defvar \$fortranArrayStartingIndex	719
46.25.23	calling	719
46.25.24	defvar \$fortranTmpDir	720
46.25.25	The top level set fortran calling tempfile handler	721
46.25.26	Validate the output directory	722
46.25.27	Describe the set fortran calling tempfile	722
46.25.28	defvar \$fortranDirectory	723
46.25.29	defun setFortDir	723
46.25.30	defun describeSetFortDir	724
46.25.31	defvar \$fortranLibraries	725
46.25.32	defun setLinkerArgs	726
46.25.33	defun describeSetLinkerArgs	726
46.26	hyperdoc	727
46.26.1	fullscreen	727
46.26.2	defvar \$fullScreenSysVars	727
46.26.3	mathwidth	728
46.26.4	defvar \$historyDisplayWidth	728

46.27	help	729
46.27.1	fullscreen	729
46.27.2	defvar \$useFullScreenHelp	729
46.28	history	730
46.28.1	defvar \$HiFiAccess	730
46.29	messages	731
46.29.1	any	732
46.29.2	defvar \$printAnyIfTrue	732
46.29.3	autoload	733
46.29.4	defvar \$printLoadMsgs	733
46.29.5	bottomup	734
46.29.6	defvar \$reportBottomUpFlag	734
46.29.7	coercion	734
46.29.8	defvar \$reportCoerceIfTrue	735
46.29.9	dropmap	735
46.29.10	defvar \$displayDroppedMap	736
46.29.11	expose	736
46.29.12	defvar \$giveExposureWarning	736
46.29.13	file	737
46.29.14	defvar \$printMsgsToFile	737
46.29.15	frame	738
46.29.16	defvar \$frameMessages	738
46.29.17	highlighting	738
46.29.18	defvar \$highlightAllowed	739
46.29.19	instant	739
46.29.20	defvar \$reportInstantiations	740
46.29.21	insteach	740
46.29.22	defvar \$reportEachInstantiation—	740
46.29.23	interponly	741
46.29.24	defvar \$reportInterpOnly	741
46.29.25	naglink	742
46.29.26	defvar \$nagMessages	742
46.29.27	number	742
46.29.28	defvar \$displayMsgNumber	743
46.29.29	prompt	743
46.29.30	defvar \$inputPromptType	744
46.29.31	selection	744
46.29.32	set	745
46.29.33	defvar \$displaySetValue	745
46.29.34	startup	746
46.29.35	defvar \$displayStartMsgs	746
46.29.36	summary	746
46.29.37	defvar \$printStatisticsSummaryIfTrue	747
46.29.38	testing	747
46.29.39	defvar \$testingSystem	748
46.29.40	time	748

46.29.41	defvar \$printTimeIfTrue	748
46.29.42	type	749
46.29.43	defvar \$printTypeIfTrue	749
46.29.44	void	750
46.29.45	defvar \$printVoidIfTrue	750
46.30	naglink	750
46.30.1	host	751
46.30.2	defvar \$nagHost	751
46.30.3	defun setNagHost	752
46.30.4	defun describeSetNagHost	752
46.30.5	persistence	753
46.30.6	defvar \$fortPersistence	753
46.30.7	defun setFortPers	754
46.30.8	defun describeFortPersistence	754
46.30.9	messages	755
46.30.10	double	755
46.30.11	defvar \$nagEnforceDouble	756
46.31	output	756
46.31.1	abbreviate	757
46.31.2	defvar \$abbreviateTypes	758
46.31.3	algebra	758
46.31.4	defvar \$algebraFormat	759
46.31.5	defvar \$algebraOutputFile	759
46.31.6	defvar \$algebraOutputStream	760
46.31.7	defun setOutputAlgebra	760
46.31.8	defun describeSetOutputAlgebra	762
46.31.9	characters	763
46.31.10	defun setOutputCharacters	764
46.31.11	fortran	765
46.31.12	defvar \$fortranFormat	766
46.31.13	defvar \$fortranOutputFile	766
46.31.14	defun setOutputFortran	767
46.31.15	defun describeSetOutputFortran	769
46.31.16	fraction	770
46.31.17	defvar \$fractionDisplayType	771
46.31.18	length	771
46.31.19	defvar \$margin	771
46.31.20	defvar \$linelength	771
46.31.21	mathml	772
46.31.22	defvar \$mathmlFormat	773
46.31.23	defvar \$mathmlOutputFile	773
46.31.24	defun setOutputMathml	774
46.31.25	defun describeSetOutputMathml	776
46.31.26	html	777
46.31.27	defvar \$htmlFormat	777
46.31.28	defvar \$htmlOutputFile	777

46.31.29	defun setOutputHtml	778
46.31.30	defun describeSetOutputHtml	780
46.31.31	defun openmath	781
46.31.32	defvar \$openMathFormat	782
46.31.33	defvar \$openMathOutputFile	782
46.31.34	defun setOutputOpenMath	783
46.31.35	defun describeSetOutputOpenMath	785
46.31.36	defun script	786
46.31.37	defvar \$formulaFormat	787
46.31.38	defvar \$formulaOutputFile	787
46.31.39	defun setOutputFormula	787
46.31.40	defun describeSetOutputFormula	790
46.31.41	defun scripts	790
46.31.42	defvar \$linearFormatScripts	791
46.31.43	defun showeditor	791
46.31.44	defvar \$useEditorForShowOutput	792
46.31.45	defun tex	792
46.31.46	defvar \$texFormat	793
46.31.47	defvar \$texOutputFile	793
46.31.48	defun setOutputTex	794
46.31.49	defun describeSetOutputTex	796
46.32	quit	797
46.32.1	defvar \$quitCommandType	797
46.33	streams	797
46.33.1	calculate	798
46.33.2	defvar \$streamCount	798
46.33.3	defun setStreamsCalculate	799
46.33.4	defun describeSetStreamsCalculate	799
46.33.5	showall	800
46.33.6	defvar \$streamsShowAll	800
46.34	system	801
46.34.1	functioncode	801
46.34.2	defvar \$reportCompilation	801
46.34.3	optimization	802
46.34.4	defvar \$reportOptimization	802
46.34.5	prettyprint	803
46.34.6	defvar \$prettyprint	803
46.35	userlevel	804
46.35.1	defvar \$UserLevel	804
46.35.2	defvar \$setOptionNames	805
46.36	Set code	805
46.36.1	defun set	805
46.36.2	defun set1	806

47)show help page Command	811
47.1 show help page man page	811
47.1.1 defun The)show command	812
47.1.2 defun The internal)show command	812
47.1.3 defun reportOperations	813
47.1.4 defun reportOpsFromLisplib0	815
47.1.5 defun reportOpsFromLisplib1	815
47.1.6 defun reportOpsFromLisplib	816
47.1.7 defun isExposedConstructor	818
47.1.8 defun displayOperationsFromLisplib	818
47.1.9 defun reportOpsFromUnitDirectly0	819
47.1.10 defun reportOpsFromUnitDirectly	819
47.1.11 defun getOpListForConstructorForm	822
47.1.12 defun getOpListWithUniqueSignatures	823
47.1.13 defun reportOpsFromUnitDirectly1	823
47.1.14 defun sayShowWarning	824
48)spool help page Command	825
48.1 spool help page man page	825
49)summary help page Command	827
49.1 summary help page man page	827
49.1.1 defun summary	828
50)synonym help page Command	829
50.1 synonym help page man page	829
50.1.1 defun The)synonym command	830
50.1.2 defun The)synonym command implementation	830
50.1.3 defun Return a sublist of applicable synonyms	831
50.1.4 defun Get the system command from the input line	831
50.1.5 defun Remove system keyword	832
50.1.6 defun processSynonymLine	833
51)system help page Command	835
51.1 system help page man page	835
52)tangle help page Command	837
52.1 tangle help page man page	837
53)trace help page Command	839
53.1 trace help page man page	839
53.1.1 The trace global variables	843
53.1.2 defvar \$traceNoisely	844
53.1.3 defvar \$reportSpadTrace	844
53.1.4 defvar \$optionAlist	844
53.1.5 defvar \$tracedMapSignatures	844

53.1.6	defvar \$traceOptionList	844
53.1.7	defun trace	845
53.1.8	defun traceSpad2Cmd	845
53.1.9	defun trace1	846
53.1.10	defun getTraceOptions	850
53.1.11	defun saveMapSig	851
53.1.12	defun getMapSig	851
53.1.13	defun getTraceOption,hn	851
53.1.14	defun getTraceOption	852
53.1.15	defun traceOptionError	855
53.1.16	defun resetTimers	856
53.1.17	defun resetSpacers	856
53.1.18	defun resetCounters	856
53.1.19	defun ptimers	857
53.1.20	defun pspacers	857
53.1.21	defun pcounters	858
53.1.22	defun transOnlyOption	858
53.1.23	defun stackTraceOptionError	859
53.1.24	defun removeOption	859
53.1.25	defun domainToGenvar	859
53.1.26	defun genDomainTraceName	860
53.1.27	defun untrace	860
53.1.28	defun transTraceItem	861
53.1.29	defun removeTracedMapSigs	862
53.1.30	defun coerceTraceArgs2E	862
53.1.31	defun coerceSpadArgs2E	863
53.1.32	defun subTypes	864
53.1.33	defun coerceTraceFunValue2E	865
53.1.34	defun coerceSpadFunValue2E	866
53.1.35	defun isListOfIdentifiers	866
53.1.36	defun isListOfIdentifiersOrStrings	867
53.1.37	defun getMapSubNames	867
53.1.38	defun getPreviousMapSubNames	868
53.1.39	defun lassocSub	869
53.1.40	defun rassocSub	869
53.1.41	defun isUncompiledMap	869
53.1.42	defun isInterpOnlyMap	870
53.1.43	defun augmentTraceNames	870
53.1.44	defun isSubForRedundantMapName	871
53.1.45	defun untraceMapSubNames	871
53.1.46	defun funfind,LAM	872
53.1.47	defmacro funfind	872
53.1.48	defun isDomainOrPackage	873
53.1.49	defun isTraceGensym	873
53.1.50	defun spadTrace,g	873
53.1.51	defun spadTrace,isTraceable	873

53.1.52 defun spadTrace	874
53.1.53 defun traceDomainLocalOps	878
53.1.54 defun untraceDomainLocalOps	878
53.1.55 defun traceDomainConstructor	878
53.1.56 defun untraceDomainConstructor,keepTraced?	880
53.1.57 defun untraceDomainConstructor	881
53.1.58 defun flattenOperationAlist	881
53.1.59 defun mapLetPrint	882
53.1.60 defun letPrint	883
53.1.61 defun Identifier beginning with a sharpsign-number?	884
53.1.62 defun Identifier beginning with a sharpsign?	884
53.1.63 defun isgenvar	884
53.1.64 defun letPrint2	885
53.1.65 defun letPrint3	886
53.1.66 defun getAliasIfTracedMapParameter	887
53.1.67 defun getBpiNameIfTracedMap	888
53.1.68 defun hasPair	889
53.1.69 defun shortenForPrinting	889
53.1.70 defun spadTraceAlias	889
53.1.71 defun getOption	890
53.1.72 defun reportSpadTrace	890
53.1.73 defun orderBySlotNumber	891
53.1.74 defun /tracereply	892
53.1.75 defun spadReply,printName	892
53.1.76 defun spadReply	893
53.1.77 defun spadUntrace	893
53.1.78 defun remover	895
53.1.79 defun prTraceNames,fn	896
53.1.80 defun prTraceNames	896
53.1.81 defvar \$constructors	897
53.1.82 defun traceReply	897
53.1.83 defun addTraceItem	900
53.1.84 defun ?t	900
53.1.85 defun tracelet	902
53.1.86 defun breaklet	903
53.1.87 defun stupidIsSpadFunction	904
53.1.88 defun break	904
53.1.89 defun compileBoot	905
54)undo help page Command	907
54.1 undo help page man page	907
54.2 Evaluation	908
54.2.1 defun evalDomain	911
54.2.2 defun mkEvalable	911
54.2.3 defun mkEvalableUnion	913
54.2.4 defun mkEvalableRecord	913

54.2.5	defun mkEvalableMapping	913
54.2.6	defun evaluateType	914
54.2.7	defun Eval args passed to a constructor	915
54.2.8	defvar \$noEvalTypeMsg	917
54.2.9	defun throwEvalTypeMsg	917
54.2.10	defun makeOrdinal	918
54.2.11	defun evaluateSignature	918
54.3	Data Structures	918
54.4	Functions	919
54.4.1	Initial Undo Variables	919
54.4.2	defvar \$undoFlag	919
54.4.3	defvar \$frameRecord	919
54.4.4	defvar \$previousBindings	919
54.4.5	defvar \$reportUndo	920
54.4.6	defun undo	920
54.4.7	defun recordFrame	921
54.4.8	defun diffAlist	922
54.4.9	defun reportUndo	925
54.4.10	defun clearFrame	927
54.4.11	Undo previous n commands	927
54.4.12	defun undoSteps	928
54.4.13	defun undoSingleStep	929
54.4.14	defun undoLocalModemapHack	931
54.4.15	Remove undo lines from history write	931
55)what help page Command	935
55.1	what help page man page	935
55.1.1	defvar \$whatOptions	937
55.1.2	defun what	937
55.1.3	defun whatSpad2Cmd,fixpat	937
55.1.4	defun whatSpad2Cmd	938
55.1.5	defun Show keywords for)what command	939
55.1.6	defun The)what commands implementation	939
55.1.7	defun Find all names contained in a pattern	940
55.1.8	defun Find function of names contained in pattern	941
55.1.9	defun satisfiesRegularExpressions	941
55.1.10	defun filterAndFormatConstructors	942
55.1.11	defun whatConstructors	943
55.1.12	Display all operation names containing the fragment	943
56)with help page Command	945
56.1	with help page man page	945
56.1.1	defun with	945

57)workfiles help page Command	947
57.1 workfiles help page man page	947
57.1.1 defun workfiles	947
57.1.2 defun workfilesSpad2Cmd	947
58)zsystemdevelopment help page Command	951
58.1 zsystemdevelopment help page man page	951
58.1.1 defun zsystemdevelopment	951
58.1.2 defun zsystemDevelopmentSpad2Cmd	951
58.1.3 defun zsystemdevelopment1	952
59 Handlers for Special Forms	955
59.0.4 defun getAndEvalConstructorArgument	956
59.0.5 defun replaceSharps	956
59.0.6 defun isDomainValuedVariable	957
59.0.7 defun evalCategory	957
60 Handling input files	959
60.0.8 defun Handle .axiom.input file	959
60.0.9 defvar \$boot-line-stack	959
60.0.10 defvar \$in-stream	959
60.0.11 defvar \$out-stream	960
60.0.12 defvar \$file-closed	960
60.0.13 defvar \$echo-meta	960
60.0.14 defvar \$noSubsumption	960
60.0.15 defvar \$envHashTable	961
60.0.16 defun Dynamically add bindings to the environment	961
60.0.17 defun Fetch a property list for a symbol from CategoryFrame	962
60.0.18 defun Search for a binding in the environment list	962
60.0.19 defun Search for a binding in the current environment	962
60.0.20 defun searchTailEnv	963
61 File Parsing	965
61.0.21 defun Bind a variable in the interactive environment	965
61.0.22 defvar \$line-handler	965
61.0.23 defvar \$spad-errors	965
61.0.24 defvar \$xtokenreader	966
61.0.25 defun Initialize the spad reader	966
61.0.26 defun spad-syntax-error	967
61.0.27 defun spad-long-error	967
61.0.28 defun spad-short-error	968
61.0.29 defun spad-error-loc	968
61.0.30 defun iostat	968
61.0.31 defun next-lines-show	969
61.0.32 defun token-stack-show	969
61.0.33 defun ioclear	970

61.0.34 defun Set boot-line-stack to nil	970
62 Handling output	973
62.1 Special Character Tables	973
62.1.1 defvar \$defaultSpecialCharacters	973
62.1.2 defvar \$plainSpecialCharacters0	974
62.1.3 defvar \$plainSpecialCharacters1	974
62.1.4 defvar \$plainSpecialCharacters2	975
62.1.5 defvar \$plainSpecialCharacters3	975
62.1.6 defvar \$plainRTspecialCharacters	976
62.1.7 defvar \$RTspecialCharacters	976
62.1.8 defvar \$specialCharacters	977
62.1.9 defvar \$specialCharacterAlist	977
62.1.10 defun Look up a special character code for a symbol	978
63 Stream and File Handling	979
63.0.11 defun make-instream	979
63.0.12 defun make-outstream	979
63.0.13 defun make-appendstream	980
63.0.14 defun defiostream	980
63.0.15 defun shut	980
63.0.16 defun eofp	981
63.0.17 defun makeStream	981
63.0.18 defun Construct a new input file name	981
63.0.19 defun getDirectoryList	982
63.0.20 defun probeName	982
63.0.21 defun makeFullNamestring	983
63.0.22 defun Replace a file by erase and rename	983
64 The Spad Server Mechanism	985
64.0.23 defun openserver	985
65 Axiom Build-time Functions	987
65.0.24 defun spad-save	987
66 Exposure Groups	989
67 Databases	991
67.1 Database structure	991
67.1.1 kaf File Format	991
67.1.2 Database Files	992
67.1.3 defstruct \$database	994
67.1.4 defvar \$*defaultdomain-list*	995
67.1.5 defvar \$*operation-hash*	995
67.1.6 defvar \$*hasCategory-hash*	995
67.1.7 defvar \$*miss*	996

67.1.8 Database streams	996
67.1.9 defvar <code>\$*compressvector*</code>	996
67.1.10 defvar <code>\$*compressVectorLength*</code>	996
67.1.11 defvar <code>\$*compress-stream*</code>	997
67.1.12 defvar <code>\$*compress-stream-stamp*</code>	997
67.1.13 defvar <code>\$*interp-stream*</code>	997
67.1.14 defvar <code>\$*interp-stream-stamp*</code>	997
67.1.15 defvar <code>\$*operation-stream*</code>	997
67.1.16 defvar <code>\$*operation-stream-stamp*</code>	998
67.1.17 defvar <code>\$*browse-stream*</code>	998
67.1.18 defvar <code>\$*browse-stream-stamp*</code>	998
67.1.19 defvar <code>\$*category-stream*</code>	998
67.1.20 defvar <code>\$*category-stream-stamp*</code>	999
67.1.21 defvar <code>\$*allconstructors*</code>	999
67.1.22 defvar <code>\$*allOperations*</code>	999
67.1.23 defun Reset all hash tables before saving system	999
67.1.24 defun Preload algebra into saved system	1000
67.1.25 defun Open the interp database	1002
67.1.26 defun Open the browse database	1004
67.1.27 defun Open the category database	1005
67.1.28 defun Open the operations database	1006
67.1.29 defun Add operations from newly compiled code	1006
67.1.30 defun Show all database attributes of a constructor	1007
67.1.31 defun Set a value for a constructor key in the database	1008
67.1.32 defun Delete a value for a constructor key in the database	1009
67.1.33 defun Get constructor information for a database key	1009
67.1.34 defun The <code>)library</code> top level command	1013
67.1.35 defun Read a local filename and update the hash tables	1013
67.1.36 defun Update the database from an <code>nrllib</code> <code>index.kaf</code> file	1015
67.1.37 defun <code>updateDatabase</code>	1017
67.1.38 defun Make new databases	1017
67.1.39 defun <code>saveDependentsHashTable</code>	1021
67.1.40 defun <code>saveUsersHashTable</code>	1022
67.1.41 defun Construct the proper database full pathname	1022
67.1.42 <code>compress.daase</code>	1023
67.1.43 defun Set up compression vectors for the databases	1023
67.1.44 defvar <code>\$*attributes*</code>	1024
67.1.45 defun Write out the compress database	1024
67.1.46 defun Compress an expression using the compress vector	1025
67.1.47 defun Uncompress an expression using the compress vector	1026
67.1.48 Building the <code>interp.daase</code> from hash tables	1026
67.1.49 defun Write the interp database	1030
67.1.50 Building the <code>browse.daase</code> from hash tables	1032
67.1.51 defun Write the browse database	1032
67.1.52 Building the <code>category.daase</code> from hash tables	1033
67.1.53 defun Write the category database	1033

67.1.54 Building the operation.daase from hash tables	1034
67.1.55 defun Write the operations database	1034
67.1.56 Database support operations	1035
67.1.57 defun Data preloaded into the image at build time	1035
67.1.58 defun Return all constructors	1035
67.1.59 defun Return all operations	1035
68 System Statistics	1037
68.1 Lisp Library Handling	1037
68.1.1 defun loadLib	1037
68.1.2 defun isSystemDirectory	1038
68.1.3 defun loadLibNoUpdate	1039
68.1.4 defun loadFunctor	1040
69 Special Lisp Functions	1041
69.1 Axiom control structure macros	1041
69.1.1 defun put	1041
69.1.2 defmacro while	1041
69.1.3 defmacro whileWithResult	1042
69.2 Filename Handling	1042
69.2.1 defun namestring	1042
69.2.2 defun pathnameName	1042
69.2.3 defun pathnameType	1042
69.2.4 defun pathnameTypeId	1043
69.2.5 defun mergePathnames	1043
69.2.6 defun pathnameDirectory	1043
69.2.7 defun Axiom pathnames	1044
69.2.8 defun makePathname	1044
69.2.9 defun Delete a file	1044
69.2.10 defun wrap	1045
69.2.11 defun lotsof	1045
69.2.12 defmacro startsId?	1046
69.2.13 defun hput	1046
69.2.14 defmacro hget	1046
69.2.15 defun hkeys	1046
69.2.16 defun digitp	1047
69.2.17 defun pname	1047
69.2.18 defun size	1047
69.2.19 defun strpos	1047
69.2.20 defun strposl	1048
69.2.21 defun qenum	1048
69.2.22 defmacro identp	1048
69.2.23 defun concat	1049
69.2.24 defun functionp	1049
69.2.25 defun brightprint	1049
69.2.26 defun brightprint-0	1050

69.2.27 defun member	1050
69.2.28 defun messageprint	1050
69.2.29 defun messageprint-1	1051
69.2.30 defun messageprint-2	1051
69.2.31 defun sayBrightly1	1051
69.2.32 defmacro assq	1052
70 Record, Union, Mapping, and Enumeration	1053
71 Common Lisp Algebra Support	1055
71.1 InputForm	1055
71.1.1 defun unparseInputForm	1055
71.2 Void	1056
71.2.1 defun voidValue	1056
71.3 U32Vector	1056
71.3.1 defun getrefv32	1056
71.3.2 defmacro qv32len	1056
71.3.3 defmacro elt32	1057
71.3.4 defmacro setelt32	1057
71.4 DirectProduct	1057
71.4.1 defun vec2list	1057
71.5 AlgebraicFunction	1057
71.5.1 defun retract	1057
71.6 Any	1059
71.6.1 defun spad2BootCoerce	1059
71.7 ParametricLinearEquations	1059
71.7.1 defun algCoerceInteractive	1059
71.8 NumberFormats	1060
71.8.1 defun ncParseFromString	1060
71.9 SingleInteger	1060
71.9.1 defun qsquotient	1060
71.9.2 defun qsremainder	1060
71.9.3 defmacro qsdifference	1061
71.9.4 defmacro qslessp	1061
71.9.5 defmacro qsadd1	1061
71.9.6 defmacro qssub1	1061
71.9.7 defmacro qsminus	1062
71.9.8 defmacro qsplus	1062
71.9.9 defmacro qstimes	1062
71.9.10 defmacro qsabsval	1062
71.9.11 defmacro qsoddp	1063
71.9.12 defmacro qszerop	1063
71.9.13 defmacro qsmax	1063
71.9.14 defmacro qsmin	1063
71.10 Boolean	1064
71.10.1 defun The Boolean = function support	1064

71.11	IndexedBits	1064
71.11.1	defmacro truth-to-bit	1064
71.11.2	defun IndexedBits new function support	1064
71.11.3	defmacro bit-to-truth	1065
71.11.4	defmacro bvec-elt	1065
71.11.5	defmacro bvec-setelt	1065
71.11.6	defmacro bvec-size	1065
71.11.7	defun IndexedBits concat function support	1065
71.11.8	defun IndexedBits copy function support	1066
71.11.9	defun IndexedBits = function support	1066
71.11.10	defun IndexedBits < function support	1066
71.11.11	defun IndexedBits And function support	1066
71.11.12	defun IndexedBits Or function support	1067
71.11.13	defun IndexedBits xor function support	1067
71.11.14	defun IndexedBits nand function support	1067
71.11.15	defun IndexedBits nor function support	1067
71.11.16	defun IndexedBits not function support	1068
71.12	KeyedAccessFile	1068
71.12.1	defun KeyedAccessFile defstream function support	1068
71.12.2	defun KeyedAccessFile defstream function support	1068
71.13	Table	1069
71.13.1	defun Table InnerTable support	1069
71.13.2	defun compiledLookup	1069
71.13.3	defun basicLookup	1069
71.13.4	defun lookupInDomainVector	1071
71.13.5	defun basicLookupCheckDefaults	1072
71.13.6	defun oldCompLookup	1072
71.13.7	defun NRTevalDomain	1073
71.14	Plot3d	1073
71.14.1	defvar \$numericFailure	1073
71.14.2	defvar \$oldBreakMode	1074
71.14.3	defmacro trapNumericErrors	1074
71.15	DoubleFloatVector	1074
71.15.1	defmacro dlen	1074
71.15.2	defmacro make-double-vector	1075
71.15.3	defmacro make-double-vector1	1075
71.15.4	defmacro delt	1075
71.15.5	defmacro dsetelt	1075
71.16	ComplexDoubleFloatVector	1076
71.16.1	defmacro make-cdouble-vector	1076
71.16.2	defmacro cdelt	1076
71.16.3	defmacro cdsetelt	1076
71.16.4	defmacro cdlen	1077
71.17	DoubleFloatMatrix	1077
71.17.1	defmacro make-double-matrix	1077
71.17.2	defmacro make-double-matrix1	1077

71.17.3 defmacro daref2	1078
71.17.4 defmacro dsetaref2	1078
71.17.5 defmacro danrows	1078
71.17.6 defmacro dancols	1078
71.18 ComplexDoubleFloatMatrix	1079
71.18.1 defmacro make-cdouble-matrix	1079
71.18.2 defmacro cdaref2	1079
71.18.3 defmacro cdsetaref2	1079
71.18.4 defmacro cdanrows	1080
71.18.5 defmacro cdancols	1080
71.19 Integer	1080
71.19.1 defun Integer divide function support	1080
71.19.2 defun Integer quo function support	1081
71.19.3 defun Integer quo function support	1081
71.19.4 defun Integer random function support	1081
71.20 IndexCard	1082
71.20.1 defun IndexCard origin function support	1082
71.20.2 defun IndexCard origin function support	1082
71.20.3 defun IndexCard elt function support	1082
71.21 OperationsQuery	1083
71.21.1 defun OperationQuery getDatabase function support	1083
71.22 Database	1084
71.22.1 defun Database elt function support	1084
71.23 FileName	1084
71.23.1 defun FileName filename function implementation	1084
71.23.2 defun FileName filename support function	1084
71.23.3 defun FileName directory function implementation	1085
71.23.4 defun FileName directory function support	1085
71.23.5 defun FileName name function implementation	1085
71.23.6 defun FileName extension function implementation	1085
71.23.7 defun FileName exists? function implementation	1086
71.23.8 defun FileName readable? function implementation	1086
71.23.9 defun FileName writeable? function implementation	1086
71.23.10 defun FileName writeable? function support	1086
71.23.11 defun FileName new function implementation	1087
71.24 DoubleFloat	1087
71.24.1 defmacro DFLessThan	1087
71.24.2 defmacro DFUnaryMinus	1088
71.24.3 defmacro DFMinusp	1088
71.24.4 defmacro DFZerop	1088
71.24.5 defmacro DFAdd	1088
71.24.6 defmacro DFSubtract	1089
71.24.7 defmacro DFMultiply	1089
71.24.8 defmacro DFIntegerMultiply	1089
71.24.9 defmacro DFMax	1089
71.24.10 defmacro DFMin	1090

71.24.11	defmacro DFEql	1090
71.24.12	defmacro DFDivide	1090
71.24.13	defmacro DFIntegerDivide	1090
71.24.14	defmacro DFSqrt	1091
71.24.15	defmacro DFLogE	1091
71.24.16	defmacro DFLog	1091
71.24.17	defmacro DFIntegerExpt	1091
71.24.18	defmacro DFExpt	1092
71.24.19	defmacro DFExp	1092
71.24.20	defmacro DFSin	1092
71.24.21	defmacro DFCos	1092
71.24.22	defmacro DFTan	1093
71.24.23	defmacro DFAsin	1093
71.24.24	defmacro DFAcos	1093
71.24.25	defmacro DFAtan	1093
71.24.26	defmacro DFAtan2	1094
71.24.27	defmacro DFSinh	1094
71.24.28	defmacro DFCosh	1094
71.24.29	defmacro DFTanh	1095
71.24.30	defmacro DFAsinh	1095
71.24.31	defmacro DFAcosh	1095
71.24.32	defmacro DFAtanh	1096
71.24.33	defun Machine specific float numerator	1096
71.24.34	defun Machine specific float denominator	1096
71.24.35	defun Machine specific float sign	1097
71.24.36	defun Machine specific float bit length	1097
71.24.37	defun Decode floating-point values	1097
71.24.38	defun The cotangent routine	1097
71.24.39	defun The inverse cotangent function	1098
71.24.40	defun The secant function	1098
71.24.41	defun The inverse secant function	1098
71.24.42	defun The cosecant function	1099
71.24.43	defun The inverse cosecant function	1099
71.24.44	defun The hyperbolic cosecant function	1099
71.24.45	defun The hyperbolic cotangent function	1100
71.24.46	defun The hyperbolic secant function	1100
71.24.47	defun The inverse hyperbolic cosecant function	1100
71.24.48	defun The inverse hyperbolic cotangent function	1100
71.24.49	defun The inverse hyperbolic secant function	1101
72 OpenMath		1103
72.1	A Technical Overview[4]	1103
72.1.1	The OpenMath Architecture	1103
72.1.2	OpenMath Encodings	1105
72.1.3	Content Dictionaries	1106
72.1.4	OpenMath in Action	1108

72.2	Technical Details[3]	1109
72.3	The Structure of the API	1109
72.4	OpenMath Expressions	1110
72.4.1	Expressions	1110
72.4.2	Symbols	1110
72.4.3	Encoding and Decoding OpenMath Expressions	1110
72.5	Big Integers	1111
72.6	Functions Dealing with OpenMath Devices	1111
72.7	Functions to Write OpenMath Expressions to Devices	1112
72.7.1	Beginning and Ending Objects	1112
72.7.2	Writing Basic Objects	1113
72.7.3	Writing Structured Objects	1113
72.8	Functions to Extract OpenMath Expressions from Devices	1114
72.8.1	Testing the type of the current token	1114
72.8.2	Extracting the current token	1115
72.9	Comments in the SGML/XML Encodings	1118
72.10	I/O Functions for Devices	1119
72.11	Communications	1119
72.11.1	Functions to Initiate an OMconn	1120
72.12	Parameters	1121
72.13	Miscellaneous Functions and Variables	1121
72.14	The OM.h header file	1122
72.15	Axiom OpenMath stub functions	1131
72.15.1	Axiom specific functions	1131
72.15.2	defun om-Read	1131
72.15.3	defun om-listCDs	1132
72.15.4	defun om-listSymbols	1132
72.15.5	defun om-supportsCD	1132
72.15.6	defun om-supportsSymbol	1132
72.15.7	Lisp conversion functions	1133
72.15.8	defun om-setDevEncoding	1133
72.15.9	Device manipulation functions	1133
72.15.10	defun om-openFileDev	1133
72.15.11	defun om-openStringDev	1134
72.15.12	defun om-closeDev	1134
72.15.13	Connection manipulation functions	1134
72.15.14	defun om-makeConn	1134
72.15.15	defun om-closeConn	1134
72.15.16	defun om-getConnInDev	1135
72.15.17	defun om-getConnOutDev	1135
72.15.18	Client/Server functions	1135
72.15.19	defun om-bindTCP	1135
72.15.20	defun om-connectTCP	1136
72.15.21	Device input/output functions	1136
72.15.22	defun om-getApp	1137
72.15.23	defun om-getAtp	1138

72.15.24	defun om-getAttr	1138
72.15.25	defun om-getBind	1138
72.15.26	defun om-getBVar	1138
72.15.27	defun om-getByteArray	1139
72.15.28	defun om-getEndApp	1139
72.15.29	defun om-getEndAtp	1139
72.15.30	defun om-getEndAttr	1139
72.15.31	defun om-getEndBind	1140
72.15.32	defun om-getEndBVar	1140
72.15.33	defun om-getEndError	1140
72.15.34	defun om-getEndObject	1140
72.15.35	defun om-getError	1141
72.15.36	defun om-getFloat	1141
72.15.37	defun om-getInt	1141
72.15.38	defun om-getObject	1141
72.15.39	defun om-getString	1142
72.15.40	defun om-getSymbol	1142
72.15.41	defun om-getType	1142
72.15.42	defun om-getVar	1142
72.15.43	defun om-putApp	1143
72.15.44	defun om-putAtp	1143
72.15.45	defun om-putAttr	1143
72.15.46	defun om-putBind	1143
72.15.47	defun om-putBVar	1144
72.15.48	defun om-putByteArray	1144
72.15.49	defun om-putEndApp	1144
72.15.50	defun om-putEndAtp	1144
72.15.51	defun om-putEndAttr	1145
72.15.52	defun om-putEndBind	1145
72.15.53	defun om-putEndBVar	1145
72.15.54	defun om-putEndError	1145
72.15.55	defun om-putEndObject	1146
72.15.56	defun om-putError	1146
72.15.57	defun om-putFloat	1146
72.15.58	defun om-putInt	1146
72.15.59	defun om-putObject	1147
72.15.60	defun om-putString	1147
72.15.61	defun om-putSymbol	1147
72.15.62	defun om-putVar	1147
72.15.63	defun om-stringToStringPtr	1148
72.15.64	defun om-stringPtrToString	1148
73	NRLIB code.lisp support code	1149
73.0.65	defun makeByteWordVec2	1149
73.0.66	defmacro spadConstant	1149

74 Monitoring execution	1151
74.0.67 defvar <code>\$*monitor-domains*</code>	1157
74.0.68 defvar <code>\$*monitor-nrlibs*</code>	1157
74.0.69 defvar <code>\$*monitor-table*</code>	1158
74.0.70 defstruct <code>\$monitor-data</code>	1158
74.0.71 defstruct <code>\$libstream</code>	1158
74.0.72 defun Initialize the monitor statistics hashtable	1158
74.0.73 defun End the monitoring process, we cannot restart	1159
74.0.74 defun Return a list of the monitor-data structures	1159
74.0.75 defun Add a function to be monitored	1160
74.0.76 defun Remove a function being monitored	1160
74.0.77 defun Enable all (or optionally one) function for monitoring	1160
74.0.78 defun Disable all (optionally one) function for monitoring	1161
74.0.79 defun Reset the table count for the table (or a function)	1161
74.0.80 defun Incr the count of fn by 1	1162
74.0.81 defun Decr the count of fn by 1	1162
74.0.82 defun Return the monitor information for a function	1163
74.0.83 defun Hang a monitor call on all of the defuns in a file	1163
74.0.84 defun Return a list of the functions with zero count fields	1163
74.0.85 defun Return a list of functions with non-zero counts	1164
74.0.86 defun Write out a list of symbols or structures to a file	1164
74.0.87 defun Save the <code>*monitor-table*</code> in loadable form	1165
74.0.88 defun restore a checkpointed file	1165
74.0.89 defun Printing help documentation	1166
74.0.90 Monitoring algebra files	1168
74.0.91 defun Monitoring algebra code.lsp files	1168
74.0.92 defun Monitor autoloaded files	1168
74.0.93 defun Monitor an nrlib	1169
74.0.94 defun Given a monitor-data item, extract the nrlib name	1169
74.0.95 defun Is this an exposed algebra function?	1170
74.0.96 defun Monitor exposed domains	1170
74.0.97 defun Generate a report of the monitored domains	1171
74.0.98 defun Parse an <code>)abbrev</code> expression for the domain name	1172
74.0.99 defun Given a spad file, report all nrlibs it creates	1172
74.0.100 defun Print percent of functions tested	1173
74.0.101 defun Find all monitored symbols containing the string	1173
75 The Interpreter	1175
76 The Global Variables	1209
76.1 Star Global Variables	1209
76.1.1 <code>*eof*</code>	1209
76.1.2 <code>*features*</code>	1209
76.1.3 <code>*package*</code>	1209
76.1.4 <code>*standard-input*</code>	1210
76.1.5 <code>*standard-output*</code>	1210

76.1.6	*top-level-hook*	1210
76.2	Dollar Global Variables	1212
76.2.1	\$boot	1213
76.2.2	coerceFailure	1213
76.2.3	\$currentLine	1213
76.2.4	\$displayStartMsgs	1213
76.2.5	\$e	1213
76.2.6	\$erMsgToss	1213
76.2.7	\$fn	1213
76.2.8	\$frameRecord	1213
76.2.9	\$HiFiAccess	1214
76.2.10	\$HistList	1214
76.2.11	\$HistListAct	1214
76.2.12	\$HistListLen	1214
76.2.13	\$HistRecord	1214
76.2.14	\$historyFileType	1215
76.2.15	\$internalHistoryTable	1215
76.2.16	\$interpreterFrameName	1215
76.2.17	\$interpreterFrameRing	1215
76.2.18	\$InteractiveFrame	1215
76.2.19	\$intRestart	1215
76.2.20	\$intTopLevel	1215
76.2.21	\$IOindex	1216
76.2.22	\$lastPos	1216
76.2.23	\$libQuiet	1216
76.2.24	\$msgDatabaseName	1216
76.2.25	\$ncMsgList	1216
76.2.26	\$newcompErrorCount	1216
76.2.27	\$newspad	1216
76.2.28	\$nopus	1216
76.2.29	\$oldHistoryFileName	1217
76.2.30	\$okToExecuteMachineCode	1217
76.2.31	\$options	1217
76.2.32	\$previousBindings	1217
76.2.33	\$PrintCompilerMessageIfTrue	1217
76.2.34	\$reportUndo	1217
76.2.35	\$spad	1217
76.2.36	\$SpadServer	1218
76.2.37	\$SpadServerName	1218
76.2.38	\$systemCommandFunction	1218
76.2.39	top_level	1218
76.2.40	\$quitTag	1218
76.2.41	\$useInternalHistoryTable	1218
76.2.42	\$undoFlag	1218

New Foreword

On October 1, 2001 Axiom was withdrawn from the market and ended life as a commercial product. On September 3, 2002 Axiom was released under the Modified BSD license, including this document. On August 27, 2003 Axiom was released as free and open source software available for download from the Free Software Foundation's website, Savannah.

Work on Axiom has had the generous support of the Center for Algorithms and Interactive Scientific Computation (CAISS) at City College of New York. Special thanks go to Dr. Gilbert Baumslag for his support of the long term goal.

The online version of this documentation is roughly 1000 pages. In order to make printed versions we've broken it up into three volumes. The first volume is tutorial in nature. The second volume is for programmers. The third volume is reference material. We've also added a fourth volume for developers. All of these changes represent an experiment in print-on-demand delivery of documentation. Time will tell whether the experiment succeeded.

Axiom has been in existence for over thirty years. It is estimated to contain about three hundred man-years of research and has, as of September 3, 2003, 143 people listed in the credits. All of these people have contributed directly or indirectly to making Axiom available. Axiom is being passed to the next generation. I'm looking forward to future milestones.

With that in mind I've introduced the theme of the "30 year horizon". We must invent the tools that support the Computational Mathematician working 30 years from now. How will research be done when every bit of mathematical knowledge is online and instantly available? What happens when we scale Axiom by a factor of 100, giving us 1.1 million domains? How can we integrate theory with code? How will we integrate theorems and proofs of the mathematics with space-time complexity proofs and running code? What visualization tools are needed? How do we support the conceptual structures and semantics of mathematics in effective ways? How do we support results from the sciences? How do we teach the next generation to be effective Computational Mathematicians?

The "30 year horizon" is much nearer than it appears.

Tim Daly
CAISS, City College of New York
November 10, 2003 ((iHy))

Chapter 1

Credits

Axiom has a very long history and many people have contributed to the effort, some in large ways and some in small ways. Any and all effort deserves recognition. There is no other criteria than contribution of effort. We would like to acknowledge and thank the following people:

1.0.1 defvar \$credits

— initvars —

```
(defvar credits '(  
  "An alphabetical listing of contributors to AXIOM:"  
  "Michael Albaugh      Cyril Alberga      Roy Adler"  
  "Christian Aistleitner Richard Anderson  George Andrews"  
  "S.J. Atkins"  
  "Henry Baker          Martin Baker      Stephen Balzac"  
  "Yuriy Baransky        David R. Barton  Gerald Baumgartner"  
  "Gilbert Baumslag      Michael Becker    Nelson H. F. Beebe"  
  "Jay Belanger           David Bindel      Fred Blair"  
  "Vladimir Bondarenko   Mark Botch        Alexandre Bouyer"  
  "Peter A. Broadbery     Martin Brock      Manuel Bronstein"  
  "Stephen Buchwald       Florian Bundschuh Luanne Burns"  
  "William Burge"  
  "Quentin Carpent        Robert Caviness    Bruce Char"  
  "Ondrej Certik          Cheekai Chin       David V. Chudnovsky"  
  "Gregory V. Chudnovsky   Mark Clements      James Cloos"  
  "Josh Cohen              Christophe Conil    Don Coppersmith"  
  "George Corliss          Robert Corless     Gary Cornell"  
  "Meino Cramer            Claire Di Crescenzo David Cyganski"  
  "Nathaniel Daly          Timothy Daly Sr.    Timothy Daly Jr."  
  "James H. Davenport     Didier Deshommes    Michael Dewar"
```

"Jean Della Dora	Gabriel Dos Reis	Claire DiCrescendo"
"Sam Dooley	Lionel Ducos	Lee Duhem"
"Martin Dunstan	Brian Dupee	Dominique Duval"
"Robert Edwards	Heow Eide-Goodman	Lars Erickson"
"Richard Fateman	Bertfried Fauser	Stuart Feldman"
"John Fletcher	Brian Ford	Albrecht Fortenbacher"
"George Frances	Constantine Frangos	Timothy Freeman"
"Korrinn Fu"		
"Marc Gaetano	Rudiger Gebauer	Kathy Gerber"
"Patricia Gianni	Samantha Goldrich	Holger Gollan"
"Teresa Gomez-Diaz	Laureano Gonzalez-Vega	Stephen Gortler"
"Johannes Grabmeier	Matt Grayson	Klaus Ebbe Grue"
"James Griesmer	Vladimir Grinberg	Oswald Gschnitzer"
"Jocelyn Guidry"		
"Gaetan Hache	Steve Hague	Satoshi Hamaguchi"
"Mike Hansen	Richard Harke	Bill Hart"
"Vilya Harvey	Martin Hassner	Arthur S. Hathaway"
"Dan Hatton	Waldek Hebisch	Karl Hegbloom"
"Ralf Hemmecke	Henderson	Antoine Hersen"
"Roger House	Gernot Hueber"	
"Pietro Iglio"		
"Alejandro Jakubi	Richard Jenks"	
"Kai Kaminski	Grant Keady	Wilfrid Kendall"
"Tony Kennedy	Ted Kosan	Paul Kosinski"
"Klaus Kusche	Bernhard Kutzler"	
"Tim Lahey	Larry Lambe	Kaj Laurson"
"Franz Lehner	Frederic Lehobey	Michel Levaud"
"Howard Levy	Liu Xiaojun	Rudiger Loos"
"Michael Lucks	Richard Luczak"	
"Camm Maguire	Francois Maltey	Alasdair McAndrew"
"Bob McElrath	Michael McGettrick	Ian Meikle"
"David Mentre	Victor S. Miller	Gerard Milmeister"
"Mohammed Mobarak	H. Michael Moeller	Michael Monagan"
"Marc Moreno-Maza	Scott Morrison	Joel Moses"
"Mark Murray"		
"William Naylor	Patrice Naudin	C. Andrew Neff"
"John Nelder	Godfrey Nolan	Arthur Norman"
"Jinzhong Niu"		
"Michael O'Connor	Summat Oemrawsingh	Kostas Oikonomou"
"Humberto Ortiz-Zuazaga"		
"Julian A. Padget	Bill Page	David Parnas"
"Susan Pelzel	Michel Petitot	Didier Pinchon"
"Ayal Pinkus	Jose Alfredo Portes"	
"Claude Quitte"		
"Arthur C. Ralfs	Norman Ramsey	Anatoly Raportirenko"
"Albert D. Rich	Michael Richardson	Guilherme Reis"
"Renaud Rioboo	Jean Rivlin	Nicolas Robidoux"
"Simon Robinson	Raymond Rogers	Michael Rothstein"
"Martin Rubey"		
"Philip Santas	Alfred Scheerhorn	William Schelter"

"Gerhard Schneider	Martin Schoenert	Marshall Schor"
"Frithjof Schulze	Fritz Schwarz	Steven Segletes"
"Nick Simicich	William Sit	Elena Smirnova"
"Jonathan Steinbach	Fabio Stumbo	Christine Sundaresan"
"Robert Sutor	Moss E. Sweedler	Eugene Surowitz"
"Max Tegmark	T. Doug Telford	James Thatcher"
"Balbir Thomas	Mike Thomas	Dylan Thurston"
"Steve Toleque	Barry Trager	Themos T. Tsikas"
"Gregory Vanuxem"		
"Bernhard Wall	Stephen Watt	Jaap Weel"
"Juergen Weiss	M. Weller	Mark Wegman"
"James Wen	Thorsten Werther	Michael Wester"
"John M. Wiley	Berhard Will	Clifton J. Williamson"
"Stephen Wilson	Shmuel Winograd	Robert Wisbauer"
"Sandra Wityak	Waldemar Wiwianka	Knut Wolf"
"Clifford Yapp	David Yun"	
"Vadim Zhytnikov	Richard Zippel	Evelyn Zoernack"
"Bruno Zuercher	Dan Zwillinge"	

))

Chapter 2

The Interpreter

The Axiom interpreter is a large common lisp program. It has several forms of interaction and run from terminal in a standalone fashion, run under the control of a session handler program, run as a web server, or run in a unix pipe.

Chapter 3

The Fundamental Data Structures

Axiom currently depends on a lot of global variables. These are generally listed here along with explanations.

3.1 The global variables

3.1.1 `defvar $current-directory`

The `$current-directory` variable is set to the current directory at startup. This is used by the `)cd` function and some of the compile routines. This is the result of the (p36) `get-current-directory` function. This variable is used to set `*default-pathname-defaults*`. The (p40) `reroot` function resets it to `$spadroot`.

An example of a runtime value is:

```
$current-directory = "/research/test/"
```

3.1.2 `defvar $current-directory`

— initvars —

```
(defvar $current-directory nil)
```

—————

3.1.3 defvar \$defaultMsgDatabaseName

The `$defaultMsgDatabaseName` variable contains the location of the international message database. This can be changed to use a translated version of the messages. It defaults to the United States English version. The relative pathname used as the default is hardcoded in the (p40) reroot function. This value is prefixed with the `$spadroot` to make the path absolute.

In general, all Axiom message text should be stored in this file to enable internationalization of messages.

An example of a runtime value is:

```
|$defaultMsgDatabaseName| =
  #p"/research/test/mnt/ubuntu/doc/messages/s2-us.messages"
```

3.1.4 defvar \$defaultMsgDatabaseName

— initvars —

```
(defvar |$defaultMsgDatabaseName| nil)
```

3.1.5 defvar \$directory-list

The `$directory-list` is a runtime list of absolute pathnames. This list is generated by the (p40) reroot function from the list of relative paths held in the variable `$relative-directory-list`. Each entry will be prefixed by `$spadroot`.

An example of a runtime value is:

```
$directory-list =
  ("/research/test/mnt/ubuntu/../../src/input/"
   "/research/test/mnt/ubuntu/doc/messages/"
   "/research/test/mnt/ubuntu/../../src/algebra/"
   "/research/test/mnt/ubuntu/../../src/interp/"
   "/research/test/mnt/ubuntu/doc/spadhelp/")
```

3.1.6 defvar \$directory-list

— initvars —

```
(defvar $directory-list nil)
```

3.1.7 defvar \$InitialModemapFrame

The `$InitialModemapFrame` is used as the initial value.

See the function “makeInitialModemapFrame” (5.3.14 p 37).

An example of a runtime value is:

```
$InitialModemapFrame = '((nil))
```

3.1.8 defvar \$InitialModemapFrame

— initvars —

```
(defvar |$InitialModemapFrame| '((nil)))
```

3.1.9 defvar \$library-directory-list

The `$library-directory-list` variable is the system-wide search path for library files. It is set up in the (p40) reroot function by prepending the `$spadroot` variable to the `$relative-library-directory-list` variable.

An example of a runtime value is:

```
$library-directory-list = ("/research/test/mnt/ubuntu/algebra/")
```

3.1.10 defvar \$library-directory-list

— initvars —

```
(defvar $library-directory-list '("/algebra/"))
```

3.1.11 defvar \$msgDatabaseName

The `$msgDatabaseName` is a locally shared variable among the message database routines.

An example of a runtime value is:

```
|$msgDatabaseName| = nil
```

3.1.12 defvar \$msgDatabaseName

— initvars —

```
(defvar |$msgDatabaseName| nil)
```

—————

3.1.13 defvar \$openServerIfTrue

The `$openServerIfTrue` It appears to control whether the interpreter will be used as an open server, probably for OpenMath use.

If an open server is not requested then this variable to NIL

See the function “openserver” (64.0.23 p 985).

An example of a runtime value is:

```
$openServerIfTrue = nil
```

3.1.14 defvar \$openServerIfTrue

— initvars —

```
(defvar $openServerIfTrue nil)
```

—————

3.1.15 defvar \$relative-directory-list

The `$relative-directory-list` variable contains a hand-generated list of directories used in the Axiom system. The relative directory list specifies a search path for files for the current directory structure. It has been changed from the NAG distribution back to the original form.

This list is used by the (p40) reroot function to generate the absolute list of paths held in the variable `$directory-list`. Each entry will be prefixed by `$spadroot`.

An example of a runtime value is:

```
$relative-directory-list =
  ("../../../../src/input/"
   "/doc/msgs/"
   "../../../../src/algebra/"
   "../../../../src/interp/"
   "/doc/spadhelp/")
```

3.1.16 defvar \$relative-directory-list

— initvars —

```
(defvar $relative-directory-list
  '("../../../../src/input/"
    "/doc/msgs/"
    "../../../../src/algebra/"
    "../../../../src/interp/" ; for lisp files (helps fd)
    "/doc/spadhelp/" ))
```

3.1.17 defvar \$relative-library-directory-list

The `$relative-library-directory-list` is a hand-generated list of directories containing algebra. The (p40) `reroot` function will prefix every path in this list with the value of the `$spadroot` variable to construct the `$library-directory-list` variable.

An example of a runtime value is:

```
$relative-library-directory-list = ("/algebra/")
```

3.1.18 defvar \$relative-library-directory-list

— initvars —

```
(defvar $relative-library-directory-list '("/algebra/"))
```

3.1.19 defvar \$spadroot

The `$spadroot` variable is the internal name for the AXIOM shell variable. It is set in `reroot` to the value of the argument. The value is expected to be a directory name. The (p35)

initroot function uses this variable if the AXIOM shell variable is not set. The (p36) make-absolute-filename function uses this path as a prefix to all of the relative filenames to make them absolute.

An example of a runtime value is:

```
$spadroot = "/research/test/mnt/ubuntu"
```

3.1.20 defvar \$spadroot

— initvars —

```
(defvar $spadroot nil)
```

—————

3.1.21 defvar \$SpadServer

The `$SpadServer` determines whether Axiom acts as a remote server.

See the function “openserver” (64.0.23 p 985).

An example of a runtime value is:

```
$SpadServer = nil
```

3.1.22 defvar \$SpadServer

— initvars —

```
(defvar $SpadServer nil "t means Axiom acts as a remote server")
```

—————

3.1.23 defvar \$SpadServerName

The `$SpadServerName` defines the name of the spad server socket. In unix these exist in the tmp directory as names.

See the function “openserver” (64.0.23 p 985).

An example of a runtime value is:

```
$SpadServerName = "/tmp/.d"
```


3.1.24 defvar \$SpadServerName

— initvars —

```
(defvar $SpadServerName "/tmp/.d" "the name of the spad server socket")
```

—————

Chapter 4

Starting Axiom

Axiom starts by invoking a function value of the lisp symbol `*top-level-hook*`. The function invocation path to from this point until the prompt is approximates (skipping initializations):

```
lisp -> restart
      -> |spad|
      -> |runspad|
      -> |ncTopLevel|
      -> |ncIntLoop|
      -> |intloop|
      -> |SpadInterpretStream|
      -> |intloopReadConsole|
```

The `—intloopReadConsole—` function does tail-recursive calls to itself (don't break this) and never exits.

4.1 Variables Used

4.2 Data Structures

4.3 Functions

4.3.1 Set the restart hook

When a lisp image containing code is reloaded there is a hook to allow a function to be called. In our case it is the restart function which is the entry to the Axiom interpreter.

— **defun set-restart-hook 0** —

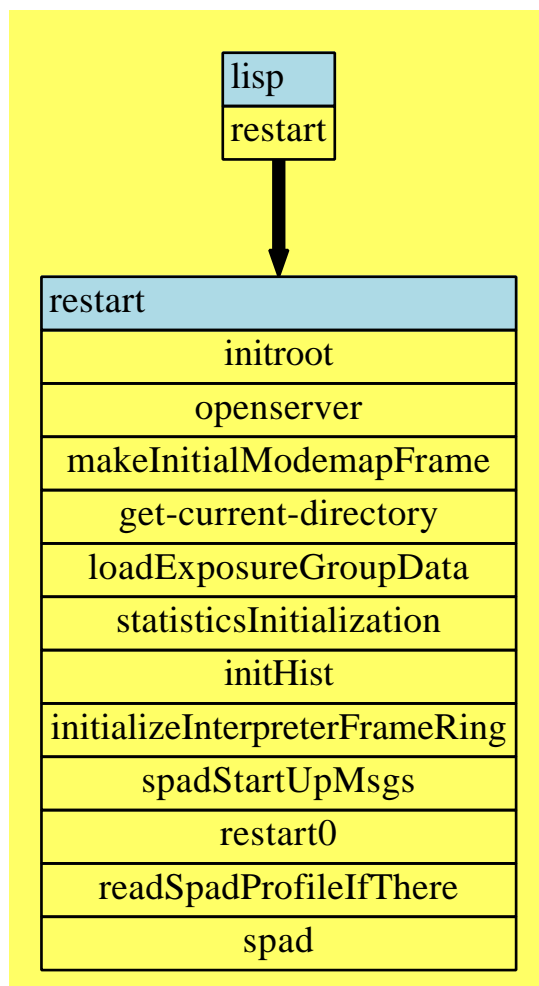
```
(defun set-restart-hook ())
```

```

"Set the restart hook"
#+KCL (setq system::*top-level-hook* 'restart)
#+Lucid (setq boot::restart-hook 'restart)
'restart
)

```

4.3.2 restart function (The restart function)



The restart function is the real root of the world. It sets up memory if we are working in a GCL/akcl version of the system.

The `compiler::*compile-verbose*` flag has been set to nil globally. We do not want to know

about the microsteps of GCL's compile facility.

The `compiler::*suppress-compiler-warnings*` flag has been set to `t`. We do not care that certain generated variables are not used.

The `compiler::*suppress-compiler-notes*` flag has been set to `t`. We do not care that tail recursion occurs.

It sets the current package to be the "BOOT" package which is the standard package in which the interpreter runs.

The "initroot" (5.3.9 p 35) function sets global variables that depend on the AXIOM shell variable. These are needed to find basic files like `s2-us.msgs`, which contains the error message text.

The "openserver" (64.0.23 p 985) function tried to set up the socket connection used for things like hyperdoc. The `$openServerIfTrue` variable starts true, which implies trying to start a server.

The `$IOindex` variable is the number associated with the input prompt. Every successful expression evaluated increments this number until a `)clear all` resets it. Here we set it to the initial value.

Axiom has multiple frames that contain independent information about a computation. There can be several frames at any one time and you can shift back and forth between the frames. By default, the system starts in "frame0" (try the `)frame names` command). See the Frame Mechanism chapter (33.3.1 page 550).

The `$InteractiveFrame` variable contains the state information related to the current frame, which includes things like the last value, the value of all of the variables, etc.

The "printLoadMsgs" (46.29.4 p 733) variable controls whether load messages will be output as library routines are loaded. We disable this by default. It can be changed by using `)set message autoload`.

The "current-directory" (3.1.2 p 7) variable is set to the current directory. This is used by the `)cd` function and some of the compile routines.

The "statisticsInitialization" (?? p ??) function initializes variables used to collect statistics. Currently, only the garbage collector information is initialized.

```
[init-memory-config p34]
[initroot p35]
[openserver p985]
[makeInitialModemapFrame p37]
[get-current-directory p36]
[statisticsInitialization p??]
[initHist p579]
[initializeInterpreterFrameRing p553]
[spadStartUpMsgs p19]
[restart0 p18]
[readSpadProfileIfThere p959]
[spad p20]
```

```

[openServerIfTrue p10]
[SpadServername p??]
[SpadServer p12]
[IOindex p??]
[InteractiveFrame p??]
[printLoadMsgs p733]
[current-directory p7]
[displayStartMsgs p746]
[currentLine p??]

```

— defun restart —

```

(defun restart ()
  (declare (special $openServerIfTrue $SpadServerName |$SpadServer|
    |$IOindex| |$InteractiveFrame| |$printLoadMsgs| $current-directory
    |$displayStartMsgs| |$currentLine|))
  #+:akcl
    (init-memory-config :cons 500 :fixnum 200 :symbol 500 :package 8
      :array 400 :string 500 :cfun 100 :cpages 3000 :rpages 1000 :hole 2000)
  #+:akcl (setq compiler::*compile-verbose* nil)
  #+:akcl (setq compiler::*suppress-compiler-warnings* t)
  #+:akcl (setq compiler::*suppress-compiler-notes* t)
    (in-package "BOOT")
    (initroot)
  #+:akcl
    (when (and $openServerIfTrue (zerop (openserver $SpadServerName)))
      (setq $openServerIfTrue nil)
      (setq |$SpadServer| t))
    (setq |$IOindex| 1)
    (setq |$InteractiveFrame| (|makeInitialModemapFrame|))
    (setq |$printLoadMsgs| nil)
    (setq $current-directory (get-current-directory))
    (setq *default-pathname-defaults* (pathname $current-directory))
    (|statisticsInitialization|)
    (|initHist|)
    (|initializeInterpreterFrameRing|)
    (when |$displayStartMsgs| (|spadStartUpMsgs|))
    (setq |$currentLine| nil)
    (restart0)
    (|readSpadProfileIfThere|)
    (|spad|))

```

—————

4.3.3 defun Non-interactive restarts

```

[compressopen p??]
[interpopen p??]

```

```
[operationopen p??]
[categoryopen p??]
[browseopen p??]
[getEnv p??]
```

— defun restart0 —

```
(defun restart0 ()
  (compressopen) ;; set up the compression tables
  (interpopen)   ;; open up the interpreter database
  (operationopen) ;; all of the operations known to the system
  (categoryopen) ;; answer hasCategory question
  (browseopen))
```

4.3.4 defun The startup banner messages

```
[fillerSpaces p20]
[specialChar p978]
[sayKeyedMsg p329]
[sayMSG p331]
[msgAlist p326]
[$opSysName p??]
[$linelength p771]
[*yearweek* p??]
[*build-version* p??]
```

— defun spadStartUpMsgs —

```
(defun |spadStartUpMsgs| ()
  (let (bar)
    (declare (special |msgAlist| |opSysName| $linelength *yearweek*
                      *build-version*))
    (when (> $linelength 60)
      (setq bar (|fillerSpaces| $linelength (|specialChar| '|hbar|)))
      (|sayKeyedMsg| 'S2GL0001 (list *build-version* *yearweek*))
      (|sayMSG| bar)
      (|sayKeyedMsg| 'S2GL0018C nil)
      (|sayKeyedMsg| 'S2GL0018D nil)
      (|sayKeyedMsg| 'S2GL0003B (list |opSysName|))
      (say " Visit http://axiom-developer.org for more information")
      (|sayMSG| bar)
      (setq |msgAlist| nil)
      (|sayMSG| '| |))))
```

4.3.5 defun Make a vector of filler characters

```
[ifcar p??]
```

— defun fillerSpaces —

```
(defun |fillerSpaces| (&rest arglist &aux charPart n)
  (setq n (car arglist))
  (setq charPart (cdr arglist))
  (if (<= n 0)
      ""
      (make-string n :initial-element (character (or (ifcar charPart) " "))))))
```

—————

4.3.6 Starts the interpreter but do not read in profiles

```
[setOutputAlgebra p760]
[runspad p21]
[$PrintCompilerMessageIfTrue p??]
```

— defun spad —

```
(defun |spad| ()
  "Starts the interpreter but do not read in profiles"
  (let (|$PrintCompilerMessageIfTrue|)
    (declare (special |$PrintCompilerMessageIfTrue|))
    (setq |$PrintCompilerMessageIfTrue| nil)
    (|setOutputAlgebra| '|%initialize%|)
    (|runspad|)
    '|EndOfSpad|))
```

—————

4.3.7 defvar \$quitTag

— initvars —

```
(defvar |$quitTag| system::*quit-tag*)
```

—————

4.3.8 defun runspad

```
[quitTag p20]
[coerceFailure p??]
[top-level p??]
[seq p??]
[exit p??]
[resetStackLimits p21]
[ncTopLevel p25]
[$quitTag p20]
```

— defun runspad —

```
(defun |runspad| ()
  (prog (mode)
    (declare (special |$quitTag|))
    (return
      (seq
        (progn
          (setq mode '|restart|)
          (do ()
            ((null (eq mode '|restart|)) nil)
            (seq
              (exit
                (progn
                  (|resetStackLimits|)
                  (catch |$quitTag|
                    (catch '|coerceFailure|
                      (setq mode (catch '|top_level| (|ncTopLevel|))))))))))))))
```

—————

4.3.9 defun Reset the stack limits

```
[reset-stack-limits p??]
```

— defun resetStackLimits 0 —

```
(defun |resetStackLimits| ()
  "Reset the stack limits"
  (system:reset-stack-limits))
```

—————

Chapter 5

Handling Terminal Input

5.1 Streams

5.1.1 defvar \$curinstream

The curinstream variable is set to the value of the `*standard-input*` common lisp variable in ncIntLoop. While not using the “dollar” convention this variable is still “global”.

— initvars —

```
(defvar curinstream (make-synonym-stream '*standard-input*))
```

5.1.2 defvar \$curoutstream

The curoutstream variable is set to the value of the `*standard-output*` common lisp variable in ncIntLoop. While not using the “dollar” convention this variable is still “global”.

— initvars —

```
(defvar curoutstream (make-synonym-stream '*standard-output*))
```

5.1.3 defvar \$errorinstream

— initvars —

```
(defvar errorinstream (make-synonym-stream '*terminal-io*))
```

5.1.4 defvar \$erroroutstream

— initvars —

```
(defvar erroroutstream (make-synonym-stream '*terminal-io*))
```

5.1.5 defvar \$*eof*

— initvars —

```
(defvar *eof* nil)
```

5.1.6 defvar \$*whitespace*

— initvars —

```
(defvar *whitespace*
  '(#\Space #\Newline #\Tab #\Page #\Linefeed #\Return #\Backspace)
  "A list of characters used by string-trim considered as whitespace")
```

5.1.7 defvar \$InteractiveMode

— initvars —

```
(defvar |$InteractiveMode| t)
```

5.1.8 defvar \$boot

— initvars —

```
(defvar $boot nil)
```

—————

5.1.9 Top-level read-parse-eval-print loop

Top-level read-parse-eval-print loop for the interpreter. Uses the Bill Burge's parser. [ncInt-Loop p25]

```
[ $e p??]
[ $spad p20]
[ $newspad p??]
[ $boot p25]
[ $InteractiveMode p24]
[ $InteractiveFrame p??]
[ *eof* p24]
[ in-stream p959]
```

— defun ncTopLevel —

```
(defun |ncTopLevel| ()
  "Top-level read-parse-eval-print loop"
  (let (|$e| $spad $newspad $boot |$InteractiveMode| *eof* in-stream)
    (declare (special |$e| $spad $newspad $boot |$InteractiveMode| *eof*
                      in-stream |$InteractiveFrame|))
    (setq in-stream curinstream)
    (setq *eof* nil)
    (setq |$InteractiveMode| t)
    (setq $boot nil)
    (setq $newspad t)
    (setq $spad t)
    (setq |$e| |$InteractiveFrame|)
    (|ncIntLoop|)))
```

—————

5.1.10 defun ncIntLoop

```
[intloop p26]
[curinstream p23]
[curoutstream p23]
```

— defun ncIntLoop —

```
(defun |ncIntLoop| ()
  (let ((curinstream *standard-output*)
        (curoutstream *standard-input*))
    (declare (special curinstream curoutstream))
    (|intloop|)))
```

—————

5.1.11 defvar \$intTopLevel

— initvars —

```
(defvar |$intTopLevel| '|top_level|)
```

—————

5.1.12 defvar \$intRestart

— initvars —

```
(defvar |$intRestart| '|restart|)
```

—————

5.1.13 defun intloop

Note that the SpadInterpretStream function uses a list of three strings as an argument. The values in the list seem to have no use and can eventually be removed. [intTopLevel p26]

[SpadInterpretStream p27]

[resetStackLimits p21]

[\$intTopLevel p26]

[\$intRestart p26]

— defun intloop —

```
(defun |intloop| ()
  (prog (mode)
    (declare (special |$intTopLevel| |$intRestart|)))
```

```

(return
 (progn
  (setq mode |$intRestart|)
  ((lambda ()
   (loop
    (cond
     ((not (equal mode |$intRestart|))
      (return nil))
     (t
      (progn
       (|resetStackLimits|)
       (setq mode
        (catch |$intTopLevel|
         (|SpadInterpretStream| 1
          (list 'tim 'daly '? t))))))))))))))

```

5.1.14 defvar \$ncMsgList

— initvars —

```
(defvar |$ncMsgList| nil)
```

5.1.15 defun SpadInterpretStream

The SpadInterpretStream function takes three arguments

str This is passed as an argument to intloopReadConsole

source This is the name of a source file but appears not to be used. It is set to the list (tim daly ?).

interactive? If this is false then various messages are suppressed and input does not use piles. If this is true then the library loading routines might output messages and piles are expected on input (as from a file).

The system commands are handled by the function kept in the “hook” variable `$systemCommandFunction` which has the default function `InterpExecuteSpadSystemCommand`. Thus, when a system command is entered this function is called.

The `$promptMsg` variable is set to the constant S2CTP023. This constant points to a message in `src/doc/msgs/s2-us.msgs`. This message does nothing but print the argument value.

5.1.16 defvar \$promptMsg

— initvars —

```
(defvar |$promptMsg| 'S2CTP023)
```

—————

5.1.17 defun GCL cmpnote function

GCL keeps noting the fact that the compiler is performing tail-recursion. Bill Schelter added this as a debugging tool for Axiom and it was never removed. Patching the lisp code in the GCL build fails as the system is actually built from the pre-compiled C code. Thus, we can only step on this message after the fact. The cmpnote function is used nowhere else in GCL so stepping on the function call seems best. We're unhappy with this hack and will try to convince the GCL crowd to fix this.

— defun cmpnote —

```
#+:gcl (defun compiler::cmpnote (&rest x) (declare (ignore x)))
```

—————

5.1.18 defvar \$newcompErrorCount

— initvars —

```
(defvar |$newcompErrorCount| 0)
```

—————

5.1.19 defvar \$nupos

— initvars —

```
(defvar |$nupos| (list '|noposition|))
```

—————


```

[mkprompt p42]
[intloopReadConsole p30]
[intloopInclude p63]
[$promptMsg p28]
[$systemCommandFunction p??]
[$ncMsgList p27]
[$errMsgToss p??]
[$lastPos p??]
[$inclAssertions p??]
[$okToExecuteMachineCode p??]
[$newcompErrorCount p28]
[$libQuiet p??]
[$fn p??]
[$nopus p28]

```

— defun SpadInterpretStream —

```

(defun |SpadInterpretStream| (str source interactive?)
  (let (|$promptMsg| |$systemCommandFunction|
        |$ncMsgList| |$errMsgToss| |$lastPos| |$inclAssertions|
        |$okToExecuteMachineCode| |$newcompErrorCount|
        |$libQuiet| |$fn|)
    (declare (special |$promptMsg|
                      |$systemCommandFunction| |$ncMsgList| |$errMsgToss| |$lastPos|
                      |$inclAssertions| |$okToExecuteMachineCode| |$newcompErrorCount|
                      |$libQuiet| |$fn| |$nopus|))
    (setq |$fn| source)
    (setq |$libQuiet| (null interactive?))
    (setq |$newcompErrorCount| 0)
    (setq |$okToExecuteMachineCode| t)
    (setq |$inclAssertions| (list 'aix '|CommonLisp|))
    (setq |$lastPos| |$nopus|)
    (setq |$errMsgToss| nil)
    (setq |$ncMsgList| nil)
    (setq |$systemCommandFunction| #'|InterpExecuteSpadSystemCommand|)
    (setq |$promptMsg| 's2ctp023)
    (if interactive?
        (progn
          (princ (mkprompt))
          (|intloopReadConsole| "" str))
        (|intloopInclude| source 0)))

```

5.2 The Read-Eval-Print Loop

5.2.1 defun intloopReadConsole

Note that this function relies on the fact that lisp can do tail-recursion. The function recursively invokes itself.

The serverReadLine function is a special readline function that handles communication with the session manager code, which is a separate process running in parallel.

We read a line from standard input.

- If it is a null line then we exit Axiom.
- If it is a zero length line we prompt and recurse
- If \$dalymode and open-paren we execute lisp code, prompt and recurse The \$dalymode will interpret any input that begins with an open-paren as a lisp expression rather than Axiom input. This is useful for debugging purposes when most of the input lines will be lisp. Setting \$dalymode non-nil will certainly break user expectations and is to be used with caution.
- If it is “)fi” or “)fin” we drop into lisp. Use the (restart) function to return to the interpreter loop.
- If it starts with “)” we process the command, prompt, and recurse
- If it is a command then we remember the current line, process the command, prompt, and recurse.
- If the input has a trailing underscore (Axiom line-continuation) then we cut off the continuation character and pass the truncated string to ourselves, prompt, and recurse
- otherwise we process the input, prompt, and recurse.

Notice that all but two paths (a null input or a “)fi” or a “)fin”) will end up as a recursive call to ourselves. [top-level p??]

[serverReadLine p44]

[leaveScratchpad p637]

[mkprompt p42]

[intloopReadConsole p30]

[intloopPrefix? p36]

[intnplisp p36]

[setCurrentLine p41]

[ncloopCommand p476]

[concat p1049]

[ncloopEscaped p37]

[intloopProcessString p37]

[\$dalymode p661]

— defun intloopReadConsole —

```
(defun |intloopReadConsole| (b n)
  (declare (special $dalymode))
  (let (c d pfx input)
    (setq input (|serverReadLine| *standard-input*))
    (when (null (stringp input)) (|leaveScratchpad|))
    (when (eql (length input) 0)
      (princ (mkprompt))
      (|intloopReadConsole| "" n))
    (when (and $dalymode (|intloopPrefix?| "(" input))
      (|intnplisp| input)
      (princ (mkprompt))
      (|intloopReadConsole| "" n))
    (setq pfx (|intloopPrefix?| ")fi" input))
    (when (and pfx (or (string= pfx ")fi") (string= pfx ")fin")))
      (throw '|top_level| nil))
    (when (and (equal b "") (setq d (|intloopPrefix?| ")" input)))
      (|setCurrentLine| d)
      (setq c (|ncloopCommand| d n))
      (princ (mkprompt))
      (|intloopReadConsole| "" c))
    (setq input (concat b input))
    (when (|ncloopEscaped| input)
      (|intloopReadConsole| (subseq input 0 (- (length input) 1)) n))
    (setq c (|intloopProcessString| input n))
    (princ (mkprompt))
    (|intloopReadConsole| "" c)))
```

—————

5.3 Helper Functions

5.3.1 Get the value of an environment variable

[getenv p??]

— defun getenviron 0 —

```
(defun getenviron (var)
  "Get the value of an environment variable"
  #+allegro (sys::getenv (string var))
  #+clisp (ext:getenv (string var))
  #+(or cmu scl)
  (cdr
   (assoc (string var) ext:*environment-list* :test #'equalp :key #'string)))
```

```

#+(or kcl akcl gcl) (si::getenv (string var))
#+lispworks (lw:environment-variable (string var))
#+lucid (lcl:environment-variable (string var))
#+mcl (ccl::getenv var)
#+sbcl (sb-ext:posix-getenv var)
)

```

5.3.2 defvar \$intCoerceFailure

— initvars —

```
(defvar |$intCoerceFailure| '|coerceFailure|)
```

5.3.3 defvar \$intSpadReader

— initvars —

```
(defvar |$intSpadReader| 'SPAD_READER)
```

5.3.4 defun InterpExecuteSpadSystemCommand

```

[intCoerceFailure p32]
[intSpadReader p32]
[ExecuteInterpSystemCommand p33]
[$intSpadReader p32]
[$intCoerceFailure p32]

```

— defun InterpExecuteSpadSystemCommand —

```

(defun |InterpExecuteSpadSystemCommand| (string)
  (declare (special |$intSpadReader| |$intCoerceFailure|))
  (catch |$intCoerceFailure|
    (catch |$intSpadReader|
      (|ExecuteInterpSystemCommand| string))))

```

5.3.5 defun ExecuteInterpSystemCommand

[intProcessSynonyms p33]
 [substring p??]
 [doSystemCommand p444]
 [\$currentLine p??]

— defun ExecuteInterpSystemCommand —

```
(defun |ExecuteInterpSystemCommand| (string)
  (let (|$currentLine|)
    (declare (special |$currentLine|))
    (setq string (|intProcessSynonyms| string))
    (setq |$currentLine| string)
    (setq string (substring string 1 nil))
    (unless (equal string "") (|doSystemCommand| string))))
```

5.3.6 defun Handle Synonyms

[processSynonyms p33]
 [line p??]

— defun intProcessSynonyms —

```
(defun |intProcessSynonyms| (str)
  (let ((line str))
    (declare (special line))
    (|processSynonyms|
     line))
```

5.3.7 defun Synonym File Reader

[strpos p1047]
 [substring p??]
 [string2id-n p??]
 [lassoc p??]
 [strconc p??]
 [size p1047]
 [concat p1049]
 [rplacstr p??]
 [processSynonyms p33]
 [\$CommandSynonymAlist p476]

[line p??]

— defun processSynonyms —

```
(defun |processSynonyms| ()
  (let (fill p aline synstr syn to opt fun cl chr)
    (declare (special |$CommandSynonymAlist| line))
    (setq p (strpos ")" line 0 nil))
    (setq fill "")
    (cond
      (p
        (setq aline (substring line p nil))
        (when (> p 0) (setq fill (substring line 0 p))))
      (t
        (setq p 0)
        (setq aline line)))
    (setq to (strpos " " aline 1 nil))
    (cond (to (setq to (1- to))))
    (setq synstr (substring aline 1 to))
    (setq syn (string2id-n synstr 1))
    (when (setq fun (lassoc syn |$CommandSynonymAlist|))
      (setq to (strpos ")" fun 1 nil))
      (cond
        ((and to (not (eql to (1- (size fun))))))
          (setq opt (strconc " " (substring fun to nil)))
          (setq fun (substring fun 0 (1- to))))
        (t (setq opt " ")))
      (when (> (size synstr) (size fun))
        (do ((G167173 (size synstr)) (i (size fun) (1+ i)))
            ((> i G167173) nil)
          (setq fun (concat fun " "))))
      (setq cl (strconc fill (rplacstr aline 1 (size synstr) fun) opt))
      (setq line cl)
      (setq chr (elt line (1+ p)))
      (|processSynonyms|))))
```

—————

5.3.8 defun init-memory-config

Austin-Kyoto Common Lisp (AKCL), now known as Gnu Common Lisp (GCL) requires some changes to the default memory setup to run Axiom efficiently. This function performs those setup commands. [allocate p??]

[allocate-contiguous-pages p??]

[allocate-relocatable-pages p??]

[set-hole-size p??]

— defun init-memory-config 0 —

```
(defun init-memory-config (&key
                          (cons 500)
                          (fixnum 200)
                          (symbol 500)
                          (package 8)
                          (array 400)
                          (string 500)
                          (cfun 100)
                          (cpages 3000)
                          (rpages 1000)
                          (hole 2000) )
  ;; initialize AKCL memory allocation parameters
  #+:AKCL
  (progn
    (system:allocate 'cons cons)
    (system:allocate 'fixnum fixnum)
    (system:allocate 'symbol symbol)
    (system:allocate 'package package)
    (system:allocate 'array array)
    (system:allocate 'string string)
    (system:allocate 'cfun cfun)
    (system:allocate-contiguous-pages cpages)
    (system:allocate-relocatable-pages rpages)
    (system:set-hole-size hole))
  # -:AKCL
  nil)
```

5.3.9 Set spadroot to be the AXIOM shell variable

Sets up the system to use the **AXIOM** shell variable if we can and default to the **\$spadroot** variable (which was the value of the **AXIOM** shell variable at build time) if we can't.

```
[reroot p40]
[getenviro p31]
[$spadroot p12]
```

— defun initroot —

```
(defun initroot (&optional (newroot (getenviro "AXIOM"))))
"Set spadroot to be the AXIOM shell variable"
(declare (special $spadroot))
(reroot (or newroot $spadroot (error "setenv AXIOM or (setq $spadroot)"))))
```

5.3.10 Does the string start with this prefix?

If the prefix string is the same as the whole string initial characters –R(ignoring spaces in the whole string) then we return the whole string minus any leading spaces.

— defun intloopPrefix? 0 —

```
(defun |intloopPrefix?| (prefix whole)
  "Does the string start with this prefix?"
  (let ((newprefix (string-left-trim '(\space) prefix))
        (newwhole (string-left-trim '(\space) whole)))
    (when (<= (length newprefix) (length newwhole))
      (when (string= newprefix newwhole :end2 (length prefix))
        newwhole))))
```

5.3.11 defun Interpret a line of lisp code

This is used to handle)lisp top level commands [nplisp p470]
[\$currentLine p??]

— defun intnplisp —

```
(defun |intnplisp| (s)
  (declare (special |$currentLine|))
  (setq |$currentLine| s)
  (|nplisp| |$currentLine|))
```

5.3.12 Get the current directory

— defun get-current-directory 0 —

```
(defun get-current-directory ()
  "Get the current directory"
  (namestring (truename "")))
```

5.3.13 Prepend the absolute path to a filename

Prefix a filename with the **AXIOM** shell variable. [\$spadroot p12]

— defun make-absolute-filename 0 —


```
(defun make-absolute-filename (name)
  "Prepend the absolute path to a filename"
  (declare (special $spadroot))
  (concatenate 'string $spadroot name))
```

5.3.14 Make the initial modemap frame

```
[copy p??]
[$InitialModemapFrame p9]
```

— defun makeInitialModemapFrame 0 —

```
(defun |makeInitialModemapFrame| ()
  "Make the initial modemap frame"
  (declare (special |$InitialModemapFrame|))
  (copy |$InitialModemapFrame|))
```

5.3.15 defun ncloopEscaped

The ncloopEscaped function will return true if the last non-blank character of a line is an underscore, the Axiom line-continuation character. Otherwise, it returns nil.

— defun ncloopEscaped 0 —

```
(defun |ncloopEscaped| (x)
  (let ((l (length x)))
    (dotimes (i l)
      (when (char= (char x (- l i 1)) #\_) (return t))
      (unless (char= (char x (- l i 1)) #\space) (return nil))))))
```

5.3.16 defun intloopProcessString

```
[setCurrentLine p41]
[intloopProcess p64]
[next p38]
[incString p39]
```

— defun intloopProcessString —

```
(defun |intloopProcessString| (s n)
  (|setCurrentLine| s)
  (|intloopProcess| n t
    (|next| #'|ncloopParse|
      (|next| #'|lineoftoks| (|incString| s))))))
```

5.3.17 defun ncloopParse

[ncloopDQlines p71]
 [npParse p141]
 [dqToList p344]

— defun ncloopParse —

```
(defun |ncloopParse| (s)
  (let (cudr lines stream dq t1)
    (setq t1 (car s))
    (setq dq (car t1))
    (setq stream (cadr t1))
    (setq t1 (|ncloopDQlines| dq stream))
    (setq lines (car t1))
    (setq cudr (cadr t1))
    (cons (list (list lines (|npParse| (|dqToList| dq)))) (cdr s))))
```

5.3.18 defun next

[Delay p103]
 [next1 p38]

— defun next —

```
(defun |next| (f s)
  (|Delay| #'|next1| (list f s)))
```

5.3.19 defun next1

[StreamNull p333]
 [incAppend p87]

[next p38]

— defun next1 —

```
(defun |next1| (&rest z)
  (let (h s f)
    (setq f (car z))
    (setq s (cadr z))
    (cond
      ((|StreamNull| s) |StreamNil|)
      (t
       (setq h (apply f (list s)))
       (|incAppend| (car h) (|next| f (cdr h)))))))
```

—————

5.3.20 defun incString

[incRenumber p74]

[incLude p76]

[Top p77]

— defun incString —

```
(defun |incString| (s)
  (declare (special |Top|))
  (|incRenumber| (|incLude| 0 (list s) 0 (list "strings") (list |Top|))))
```

—————

5.3.21 Call the garbage collector

Call the garbage collector on various platforms.

— defun reclaim 0 —

```
#+abcl
(defun reclaim () "Call the garbage collector" (ext::gc))
#+allegro
(defun reclaim () "Call the garbage collector" (excl::gc t))
#+CCL
(defun reclaim () "Call the garbage collector" (gc))
#+clisp
(defun reclaim ()
  "Call the garbage collector"
  (#+lisp=cl ext::gc #-lisp=cl lisp::gc))
```

```

#+(or :cmulisp :cmu)
(defun reclaim () "Call the garbage collector" (ext:gc))
#+cormanlisp
(defun reclaim () "Call the garbage collector" (cl::gc))
#+(OR IBCL KCL GCL)
(defun reclaim () "Call the garbage collector" (si::gbc t))
#+lispworks
(defun reclaim () "Call the garbage collector" (hcl::normal-gc))
#+Lucid
(defun reclaim () "Call the garbage collector" (lcl::gc))
#+sbcl
(defun reclaim () "Call the garbage collector" (sb-ext::gc))

```

5.3.22 defun reroot

The `reroot` function is used to reset the important variables used by the system. In particular, these variables are sensitive to the **AXIOM** shell variable. That variable is renamed internally to be **\$spadroot**. The **reroot** function will change the system to use a new root directory and will have the same effect as changing the **AXIOM** shell variable and rerunning the system from scratch. Note that we have changed from the NAG distribution back to the original form. If you need the NAG version you can push **:tpd** on the ***features*** variable before compiling this file. A correct call looks like:

```

(in-package "BOOT")
(reroot "/spad/mnt/${SYS}")

```

where the `${SYS}` variable is the same one set at build time.

For the example call:

```
(REROOT "/research/test/mnt/ubuntu")
```

the variables are set as:

```

$spadroot = "/research/test/mnt/ubuntu"

$relative-directory-list =
  ("../../../../src/input/"
   "/doc/msgs/"
   "../../../../src/algebra/"
   "../../../../src/interp/"
   "/doc/spadhelp/")

$directory-list =
  ("/research/test/mnt/ubuntu/../../../../src/input/"

```

```

"/research/test/mnt/ubuntu/doc/messages/"
"/research/test/mnt/ubuntu/../../src/algebra/"
"/research/test/mnt/ubuntu/../../src/interp/"
"/research/test/mnt/ubuntu/doc/spadhelp/")

$relative-library-directory-list = ("/algebra/")

$library-directory-list = ("/research/test/mnt/ubuntu/algebra/")

|$defaultMsgDatabaseName| = #p"/research/test/mnt/ubuntu/doc/messages/s2-us.messages"

|$msgDatabaseName| = nil

$current-directory = "/research/test/"

[make-absolute-filename p36]
[$spadroot p12]
[$directory-list p8]
[$relative-directory-list p11]
[$library-directory-list p9]
[$relative-library-directory-list p11]
[$defaultMsgDatabaseName p8]
[$msgDatabaseName p326]
[$current-directory p7]

```

— defun reroot —

```

(defun reroot (dir)
  (declare (special $spadroot $directory-list $relative-directory-list
    $library-directory-list $relative-library-directory-list
    |$defaultMsgDatabaseName| |$msgDatabaseName| $current-directory))
  (setq $spadroot dir)
  (setq $directory-list
    (mapcar #'make-absolute-filename $relative-directory-list))
  (setq $library-directory-list
    (mapcar #'make-absolute-filename $relative-library-directory-list))
  (setq |$defaultMsgDatabaseName|
    (pathname (make-absolute-filename "/doc/messages/s2-us.messages")))
  (setq |$msgDatabaseName| ())
  (setq $current-directory $spadroot))

```

—————

5.3.23 defun setCurrentLine

Remember the current line. The cases are:

- If there is no `$currentLine` set it to the input
- Is the current line a string and the input a string? Make them into a list
- Is `$currentLine` not a cons cell? Make it one.
- Is the input a string? Cons it on the end of the list.
- Otherwise stick it on the end of the list

Note I suspect the last two cases do not occur in practice since they result in a dotted pair if the input is not a cons. However, this is what the current code does so I won't change it. `[$currentLine p??]`

— **defun setCurrentLine 0** —

```
(defun |setCurrentLine| (s)
  (declare (special |$currentLine|))
  (cond
    ((null |$currentLine|) (setq |$currentLine| s))
    ((and (stringp |$currentLine|) (stringp s))
     (setq |$currentLine| (list |$currentLine| s)))
    ((not (consp |$currentLine|)) (setq |$currentLine| (cons |$currentLine| s)))
    ((stringp s) (rplacd (last |$currentLine|) (cons s nil))))
  (t (rplacd (last |$currentLine|) s)))
|$currentLine|)
```

—————

5.3.24 Show the Axiom prompt

```
[concat p1049]
[substring p??]
[currenttime p??]
[$inputPromptType p744]
[$IOindex p??]
[$interpreterFrameName p??]
```

— **defun mkprompt** —

```
(defun mkprompt ()
  "Show the Axiom prompt"
  (declare (special |$inputPromptType| |$IOindex| |$interpreterFrameName|))
  (case |$inputPromptType|
    (|none| "")
    (|plain| "-> ")
    (|step| (concat "(" (princ-to-string |$IOindex|) ") -> ")))
```

```
(|frame|
  (concat (princ-to-string |$interpreterFrameName|) " ("
    (princ-to-string |$IOindex|) ") -> "))
  (t (concat (princ-to-string |$interpreterFrameName|) " ["
    (substring (currenttime) 8 nil) "]" ["
    (princ-to-string |$IOindex|) "]" -> "))))
```

5.3.25 defvar \$frameAlist

— initvars —

```
(defvar |$frameAlist| nil)
```

5.3.26 defvar \$frameNumber

— initvars —

```
(defvar |$frameNumber| 0)
```

5.3.27 defvar \$currentFrameNum

— initvars —

```
(defvar |$currentFrameNum| 0)
```

5.3.28 defvar \$EndServerSession

— initvars —

```
(defvar |$EndServerSession| nil)
```

5.3.29 defvar \$NeedToSignalSessionManager

— initvars —

```
(defvar |$NeedToSignalSessionManager| nil)
```

5.3.30 defvar \$sockBufferLength

— initvars —

```
(defvar |$sockBufferLength| 9217)
```

5.3.31 READ-LINE in an Axiom server system

```
[coerceFailure p??]
[top-level p??]
[spad-reader p??]
[read-line p??]
[addNewInterpreterFrame p559]
[sockSendInt p??]
[sockSendString p??]
[mkprompt p42]
[sockGetInt p??]
[lassoc p??]
[changeToNamedInterpreterFrame p558]
[sockGetString p??]
[unescapeStringsInForm p62]
[protectedEVAL p47]
[executeQuietCommand p47]
[parseAndInterpret p48]
[serverReadLine is-console (vol9)]
```



```

[serverSwitch p??]
[$KillLispSystem p??]
[$NonSmanSession p??]
[$SpadCommand p??]
[$QuietSpadCommand p??]
[$MenuServer p??]
[$sockBufferLength p44]
[$LispCommand p??]
[$EndServerSession p43]
[$EndSession p??]
[$SwitchFrames p??]
[$CreateFrameAnswer p??]
[$currentFrameNum p43]
[$frameNumber p43]
[$frameAlist p43]
[$CreateFrame p??]
[$CallInterp p??]
[$EndOfOutput p??]
[$SessionManager p??]
[$NeedToSignalSessionManager p44]
[$EndServerSession p43]
[$SpadServer p12]
[*eof* p24]
[in-stream p959]

```

— defun serverReadLine —

```

(defun |serverReadLine| (stream)
  "used in place of READ-LINE in a Axiom server system."
  (let (in-stream *eof* 1 framename currentframe form stringbuf line action)
    (declare (special in-stream *eof* |$SpadServer| |$EndServerSession|
      |$NeedToSignalSessionManager| |$SessionManager| |$EndOfOutput| | |
      |$CallInterp| |$CreateFrame| |$frameAlist| |$frameNumber|
      |$currentFrameNum| |$CreateFrameAnswer| |$SwitchFrames| |$EndSession|
      |$EndServerSession| |$LispCommand| |$sockBufferLength| |$MenuServer|
      |$QuietSpadCommand| |$SpadCommand| |$NonSmanSession| |$KillLispSystem|))
    (force-output)
    (if (or (null |$SpadServer|) (null (is-console stream)))
      (|read-line| stream)
      (progn
        (setq in-stream stream)
        (setq *eof* nil)
        (setq line
          (do ()
            ((null (and (null |$EndServerSession|) (null *eof*))) nil)
            (when |$NeedToSignalSessionManager|
              (|sockSendInt| |$SessionManager| |$EndOfOutput|))
            (setq |$NeedToSignalSessionManager| nil)

```

```

(setq action (|serverSwitch|))
(cond
  ((= action |$CallInterp|)
   (setq l (|read-line| stream))
   (setq |$NeedToSignalSessionManager| t)
   (return l))
  ((= action |$CreateFrame|)
   (setq framename (gentemp "frame"))
   (|addNewInterpreterFrame| framename)
   (setq |$frameAlist|
    (cons (cons |$frameNumber| framename) |$frameAlist|))
   (setq |$currentFrameNum| |$frameNumber|)
   (|sockSendInt| |$SessionManager| |$CreateFrameAnswer|)
   (|sockSendInt| |$SessionManager| |$frameNumber|)
   (setq |$frameNumber| (1+ |$frameNumber|))
   (|sockSendString| |$SessionManager| (mkprompt)))
  ((= action |$SwitchFrames|)
   (setq |$currentFrameNum| (|sockGetInt| |$SessionManager|))
   (setq currentframe (lassoc |$currentFrameNum| |$frameAlist|))
   (|changeToNamedInterpreterFrame| currentframe))
  ((= action |$EndSession|)
   (setq |$EndServerSession| t))
  ((= action |$LispCommand|)
   (setq |$NeedToSignalSessionManager| t)
   (setq stringbuf (make-string |$sockBufferLength|))
   (|sockGetString| |$MenuServer| stringbuf |$sockBufferLength|)
   (setq form (|unescapeStringsInForm| (read-from-string stringbuf)))
   (|protectedEVAL| form))
  ((= action |$QuietSpadCommand|)
   (setq |$NeedToSignalSessionManager| t)
   (|executeQuietCommand|))
  ((= action |$SpadCommand|)
   (setq |$NeedToSignalSessionManager| t)
   (setq stringbuf (make-string 512))
   (|sockGetString| |$MenuServer| stringbuf 512)
   (catch '|coerceFailure|
    (catch '|top_level|
     (catch '|spad_reader|
      (|parseAndInterpret| stringbuf))))
   (princ (mkprompt))
   (finish-output))
  ((= action |$NonSmanSession|) (setq |$SpadServer| nil))
  ((= action |$KillLispSystem|) (bye))
  (t nil))))
(cond
  (line line)
  (t '||))))))

```

5.3.32 defun protectedEVAL

```
[resetStackLimits p21]
[sendHTErrorSignal p??]
```

— **defun protectedEVAL** —

```
(defun |protectedEVAL| (x)
  (let (val (error t))
    (unwind-protect
      (progn
        (setq val (eval x))
        (setq error nil))
      (when error
        (|resetStackLimits|)
        (|sendHTErrorSignal|))))
  (unless error val)))
```

5.3.33 defvar \$QuietCommand

— **initvars** —

```
(defvar |$QuietCommand| nil "If true, produce no top level output")
```

5.3.34 defun executeQuietCommand

When **\$QuietCommand** is true Spad will not produce any output from a top level command

```
[spad-reader p??]
[coerceFailure p??]
[toplevel p??]
[spadreader p??]
[make-string p??]
[sockGetString p??]
[parseAndInterpret p48]
[$MenuServer p??]
[$QuietCommand p47]
```

— **defun executeQuietCommand** —

```
(defun |executeQuietCommand| ()
  (let (|$QuietCommand| stringBuffer)
    (declare (special |$QuietCommand| |$MenuServer|))
    (setq |$QuietCommand| t)
    (setq stringBuffer (make-string 512))
    (|sockGetString| |$MenuServer| stringBuffer 512)
    (catch '|coerceFailure|
      (catch '|top_level|
        (catch '|spad_reader| (|parseAndInterpret| stringBuffer))))))
```

5.3.35 defun parseAndInterpret

```
[|InteractiveMode| p24]
|$boot| p25]
|$spad| p20]
|$e| p??]
[|InteractiveFrame| p??]
```

— defun parseAndInterpret —

```
(defun |parseAndInterpret| (str)
  (let (|$InteractiveMode| $boot $spad |$e|)
    (declare (special |$InteractiveMode| $boot $spad |$e|
      |$InteractiveFrame|))
    (setq |$InteractiveMode| t)
    (setq $boot nil)
    (setq $spad t)
    (setq |$e| |$InteractiveFrame|)
    (|processInteractive| (|parseFromString| str) nil)))
```

5.3.36 defun parseFromString

```
[next| p38]
[ncloopParse| p38]
[lineoftoks| p111]
[incString| p39]
[StreamNull| p333]
[pf2Sex| p299]
[macroExpanded| p222]
```

— defun parseFromString —

```
(defun |parseFromString| (s)
  (setq s (|next| #'|ncloopParse| (|next| #'|lineoftoks| (|incString| s))))
  (unless (|StreamNull| s) (|pf2Sex| (|macroExpanded| (cadar s)))))
```

5.3.37 defvar \$interpOnly

— initvars —

```
(defvar |$interpOnly| nil)
```

5.3.38 defvar \$minivectorNames

— initvars —

```
(defvar |$minivectorNames| nil)
```

5.3.39 defvar \$domPvar

— initvars —

```
(defvar |$domPvar| nil)
```

5.3.40 defun processInteractive

Parser Output --> Interpreter

Top-level dispatcher for the interpreter. It sets local variables and then calls processInteractive1 to do most of the work. This function receives the output from the parser. [initialize-TimedNames p??]

[qcar p??]

```

[processInteractive1 p52]
[reportInstantiations p740]
[clrhash p??]
[writeHistModesAndValues p601]
[updateHist p587]
[$op p??]
[$Coerce p??]
[$compErrorMessageStack p??]
[$freeVars p??]
[$mapList p??]
[$compilingMap p??]
[$compilingLoop p??]
[$interpOnly p49]
[$whereCacheList p??]
[$timeGlobalName p??]
[$StreamFrame p??]
[$declaredMode p??]
[$localVars p??]
[$analyzingMapList p??]
[$lastLineInSEQ p??]
[$instantCoerceCount p??]
[$instantCanCoerceCount p??]
[$instantMmCondCount p??]
[$fortVar p??]
[$minivector p??]
[$minivectorCode p??]
[$minivectorNames p49]
[$domPvar p49]
[$inRetract p??]
[$instantRecord p??]
[$reportInstantiations p740]
[$ProcessInteractiveValue p52]
[$defaultFortVar p??]
[$interpreterTimedNames p??]
[$interpreterTimedClasses p??]

```

— **defun processInteractive** —

```

(defun |processInteractive| (form posnForm)
  (let (|$op| |$Coerce| |$compErrorMessageStack| |$freeVars|
        |$mapList| |$compilingMap| |$compilingLoop|
        |$interpOnly| |$whereCacheList| |$timeGlobalName|
        |$StreamFrame| |$declaredMode| |$localVars|
        |$analyzingMapList| |$lastLineInSEQ|
        |$instantCoerceCount| |$instantCanCoerceCount|
        |$instantMmCondCount| |$fortVar| |$minivector|
        |$minivectorCode| |$minivectorNames| |$domPvar|

```

```

    |$inRetract| object)
(declare (special |$op| |$Coerce| |$compErrorMessageStack|
    |$freeVars| |$mapList| |$compilingMap|
    |$compilingLoop| |$interpOnly| |$whereCacheList|
    |$timeGlobalName| |$StreamFrame| |$declaredMode|
    |$localVars| |$analyzingMapList| |$lastLineInSEQ|
    |$instantCoerceCount| |$instantCanCoerceCount|
    |$instantMmCondCount| |$fortVar| |$minivector|
    |$minivectorCode| |$minivectorNames| |$domPvar|
    |$inRetract| |$instantRecord| |$reportInstantiations|
    |$ProcessInteractiveValue| |$defaultFortVar|
    |$interpreterTimedNames| |$interpreterTimedClasses|))
(|initializeTimedNames| |$interpreterTimedNames| |$interpreterTimedClasses|)
(if (consp form)
    ; compute name of operator
    (setq |$op| (qcar form))
    (setq |$op| form))
(setq |$Coerce| nil)
(setq |$compErrorMessageStack| nil)
(setq |$freeVars| nil)
(setq |$mapList| nil) ; list of maps being type analyzed
(setq |$compilingMap| nil) ; true when compiling a map
(setq |$compilingLoop| nil) ; true when compiling a loop body
(setq |$interpOnly| nil) ; true when in interp only mode
(setq |$whereCacheList| nil) ; maps compiled because of where
(setq |$timeGlobalName| '$compTimeSum|); see incrementTimeSum
(setq |$StreamFrame| nil) ; used in printing streams
(setq |$declaredMode| nil) ; weak type propagation for symbols
(setq |$localVars| nil) ; list of local variables in function
(setq |$analyzingMapList| nil) ; names of maps currently being analyzed
(setq |$lastLineInSEQ| t) ; see evalIF and friends
(setq |$instantCoerceCount| 0)
(setq |$instantCanCoerceCount| 0)
(setq |$instantMmCondCount| 0)
(setq |$defaultFortVar| 'x) ; default FORTRAN variable name
(setq |$fortVar| |$defaultFortVar|) ; variable name for FORTRAN output
(setq |$minivector| nil)
(setq |$minivectorCode| nil)
(setq |$minivectorNames| nil)
(setq |$domPvar| nil)
(setq |$inRetract| nil)
(setq object (|processInteractive1| form posnForm))
(unless |$ProcessInteractiveValue|
    (when |$reportInstantiations|
        (|reportInstantiations|)
        (clrhash |$instantRecord|))
    (|writeHistModesAndValues|)
    (|updateHist|))
object))

```

5.3.41 defvar \$ProcessInteractiveValue

— initvars —

```
(defvar |$ProcessInteractiveValue| nil "If true, no output or record")
```

5.3.42 defvar \$HTCompanionWindowID

— initvars —

```
(defvar |$HTCompanionWindowID| nil)
```

5.3.43 defun processInteractive1

This calls the analysis and output printing routines [recordFrame p921]

```
[startTimingProcess p??]
[interpretTopLevel p53]
[stopTimingProcess p??]
[recordAndPrint p56]
[objValUnwrap p??]
[objMode p??]
[$e p??]
[$ProcessInteractiveValue p52]
[$InteractiveFrame p??]
```

— defun processInteractive1 —

```
(defun |processInteractive1| (form posnForm)
  (let (|$e| object)
    (declare (special |$e| |$ProcessInteractiveValue| |$InteractiveFrame|))
    (setq |$e| |$InteractiveFrame|)
    (|recordFrame| ' |system|)
    (|startTimingProcess| ' |analysis|)
    (setq object (|interpretTopLevel| form posnForm))
    (|stopTimingProcess| ' |analysis|))
```



```
(|startTimingProcess| ' |print|)
(unless |$ProcessInteractiveValue|
  (|recordAndPrint| (|objValUnwrap| object) (|objMode| object)))
(|recordFrame| ' |normal|)
(|stopTimingProcess| ' |print|)
object))
```

5.3.44 defun interpretTopLevel

```
[interpreter p??]
[interpret p54]
[stopTimingProcess p??]
[peekTimedName p??]
[interpretTopLevel p53]
[$timedNameStack p??]
```

— defun interpretTopLevel —

```
(defun |interpretTopLevel| (x posnForm)
  (let (savedTimerStack c)
    (declare (special |$timedNameStack|))
    (setq savedTimerStack (copy |$timedNameStack|))
    (setq c (catch ' |interpreter| (|interpret| x posnForm)))
    (do ()
      ((equal savedTimerStack |$timedNameStack|) nil)
      (|stopTimingProcess| (|peekTimedName|)))
    (if (eq c ' |tryAgain|)
      (|interpretTopLevel| x posnForm)
      c)))
```

5.3.45 defvar \$genValue

If the `$genValue` variable is true then evaluate generated code, otherwise leave code unevaluated. If `$genValue` is false then we are compiling. This variable is only defined and used locally.

— initvars —

```
(defvar |$genValue| nil "evaluate generated code if true")
```

5.3.46 defun Type analyzes and evaluates expression x, returns object

```
[interpret1 p54]
[$env p??]
[$eval p??]
[$genValue p53]
```

— defun interpret —

```
(defun |interpret| (&rest arg &aux restarts x)
  (let (|$env| |$eval| |$genValue| posnForm)
    (declare (special |$env| |$eval| |$genValue|))
    (setq x (car arg))
    (setq restarts (cdr arg))
    (if (consp restarts)
        (setq posnForm (car restarts))
        (setq posnForm restarts))
    (setq |$env| (list (list nil)))
    (setq |$eval| t) ; generate code -- don't just type analyze
    (setq |$genValue| t) ; evaluate all generated code
    (|interpret1| x nil posnForm)))
```

5.3.47 defun Dispatcher for the type analysis routines

This is the dispatcher for the type analysis routines. It type analyzes and evaluates the expression x in the rootMode (if non-nil) which may be \$EmptyMode. It returns an object if evaluating, and a modeset otherwise. It creates the attributed tree. [mkAtreeWithSrcPos p??]

```
[putTarget p??]
[bottomUp p??]
[getArgValue p??]
[objNew p??]
[getValue p??]
[interpret2 p55]
[keyedSystemError p??]
[$genValue p53]
[$eval p??]
```

— defun interpret1 —

```
(defun |interpret1| (x rootMode posnForm)
  (let (node modeSet newRootMode argVal val)
    (declare (special |$genValue| |$eval|))
```

```

(setq node (|mkAtreeWithSrcPos| x posnForm))
(when rootMode (|putTarget| node rootMode))
(setq modeSet (|bottomUp| node))
(if (null |$eval|)
    modeSet
    (progn
      (if (null rootMode)
          (setq newRootMode (car modeSet))
          (setq newRootMode rootMode))
      (setq argVal (|getArgValue| node newRootMode))
      (cond
        ((and argVal (null |$genValue|))
         (|objNew| argVal newRootMode))
        ((and argVal (setq val (|getValue| node)))
         (|interpret2| val newRootMode posnForm))
        (t
         (|keyedSystemError| 'S2IS0053 (list x)))))))

```

5.3.48 defun interpret2

This is the late interpretCoerce. I removed the call to coerceInteractive, so it only does the JENKS cases ALBI [objVal p??]

```

[objMode p??]
[member p1050]
[objNew p??]
[systemErrorHere p??]
[coerceInteractive p??]
[throwKeyedMsgCannotCoerceWithValue p??]
[$EmptyMode p??]
[$ThrowAwayMode p??]

```

— defun interpret2 —

```

(defun |interpret2| (object m1 posnForm)
  (declare (ignore posnForm))
  (let (x m op ans)
    (declare (special |$EmptyMode| |$ThrowAwayMode|))
    (cond
      ((equal m1 |$ThrowAwayMode|) object)
      (t
       (setq x (|objVal| object))
       (setq m (|objMode| object))
       (cond
         ((equal m |$EmptyMode|)
          (cond

```

```

((and (consp x)
      (progn (setq op (qcar x)) t)
      (|member| op '(map stream)))
      (|objNew| x m1))
((equal m1 |$EmptyMode|)
  (|objNew| x m))
(t
  (|systemErrorHere| "interpret2"))))
(m1
  (if (setq ans (|coerceInteractive| object m1))
      ans
      (|throwKeyedMsgCannotCoerceWithValue| x m m1)))
(t object))))))

```

5.3.49 defun Result Output Printing

Prints out the value `x` which is of type `m`, and records the changes in environment `$e` into `$InteractiveFrame $printAnyIfTrue` is documented in `setvar.boot`. It is controlled with the `)se me any` command. [output p??]

```

[putHist p588]
[objNewWrap p??]
[printTypeAndTime p58]
[printStorage p58]
[printStatisticsSummary p57]
[mkCompanionPage p??]
[recordAndPrintTest p??]
[$outputMode p??]
[$mkTestOutputType p??]
[$runTestFlag p??]
[$e p??]
[$mkTestFlag p??]
[$HTCompanionWindowID p52]
[$QuietCommand p47]
[$printStatisticsSummaryIfTrue p747]
[$printTypeIfTrue p749]
[$printStorageIfTrue p??]
[$printTimeIfTrue p748]
[$Void p??]
[$algebraOutputStream p760]
[$collectOutput p??]
[$EmptyMode p??]
[$printVoidIfTrue p750]
[$outputMode p??]

```

[\$printAnyIfTrue p732]

— defun recordAndPrint —

```
(defun |recordAndPrint| (x md)
  (let (|$outputMode| xp mdp mode)
    (declare (special |$outputMode| |$mkTestOutputType| |$runTestFlag| |$e|
                      |$mkTestFlag| |$HTCompanionWindowID| |$QuietCommand|
                      |$printStatisticsSummaryIfTrue| |$printTypeIfTrue|
                      |$printStorageIfTrue| |$printTimeIfTrue| |$Void|
                      |$algebraOutputStream| |$collectOutput| |$EmptyMode|
                      |$printVoidIfTrue| |$outputMode| |$printAnyIfTrue|))
    (cond
      ((and (equal md '(|Any|)) |$printAnyIfTrue|)
        (setq mdp (car x))
        (setq xp (cdr x)))
      (t
        (setq mdp md)
        (setq xp x)))
    (setq |$outputMode| md)
    (if (equal md |$EmptyMode|)
      (setq mode (|quadSch|))
      (setq mode md))
    (when (or (not (equal md |$Void|)) |$printVoidIfTrue|)
      (unless |$collectOutput| (terpri |$algebraOutputStream|))
      (unless |$QuietCommand| (|output| xp mdp)))
    (|putHist| '% '|value| (|objNewWrap| x md) |$e|)
    (when (or |$printTimeIfTrue| |$printTypeIfTrue|)
      (|printTypeAndTime| xp mdp))
    (when |$printStorageIfTrue| (|printStorage|))
    (when |$printStatisticsSummaryIfTrue| (|printStatisticsSummary|))
    (when (integerp |$HTCompanionWindowID|) (|mkCompanionPage| md))
    (cond
      (|$mkTestFlag| (|recordAndPrintTest| md))
      (|$runTestFlag|
        (setq |$mkTestOutputType| md)
        '|done|)
      (t '|done|))))
```

—

5.3.50 defun printStatisticsSummary

[sayKeyedMsg p329]
 [statisticsSummary p??]
 [\$collectOutput p??]

— defun printStatisticsSummary —

```
(defun |printStatsSummary| ()
  (declare (special |$collectOutput|))
  (unless |$collectOutput|
    (|sayKeyedMsg| 'S2GL0017 (list (|statisticsSummary|)))))
```

5.3.51 defun printStorage

```
[makeLongSpaceString p??]
[$interpreterTimedClasses p??]
[$collectOutput p??]
[$interpreterTimedNames p??]
```

— defun printStorage —

```
(defun |printStorage| ()
  (declare (special |$interpreterTimedClasses| |$collectOutput|
    |$interpreterTimedNames|))
  (unless |$collectOutput|
    (|sayKeyedMsg| 'S2GL0016
      (list
        (|makeLongSpaceString|
          |$interpreterTimedNames|
          |$interpreterTimedClasses|))))))
```

5.3.52 defun printTypeAndTime

```
[printTypeAndTimeSaturn p60]
[printTypeAndTimeNormal p59]
[$saturn p??]
```

— defun printTypeAndTime —

```
(defun |printTypeAndTime| (x m)
  (declare (special |$saturn|))
  (if |$saturn|
    (|printTypeAndTimeSaturn| x m)
    (|printTypeAndTimeNormal| x m)))
```

5.3.53 defun printTypeAndTimeNormal

```
[retract p1057]
[qcar p??]
[retract p1057]
[objNewWrap p??]
[objMode p??]
[sameUnionBranch p61]
[makeLongTimeString p??]
[msgText p61]
[sayKeyedMsg p329]
[justifyMyType p62]
[$outputLines p??]
[$collectOutput p??]
[$printTypeIfTrue p749]
[$printTimeIfTrue p748]
[$outputLines p??]
[$interpreterTimedNames p??]
[$interpreterTimedClasses p??]
```

— defun printTypeAndTimeNormal —

```
(defun |printTypeAndTimeNormal| (x m)
  (let (xp mp timeString result)
    (declare (special |$outputLines| |$collectOutput| |$printTypeIfTrue|
                      |$printTimeIfTrue| |$outputLines|
                      |$interpreterTimedNames| |$interpreterTimedClasses|))
    (cond
      ((and (consp m) (eq (qcar m) '|Union|))
       (setq xp (|retract| (|objNewWrap| x m)))
       (setq mp (|objMode| xp))
       (setq m
        (cons '|Union|
              (append
               (dolist (arg (qcdr m) (nreverse result))
                 (when (|sameUnionBranch| arg mp) (push arg result)))
               (list "...")))))
      (when |$printTimeIfTrue|
       (setq timeString
        (|makeLongTimeString|
         |$interpreterTimedNames|
         |$interpreterTimedClasses|)))
      (cond
        ((and |$printTimeIfTrue| |$printTypeIfTrue|
         (if |$collectOutput|
            (push (|msgText| 'S2GL0012 (list m)) |$outputLines|)
            (|sayKeyedMsg| 'S2GL0014 (list m timeString))))
         (|$printTimeIfTrue|
```

```

(unless |$collectOutput| (|sayKeyedMsg| 'S2GL0013 (list timeString)))
(|$printTypeIfTrue|
 (if |$collectOutput|
  (push (|justifyMyType| (|msgText| 'S2GL0012 (list m))) |$outputLines|)
  (|sayKeyedMsg| 'S2GL0012 (list m))))))

```

5.3.54 defun printTypeAndTimeSaturn

```

[makeLongTimeString p??]
[form2StringAsTeX p??]
[devaluate p??]
[printAsTeX p61]
[$printTimeIfTrue p748]
[$printTypeIfTrue p749]
[$interpreterTimedClasses p??]
[$interpreterTimedNames p??]

```

— defun printTypeAndTimeSaturn —

```

(defun |printTypeAndTimeSaturn| (x m)
  (declare (ignore x))
  (let (timeString typeString)
    (declare (special |$printTimeIfTrue| |$printTypeIfTrue|
                      |$interpreterTimedClasses| |$interpreterTimedNames|))
    (if |$printTimeIfTrue|
      (setq timeString
        (|makeLongTimeString|
         |$interpreterTimedNames|
         |$interpreterTimedClasses|))
      (setq timeString ""))
    (if |$printTypeIfTrue|
      (setq typeString (|form2StringAsTeX| (|devaluate| m)))
      (setq typeString ""))
    (when |$printTypeIfTrue|
      (|printAsTeX| "\\axPrintType{")
      (if (consp typeString)
        (mapc #'|printAsTeX| typeString)
        (|printAsTeX| typeString))
      (|printAsTeX| "}"))
    (when |$printTimeIfTrue|
      (|printAsTeX| "\\axPrintTime{")
      (|printAsTeX| timeString)
      (|printAsTeX| "}"))))

```

5.3.55 defun printAsTeX[*\$texOutputStream* *p??*]

— defun printAsTeX 0 —

```
(defun |printAsTeX| (x)
  (declare (special |$texOutputStream|))
  (princ x |$texOutputStream|))
```

5.3.56 defun sameUnionBranch

```
sameUnionBranch(uArg, m) ==
  uArg is [":", ., t] => t = m
  uArg = m
```

— defun sameUnionBranch 0 —

```
(defun |sameUnionBranch| (uArg m)
  (let (t1 t2 t3)
    (cond
      ((and (consp uArg)
            (eq (qcar uArg) ' |:|)
            (progn
              (setq t1 (qcdr uArg))
              (and (consp t1)
                    (progn
                     (setq t2 (qcdr t1))
                     (and (consp t2)
                           (eq (qcdr t2) nil)
                           (progn (setq t3 (qcar t2)) t)))))))
        (equal t3 m))
      (t (equal uArg m)))))
```

5.3.57 defun msgText

```
[segmentKeyedMsg p330]
[getKeyedMsg p329]
```

```
[substituteSegmentedMsg p??]
[flowSegmentedMsg p??]
[$linelength p771]
[$margin p771]
```

— **defun msgText** —

```
(defun |msgText| (key args)
  (let (msg)
    (declare (special $linelength $margin))
    (setq msg (|segmentKeyedMsg| (|getKeyedMsg| key)))
    (setq msg (|substituteSegmentedMsg| msg args))
    (setq msg (|flowSegmentedMsg| msg $linelength $margin))
    (apply #'concat (mapcar #'princ-to-string (cdar msg)))))
```

—————

5.3.58 defun Right-justify the Type output

```
[fillerSpaces p20]
[$linelength p771]
```

— **defun justifyMyType** —

```
(defun |justifyMyType| (arg)
  (let (len)
    (declare (special $linelength))
    (setq len (|#| arg))
    (if (> len $linelength)
        arg
        (concat (|fillerSpaces| (- $linelength len)) arg))))
```

—————

5.3.59 defun Destructively fix quotes in strings

```
[unescapeStringsInForm p62]
[$funnyBacks p??]
[$funnyQuote p??]
```

— **defun unescapeStringsInForm** —

```
(defun |unescapeStringsInForm| (form)
  (let (str)
```

```
(declare (special |$funnyBacks| |$funnyQuote|))
(cond
  ((stringp form)
    (setq str (nsubstitute #" |$funnyQuote| form))
    (nsubstitute #\\ |$funnyBacks| str))
  ((consp form)
    (|unescapeStringsInForm| (car form))
    (|unescapeStringsInForm| (cdr form))
    form)
  (t form))))
```

5.3.60 Include a file into the stream

[ST p??]
[intloopInclude0 p63]

— defun intloopInclude —

```
(defun |intloopInclude| (name n)
  "Include a file into the stream"
  (with-open-file (st name) (|intloopInclude0| st name n)))
```

5.3.61 defun intloopInclude0

[incStream p73]
[intloopProcess p64]
[next p38]
[intloopEchoParse p69]
[insertpile p335]
[lineoftoks p111]
[\$lines p??]

— defun intloopInclude0 —

```
(defun |intloopInclude0| (|st| |name| |n|)
  (let (|$lines|)
    (declare (special |$lines|))
    (setq |$lines| (|incStream| |st| |name|))
    (|intloopProcess| |n| NIL
      (|next| #'|intloopEchoParse|
```

```
(|next| #'|insertpile|
(|next| #'|lineoftoks|
|$lines|))))))
```

5.3.62 defun intloopProcess

```
[StreamNull p333]
[pfAbSynOp? p412]
[setCurrentLine p41]
[tokPart p413]
[intloopProcess p64]
[intloopSpadProcess p64]
[$systemCommandFunction p??]
[$systemCommandFunction p??]
```

— defun intloopProcess —

```
(defun |intloopProcess| (n interactive s)
  (let (ptree lines t1)
    (declare (special |$systemCommandFunction|))
    (cond
      ((|StreamNull| s) n)
      (t
       (setq t1 (car s))
       (setq lines (car t1))
       (setq ptree (cadr t1))
       (cond
         ((|pfAbSynOp?| ptree 'command|)
          (when interactive (|setCurrentLine| (|tokPart| ptree)))
          (funcall |$systemCommandFunction| (|tokPart| ptree))
          (|intloopProcess| n interactive (cdr s)))
         (t
          (|intloopProcess|
           (|intloopSpadProcess| n lines ptree interactive)
           interactive (cdr s))))))))
```

5.3.63 defun intloopSpadProcess

```
[flung p??]
[SpadCompileItem p??]
[intCoerceFailure p32]
```

```

[intSpadReader p32]
[ncPutQ p416]
[CatchAsCan p??]
[Catch p??]
[intloopSpadProcess,interp p65]
[$currentCarrier p??]
[$ncMsgList p27]
[$intCoerceFailure p32]
[$intSpadReader p32]
[$prevCarrier p??]
[$stepNo p??]
[$NeedToSignalSessionManager p44]
[flung p??]

```

— defun intloopSpadProcess —

```

(defun |intloopSpadProcess| (stepNo lines ptree interactive?)
  (let (|$stepNo| result cc)
    (declare (special |$stepNo| |$prevCarrier| |$intSpadReader| |flung|
                      |$intCoerceFailure| |$ncMsgList| |$currentCarrier|
                      |$NeedToSignalSessionManager|))
    (setq |$stepNo| stepNo)
    (setq |$currentCarrier| (setq cc (list '|carrier|)))
    (|ncPutQ| cc '|stepNumber| stepNo)
    (|ncPutQ| cc '|messages| |$ncMsgList|)
    (|ncPutQ| cc '|lines| lines)
    (setq |$ncMsgList| nil)
    (setq result
      (catch '|SpadCompileItem|
        (catch |$intCoerceFailure|
          (catch |$intSpadReader|
            (|intloopSpadProcess,interp| cc ptree interactive?))))))
    (setq |$NeedToSignalSessionManager| t)
    (setq |$prevCarrier| |$currentCarrier|)
    (cond
      ((eq result '|ncEnd|) stepNo)
      ((eq result '|ncError|) stepNo)
      ((eq result '|ncEndItem|) stepNo)
      (t (1+ stepNo)))))

```

5.3.64 defun intloopSpadProcess,interp

```

[ncConversationPhase p68]
[ncEltQ p416]

```

[ncError p69]

— defun intloopSpadProcess,interp —

```
(defun |intloopSpadProcess,interp| (cc ptree interactive?)
  (|ncConversationPhase| #'|phParse| (list cc ptree))
  (|ncConversationPhase| #'|phMacro| (list cc))
  (|ncConversationPhase| #'|phIntReportMsgs| (list cc interactive?))
  (|ncConversationPhase| #'|phInterpret| (list cc))
  (unless (eql (length (|ncEltQ| cc ' |messages|)) 0) (|ncError|)))
```

—————

5.3.65 defun phParse

TPDHERE: The pform function has a leading percent sign. fix this

```
phParse: carrier[tokens,...] -> carrier[ptree, tokens,...]
```

[ncPutQ p416]

— defun phParse —

```
(defun |phParse| (carrier ptree)
  (|ncPutQ| carrier ' |ptree| ptree)
  'ok)
```

—————

5.3.66 defun phIntReportMsgs

```
carrier[lines,messages,...]-> carrier[lines,messages,...]
```

```
[ncEltQ p416]
[ncPutQ p416]
[processMsgList p369]
[$erMsgToss p??]
```

— defun phIntReportMsgs —

```
(defun |phIntReportMsgs| (carrier interactive?)
  (declare (ignore interactive?))
  (let (nerr msgs lines)
    (declare (special |$erMsgToss|))
```

```
(cond
  (|$erMsgToss| 'ok)
  (t
    (setq lines (|ncEltQ| carrier '|lines|))
    (setq msgs (|ncEltQ| carrier '|messages|))
    (setq nerr (length msgs))
    (|ncPutQ| carrier '|ok?'| (eq1 nerr 0))
    (cond
      ((eq1 nerr 0) 'ok)
      (t
        (|processMsgList| msgs lines)
        (|sayKeyedMsg| 'S2CTP010 (list nerr))
        'ok))))))
```

5.3.67 defun phInterpret

```
[ncEltQ p416]
[intInterpretPform p67]
[ncPutQ p416]
```

— defun phInterpret —

```
(defun |phInterpret| (carrier)
  (let (val ptree)
    (setq ptree (|ncEltQ| carrier '|ptree|))
    (setq val (|intInterpretPform| ptree))
    (|ncPutQ| carrier '|value| val)))
```

5.3.68 defun intInterpretPform

```
[processInteractive p49]
[zeroOneTran p68]
[pf2Sex p299]
```

— defun intInterpretPform —

```
(defun |intInterpretPform| (pf)
  (|processInteractive| (|zeroOneTran| (|pf2Sex| pf)) pf))
```

5.3.69 defun zeroOneTran

```
[nsubst p??]
```

```
— defun zeroOneTran 0 —
```

```
(defun |zeroOneTran| (sex)
  (nsubst '|$EmptyMode| '? sex))
```

```
—————
```

5.3.70 defun ncConversationPhase

```
[ncConversationPhase,wrapup p68]
```

```
[$ncMsgList p27]
```

```
— defun ncConversationPhase —
```

```
(defun |ncConversationPhase| (fn args)
  (let (|$ncMsgList| carrier)
    (declare (special |$ncMsgList|))
    (setq carrier (car args))
    (setq |$ncMsgList| nil)
    (unwind-protect
      (apply fn args)
      (|ncConversationPhase,wrapup| carrier))))
```

```
—————
```

5.3.71 defun ncConversationPhase,wrapup

```
[$ncMsgList p27]
```

```
— defun ncConversationPhase,wrapup —
```

```
(defun |ncConversationPhase,wrapup| (carrier)
  (declare (special |$ncMsgList|))
  ((lambda (Var5 m)
    (loop
      (cond
        ((or (atom Var5) (progn (setq m (car Var5)) nil))
         (return nil))
        (t
         (|ncPutQ| carrier '|messages| (cons m (|ncEltQ| carrier '|messages|))))
      (setq Var5 (cdr Var5)))))
```



```
|$ncMsgList| nil))
```

5.3.72 defun ncError

```
[SpadCompileItem p??]
```

— defun ncError 0 —

```
(defun |ncError| ()
  (throw '|SpadCompileItem| '|ncError|))
```

5.3.73 defun intloopEchoParse

```
[ncloopDQlines p71]
[setCurrentLine p41]
[mkLineList p70]
[ncloopPrintLines p70]
[npParse p141]
[dqToList p344]
[$EchoLines p??]
[$lines p??]
```

— defun intloopEchoParse —

```
(defun |intloopEchoParse| (s)
  (let (cudr lines stream dq t1)
    (declare (special |$EchoLines| |$lines|))
    (setq t1 (car s))
    (setq dq (car t1))
    (setq stream (cadr t1))
    (setq t1 (|ncloopDQlines| dq |$lines|))
    (setq lines (car t1))
    (setq cudr (cadr t1))
    (|setCurrentLine| (|mkLineList| lines))
    (when |$EchoLines| (|ncloopPrintLines| lines))
    (setq |$lines| cudr)
    (cons (list (list lines (|npParse| (|dqToList| dq)))) (cdr s))))
```

5.3.74 defun ncloopPrintLines

```
;ncloopPrintLines lines ==
;      for line in lines repeat WRITE_-LINE CDR line
;      WRITE_-LINE ' " "
```

— defun ncloopPrintLines 0 —

```
(defun |ncloopPrintLines| (lines)
  ((lambda (Var4 line)
    (loop
      (cond
        ((or (atom Var4) (progn (setq line (car Var4)) nil))
         (return nil))
        (t (write-line (cdr line))))
      (setq Var4 (cdr Var4))))
    lines nil)
  (write-line " " ))
```

—————→

5.3.75 defun mkLineList

```
;mkLineList lines ==
; 1 := [CDR line for line in lines | nonBlank CDR line]
; #1 = 1 => CAR 1
; 1
```

— defun mkLineList —

```
(defun |mkLineList| (lines)
  (let (l)
    (setq l
      ((lambda (Var2 Var1 line)
        (loop
          (cond
            ((or (atom Var1) (progn (setq line (car Var1)) nil))
             (return (nreverse Var2)))
            (t
              (and (|nonBlank| (cdr line))
                (setq Var2 (cons (cdr line) Var2))))
            (setq Var1 (cdr Var1))))
        nil lines nil))
    (cond
      ((eq1 (length l) 1) (car l))
```

```
(t 1))))
```

5.3.76 defun nonBlank

```
;nonBlank str ==
; value := false
; for i in 0..MAXINDEX str repeat
;   str.i ^= char " " =>
;     value := true
;   return value
; value
```

— defun nonBlank 0 —

```
(defun |nonBlank| (str)
  (let (value)
    ((lambda (Var3 i)
      (loop
        (cond
          ((> i Var3) (return nil))
          (t
           (cond
            ((not (equal (elt str i) (|char| ' | |)))
             (identity (progn (setq value t) (return value))))))
        (setq i (+ i 1))))
      (maxindex str) 0)
    value))
```

5.3.77 defun ncloopDQlines

```
[StreamNull p333]
[poGlobalLinePosn p72]
[tokPosn p413]
[streamChop p72]
```

— defun ncloopDQlines —

```
(defun |ncloopDQlines| (dq stream)
  (let (b a)
    (|StreamNull| stream)
```

```
(setq a (|poGlobalLinePosn| (|tokPosn| (cadr dq))))
(setq b (|poGlobalLinePosn| (caar stream)))
(|streamChop| (+ (- a b) 1) stream)))
```

5.3.78 defun poGlobalLinePosn

```
[lnGlobalNum p346]
[poGetLineObject p361]
[ncBug p368]
```

— defun poGlobalLinePosn —

```
(defun |poGlobalLinePosn| (posn)
  (if posn
    (|lnGlobalNum| (|poGetLineObject| posn))
    (|ncBug| "old style pos objects have no global positions" nil)))
```

5.3.79 defun streamChop

Note that changing the name “lyne” to “line” will break the system. I do not know why. The symptom shows up when there is a file with a large contiguous comment spanning enough lines to overflow the stack. [StreamNull p333]

```
[streamChop p72]
[ncloopPrefix? p477]
```

— defun streamChop —

```
(defun |streamChop| (n s)
  (let (d c lyne b a tmp1)
    (cond
      ((|StreamNull| s) (list nil nil))
      ((eql n 0) (list nil s))
      (t
       (setq tmp1 (|streamChop| (- n 1) (cdr s)))
       (setq a (car tmp1))
       (setq b (cadr tmp1))
       (setq lyne (car s))
       (setq c (|ncloopPrefix?| "command" (cdr lyne)))
       (setq d (cons (car lyne) (cond (c c) (t (cdr lyne)))))
       (list (cons d a) b)))))
```

5.3.80 defun ncloopInclude0

```
[incStream p73]
[ncloopProcess p??]
[next p38]
[ncloopEchoParse p??]
[insertpile p335]
[lineoftoks p111]
[$lines p??]
```

— defun ncloopInclude0 —

```
(defun |ncloopInclude0| (st name n)
  (let (|$lines|)
    (declare (special |$lines|))
    (setq |$lines| (|incStream| st name))
    (|ncloopProcess| n nil
      (|next| #'|ncloopEchoParse|
        (|next| #'|insertpile|
          (|next| #'|lineoftoks|
            |$lines|))))))
```

5.3.81 defun incStream

```
[incRenumbr p74]
[incLude p76]
[incRgen p103]
[Top p77]
```

— defun incStream —

```
(defun |incStream| (st fn)
  (declare (special |Top|))
  (|incRenumbr| (|incLude| 0 (|incRgen| st) 0 (list fn) (list |Top|))))
```

5.3.82 defun incRenumber

[incZip p74]
 [incIgen p75]

— defun incRenumber —

```
(defun |incRenumber| (ssx)
  (|incZip| #'|incRenumberLine| ssx (|incIgen| 0)))
```

—————

5.3.83 defun incZip

[Delay p103]
 [incZip1 p74]

— defun incZip —

```
(defun |incZip| (g f1 f2)
  (|Delay| #'|incZip1| (list g f1 f2)))
```

—————

5.3.84 defun incZip1

[StreamNull p333]
 [incZip p74]

— defun incZip1 —

```
(defun |incZip1| (&rest z)
  (let (f2 f1 g)
    (setq g (car z))
    (setq f1 (cadr z))
    (setq f2 (caddr z))
    (cond
      ((|StreamNull| f1) |StreamNil|)
      ((|StreamNull| f2) |StreamNil|)
      (t
       (cons
        (funcall g (car f1) (car f2))
        (|incZip| g (cdr f1) (cdr f2)))))))
```

—————

5.3.85 defun incIgen

[Delay p103]
[incIgen1 p75]

— defun incIgen —

```
(defun |incIgen| (n)
  (|Delay| #'|incIgen1| (list n)))
```

—————

5.3.86 defun incIgen1

[incIgen p75]

— defun incIgen1 —

```
(defun |incIgen1| (&rest z)
  (let (n)
    (setq n (car z))
    (setq n (+ n 1))
    (cons n (|incIgen| n))))
```

—————

5.3.87 defun incRenumberLine

[incRenumberItem p76]
[incHandleMessage p76]

— defun incRenumberLine —

```
(defun |incRenumberLine| (xl gno)
  (let (l)
    (setq l (|incRenumberItem| (elt xl 0) gno))
    (|incHandleMessage| xl)
    l))
```

—————

5.3.88 defun incRenumberItem

[lnSetGlobalNum p346]

— defun incRenumberItem —

```
(defun |incRenumberItem| (f i)
  (let (l)
    (setq l (caar f))
    (|lnSetGlobalNum| l i) f))
```

—————→

5.3.89 defun incHandleMessage

[ncSoftError p351]

[ncBug p368]

— defun incHandleMessage 0 —

```
(defun |incHandleMessage| (x)
  "Message handling for the source includer"
  (let ((msgtype (elt (elt x 1) 1))
        (pos (car (elt x 0)))
        (key (car (elt (elt x 1) 0)))
        (args (cadr (elt (elt x 1) 0))))
    (cond
      ((eq msgtype '|none|) 0)
      ((eq msgtype '|error|) (|ncSoftError| pos key args))
      ((eq msgtype '|warning|) (|ncSoftError| pos key args))
      ((eq msgtype '|say|) (|ncSoftError| pos key args))
      (t (|ncBug| key args)))))
```

—————→

5.3.90 defun incLude

[Delay p103]

[incLude1 p81]

— defun incLude —

```
(defun |incLude| (eb ss ln ufos states)
  (|Delay| #'|incLude1| (list eb ss ln ufos states)))
```

5.3.91 defmacro Rest

— defmacro Rest —

```
(defmacro |Rest| ()  
  "used in include1 for parsing; s is not used."  
  '(|include| eb (cdr ss) lno ufos states))
```

5.3.92 defvar \$Top

— initvars —

```
(defvar |Top| 1 "used in include1 for parsing")
```

5.3.93 defvar \$IfSkipToEnd

— initvars —

```
(defvar |IfSkipToEnd| 10 "used in include1 for parsing")
```

5.3.94 defvar \$IfKeepPart

— initvars —

```
(defvar |IfKeepPart| 11 "used in include1 for parsing")
```

5.3.95 defvar \$IfSkipPart

— initvars —

```
(defvar |IfSkipPart| 12 "used in include1 for parsing")
```

—————

5.3.96 defvar \$ElseifSkipToEnd

— initvars —

```
(defvar |ElseifSkipToEnd| 20 "used in include1 for parsing")
```

—————

5.3.97 defvar \$ElseifKeepPart

— initvars —

```
(defvar |ElseifKeepPart| 21 "used in include1 for parsing")
```

—————

5.3.98 defvar \$ElseifSkipPart

— initvars —

```
(defvar |ElseifSkipPart| 22 "used in include1 for parsing")
```

—————

5.3.99 defvar \$ElseSkipToEnd

— initvars —

```
(defvar |ElseSkipToEnd| 30 "used in include1 for parsing")
```

5.3.100 defvar \$ElseKeepPart

— initvars —

```
(defvar |ElseKeepPart| 31 "used in include1 for parsing")
```

5.3.101 defvar \$Top?

[quotient p??]

— defun Top? 0 —

```
(defun |Top?| (|st|)
  "used in include1 for parsing"
  (eq1 (quotient |st| 10) 0))
```

5.3.102 defvar \$If?

[quotient p??]

— defun If? —

```
(defun |If?| (|st|)
  "used in include1 for parsing"
  (eq1 (quotient |st| 10) 1))
```

5.3.103 defvar \$Elseif?

[QUOTIENT p??]

— defun Elseif? —

```
(defun |Elseif?| (|st|)
  "used in include1 for parsing"
  (eq1 (quotient |st| 10) 2))
```

5.3.104 defvar \$Else?

[QUOTIENT p??]

— defun Else? —

```
(defun |Else?| (|st|)
  "used in include1 for parsing"
  (eq1 (quotient |st| 10) 3))
```

5.3.105 defvar \$SkipEnd?

[remainder p??]

— defun SkipEnd? —

```
(defun |SkipEnd?| (|st|)
  "used in include1 for parsing"
  (eq1 (remainder |st| 10) 0))
```

5.3.106 defvar \$KeepPart?

[remainder p??]

— defun KeepPart? —

```
(defun |KeepPart?| (|st|)
  "used in include1 for parsing"
  (eq1 (remainder |st| 10) 1))
```

5.3.107 defvar \$SkipPart?

[remainder p??]

— defun SkipPart? —

```
(defun |SkipPart?| (|st|)
  "used in incLude1 for parsing"
  (eq1 (remainder |st| 10) 2))
```

—————

5.3.108 defvar \$Skipping?

[KeepPart? p80]

— defun Skipping? —

```
(defun |Skipping?| (|st|)
  "used in incLude1 for parsing"
  (null (|KeepPart?| |st|)))
```

—————

5.3.109 defun incLude1

```
[StreamNull p333]
[Top? p79]
[xlPrematureEOF p86]
[Skipping? p81]
[xlSkip p89]
[Rest p77]
[xlOK p86]
[xlOK1 p86]
[concat p1049]
[incCommandTail p101]
[xlSay p89]
[xlNoSuchFile p90]
[xlCannotRead p91]
[incActive? p103]
[xlFileCycle p92]
[incLude p76]
[incFileInput p102]
```

```

[incAppend p87]
[inclFname p102]
[xlConActive p93]
[xlConStill p94]
[incConsoleInput p102]
[incNConsoles p103]
[xlConsole p94]
[xlSkippingFin p95]
[xlPrematureFin p95]
[assertCond p96]
[ifCond p89]
[If? p79]
[Elseif? p79]
[xlIfSyntax p96]
[SkipEnd? p80]
[KeepPart? p80]
[SkipPart? p81]
[xlIfBug p97]
[xlCmdBug p98]
[expand-tabs p??]
[incClassify p99]

```

— defun incLude1 —

```

(defun |incLude1| (&rest z)
  (let (pred s1 n tail head includee fn1 info str state lno states
        ufos ln ss eb)
    (setq eb (car z))
    (setq ss (cadr . (z)))
    (setq ln (caddr . (z)))
    (setq ufos (caddr . (z)))
    (setq states (car (cddddr . (z))))
    (setq lno (+ ln 1))
    (setq state (elt states 0))
    (cond
      ((|StreamNull| ss)
       (cond
         ((null (|Top?| state))
          (cons (|xlPrematureEOF| eb "--premature end" lno ufos)
                 |StreamNil|))
         (t |StreamNil|)))
      (t
       (progn
        (setq str (expand-tabs (car ss)))
        (setq info (|incClassify| str))
        (cond
          ((null (elt info 0))
           (cond

```

```

((|Skipping?| state)
 (cons (|xlSkip| eb str lno (elt ufos 0)) (|Rest|)))
(t
 (cons (|xlOK| eb str lno (elt ufos 0)) (|Rest|))))
(equal (elt info 2) "other")
(cond
 ((|Skipping?| state)
  (cons (|xlSkip| eb str lno (elt ufos 0)) (|Rest|)))
 (t
  (cons
   (|xlOK1| eb str (concat ")command" str) lno (elt ufos 0))
   (|Rest|))))))
(equal (elt info 2) "say")
(cond
 ((|Skipping?| state)
  (cons (|xlSkip| eb str lno (elt ufos 0)) (|Rest|)))
 (t
  (progn
   (setq str (|incCommandTail| str info))
   (cons (|xlSay| eb str lno ufos str)
         (cons (|xlOK| eb str lno (ELT ufos 0)) (|Rest|)))))))
(equal (elt info 2) "include")
(cond
 ((|Skipping?| state)
  (cons (|xlSkip| eb str lno (elt ufos 0)) (|Rest|)))
 (t
  (progn
   (setq fn1 (|inclFname| str info))
   (cond
    ((null fn1)
     (cons (|xlNoSuchFile| eb str lno ufos fn1) (|Rest|)))
    ((null (probe-file fn1))
     (cons (|xlCannotRead| eb str lno ufos fn1) (|Rest|)))
    ((|incActive?| fn1 ufos)
     (cons (|xlFileCycle| eb str lno ufos fn1) (|Rest|)))
    (t
     (progn
      (setq includee
              (|inclLude| (+ eb (elt info 1))
                          (|incFileInput| fn1)
                          0
                          (cons fn1 ufos)
                          (cons |Top| states)))
      (cons (|xlOK| eb str lno (elt ufos 0))
            (|incAppend| includee (|Rest|))))))))))
(equal (elt info 2) "console")
(cond
 ((|Skipping?| state)
  (cons (|xlSkip| eb str lno (elt ufos 0)) (|Rest|)))
 (t

```

```

(progn
  (setq head
    (|incLude| (+ eb (elt info 1))
              (|incConsoleInput|
               0
               (cons "console" ufos)
               (cons |Top| states))))
  (setq tail (|Rest|))
  (setq n (|incNConsoles| ufos))
  (cond
    ((< 0 n)
     (setq head
       (cons (|xlConActive| eb str lno ufos n) head))
     (setq tail
       (cons (|xlConStill| eb str lno ufos n) tail)))
    (setq head (cons (|xlConsole| eb str lno ufos) head))
    (cons (|xlOK| eb str lno (elt ufos 0))
          (|incAppend| head tail))))))
(equal (elt info 2) "fin")
(cond
  ((|Skipping?| state)
   (cons (|xlSkippingFin| eb str lno ufos) (|Rest|)))
  ((null (|Top?| state))
   (cons (|xlPrematureFin| eb str lno ufos) |StreamNil|))
  (t
   (cons (|xlOK| eb str lno (elt ufos 0)) |StreamNil|)))
(equal (elt info 2) "assert")
(cond
  ((|Skipping?| state)
   (cons (|xlSkippingFin| eb str lno ufos) (|Rest|)))
  (t
   (progn
    (|assertCond| str info)
    (cons (|xlOK| eb str lno (elt ufos 0))
          (|incAppend| includee (|Rest|))))))
  (equal (elt info 2) "if")
  (progn
   (setq s1
     (cond
      ((|Skipping?| state) |IfSkipToEnd|)
      (t
       (cond
        ((|ifCond| str info) |IfKeepPart|)
        (t |IfSkipPart|))))
     (cons (|xlOK| eb str lno (elt ufos 0))
           (|incLude| eb (cdr ss) lno ufos (cons s1 states))))))
  (equal (elt info 2) "elseif")
  (cond
    ((and (null (|If?| state)) (null (|Elseif?| state)))
     (cons (|xlIfSyntax| eb str lno ufos info states)

```



```

        |StreamNil|))
(t
  (cond
    ((or (|SkipEnd?| state)
         (|KeepPart?| state)
         (|SkipPart?| state))
     (setq s1
       (cond
         ((|SkipPart?| state)
          (setq pred (|ifCond| str info))
          (cond
            (pred |ElseifKeepPart|)
            (t |ElseifSkipPart|)))
         (t |ElseifSkipToEnd|)))
       (cons (|xlOK| eb str lno (elt ufos 0))
             (|incLude| eb (cdr ss) lno ufos (cons s1 (cdr states))))))
    (t
     (cons (|xlIfBug| eb str lno ufos) |StreamNil|))))))
(equal (elt info 2) "else")
(cond
  ((and (null (|If?| state)) (null (|Elseif?| state)))
   (cons (|xlIfSyntax| eb str lno ufos info states)
         |StreamNil|))
  (t
   (cond
     ((or (|SkipEnd?| state)
          (|KeepPart?| state)
          (|SkipPart?| state))
      (setq s1
        (cond ((|SkipPart?| state) |ElseKeepPart|) (t |ElseSkipToEnd|)))
        (cons (|xlOK| eb str lno (elt ufos 0))
              (|incLude| eb (cdr ss) lno ufos (cons s1 (cdr states))))))
     (t
      (cons (|xlIfBug| eb str lno ufos) |StreamNil|))))))
(equal (elt info 2) "endif")
(cond
  ((|Top?| state)
   (cons (|xlIfSyntax| eb str lno ufos info states)
         |StreamNil|))
  (t
   (cons (|xlOK| eb str lno (elt ufos 0))
         (|incLude| eb (cdr ss) lno ufos (cdr states))))))
(t (cons (|xlCmdBug| eb str lno ufos) |StreamNil|))))))

```

5.3.110 defun xlPrematureEOF

[xlMsg p86]

[inclmsgPrematureEOF p88]

— defun xlPrematureEOF —

```
(defun |xlPrematureEOF| (eb str lno ufos)
  (|xlMsg| eb str lno (elt ufos 0)
    (list (|inclmsgPrematureEOF| (elt ufos 0)) 'error)))
```

—————

5.3.111 defun xlMsg

[incLine p87]

— defun xlMsg —

```
(defun |xlMsg| (extrablanks string localnum fileobj mess)
  (let ((globalnum -1))
    (list (incLine extrablanks string globalnum localnum fileobj) mess)))
```

—————

5.3.112 defun xlOK

[lxOK1 p??]

— defun xlOK —

```
(defun |xlOK| (extrablanks string localnum fileobj)
  (|xlOK1| extrablanks string string localnum fileobj))
```

—————

5.3.113 defun xlOK1

[incLine1 p88]

— defun xlOK1 —

```
(defun |x10K1| (extrablanks string string1 localnum fileobj)
  (let ((globalnum -1))
    (list (incLine1 extrablanks string string1 globalnum localnum fileobj)
          (list nil '|none|))))
```

5.3.114 defun incAppend

[Delay p103]
[incAppend1 p87]

— defun incAppend —

```
(defun |incAppend| (x y)
  (|Delay| #'|incAppend1| (list x y)))
```

5.3.115 defun incAppend1

[StreamNull p333]
[incAppend p87]

— defun incAppend1 —

```
(defun |incAppend1| (&rest z)
  (let (y x)
    (setq x (car z))
    (setq y (cadr z))
    (cond
     ((|StreamNull| x)
      (cond ((|StreamNull| y) |StreamNil|) (t y)))
     (t
      (cons (car x) (|incAppend| (cdr x) y))))))
```

5.3.116 defun incLine

[incLine1 p88]

— defun incLine —

```
(defun incLine (extrablanks string globalnum localnum fileobj)
  (incLine1 extrablanks string string globalnum localnum fileobj))
```

5.3.117 defun incLine1

[lnCreate p345]

— defun incLine1 —

```
(defun incLine1 (extrablanks string string1 globalnum localnum fileobj)
  (cons
    (cons (|lnCreate| extrablanks string globalnum localnum fileobj) 1) string1))
```

5.3.118 defun inclmsgPrematureEOF

[origin p??]

— defun inclmsgPrematureEOF 0 —

```
(defun |inclmsgPrematureEOF| (ufo)
  (list 'S2CI0002 (list (|theorigin| ufo))))
```

5.3.119 defun theorigin

— defun theorigin 0 —

```
(defun |theorigin| (x) (list #'|porigin| x))
```

5.3.120 defun porigin

[stringp p??]

— defun porigin —

```
(defun |porigin| (x)
  (if (stringp x)
      x
      (|pfname| x)))
```

5.3.121 defun ifCond

```
[MakeSymbol p??]
[incCommandTail p101]
[$inclAssertions p??]
```

— defun ifCond —

```
(defun |ifCond| (s info)
  (let (word)
    (declare (special |$inclAssertions|))
    (setq word
      (|MakeSymbol| (string-trim *whitespace* (|incCommandTail| s info))))
    (member word |$inclAssertions|)))
```

5.3.122 defun xlSkip

```
[incLine p87]
[CONCAT p??]
```

— defun xlSkip —

```
(defun |xlSkip| (extrablanks str localnum fileobj)
  (let ((string (concat "-- Omitting:" str)) (globalnum -1))
    (list
      (incLine extrablanks string globalnum localnum fileobj)
      (list nil '|none|))))
```

5.3.123 defun xlSay

```
[xlMsg p86]
[inclmsgSay p90]
```

— defun xlSay —

```
(defun |xlSay| (eb str lno ufos x)
  (|xlMsg| eb str lno (elt ufos 0) (list (|inclmsgSay| x) '|say|)))
```

—————

5.3.124 defun inclmsgSay

[id p??]

— defun inclmsgSay —

```
(defun |inclmsgSay| (str)
  (list 'S2CI0001 (list (|theid| str))))
```

—————

5.3.125 defun theid

— defun theid 0 —

```
(defun |theid| (a) (list identity a))
```

—————

5.3.126 defun xlNoSuchFile

[xlMsg p86]
[inclmsgNoSuchFile p91]

— defun xlNoSuchFile —

```
(defun |xlNoSuchFile| (eb str lno ufos fn)
  (|xlMsg| eb str lno (elt ufos 0) (list (|inclmsgNoSuchFile| fn) '|error|)))
```

—————

5.3.127 defun inclmsgNoSuchFile

[thefname p91]

— defun inclmsgNoSuchFile —

```
(defun |inclmsgNoSuchFile| (fn)
  (list 'S2CI0010 (list (|thefname| fn))))
```

—————

5.3.128 defun thefname

[pfname p91]

— defun thefname 0 —

```
(defun |thefname| (x) (list #'|pfname| x))
```

—————

5.3.129 defun pfname

[PathnameString p??]

— defun pfname —

```
(defun |pfname| (x) (|PathnameString| x))
```

—————

5.3.130 defun xlCannotRead

[xlMsg p86]

[inclmsgCannotRead p92]

— defun xlCannotRead —

```
(defun |xlCannotRead| (eb str lno ufos fn)
  (|xlMsg| eb str lno (elt ufos 0) (list (|inclmsgCannotRead| fn) '|error|)))
```

—————

5.3.131 defun inclmsgCannotRead

[thefname p91]

— defun inclmsgCannotRead —

```
(defun |inclmsgCannotRead| (fn)
  (list 'S2CI0011 (list (|thefname| fn))))
```

—————

5.3.132 defun xlFileCycle

[xlMsg p86]

[inclmsgFileCycle p92]

— defun xlFileCycle —

```
(defun |xlFileCycle| (eb str lno ufos fn)
  (|xlMsg| eb str lno (elt ufos 0)
    (list (|inclmsgFileCycle| ufos fn) '|error|)))
```

—————

5.3.133 defun inclmsgFileCycle

```
;inclmsgFileCycle(ufos,fn) ==
;   flist := [porigin n for n in reverse ufos]
;   f1    := porigin fn
;   cycle := [:[n, '==>'] for n in flist], f1]
;   ['S2CI0004, [%id cycle, %id f1] ]
```

[porigin p88]

[id p??]

— defun inclmsgFileCycle —

```
(defun |inclmsgFileCycle| (ufos fn)
  (let (cycle f1 flist)
    (setq flist
      ((lambda (Var8 Var7 n)
        (loop
          (cond
```



```

((or (atom Var7) (progn (setq n (car Var7)) nil))
 (return (nreverse Var8)))
(t
 (setq Var8 (cons (|porigin| n) Var8)))
(setq Var7 (cdr Var7)))
nil (reverse ufos) nil))
(setq f1 (|porigin| fn))
(setq cycle
 (append
 ((lambda (Var10 Var9 n)
  (loop
   (cond
    ((or (atom Var9) (progn (setq n (car Var9)) nil))
     (return (nreverse Var10)))
    (t
     (setq Var10 (append (reverse (list n "==">)) Var10)))
     (setq Var9 (cdr Var9))))
   nil flist nil)
 (cons f1 nil)))
(list 'S2CI0004 (list (|theid| cycle) (|theid| f1))))

```

5.3.134 defun xlConActive

[xlMsg p86]
[inclmsgConActive p93]

— defun xlConActive —

```

(defun |xlConActive| (eb str lno ufos n)
  (|xlMsg| eb str lno (elt ufos 0) (list (|inclmsgConActive| n) '|warning|)))

```

5.3.135 defun inclmsgConActive

[id p??]

— defun inclmsgConActive —

```

(defun |inclmsgConActive| (n)
  (list 'S2CI0006 (list (|theid| n))))

```

5.3.136 defun xlConStill

```
[xlMsg p86]
[inclmsgConStill p94]

— defun xlConStill —

(defun |xlConStill| (eb str lno ufos n)
  (|xlMsg| eb str lno (elt ufos 0) (list (|inclmsgConStill| n) '|say|)))
```

5.3.137 defun inclmsgConStill

```
[id p??]

— defun inclmsgConStill —

(defun |inclmsgConStill| (n)
  (list 'S2CI0007 (list (|theid| n))))
```

5.3.138 defun xlConsole

```
[xlMsg p86]
[inclmsgConsole p94]

— defun xlConsole —

(defun |xlConsole| (eb str lno ufos)
  (|xlMsg| eb str lno (elt ufos 0) (list (|inclmsgConsole|) '|say|)))
```

5.3.139 defun inclmsgConsole

```
— defun inclmsgConsole 0 —

(defun |inclmsgConsole| ()
  (list 'S2CI0005 nil))
```

5.3.140 defun xlSkippingFin

[xlMsg p86]

[inclmsgFinSkipped p95]

— defun xlSkippingFin —

```
(defun |xlSkippingFin| (eb str lno ufos)
  (|xlMsg| eb str lno (elt ufos 0)
    (list (|inclmsgFinSkipped|) '|warning|)))
```

—————

5.3.141 defun inclmsgFinSkipped

— defun inclmsgFinSkipped 0 —

```
(defun |inclmsgFinSkipped| ()
  (list 'S2CI0008 nil))
```

—————

5.3.142 defun xlPrematureFin

[xlMsg p86]

[inclmsgPrematureFin p95]

— defun xlPrematureFin —

```
(defun |xlPrematureFin| (eb str lno ufos)
  (|xlMsg| eb str lno (elt ufos 0)
    (list (|inclmsgPrematureFin| (elt ufos 0)) '|error|)))
```

—————

5.3.143 defun inclmsgPrematureFin

[origin p??]

— defun inclmsgPrematureFin —

```
(defun |inclmsgPrematureFin| (ufo)
  (list 'S2CI0003 (list (|theorigin| ufo))))
```

5.3.144 defun assertCond

```
[MakeSymbol p??]
[incCommandTail p101]
[$inclAssertions p??]
[*whitespace* p24]
```

— defun assertCond —

```
(defun |assertCond| (s info)
  (let (word)
    (declare (special |$inclAssertions| *whitespace*))
    (setq word
      (|MakeSymbol| (string-trim *whitespace* (|incCommandTail| s info))))
    (unless (member word |$inclAssertions|)
      (setq |$inclAssertions| (cons word |$inclAssertions|)))))
```

5.3.145 defun xIfSyntax

```
[Top? p79]
[Else? p80]
[xlMsg p86]
[inclmsgIfSyntax p97]
```

— defun xIfSyntax —

```
(defun |xIfSyntax| (eb str lno ufos info sts)
  (let (context found st)
    (setq st (elt sts 0))
    (setq found (elt info 2))
    (setq context
      (cond
        ((|Top?| st) '|not in an |if...|endif|)
        ((|Else?| st) '|after an |else|)
        (t '|but can't figure out where|)))
    (|xlMsg| eb str lno (elt ufos 0)
      (list (|inclmsgIfSyntax| (elt ufos 0) found context) '|error|))))
```

5.3.146 defun inclmsgIfSyntax

[concat p1049]
[id p??]
[origin p??]

— defun inclmsgIfSyntax —

```
(defun |inclmsgIfSyntax| (ufo found context)
  (setq found (concat ")" found))
  (list 'S2CI0009 (list (|theid| found)
                        (|theid| context)
                        (|theorigin| ufo))))
```

5.3.147 defun xIfBug

[xlMsg p86]
[inclmsgIfBug p97]

— defun xIfBug —

```
(defun |xIfBug| (eb str lno ufos)
  (|xlMsg| eb str lno (elt ufos 0) (list (|inclmsgIfBug|) '|bug|)))
```

5.3.148 defun inclmsgIfBug

— defun inclmsgIfBug 0 —

```
(defun |inclmsgIfBug| ()
  (list 'S2CB0002 nil))
```

5.3.149 defun xlCmdBug

```
[xlMsg p86]
[inclmsgCmdBug p98]

— defun xlCmdBug —

(defun |xlCmdBug| (eb str lno ufos)
  (|xlMsg| eb str lno (elt ufos 0) (list (|inclmsgCmdBug|) '|bug|)))
```

5.3.150 defun inclmsgCmdBug

```
— defun inclmsgCmdBug 0 —

(defun |inclmsgCmdBug| ()
  (list 'S2CB0003 nil))
```

5.3.151 defvar \$incCommands

This is a list of commands that can be in an include file

```
— postvars —

(eval-when (eval load)
  (setq |incCommands|
    (list "say" "include" "console" "fin" "assert" "if" "elseif" "else" "endif")))
```

5.3.152 defvar \$pfMacros

The \$pfMacros variable is an alist [[id, state, body-pform], ...] where state is one of: mbody, mparam, mlambda

User-defined macros are maintained in a stack of definitions. This is the stack sequence resulting from the command lines:

```
a ==> 3
a ==> 4
```

```

b ==> 7
(
  (|b| |mbody| ((|integer| (|posn| (0 "b ==> 7" 1 1 "strings") . 6)) . "7"))
  (|a| |mbody| ((|integer| (|posn| (0 "a ==> 4" 1 1 "strings") . 6)) . "4"))
  (|a| |mbody| ((|integer| (|posn| (0 "a ==> 3" 1 1 "strings") . 6)) . "3"))
)

```

— initvars —

```
(defvar |$pfMacros| nil)
```

—————

5.3.153 defun incClassify

```

;incClassify(s) ==
;      not incCommand? s => [false,0, '"]
;      i := 1; n := #s
;      while i < n and s.i = char " " repeat i := i + 1
;      i >= n => [true,0,'other"]
;      eb := (i = 1 => 0; i)
;      bad:=true
;      for p in incCommands while bad repeat
;          incPrefix?(p, i, s) =>
;              bad:=false
;              p1 :=p
;      if bad then [true,0,'other"] else [true,eb,p1]

```

```

[incCommand? p100]
[incCommands p98]

```

— defun incClassify —

```

(defun |incClassify| (s)
  (let (p1 bad eb n i)
    (declare (special |incCommands|))
    (if (null (|incCommand?| s))
      (list nil 0 "")
      (progn
        (setq i 1)
        (setq n (length s))
        ((lambda ()
          (loop
            (cond
              ((not (and (< i n) (char= (elt s i) #\space))))
              (return nil))

```

```

      (t (setq i (1+ i))))))
(cond
  ((not (< i n)) (list t 0 "other"))
  (t
   (if (= i 1)
       (setq eb 0)
       (setq eb i))
   (setq bad t)
   ((lambda (tmp1 p)
      (loop
        (cond
          ((or (atom tmp1)
               (progn (setq p (car tmp1)) nil)
               (not bad))
           (return nil))
          (t
           (cond
            ((|incPrefix?| p i s)
             (identity
              (progn
                (setq bad nil)
                (setq p1 p))))))
            (setq tmp1 (cdr tmp1))))
        |incCommands| nil)
      (if bad
          (list t 0 "other")
          (list t eb p1))))))

```

5.3.154 defun incCommand?

[char p??]

— defun incCommand? 0 —

```

(defun |incCommand?| (s)
  "does this start with a close paren?"
  (and (< 0 (length s)) (equal (elt s 0) (|char| ')|))))

```

5.3.155 defun incPrefix?

;incPrefix?(prefix, start, whole) ==


```
;          #prefix > #whole-start => false
;          good:=true
;          for i in 0..#prefix-1 for j in start.. while good repeat
;              good:= prefix.i = whole.j
;          good
```

— defun incPrefix? 0 —

```
(defun |incPrefix?| (prefix start whole)
  (let (good)
    (cond
      ((< (- (length whole) start) (length prefix)) nil)
      (t
       (setq good t)
       ((lambda (Var i j)
          (loop
            (cond
              ((or (> i Var) (not good)) (return nil))
              (t (setq good (equal (elt prefix i) (elt whole j)))))
            (setq i (+ i 1))
            (setq j (+ j 1))))
        (- (length prefix) 1) 0 start)
       good))))
```

—————

5.3.156 defun incCommandTail

[incDrop p101]

— defun incCommandTail —

```
(defun |incCommandTail| (s info)
  (let ((start (elt info 1)))
    (when (= start 0) (setq start 1))
    (|incDrop| (+ start (length (elt info 2)) 1) s)))
```

—————

5.3.157 defun incDrop

[substring p??]

— defun incDrop 0 —

```
(defun |incDrop| (n b)
  (if (>= n (length b))
      '||
      (substring b n nil)))
```

5.3.158 defun inclFname

```
[incFileName p620]
[incCommandTail p101]
```

— defun inclFname —

```
(defun |inclFname| (s info)
  (|incFileName| (|incCommandTail| s info)))
```

5.3.159 defun incFileInput

```
[incRgen p103]
[make-instream p979]
```

— defun incFileInput —

```
(defun |incFileInput| (fn)
  (|incRgen| (make-instream fn)))
```

5.3.160 defun incConsoleInput

```
[incRgen p103]
[make-instream p979]
```

— defun incConsoleInput —

```
(defun |incConsoleInput| ()
  (|incRgen| (make-instream 0)))
```

5.3.161 defun incNConsoles

[incNConsoles p103]

— defun incNConsoles —

```
(defun |incNConsoles| (ufos)
  (let ((a (member "console" ufos)))
    (if a
        (+ 1 (|incNConsoles| (cdr a)))
        0)))
```

5.3.162 defun incActive?

— defun incActive? 0 —

```
(defun |incActive?| (fn ufos)
  (member fn ufos))
```

5.3.163 defun incRgen

Note that incRgen1 recursively calls this function. [Delay p103]
[incRgen1 p104]

— defun incRgen —

```
(defun |incRgen| (s)
  (|Delay| #'|incRgen1| (list s)))
```

5.3.164 defun Delay

— defun Delay 0 —

```
(defun |Delay| (f x)
  (cons 'nonnullstream (cons f x)))
```

5.3.165 `defvar $StreamNil`

— `initvars` —

```
(defvar |StreamNil| (list '|nullstream|))
```

5.3.166 `defvar $StreamNil`

— `postvars` —

```
(eval-when (eval load)
  (setq |StreamNil| (list '|nullstream|)))
```

5.3.167 `defun incRgen1`

This function reads a line from the stream and then conses it up with a recursive call to `incRgen`. Note that `incRgen` recursively wraps this function in a delay list. [`incRgen` p103] [`StreamNil` p104]

— `defun incRgen1` —

```
(defun |incRgen1| (&rest z)
  (let (a s)
    (declare (special |StreamNil|))
    (setq s (car z))
    (setq a (read-line s nil nil))
    (if (null a)
        (progn
          (close s)
          |StreamNil|)
        (cons a (|incRgen1| s)))))
```

Chapter 6

The Token Scanner

6.0.168 defvar \$SPACE

— postvars —

```
(eval-when (eval load)
  (defvar SPACE (qenum ' " " 0)))
```

—————

6.0.169 defvar \$ESCAPE

— postvars —

```
(eval-when (eval load)
  (defvar ESCAPE (qenum ' "_ " 0)))
```

—————

6.0.170 defvar \$STRINGCHAR

— postvars —

```
(eval-when (eval load)
  (defvar STRINGCHAR (qenum ' "\" " 0)))
```

6.0.171 defvar \$PLUSCOMMENT

— postvars —

```
(eval-when (eval load)
  (defvar PLUSCOMMENT (qenum '+' " 0)))
```

6.0.172 defvar \$MINUSCOMMENT

— postvars —

```
(eval-when (eval load)
  (defvar MINUSCOMMENT (qenum '-' " 0)))
```

6.0.173 defvar \$RADIXCHAR

— postvars —

```
(eval-when (eval load)
  (defvar RADIXCHAR (qenum 'r " 0)))
```

6.0.174 defvar \$DOT

— postvars —

```
(eval-when (eval load)
  (defvar DOT (qenum '.' " 0)))
```

6.0.175 defvar \$EXPONENT1

— postvars —

```
(eval-when (eval load)
  (defvar EXPONENT1 (qenum ' "E" 0)))
```

—————

6.0.176 defvar \$EXPONENT2

— postvars —

```
(eval-when (eval load)
  (defvar EXPONENT2 (qenum ' "e" 0)))
```

—————

6.0.177 defvar \$CLOSEPAREN

— postvars —

```
(eval-when (eval load)
  (defvar CLOSEPAREN (qenum ' " " 0)))
```

—————

6.0.178 defvar \$QUESTION

— postvars —

```
(eval-when (eval load)
  (defvar QUESTION (qenum ' "?" 0)))
```

—————

6.0.179 defvar \$scanKeyWords

— postvars —

```

(eval-when (eval load)
(defvar |scanKeyWords|
  (list
    (list "add" 'add)
    (list "and" 'and)
    (list "break" 'break)
    (list "by" 'by)
    (list "case" 'case)
    (list "default" 'default)
    (list "define" 'defn)
    (list "do" 'do)
    (list "else" 'else)
    (list "exit" 'exit)
    (list "export" 'export)
    (list "for" 'for)
    (list "free" 'free)
    (list "from" 'from)
    (list "has" 'has)
    (list "if" 'if)
    (list "import" 'import)
    (list "in" 'in)
    (list "inline" 'inline)
    (list "is" 'is)
    (list "isnt" 'isnt)
    (list "iterate" 'iterate)
    (list "local" '||local|)
    (list "macro" 'macro)
    (list "mod" 'mod)
    (list "or" 'or)
    (list "pretend" 'pretend)
    (list "quo" 'quo)
    (list "rem" 'rem)
    (list "repeat" 'repeat)
    (list "return" 'return)
    (list "rule" 'rule)
    (list "then" 'then)
    (list "where" 'where)
    (list "while" 'while)
    (list "with" 'with)
    (list "|" 'bar)
    (list "." 'dot)
    (list "::" 'coerce)
    (list ":" 'colon)
    (list ":-" 'colondash)
    (list "@" 'at)

```



```

(list "@@" 'atat)
(list "," 'comma)
(list ";" 'semicolon)
(list "***" 'power)
(list "*" 'times)
(list "+" 'plus)
(list "-" 'minus)
(list "<" 'lt)
(list ">" 'gt)
(list "<=" 'le)
(list ">=" 'ge)
(list "=" 'equal)
(list "~=" 'notequal)
(list "~" '~)
(list "^" 'carat)
(list ".." 'seg)
(list "#" '|#|)
(list "&" 'ampersand)
(list "$" '$)
(list "/" 'slash)
(list "\" 'backslash)
(list "//" 'slasheslash)
(list "\\\" 'backslashbackslash)
(list "/\" 'slashbackslash)
(list "\\\" 'backslashslash)
(list "=>" 'exit)
(list "!=" 'becomes)
(list "==" 'def)
(list "==" 'mdef)
(list "->" 'arrow)
(list "<-" 'larrow)
(list "+->" 'gives)
(list "(" '|(|)
(list ")" '|)|)
(list "(|" '|(|(|)
(list "|)" '|)|)|)
(list "[" '[])
(list "]" '])
(list "[_]" '[_])
(list "{" '{)
(list "}" '})
(list "{_}" '{})
(list "[|" '|[|(|)
(list "|]" '|]|(|)
(list "[_|]" '|[|]|(|)
(list "{|" '|{|(|)
(list "|}" '|}|(|)
(list "{_|}" '|{|]|(|)
(list "<<" 'oangle)
(list ">>" 'cangle)

```

```
(list "'" '|'|)
(list "``" 'backquote))))
```

—————

6.0.180 defvar \$infgeneric

— postvars —

```
(eval-when (eval load)
(prog ()
  (return
    ((lambda (var value)
      (loop
        (cond
          ((or (atom var) (progn (setq value (car var)) nil))
           (return nil))
          (t
           (setf (get (car value) 'infgeneric) (cadr value))))
        (setq var (cdr var))))))
(list
  (list 'equal '=)
  (list 'times '*)
  (list 'has '|has|)
  (list 'case '|case|)
  (list 'rem '|rem|)
  (list 'mod '|mod|)
  (list 'quo '|quo|)
  (list 'slash '/')
  (list 'backslash '\\|)
  (list 'slasheslash '//)
  (list 'backslashbackslash '\\\\\\|)
  (list 'slashbackslash '|/\\\\|)
  (list 'backslasheslash '\\\\\\|)
  (list 'power '**)
  (list 'carat '^)
  (list 'plus '+)
  (list 'minus '-')
  (list 'lt '<)
  (list 'gt '>)
  (list 'oangle '<<)
  (list 'cangle '>>)
  (list 'le '<=)
  (list 'ge '>=)
  (list 'notequal '~=)
  (list 'by '|by|)
  (list 'arrow '->))
```

```

(list 'larrow '<-)
(list 'bar '|\\|)
(list 'seg '|..|)
nil))))

```

6.0.181 defun lineoftoks

lineoftoks bites off a token-dq from a line-stream returning the token-dq and the rest of the line-stream

```

;lineoftoks(s)==
;  $f: local:=nil
;  $r:local :=nil
;  $ln:local :=nil
;  $linepos:local:=nil
;  $n:local:=nil
;  $sz:local := nil
;  $floatok:local:=true
;  if not nextline s
;  then CONS(nil,nil)
;  else
;    if null scanIgnoreLine($ln,$n) -- line of spaces or starts ) or >
;    then cons(nil,$r)
;    else
;      toks:=[]
;      a:= incPrefix?('command",1,$ln)
;      a =>
;          $ln:=SUBSTRING($ln,8,nil)
;          b:= dqUnit constoken($ln,$linepos,["command",$ln],0)
;          cons([ [b,s] ],$r)
;
;      while $n<$sz repeat toks:=dqAppend(toks,scanToken())
;      if null toks
;      then cons([],$r)
;      else cons([ [toks,s] ],$r)

```

```

[nextline p112]
[scanIgnoreLine p113]
[incPrefix? p100]
[substring p??]
[dqUnit p343]
[constoken p113]
[$floatok p??]
[$f p??]
[$sz p??]

```

```
[$linepos p??]
[$r p??]
[$n p??]
[$ln p??]
```

— defun lineoftoks —

```
(defun |lineoftoks| (s)
  (let (|$floatok| |$sz| |$n| |$linepos| |$ln| |$r| |$f| |b| |a| |toks|)
    (declare (special |$floatok| |$f| |$sz| |$linepos| |$r| |$n| |$ln|))
    (setq |$f| nil)
    (setq |$r| nil)
    (setq |$ln| nil)
    (setq |$linepos| nil)
    (setq |$n| nil)
    (setq |$sz| nil)
    (setq |$floatok| t)
    (cond
      ((null (|nextline| s)) (cons nil nil))
      ((null (|scanIgnoreLine| |$ln| |$n|)) (cons nil |$r|))
      (t
       (setq |toks| nil)
       (setq |a| (|incPrefix?| "command" 1 |$ln|))
       (cond
         (|a|
          (setq |$ln| (substring |$ln| 8 nil))
          (setq |b|
               (|dqUnit| (|constoken| |$ln| |$linepos| (list '|command| |$ln|) 0)))
          (cons (list (list |b| s)) |$r|))
         (t
          ((lambda ()
              (loop
                (cond
                  ((not (< |$n| |$sz|)) (return nil))
                  (t (setq |toks| (|dqAppend| |toks| (|scanToken|)))))))
              (cond
                ((null |toks|) (cons nil |$r|))
                (t (cons (list (list |toks| s)) |$r|))))))))))
```

—————

6.0.182 defun nextline

```
[npNull p333]
[|strposl| p1048]
[$sz p??]
[$n p??]
```

```
[$linepos p??]
[$ln p??]
[$r p??]
[$f p??]
```

— defun nextline —

```
(defun |nextline| (s)
  (declare (special |$sz| |$n| |$linepos| |$ln| |$r| |$f|))
  (cond
    ((|npNull| s) nil)
    (t
     (setq |$f| (car s))
     (setq |$r| (cdr s))
     (setq |$ln| (cdr |$f|))
     (setq |$linepos| (caar |$f|))
     (setq |$n| (strpos1 " " |$ln| 0 t)) ; spaces at beginning
     (setq |$sz| (length |$ln|))
     t))))
```

—————

6.0.183 defun scanIgnoreLine

```
[qenum p1048]
[incPrefix? p100]
```

— defun scanIgnoreLine —

```
(defun |scanIgnoreLine| (ln n)
  (cond
    ((null n) n)
    (t
     (cond
       ((equal (qenum ln 0) CLOSEPAREN)
        (cond
          ((|incPrefix?| "command" 1 ln) t)
          (t nil)))
       (t n))))))
```

—————

6.0.184 defun constoken

```
[ncPutQ p416]
```

— defun constoken —

```
(defun |constoken| (ln lp b n)
  (declare (ignore ln))
  (let (a)
    (setq a (cons (elt b 0) (elt b 1)))
    (|ncPutQ| a '|posn| (cons lp n))
    a))
```

—————

6.0.185 defun scanToken

```
[qenum p1048]
[startsComment? p115]
[scanComment p116]
[startsNegComment? p117]
[scanNegComment p117]
[lfid p115]
[punctuation? p118]
[scanPunct p118]
[startsId? p1046]
[scanWord p126]
[scanSpace p129]
[scanString p130]
[digit? p122]
[scanNumber p132]
[scanEscape p135]
[scanError p135]
[dqUnit p343]
[constoken p113]
[lnExtraBlanks p345]
[$linepos p??]
[$n p??]
[$ln p??]
```

— defun scanToken —

```
(defun |scanToken| ()
  (let (b ch n linepos c ln)
    (declare (special |$linepos| |$n| |$ln|))
    (setq ln |$ln|)
    (setq c (qenum |$ln| |$n|))
    (setq linepos |$linepos|)
    (setq n |$n|)
    (setq ch (elt |$ln| |$n|))
```

```

(setq b
  (cond
    ((|startsComment?) (|scanComment|) nil)
    ((|startsNegComment?) (|scanNegComment|) nil)
    ((equal c QUESTION)
      (setq |$n| (+ |$n| 1))
      (|lfid| "?"))
    ((|punctuation?| c) (|scanPunct|))
    ((|startsId?| ch) (|scanWord| nil))
    ((equal c SPACE) (|scanSpace|) nil)
    ((equal c STRINGCHAR) (|scanString|))
    ((|digit?| ch) (|scanNumber|))
    ((equal c ESCAPE) (|scanEscape|))
    (t (|scanError|))))
(cond
  ((null b) nil)
  (t
    (|dqUnit|
      (|constoken| ln linepos b (+ n (|lnExtraBlanks| linepos)))))))

```

6.0.186 defun lfid

To pair badge and badgee

— defun lfid 0 —

```

(defun |lfid| (x)
  (list '|id| (intern x "BOOT")))

```

6.0.187 defun startsComment?

[qenum p1048]

[\$ln p??]

[\$sz p??]

[\$n p??]

— defun startsComment? —

```

(defun |startsComment?| ()
  (let (www)
    (declare (special |$ln| |$sz| |$n|))
    (cond

```

```

((< |$n| |$sz|)
 (cond
  ((equal (qenum |$ln| |$n|) PLUSCOMMENT)
   (setq www (+ |$n| 1))
   (cond
    ((not (< www |$sz|)) nil)
    (t (equal (qenum |$ln| www) PLUSCOMMENT))))
  (t nil)))
(t nil)))

```

6.0.188 defun scanComment

```

[lfcomment p116]
[substring p??]
[$ln p??]
[$sz p??]
[$n p??]

```

— defun scanComment —

```

(defun |scanComment| ()
  (let (n)
    (declare (special |$ln| |$sz| |$n|))
    (setq n |$n|)
    (setq |$n| |$sz|)
    (|lfcomment| (substring |$ln| n nil))))

```

6.0.189 defun lfcomment

— defun lfcomment 0 —

```

(defun |lfcomment| (x)
  (list '|comment| x))

```

6.0.190 defun startsNegComment?

```
[qenum p1048]
[$ln p??]
[$sz p??]
[$n p??]
```

— defun startsNegComment? —

```
(defun |startsNegComment?| ()
  (let (www)
    (declare (special |$ln| |$sz| |$n|))
    (cond
      ((< |$n| |$sz|)
        (cond
          ((equal (qenum |$ln| |$n|) MINUSCOMMENT)
            (setq www (+ |$n| 1))
            (cond
              ((not (< www |$sz|)) nil)
              (t (equal (qenum |$ln| www) MINUSCOMMENT))))
          (t nil)))
      (t nil))))
```

—————

6.0.191 defun scanNegComment

```
[lfnegcomment p118]
[substring p??]
[$ln p??]
[$sz p??]
[$n p??]
```

— defun scanNegComment —

```
(defun |scanNegComment| ()
  (let (n)
    (declare (special |$ln| |$sz| |$n|))
    (setq n |$n|)
    (setq |$n| |$sz|)
    (|lfnegcomment| (substring |$ln| n nil))))
```

—————

6.0.192 defun lfnegcomment

— defun lfnegcomment 0 —

```
(defun |lfnegcomment| (x)
  (list '|negcomment| x))
```

—————

6.0.193 defun punctuation?

— defun punctuation? —

```
(defun |punctuation?| (c)
  (eq1 (elt |scanPun| c) 1))
```

—————

6.0.194 defun scanPunct

```
[subMatch p119]
[scanError p135]
[scanKeyTr p120]
[$n p??]
[$ln p??]
```

— defun scanPunct —

```
(defun |scanPunct| ()
  (let (a sss)
    (declare (special |$n| |$ln|))
    (setq sss (|subMatch| |$ln| |$n|))
    (setq a (length sss))
    (cond
      ((eq1 a 0) (|scanError|))
      (t (setq |$n| (+ |$n| a)) (|scanKeyTr| sss)))))
```

—————

6.0.195 defun subMatch

[substringMatch p119]

— defun subMatch —

```
(defun |subMatch| (a b)
  (|substringMatch| a |scanDict| b))
```

—————

6.0.196 defun substringMatch

```
;substringMatch (l,d,i)==
;      h:= QENUM(l, i)
;      u:=ELT(d,h)
;      ll:=SIZE l
;      done:=false
;      s1:=""
;      for j in 0.. SIZE u - 1 while not done repeat
;        s:=ELT(u,j)
;        ls:=SIZE s
;        done:=if ls+i > ll
;              then false
;              else
;                eql:= true
;                for k in 1..ls-1 while eql repeat
;                  eql:= EQL(QENUM(s,k),QENUM(l,k+i))
;                if eql
;                then
;                  s1:=s
;                  true
;                else false
;      s1
```

[qenum p1048]

[size p1047]

— defun substringMatch —

```
(defun |substringMatch| (l dict i)
  (let (eql ls s s1 done ll u h)
    (setq h (qenum l i))
    (setq u (elt dict h))
    (setq ll (size l))
    (setq s1 "")
    ((lambda (Var4 j)
```

```

(loop
  (cond
    ((or (> j Var4) done) (return nil))
    (t
     (setq s (elt u j))
     (setq ls (size s))
     (setq done
      (cond
        ((< ll (+ ls i)) nil)
        (t
         (setq eql t)
         ((lambda (Var5 k)
            (loop
              (cond
                ((or (> k Var5) (not eql)) (return nil))
                (t
                 (setq eql (eql (qenum s k) (qenum l (+ k i))))
                 (setq k (+ k 1))))
              (- ls 1) 1)
          (cond (eql (setq s1 s) t) (t nil)))))))
     (setq j (+ j 1))))
  (- (size u) 1) 0)
s1))

```

6.0.197 defun scanKeyTr

```

[keyword p121]
[scanPossFloat p121]
[lfkey p122]
[scanCloser? p125]
[$floatok p??]

```

— defun scanKeyTr —

```

(defun |scanKeyTr| (w)
  (declare (special |$floatok|))
  (cond
    ((eq (|keyword| w) 'dot)
     (cond
       (|$floatok| (|scanPossFloat| w))
       (t (|lfkey| w))))
    (t (setq |$floatok| (null (|scanCloser?| w)) (|lfkey| w))))

```

6.0.198 defun keyword

[hget p1046]

— defun keyword 0 —

```
(defun |keyword| (st)
  (hget |scanKeyTable| st))
```

6.0.199 defun keyword?

[hget p1046]

— defun keyword? 0 —

```
(defun |keyword?| (st)
  (null (null (hget |scanKeyTable| st))))
```

6.0.200 defun scanPossFloat

```
[digit? p122]
[lfkey p122]
[spleI p122]
[scanExponent p126]
[$ln p??]
[$sz p??]
[$n p??]
```

— defun scanPossFloat —

```
(defun |scanPossFloat| (w)
  (declare (special |$ln| |$sz| |$n|))
  (cond
    ((or (not (< |$n| |$sz|)) (null (|digit?| (elt |$ln| |$n|)))))
    (|lfkey| w))
  (t
    (setq w (|spleI| #'|digit?|)) (|scanExponent| "0" w))))
```

6.0.201 defun digit?

[digitp p1047]

— defun digit? —

```
(defun |digit?| (x)
  (digitp x))
```

—————

6.0.202 defun lfkey

[keyword p121]

— defun lfkey —

```
(defun |lfkey| (x)
  (list '|key| (|keyword| x)))
```

—————

6.0.203 defun spleI

[spleI1 p122]

— defun spleI —

```
(defun |spleI| (dig)
  (|spleI1| dig nil))
```

—————

6.0.204 defun spleI1

```
[qenum p1048]
[substring p??]
[scanEsc p123]
[spleI1 p122]
[concat p1049]
[$ln p??]
[$sz p??]
```

`[$n p??]`

— defun spleI1 —

```
(defun |spleI1| (dig zro)
  (let (bb a str l n)
    (declare (special |$ln| |$sz| |$n|))
    (setq n |$n|)
    (setq l |$sz|)
    ; while $n<l and FUNCALL(dig,($ln.$n)) repeat $n:=$n+1
    ((lambda ()
      (loop
        (cond
          ((not (and (< |$n| l) (funcall dig (elt |$ln| |$n|))))
            (return nil))
          (t
            (setq |$n| (+ |$n| 1)))))))
    (cond
      ((or (equal |$n| l) (not (equal (qenum |$ln| |$n|) ESCAPE)))
        (cond
          ((and (equal n |$n|) zro) "0")
          (t (substring |$ln| n (- |$n| n)))))
      (t
        ; escaped
        (setq str (substring |$ln| n (- |$n| n)))
        (setq |$n| (+ |$n| 1))
        (setq a (|scanEsc|))
        (setq bb (|spleI1| dig zro)) ; escape, any number of spaces are ignored
        (concat str bb)))))
```

—————

6.0.205 defun scanEsc

```
;scanEsc()==
;   if $n>=$sz
;   then if nextline($r)
;       then
;           while null $n repeat nextline($r)
;           scanEsc()
;       false
;   else false
;   else
;       n1:=STRPOSL(' "',$ln,$n,true)
;       if null n1
;       then if nextline($r)
;           then
;               while null $n repeat nextline($r)
;               scanEsc()
```

```

;           false
;         else false
;       else
;         if $n=n1
;         then true
;         else if QENUM($ln,n1)=ESCAPE
;           then
;             $n:=n1+1
;             scanEsc()
;             false
;         else
;           $n:=n1
;           startsNegComment?() or startsComment?() =>
;             nextline($r)
;             scanEsc()
;             false
;         false
;

```

```

[nextline p112]
[scanEsc p123]
[strposl p1048]
[qenum p1048]
[startsNegComment? p117]
[startsComment? p115]
[$ln p??]
[$r p??]
[$sz p??]
[$n p??]

```

— defun scanEsc —

```

(defun |scanEsc| ()
  (let (n1)
    (declare (special |$ln| |$r| |$sz| |$n|))
    (cond
      ((not (< |$n| |$sz|))
        (cond
          ((|nextline| |$r|)
            ((lambda ()
              (loop
                (cond
                  (|$n| (return nil))
                  (t (|nextline| |$r|))))))
            (|scanEsc|)
            nil)
          (t nil)))
      (t
        (setq n1 (strposl " " |$ln| |$n| t))
        (cond

```



```

((null n1)
 (cond
  ((|nextline| |$r|)
   ((lambda ()
    (loop
     (cond
      (|$n| (return nil))
      (t (|nextline| |$r|))))))
   (|scanEsc|)
   nil)
  (t nil)))
((equal |$n| n1) t)
((equal (qenum |$ln| n1) ESCAPE)
 (setq |$n| (+ n1 1))
 (|scanEsc|)
 nil)
(t (setq |$n| n1)
 (cond
  ((or (|startsNegComment?|) (|startsComment?|))
   (progn
    (|nextline| |$r|)
    (|scanEsc|)
    nil))
  (t nil))))))

```

6.0.206 defvar \$scanCloser

— postvars —

```

(eval-when (eval load)
 (defvar |scanCloser| (list ')| '}' ']' '\|'| '\|}| '\|]|)))

```

6.0.207 defun scanCloser?

[keyword p121]
[scanCloser p125]

— defun scanCloser? 0 —

```

(defun |scanCloser?| (w)

```

```
(declare (special |scanCloser|))
(member (|keyword| w) |scanCloser|))
```

6.0.208 defun scanWord

```
[scanW p128]
[lfid p115]
[keyword? p121]
[lfkey p122]
[$floatok p??]
```

— defun scanWord —

```
(defun |scanWord| (esp)
  (let (w aaa)
    (declare (special |$floatok|))
    (setq aaa (|scanW| nil))
    (setq w (elt aaa 1))
    (setq |$floatok| nil)
    (cond
      ((or esp (elt aaa 0))
       (|lfid| w))
      ((|keyword?| w)
       (setq |$floatok| t)
       (|lfkey| w))
      (t
       (|lfid| w))))))
```

6.0.209 defun scanExponent

```
[lffloat p127]
[qenum p1048]
[digit? p122]
[spleI p122]
[concat p1049]
[$ln p??]
[$sz p??]
[$n p??]
```

— defun scanExponent —

```

(defun |scanExponent| (a w)
  (let (c1 e c n)
    (declare (special |$ln| |$sz| |$n|))
    (cond
      ((not (< |$n| |$sz|)) (|lffloat| a w "0"))
      (t
       (setq n |$n|)
       (setq c (qenum |$ln| |$n|))
       (cond
         ((or (equal c EXPONENT1) (equal c EXPONENT2))
          (setq |$n| (+ |$n| 1))
          (cond
            ((not (< |$n| |$sz|))
             (setq |$n| n)
             (|lffloat| a w "0"))
            ((|digit?| (elt |$ln| |$n|))
             (setq e (|spleI| #'|digit?|))
             (|lffloat| a w e))
            (t
             (setq c1 (qenum |$ln| |$n|))
             (cond
               ((or (equal c1 PLUSCOMMENT) (equal c1 MINUSCOMMENT))
                (setq |$n| (+ |$n| 1))
                (cond
                  ((not (< |$n| |$sz|))
                   (setq |$n| n)
                   (|lffloat| a w "0"))
                  ((|digit?| (elt |$ln| |$n|))
                   (setq e (|spleI| #'|digit?|))
                   (|lffloat| a w
                     (cond
                       ((equal c1 MINUSCOMMENT)
                        (concat "-" e))
                       (t e))))
                  (t
                   (setq |$n| n)
                   (|lffloat| a w "0"))))))))
             (t (|lffloat| a w "0"))))))))

```

6.0.210 defun lffloat

[concat p1049]

— defun lffloat 0 —

```

(defun |lffloat| (a w e)

```

```
(list '|float| (concat a "." w "e" e)))
```

6.0.211 defmacro idChar?

— defmacro idChar? 0 —

```
(defmacro |idChar?| (x)
  '(or (alphanumericp ,x) (member ,x '(#\? #\% #\' #\!) :test #'char=)))
```

6.0.212 defun scanW

```
[posend p129]
[qenum p1048]
[substring p??]
[scanEsc p123]
[scanW p128]
[idChar? p128]
[concat p1049]
[$ln p??]
[$sz p??]
[$n p??]
```

— defun scanW —

```
(defun |scanW| (b)
  (let (bb a str endid l n1)
    (declare (special |$ln| |$sz| |$n|))
    (setq n1 |$n|)
    (setq |$n| (+ |$n| 1))
    (setq l |$sz|)
    (setq endid (|posend| |$ln| |$n|))
    (cond
      ((or (equal endid l) (not (equal (qenum |$ln| endid) ESCAPE)))
       (setq |$n| endid)
       (list b (substring |$ln| n1 (- endid n1))))
      (t
       (setq str (substring |$ln| n1 (- endid n1)))
       (setq |$n| (+ endid 1))
       (setq a (|scanEsc|))
```

```
(setq bb
  (cond
    (a (|scanW| t))
    ((not (< |$n| |$sz|)) (list b ""))
    ((|idChar?| (elt |$ln| |$n|)) (|scanW| b))
    (t (list b ""))))
(list (or (elt bb 0) b) (concat str (elt bb 1))))))
```

6.0.213 defun posend

```
;posend(line,n)==
;   while n<#line and idChar? line.n repeat n:=n+1
;   n
```

NOTE: do not replace “lyne” with “line”

— defun posend —

```
(defun |posend| (lyne n)
  ((lambda ()
    (loop
      (cond
        ((not (and (< n (length lyne)) (|idChar?| (elt lyne n))))
         (return nil))
        (t (setq n (+ n 1)))))))
  n)
```

6.0.214 defun scanSpace

```
[strposl p1048]
[lfspaces p130]
[$floatok p??]
[$ln p??]
[$n p??]
```

— defun scanSpace —

```
(defun |scanSpace| ()
  (let (n)
    (declare (special |$floatok| |$ln| |$n|))
    (setq n |$n|)
    (setq |$n| (strposl " " |$ln| |$n| t))
```

```
(when (null |$n|) (setq |$n| (length |$ln|)))
(setq |$floatok| t)
(|lfspaces| (- |$n| n))))
```

6.0.215 defun lfspaces

```
— defun lfspaces 0 —

(defun |lfspaces| (x)
  (list '|spaces| x))
```

6.0.216 defun scanString

```
[lfstring p130]
[scanS p131]
[$floatok p??]
[$n p??]

— defun scanString —

(defun |scanString| ()
  (declare (special |$floatok| |$n|))
  (setq |$n| (+ |$n| 1))
  (setq |$floatok| nil)
  (|lfstring| (|scanS|)))
```

6.0.217 defun lfstring

```
— defun lfstring 0 —

(defun |lfstring| (x)
  (if (eql (length x) 1)
      (list '|char| x)
      (list '|string| x)))
```

6.0.218 defun scanS

```
[ncSoftError p351]
[lnExtraBlanks p345]
[strpos p1047]
[substring p??]
[scanEsc p123]
[concat p1049]
[scanTransform p132]
[scanS p131]
[$ln p??]
[$linepos p??]
[$sz p??]
[$n p??]
```

— defun scanS —

```
(defun |scanS| ()
  (let (b a str mn escsym strsym n)
    (declare (special |$ln| |$linepos| |$sz| |$n|))
    (cond
      ((not (< |$n| |$sz|))
        (|ncSoftError|
          (cons |$linepos| (+ (|lnExtraBlanks| |$linepos|) |$n|)) 'S2CN0001 nil) ""))
      (t
        (setq n |$n|)
        (setq strsym (or (strpos "\" |$ln| |$n| nil) |$sz|))
        (setq escsym (or (strpos "_" |$ln| |$n| nil) |$sz|))
        (setq mn (min strsym escsym))
        (cond
          ((equal mn |$sz|)
            (setq |$n| |$sz|)
            (|ncSoftError|
              (cons |$linepos| (+ (|lnExtraBlanks| |$linepos|) |$n|)) 'S2CN0001 nil)
            (substring |$ln| n nil))
          ((equal mn strsym)
            (setq |$n| (+ mn 1))
            (substring |$ln| n (- mn n)))
          (t
            (setq str (substring |$ln| n (- mn n)))
            (setq |$n| (+ mn 1))
            (setq a (|scanEsc|))
            (setq b
              (cond
                (a
                  (setq str (concat str (|scanTransform| (elt |$ln| |$n|))))
                  (setq |$n| (+ |$n| 1)) (|scanS|))
                (t (|scanS|))))
              (concat str b)))))))
```

6.0.219 defun scanTransform

— defun scanTransform —

```
(defun |scanTransform| (x) x)
```

6.0.220 defun scanNumber

```
[spleI p122]
[lfinteger p133]
[qenum p1048]
[spleI1 p122]
[scanExponent p126]
[scanCheckRadix p134]
[lfrinteger p134]
[concat p1049]
[$floatok p??]
[$ln p??]
[$sz p??]
[$n p??]
```

— defun scanNumber —

```
(defun |scanNumber| ()
  (let (v w n a)
    (declare (special |$floatok| |$ln| |$sz| |$n|))
    (setq a (|spleI| #'|digit?|))
    (cond
      ((not (< |$n| |$sz|))
       (|lfinteger| a))
      ((not (equal (qenum |$ln| |$n|) RADIXCHAR))
       (cond
         ((and |$floatok| (equal (qenum |$ln| |$n|) DOT))
          (setq n |$n|)
          (setq |$n| (+ |$n| 1))
          (cond
            ((and (< |$n| |$sz|) (equal (qenum |$ln| |$n|) DOT))
             (setq |$n| n))
```



```

(|lfinteger| a))
(t
  (setq w (|spleI1| #'|digit?| t))
  (|scanExponent| a w)))
(t (|lfinteger| a)))
(t
  (setq |$n| (+ |$n| 1))
  (setq w (|spleI1| #'|rdigit?| t))
  (|scanCheckRadix| (parse-integer a) w)
  (cond
    ((not (< |$n| |$sz|))
     (|lfrinteger| a w))
    ((equal (qenum |$ln| |$n|) DOT)
     (setq n |$n|)
     (setq |$n| (+ |$n| 1))
     (cond
       ((and (< |$n| |$sz|) (equal (qenum |$ln| |$n|) DOT))
        (setq |$n| n)
        (|lfrinteger| a w))
       (t
        (setq v (|spleI1| #'|rdigit?| t))
        (|scanCheckRadix| (parse-integer a) v)
        (|scanExponent| (concat a "r" w) v))))
    (t (|lfrinteger| a w))))))

```

6.0.221 defun rdigit?

[strpos p1047]

— defun rdigit? 0 —

```

(defun |rdigit?| (x)
  (strpos x "0123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ" 0 nil))

```

6.0.222 defun lfinteger

— defun lfinteger 0 —

```

(defun |lfinteger| (x)
  (list '|integer| x))

```

6.0.223 defun lfrinteger

[concat p1049]

— defun lfrinteger 0 —

```
(defun |lfrinteger| (r x)
  (list '|integer| (concat r (concat "r" x))))
```

6.0.224 defun scanCheckRadix

```
;scanCheckRadix(r,w)==
;      ns:=#w
;      done:=false
;      for i in 0..ns-1 repeat
;        a:=rdigit? w.i
;        if null a or a>=r
;          then ncSoftError(cons($linepos,lnExtraBlanks $linepos+$n-ns+i),
;                                "S2CN0002", [w.i])
```

```
[$n p??]
[$linepos p??]
```

— defun scanCheckRadix —

```
(defun |scanCheckRadix| (r w)
  (let (a ns)
    (declare (special |$n| |$linepos|))
    (setq ns (length w))
    ((lambda (Var1 i)
      (loop
        (cond
          ((> i Var1) (return nil))
          (t
           (setq a (|rdigit?| (elt w i)))
           (cond
             ((or (null a) (not (< a r)))
              (|ncSoftError|
               (cons |$linepos| (+ (- (+ (|lnExtraBlanks| |$linepos|) |$n|) ns) i))
               'S2CN0002 (list (elt w i)))))))
        (setq i (+ i 1))))
    (- ns 1) 0)))
```

6.0.225 defun scanEscape

```
[scanEsc p123]
[scanWord p126]
[$n p??]
```

— defun scanEscape —

```
(defun |scanEscape| ()
  (declare (special |$n|))
  (setq |$n| (+ |$n| 1))
  (when (|scanEsc|) (|scanWord| t)))
```

6.0.226 defun scanError

```
[ncSoftError p351]
[lnExtraBlanks p345]
[lferror p135]
[$ln p??]
[$linepos p??]
[$n p??]
```

— defun scanError —

```
(defun |scanError| ()
  (let (n)
    (declare (special |$ln| |$linepos| |$n|))
    (setq n |$n|)
    (setq |$n| (+ |$n| 1))
    (|ncSoftError|
     (cons |$linepos| (+ (|lnExtraBlanks| |$linepos|) |$n|))
     'S2CN0003 (list (elt |$ln| n)))
    (|lferror| (elt |$ln| n))))
```

6.0.227 defun lferror

— defun lferror 0 —

```
(defun |lferror| (x)
  (list '|error| x))
```

6.0.228 defvar \$scanKeyTable

— postvars —

```
(eval-when (eval load)
  (defvar |scanKeyTable| (|scanKeyTableCons|)))
```

6.0.229 defun scanKeyTableCons

This function is used to build the scanKeyTable

```
;scanKeyTableCons()==
;  KeyTable:=MAKE_-HASHTABLE("CVEC",true)
;  for st in scanKeyWords repeat
;    HPUT(KeyTable,CAR st,CADR st)
;  KeyTable
```

— defun scanKeyTableCons —

```
(defun |scanKeyTableCons| ()
  (let (KeyTable)
    (setq KeyTable (make-hash-table :test #'equal))
    ((lambda (Var6 st)
      (loop
        (cond
          ((or (atom Var6) (progn (setq st (car Var6)) nil))
            (return nil))
          (t
            (hput KeyTable (car st) (cadr st))))
        (setq Var6 (cdr Var6))))
      |scanKeyWords| nil)
    KeyTable))
```

6.0.230 defvar \$scanDict

— postvars —

```
(eval-when (eval load)
  (defvar |scanDict| (|scanDictCons|)))
```

—————

6.0.231 defun scanDictCons

```
;scanDictCons()==
;      l:= HKEYS scanKeyTable
;      d :=
;          a:=MAKE_-VEC(256)
;          b:=MAKE_-VEC(1)
;          VEC_-SETELT(b,0,MAKE_-CVEC 0)
;          for i in 0..255 repeat VEC_-SETELT(a,i,b)
;          a
;      for s in l repeat scanInsert(s,d)
;      d
```

[hkeys p1046]

— defun scanDictCons —

```
(defun |scanDictCons| ()
  (let (d b a l)
    (setq l (hkeys |scanKeyTable|))
    (setq d
      (progn
        (setq a (make-array 256))
        (setq b (make-array 1))
        (setf (svref b 0)
          (make-array 0 :fill-pointer 0 :element-type 'string-char))
        ((lambda (i)
          (loop
            (cond
              ((> i 255) (return nil))
              (t (setf (svref a i) b)))
            (setq i (+ i 1))))
          0)
        a))
    ((lambda (Var7 s)
      (loop
        (cond
```

```

      ((or (atom Var7) (progn (setq s (car Var7)) nil))
       (return nil))
      (t (|scanInsert| s d)))
      (setq Var7 (cdr Var7))))
  1 nil)
d))

```

6.0.232 defun scanInsert

```

;scanInsert(s,d) ==
;   l := #s
;   h := QENUM(s,0)
;   u := ELT(d,h)
;   n := #u
;   k:=0
;   while l <= #(ELT(u,k)) repeat
;     k:=k+1
;   v := MAKE_-VEC(n+1)
;   for i in 0..k-1 repeat VEC_-SETELT(v,i,ELT(u,i))
;   VEC_-SETELT(v,k,s)
;   for i in k..n-1 repeat VEC_-SETELT(v,i+1,ELT(u,i))
;   VEC_-SETELT(d,h,v)
;   s

```

[qenum p1048]

— defun scanInsert —

```

(defun |scanInsert| (s d)
  (let (v k n u h l)
    (setq l (length s))
    (setq h (qenum s 0))
    (setq u (elt d h))
    (setq n (length u))
    (setq k 0)
    ((lambda ()
      (loop
        (cond
          ((< (length (elt u k)) l) (return nil))
          (t (setq k (+ k 1))))))
      (setq v (make-array (+ n 1)))
      ((lambda (Var2 i)
        (loop
          (cond
            ((> i Var2) (return nil))

```

```

      (t (setf (svref v i) (elt u i))))
    (setq i (+ i 1))))
  (- k 1) 0)
(setf (svref v k) s)
((lambda (Var3 i)
  (loop
    (cond
      ((> i Var3) (return nil))
      (t (setf (svref v (+ i 1)) (elt u i))))
    (setq i (+ i 1))))
  (- n 1) k)
(setf (svref d h) v)
s))

```

6.0.233 defvar \$scanPun

— postvars —

```

(eval-when (eval load)
  (defvar |scanPun| (|scanPunCons|)))

```

6.0.234 defun scanPunCons

```

;scanPunCons()==
;   listing := HKEYS scanKeyTable
;   a:=MAKE_-BVEC 256
;   for i in 0..255 repeat BVEC_-SETELT(a,i,0)
;   for k in listing repeat
;     if not startsId? k.0
;     then BVEC_-SETELT(a,QENUM(k,0),1)
;   a

```

[hkeys p1046]

— defun scanPunCons —

```

(defun |scanPunCons| ()
  (let (a listing)
    (setq listing (hkeys |scanKeyTable|))
    (setq a (make-array (list 256) :element-type 'bit :initial-element 0))

```

```
((lambda (i)
  (loop
    (cond
      ((> i 255) (return nil))
      (t (setf (sbit a i) 0)))
    (setq i (+ i 1))))
  0)
(lambda (Var8 k)
  (loop
    (cond
      ((or (atom Var8) (progn (setq k (car Var8)) nil))
        (return nil))
      (t
        (cond
          ((null (|startsId?| (elt k 0)))
            (setf (sbit a (qenum k 0)) 1))))
        (setq Var8 (cdr Var8))))
    listing nil)
  a))
```

Chapter 7

Input Stream Parser

7.0.235 defun Input Stream Parser

```
[trappoint p??]  
[npFirstTok p143]  
[npItem p142]  
[ncSoftError p351]  
[tokPosn p413]  
[pfWrong p296]  
[pfDocument p246]  
[pfListOf p245]  
[$ttok p??]  
[$stok p??]  
[$stack p??]  
[$inputStream p??]
```

— defun npParse —

```
(defun |npParse| (stream)  
  (let (|$ttok| |$stok| |$stack| |$inputStream| found)  
    (declare (special |$ttok| |$stack| |$inputStream| |$stok|))  
    (setq |$inputStream| stream)  
    (setq |$stack| nil)  
    (setq |$stok| nil)  
    (setq |$ttok| nil)  
    (|npFirstTok|)  
    (setq found (catch 'trappoint (|npItem|)))  
    (cond  
      ((eq found 'trapped)  
       (|ncSoftError| (|tokPosn| |$stok|) 's2cy0006 nil)  
       (|pfWrong| (|pfDocument| "top level syntax error") (|pfListOf| nil)))  
      ((null (null |$inputStream|))
```

```

(|ncSoftError| (|tokPosn| |$stok|) 's2cy0002 nil)
(|pfWrong|
  (|pfDocument| (list "input stream not exhausted"))
  (|pfListOf| nil)))
((null |$stack|)
  (|ncSoftError| (|tokPosn| |$stok|) 's2cy0009 nil)
  (|pfWrong| (|pfDocument| (list "stack empty")) (|pfListOf| nil)))
(t (car |$stack|))))

```

7.0.236 defun npItem

```

[npQualDef p145]
[npEqKey p145]
[npItem1 p142]
[npPop1 p144]
[pfEnSequence p263]
[npPush p143]
[pfNovalue p279]

```

— defun npItem —

```

(defun |npItem| ()
  (let (c b a tmp1)
    (when (|npQualDef|)
      (if (|npEqKey| 'semicolon)
        (progn
          (setq tmp1 (|npItem1| (|npPop1|)))
          (setq a (car tmp1))
          (setq b (cadr tmp1))
          (setq c (|pfEnSequence| b))
          (if a
            (|npPush| c)
            (|npPush| (|pfNovalue| c))))
        (|npPush| (|pfEnSequence| (|npPop1|)))))))

```

7.0.237 defun npItem1

```

[npQualDef p145]
[npEqKey p145]
[npItem1 p142]
[npPop1 p144]

```

— defun npItem1 —

```
(defun |npItem1| (c)
  (let (b a tmp1)
    (if (|npQualDef|)
      (if (|npEqKey| 'semicolon)
        (progn
          (setq tmp1 (|npItem1| (|npPop1|)))
          (setq a (car tmp1))
          (setq b (cadr tmp1))
          (list a (append c b)))
        (list t (append c (|npPop1|))))
      (list nil c))))
```

—————

7.0.238 defun npFirstTok

Sets the current leaf (\$tok) to the next leaf in the input stream. Sets the current token (\$ttok) cdr of the leaf. A leaf token looks like [head, token, position] where head is either an id or (id . alist) [tokConstruct p411]

```
[tokPosn p413]
[tokPart p413]
[$ttok p??]
[$tok p??]
[$inputStream p??]
```

— defun npFirstTok —

```
(defun |npFirstTok| ()
  (declare (special |$ttok| |$tok| |$inputStream|))
  (if (null |$inputStream|)
    (setq |$tok| (|tokConstruct| 'error 'nomore (|tokPosn| |$tok|)))
    (setq |$tok| (car |$inputStream|)))
  (setq |$ttok| (|tokPart| |$tok|)))
```

—————

7.0.239 defun Push one item onto \$stack

```
[$stack p??]
```

— defun npPush 0 —

```
(defun |npPush| (x)
  (declare (special |$stack|))
  (push x |$stack|))
```

7.0.240 defun Pop one item off \$stack

[\$stack p??]

— defun npPop1 0 —

```
(defun |npPop1| ()
  (declare (special |$stack|))
  (pop |$stack|))
```

7.0.241 defun Pop the second item off \$stack

[\$stack p??]

— defun npPop2 0 —

```
(defun |npPop2| ()
  (let (a)
    (declare (special |$stack|))
    (setq a (cadr |$stack|))
    (rplacd |$stack| (cddr |$stack|))
    a))
```

7.0.242 defun Pop the third item off \$stack

[\$stack p??]

— defun npPop3 0 —

```
(defun |npPop3| ()
  (let (a)
    (declare (special |$stack|))
    (setq a (caddr |$stack|))
```

```
(rplacd (cdr |$stack|) (cdddr |$stack|)) a))
```

7.0.243 defun npQualDef

```
[npComma p146]
[npPush p143]
[npPop1 p144]
```

— defun npQualDef —

```
(defun |npQualDef| ()
  (and (|npComma|) (|npPush| (list (|npPop1|)))))
```

7.0.244 defun Advance over a keyword

Test for the keyword, if found advance the token stream [npNext p145]

```
[$ttok p??]
[$stok p??]
```

— defun npEqKey —

```
(defun |npEqKey| (keyword)
  (declare (special |$ttok| |$stok|))
  (and
    (eq (caar |$stok|) '|key|)
    (eq keyword |$ttok|)
    (|npNext|)))
```

7.0.245 defun Advance the input stream

This advances the input stream. The call to npFirstTok picks off the next token in the input stream and updates the current leaf (\$stok) and the current token (\$ttok) [npFirstTok p143]

```
[$inputStream p??]
```

— defun npNext —

```
(defun |npNext| ()
  (declare (special |$inputStream|))
  (setq |$inputStream| (cdr |$inputStream|))
  (|npFirstTok|))
```

7.0.246 defun npComma

[npTuple p146]
[npQualifiedDefinition p147]

— defun npComma —

```
(defun |npComma| ()
  (|npTuple| #'|npQualifiedDefinition|))
```

7.0.247 defun npTuple

[npListofFun p221]
[npCommaBackSet p146]
[pfTupleListOf p292]

— defun npTuple —

```
(defun |npTuple| (|p|)
  (|npListofFun| |p| #'|npCommaBackSet| #'|pfTupleListOf|))
```

7.0.248 defun npCommaBackSet

[npEqKey p145]

— defun npCommaBackSet —

```
(defun |npCommaBackSet| ()
  (and
    (|npEqKey| 'comma)
    (or (|npEqKey| 'backset) t)))
```

7.0.249 defun npQualifiedDefinition

[npQualified p147]
[npDefinitionOrStatement p147]

— defun npQualifiedDefinition —

```
(defun |npQualifiedDefinition| ()
  (|npQualified| #'|npDefinitionOrStatement|))
```

7.0.250 defun npQualified

[npEqKey p145]
[npDefinition p167]
[npTrap p212]
[npPush p143]
[pfWhere p294]
[npPop1 p144]
[npLetQualified p166]

— defun npQualified —

```
(defun |npQualified| (f)
  (if (funcall f)
      (progn
        (do () ; while ... do
          ((not (and (|npEqKey| 'where) (or (|npDefinition|) (|npTrap|)))))
          (|npPush| (|pfWhere| (|npPop1|) (|npPop1|))))
        t)
      (|npLetQualified| f)))
```

7.0.251 defun npDefinitionOrStatement

[npBackTrack p148]
[npGives p148]
[npDef p187]

— defun npDefinitionOrStatement —

```
(defun |npDefinitionOrStatement| ()
  (|npBackTrack| #'|npGives| 'def #'|npDef|))
```

7.0.252 defun npBackTrack

```
[npState p212]
[npEqPeek p152]
[npRestore p152]
[npTrap p212]
```

— defun npBackTrack —

```
(defun |npBackTrack| (p1 p2 p3)
  (let (a)
    (setq a (|npState|))
    (when (apply p1 nil)
      (cond
        ((|npEqPeek| p2)
         (|npRestore| a)
         (or (apply p3 nil) (|npTrap|)))
        (t t)))))
```

7.0.253 defun npGives

```
[npBackTrack p148]
[npExit p215]
[npLambda p148]
```

— defun npGives —

```
(defun |npGives| ()
  (|npBackTrack| #'|npExit| 'gives #'|npLambda|))
```

7.0.254 defun npLambda

```
[npVariable p213]
[npLambda p148]
```


[npTrap p212]
 [npPush p143]
 [pfLam p272]
 [npPop2 p144]
 [npPop1 p144]
 [npEqKey p145]
 [npDefinitionOrStatement p147]
 [npType p149]
 [pfReturnTyped p285]

— defun npLambda —

```
(defun |npLambda| ()
  (or
    (and
      (|npVariable|)
      (or (|npLambda|) (|npTrap|))
      (|npPush| (|pfLam| (|npPop2|) (|npPop1|))))
    (and
      (|npEqKey| 'gives)
      (or (|npDefinitionOrStatement|) (|npTrap|)))
    (and
      (|npEqKey| 'colon)
      (or (|npType|) (|npTrap|))
      (|npEqKey| 'gives)
      (or (|npDefinitionOrStatement|) (|npTrap|))
      (|npPush| (|pfReturnTyped| (|npPop2|) (|npPop1|))))))
```

—————

7.0.255 defun npType

[npMatch p150]
 [npPop1 p144]
 [npWith p150]
 [npPush p143]

— defun npType —

```
(defun |npType| ()
  (and
    (|npMatch|)
    (let ((a (|npPop1|)))
      (or
        (|npWith| a)
        (|npPush| a))))
```

7.0.256 defun npMatch

[npLeftAssoc p206]
[npSuch p150]

— defun npMatch —

```
(defun |npMatch| ()
  (|npLeftAssoc| '(is isnt) #'|npSuch|))
```

7.0.257 defun npSuch

[npLeftAssoc p206]
[npLogical p197]

— defun npSuch —

```
(defun |npSuch| ()
  (|npLeftAssoc| '(bar) #'|npLogical|))
```

7.0.258 defun npWith

[npEqKey p145]
[npState p212]
[npCategoryL p152]
[npTrap p212]
[npEqPeek p152]
[npRestore p152]
[npVariable p213]
[npCompMissing p151]
[npPush p143]
[pfWith p296]
[npPop2 p144]
[npPop1 p144]
[pfNothing p245]

— defun npWith —

```
(defun |npWith| (extra)
  (let (a)
    (and
      (|npEqKey| 'with)
      (progn
        (setq a (|npState|))
        (or (|npCategoryL|) (|npTrap|))
        (if (|npEqPeek| 'in)
          (progn
            (|npRestore| a)
            (and
              (or (|npVariable|) (|npTrap|))
              (|npCompMissing| 'in)
              (or (|npCategoryL|) (|npTrap|))
              (|npPush| (|pfWith| (|npPop2|) (|npPop1|) extra))))
            (|npPush| (|pfWith| (|pfNothing|) (|npPop1|) extra)))))))
```

7.0.259 defun npCompMissing

[npEqKey p145]
[npMissing p151]

— defun npCompMissing —

```
(defun |npCompMissing| (s)
  (or (|npEqKey| s) (|npMissing| s)))
```

7.0.260 defun npMissing

[trappoint p??]
[ncSoftError p351]
[tokPosn p413]
[pname p1047]
[\$stok p??]

— defun npMissing —

```
(defun |npMissing| (s)
  (declare (special |$stok|))
  (|ncSoftError| (|tokPosn| |$stok|) 'S2CY0007 (list (pname s)))
  (throw 'trappoint 'trapped))
```

7.0.261 defun npRestore

[npFirstTok p143]
 [\$stack p??]
 [\$inputStream p??]

— defun npRestore —

```
(defun |npRestore| (x)
  (declare (special |$stack| |$inputStream|))
  (setq |$inputStream| (car x))
  (|npFirstTok|)
  (setq |$stack| (cdr x))
  t)
```

7.0.262 defun Peek for keyword s, no advance of token stream

[\$ttok p??]
 [\$stok p??]

— defun npEqPeek 0 —

```
(defun |npEqPeek| (s)
  (declare (special |$ttok| |$stok|))
  (and (eq (caar |$stok|) '|key|) (eq s |$ttok|)))
```

7.0.263 defun npCategoryL

[npCategory p153]
 [npPush p143]
 [pfUnSequence p293]
 [npPop1 p144]

— defun npCategoryL —

```
(defun |npCategoryL| ()
  (and
    (|npCategory|)
    (|npPush| (|pfUnSequence| (|npPop1|)))))
```

7.0.264 defun npCategory

[npPP p209]
[npSCategory p153]

— defun npCategory —

```
(defun |npCategory| ()
  (|npPP| #'|npSCategory|))
```

7.0.265 defun npSCategory

[npWConditional p195]
[npCategoryL p152]
[npPush p143]
[npPop1 p144]
[npDefaultValue p194]
[npState p212]
[npPrimary p157]
[npEqPeek p152]
[npRestore p152]
[npSignature p154]
[npApplication p162]
[pfAttribute p253]
[npTrap p212]

— defun npSCategory —

```
(defun |npSCategory| ()
  (let (a)
    (cond
      ((|npWConditional| #'|npCategoryL|) (|npPush| (list (|npPop1|)))))
      ((|npDefaultValue|) t)
      (t
       (setq a (|npState|))
```

```

(cond
  ((|npPrimary|)
    (cond
      ((|npEqPeek| 'colon) (|npRestore| a) (|npSignature|))
      (t
        (|npRestore| a)
        (or
          (and (|npApplication|) (|npPush| (list (|pfAttribute| (|npPop1|)))))
          (|npTrap|))))))
    (t nil))))))

```

7.0.266 defun npSignature

[npSigItemList p154]
 [npPush p143]
 [pfWDec p293]
 [pfNothing p245]
 [npPop1 p144]

— defun npSignature —

```

(defun |npSignature| ()
  (and (|npSigItemList|) (|npPush| (|pfWDec| (|pfNothing|) (|npPop1|)))))

```

7.0.267 defun npSigItemList

[npListing p155]
 [npSigItem p156]
 [npPush p143]
 [pfListOf p245]
 [pfAppend p255]
 [pfParts p249]
 [npPop1 p144]

— defun npSigItemList —

```

(defun |npSigItemList| ()
  (and
    (|npListing| #'|npSigItem|)
    (|npPush| (|pfListOf| (|pfAppend| (|pfParts| (|npPop1|)))))
  ))

```

7.0.268 defun npListing

```
[npList p155]
[pfListOf p245]
```

— defun npListing —

```
(defun |npListing| (p)
  (|npList| p 'comma #'|pfListOf|))
```

7.0.269 defun Always produces a list, fn is applied to it

```
[npEqKey p145]
[npTrap p212]
[npPush p143]
[npPop3 p144]
[npPop2 p144]
[npPop1 p144]
[$stack p??]
```

— defun npList —

```
(defun |npList| (f str1 fn)
  (let (a)
    (declare (special |$stack|))
    (cond
      ((apply f nil)
       (cond
         ((and (|npEqKey| str1)
              (or (|npEqKey| 'backset) t)
              (or (apply f nil) (|npTrap|))))
         (setq a |$stack|)
         (setq |$stack| nil)
         (do () ; while .. do nothing
              ((not
                (and (|npEqKey| str1)
                     (or (|npEqKey| 'backset) t)
                     (or (apply f nil) (|npTrap|))))
               nil))
         (setq |$stack| (cons (nreverse |$stack|) a))
         (|npPush| (funcall fn (cons (|npPop3|) (cons (|npPop2|) (|npPop1|))))))
      (t (|npPush| (funcall fn (list (|npPop1|))))))
```

```
(t (|npPush| (funcall fn nil))))))
```

7.0.270 defun npSigItem

```
[npTypeVariable p156]
[npSigDecl p157]
[npTrap p212]
```

— defun npSigItem —

```
(defun |npSigItem| ()
  (and (|npTypeVariable|) (or (|npSigDecl|) (|npTrap|))))
```

7.0.271 defun npTypeVariable

```
[npParenthesized p214]
[npTypeVariablelist p157]
[npSignatureDefinee p156]
[npPush p143]
[pfListOf p245]
[npPop1 p144]
```

— defun npTypeVariable —

```
(defun |npTypeVariable| ()
  (or
    (|npParenthesized| #'|npTypeVariablelist|)
    (and (|npSignatureDefinee|) (|npPush| (|pfListOf| (list (|npPop1|)))))))
```

7.0.272 defun npSignatureDefinee

```
[npName p204]
[npInfixOperator p160]
[npPrefixColon p161]
```

— defun npSignatureDefinee —


```
(defun |npSignatureDefinee| ()
  (or (|npName|) (|npInfixOperator|) (|npPrefixColon|)))
```

7.0.273 defun npTypeVariablelist

[npListing p155]
[npSignatureDefinee p156]

— defun npTypeVariablelist —

```
(defun |npTypeVariablelist| ()
  (|npListing| #'|npSignatureDefinee|))
```

7.0.274 defun npSigDecl

[npEqKey p145]
[npType p149]
[npTrap p212]
[npPush p143]
[pfSpread p239]
[pfParts p249]
[npPop2 p144]
[npPop1 p144]

— defun npSigDecl —

```
(defun |npSigDecl| ()
  (and
    (|npEqKey| 'colon)
    (or (|npType|) (|npTrap|))
    (|npPush| (|pfSpread| (|pfParts| (|npPop2|)) (|npPop1|)))))
```

7.0.275 defun npPrimary

[npPrimary1 p164]
[npPrimary2 p158]

— defun npPrimary —

```
(defun |npPrimary| ()
  (or (|npPrimary1|) (|npPrimary2|)))
```

—————

7.0.276 defun npPrimary2

```
[npEncAp p182]
[npAtom2 p159]
[npAdd p159]
[pfNothing p245]
[npWith p150]
```

— defun npPrimary2 —

```
(defun |npPrimary2| ()
  (or
    (|npEncAp| #'|npAtom2|)
    (|npAdd| (|pfNothing|))
    (|npWith| (|pfNothing|))))
```

—————

7.0.277 defun npADD

TPDHERE: Note that there is also an npAdd function [npType p149]

```
[npPop1 p144]
[npAdd p159]
[npPush p143]
```

— defun npADD —

```
(defun |npADD| ()
  (let (a)
    (and
      (|npType|)
      (progn
        (setq a (|npPop1|))
        (or
          (|npAdd| a)
          (|npPush| a))))))
```

7.0.278 defun npAdd

TPDHERE: Note that there is also an npADD function [npEqKey p145]

[npState p212]
 [npDefinitionOrStatement p147]
 [npTrap p212]
 [npEqPeek p152]
 [npRestore p152]
 [npVariable p213]
 [npCompMissing p151]
 [npDefinitionOrStatement p147]
 [npPush p143]
 [pfAdd p252]
 [npPop2 p144]
 [npPop1 p144]
 [pfNothing p245]

— defun npAdd —

```
(defun |npAdd| (extra)
  (let (a)
    (and
      (|npEqKey| 'add)
      (progn
        (setq a (|npState|))
        (or (|npDefinitionOrStatement|) (|npTrap|))
        (cond
          ((|npEqPeek| 'in)
            (progn
              (|npRestore| a)
              (and
                (or (|npVariable|) (|npTrap|))
                (|npCompMissing| 'in)
                (or (|npDefinitionOrStatement|) (|npTrap|))
                (|npPush| (|pfAdd| (|npPop2|) (|npPop1|) extra))))))
          (t
            (|npPush| (|pfAdd| (|pfNothing|) (|npPop1|) extra))))))))))
```

7.0.279 defun npAtom2

[npInfixOperator p160]
 [npAmpersand p204]

```
[npPrefixColon p161]
[npFromdom p202]
```

— defun npAtom2 —

```
(defun |npAtom2| ()
  (and
    (or (|npInfixOperator|) (|npAmpersand|) (|npPrefixColon|))
    (|npFromdom|)))
```

—————

7.0.280 defun npInfixOperator

```
[npInfixOp p161]
[npState p212]
[npEqKey p145]
[npInfixOp p161]
[npPush p143]
[pfSymb p251]
[npPop1 p144]
[tokPosn p413]
[npRestore p152]
[tokConstruct p411]
[tokPart p413]
[$stok p??]
```

— defun npInfixOperator —

```
(defun |npInfixOperator| ()
  (let (b a)
    (declare (special |$stok|))
    (or (|npInfixOp|)
      (progn
        (setq a (|npState|))
        (setq b |$stok|)
        (cond
          ((and (|npEqKey| ' '|) (|npInfixOp|))
            (|npPush| (|pfSymb| (|npPop1|) (|tokPosn| b))))
          (t
            (|npRestore| a)
            (cond
              ((and (|npEqKey| 'backquote) (|npInfixOp|))
                (setq a (|npPop1|))
                (|npPush| (|tokConstruct| '|idsy| (|tokPart| a) (|tokPosn| a))))
              (t
```

```
(|npRestore| a)
nil))))))
```

7.0.281 defun npInfixOp

```
[npPushId p209]
[|$tok p??|
|$stok p??|
```

— defun npInfixOp —

```
(defun |npInfixOp| ()
  (declare (special |$tok| |$stok|))
  (and
    (eq (caar |$stok|) '|key|)
    (get |$tok| 'infgeneric)
    (|npPushId|)))
```

7.0.282 defun npPrefixColon

```
[npEqPeek p152]
[|npPush p143|
|tokConstruct p411|
|tokPosn p413|
|npNext p145|
|$stok p??|
```

— defun npPrefixColon —

```
(defun |npPrefixColon| ()
  (declare (special |$stok|))
  (and
    (|npEqPeek| 'colon)
    (progn
      (|npPush| (|tokConstruct| '|id| '|:| (|tokPosn| |$stok|)))
      (|npNext|))))
```

7.0.283 defun npApplication

```
[npDotted p162]
[ npPrimary p157]
[ npApplication2 p163]
[ npPush p143]
[ pfApplication p253]
[ npPop2 p144]
[ npPop1 p144]
```

— **defun npApplication** —

```
(defun |npApplication| ()
  (and
    (|npDotted| #'|npPrimary|)
    (or
      (and
        (|npApplication2|)
        (|npPush| (|pfApplication| (|npPop2|) (|npPop1|))))
      t)))
```

—————

7.0.284 defun npDotted

```
[ p??]
```

— **defun npDotted** —

```
(defun |npDotted| (f)
  (and (apply f nil) (|npAnyNo| #'|npSelector|)))
```

—————

7.0.285 defun npAnyNo

fn must transform the head of the stack

— **defun npAnyNo 0** —

```
(defun |npAnyNo| (fn)
  (do () ((not (apply fn nil)))) ; while apply do...
  t)
```

—————

7.0.286 defun npSelector

```
[npEqKey p145]
[npPrimary p157]
[npTrap p212]
[npPush p143]
[pfApplication p253]
[npPop2 p144]
[npPop1 p144]
```

— defun npSelector —

```
(defun |npSelector| ()
  (and
    (|npEqKey| 'dot)
    (or (|npPrimary|) (|npTrap|))
    (|npPush| (|pfApplication| (|npPop2|) (|npPop1|)))))
```

—————

7.0.287 defun npApplication2

```
[npDotted p162]
[npPrimary1 p164]
[npApplication2 p163]
[npPush p143]
[pfApplication p253]
[npPop2 p144]
[npPop1 p144]
```

— defun npApplication2 —

```
(defun |npApplication2| ()
  (and
    (|npDotted| #'|npPrimary1|)
    (or
      (and
        (|npApplication2|)
        (|npPush| (|pfApplication| (|npPop2|) (|npPop1|)))))
      t)))
```

—————

7.0.288 defun npPrimary1

[npEncAp p182]
 [npAtom1 p183]
 [npLet p166]
 [npFix p166]
 [npMacro p164]
 [npBFileDefinition p188]
 [npDefn p187]
 [npRule p193]

— defun npPrimary1 —

```
(defun |npPrimary1| ()
  (or
    (|npEncAp| #'|npAtom1|)
    (|npLet|)
    (|npFix|)
    (|npMacro|)
    (|npBFileDefinition|)
    (|npDefn|)
    (|npRule|)))
```

7.0.289 defun npMacro

[npPP p209]
 [npMdef p164]

— defun npMacro —

```
(defun |npMacro| ()
  (and
    (|npEqKey| 'macro)
    (|npPP| #'|npMdef|)))
```

7.0.290 defun npMdef

TPDHERE: Beware that this function occurs with uppercase also [npQuiver p198]

[pfCheckMacroOut p240]
 [npPop1 p144]

[npDefTail p194]
 [npTrap p212]
 [npPop1 p144]
 [npPush p143]
 [pfMacro p277]
 [pfPushMacroBody p243]

— defun npMdef —

```
(defun |npMdef| ()
  (let (body arg op tmp)
    (when (|npQuiver|) ;[op,arg] := pfCheckMacroOut(npPop1())
      (setq tmp (|pfCheckMacroOut| (|npPop1|)))
      (setq op (car tmp))
      (setq arg (cadr tmp))
      (or (|npDefTail|) (|npTrap|))
      (setq body (|npPop1|))
      (if (null arg)
          (|npPush| (|pfMacro| op body))
          (|npPush| (|pfMacro| op (|pfPushMacroBody| arg body)))))))
```

—————

7.0.291 defun npMDEF

TPDHERE: Beware that this function occurs with lowercase also [npBackTrack p148]

[npStatement p170]
 [npMDEFinition p165]

— defun npMDEF —

```
(defun |npMDEF| ()
  (|npBackTrack| #'|npStatement| 'mdef #'|npMDEFinition|))
```

—————

7.0.292 defun npMDEFinition

[npPP p209]
 [npMdef p164]

— defun npMDEFinition —

```
(defun |npMDEFinition| ()
  (|npPP| #'|npMdef|))
```

7.0.293 defun npFix

```
[npEqKey p145]
[npDef p187]
[npPush p143]
[pfFix p265]
[npPop1 p144]
```

— defun npFix —

```
(defun |npFix| ()
  (and
    (|npEqKey| 'fix)
    (|npPP| #'|npDef|)
    (|npPush| (|pfFix| (|npPop1|)))))
```

7.0.294 defun npLet

```
[npLetQualified p166]
[npDefinitionOrStatement p147]
```

— defun npLet —

```
(defun |npLet| ()
  (|npLetQualified| #'|npDefinitionOrStatement|))
```

7.0.295 defun npLetQualified

```
[npEqKey p145]
[npDefinition p167]
[npTrap p212]
[npCompMissing p151]
[npPush p143]
```

[pfWhere p294]
 [npPop2 p144]
 [npPop1 p144]

— **defun npLetQualified** —

```
(defun |npLetQualified| (f)
  (and
    (|npEqKey| 'let)
    (or (|npDefinition|) (|npTrap|))
    (|npCompMissing| 'in)
    (or (funcall f) (|npTrap|))
    (|npPush| (|pfWhere| (|npPop2|) (|npPop1|))))))
```

—————

7.0.296 **defun npDefinition**

[npPP p209]
 [npDefinitionItem p167]
 [npPush p143]
 [pfSequenceToList p238]
 [npPop1 p144]

— **defun npDefinition** —

```
(defun |npDefinition| ()
  (and
    (|npPP| #'|npDefinitionItem|)
    (|npPush| (|pfSequenceToList| (|npPop1|))))))
```

—————

7.0.297 **defun npDefinitionItem**

[npTyping p168]
 [npImport p180]
 [npState p212]
 [npStatement p170]
 [npEqPeek p152]
 [npRestore p152]
 [npDef p187]
 [npMacro p164]
 [npDefn p187]

[npTrap p212]

— defun npDefinitionItem —

```
(defun |npDefinitionItem| ()
  (let (a)
    (or (|npTyping|)
        (|npImport|)
        (progn
          (setq a (|npState|))
          (cond
            ((|npStatement|)
             (cond
              ((|npEqPeek| 'def)
               (|npRestore| a)
               (|npDef|))
              (t
               (|npRestore| a)
               (or (|npMacro|) (|npDefn|))))))
          (t (|npTrap|))))))
```

—————

7.0.298 defun npTyping

[npEqKey p145]
 [npDefaultItemList p168]
 [npTrap p212]
 [npPush p143]
 [pfTyping p291]
 [npPop1 p144]

— defun npTyping —

```
(defun |npTyping| ()
  (and
    (|npEqKey| 'default)
    (or (|npDefaultItemList|) (|npTrap|))
    (|npPush| (|pfTyping| (|npPop1|)))))
```

—————

7.0.299 defun npDefaultItemList

[npPC p??]
 [npSDefaultItem p169]

[npPush p143]
 [pfUnSequence p293]
 [npPop1 p144]

— defun npDefaultItemList —

```
(defun |npDefaultItemList| ()
  (and
    (|npPC| #'|npSDefaultItem|)
    (|npPush| (|pfUnSequence| (|npPop1|)))))
```

—————

7.0.300 defun npSDefaultItem

[npListing p155]
 [npDefaultItem p169]
 [npPush p143]
 [pfAppend p255]
 [pfParts p249]
 [npPop1 p144]

— defun npSDefaultItem —

```
(defun |npSDefaultItem| ()
  (and
    (|npListing| #'|npDefaultItem|)
    (|npPush| (|pfAppend| (|pfParts| (|npPop1|)))))
```

—————

7.0.301 defun npDefaultItem

[npTypeVariable p156]
 [npDefaultDecl p170]
 [npTrap p212]

— defun npDefaultItem —

```
(defun |npDefaultItem| ()
  (and
    (|npTypeVariable|)
    (or (|npDefaultDecl|) (|npTrap|))))
```

—————

7.0.302 defun npDefaultDecl

[npEqKey p145]
 [npType p149]
 [npTrap p212]
 [npPush p143]
 [pfSpread p239]
 [pfParts p249]
 [npPop2 p144]
 [npPop1 p144]

— **defun npDefaultDecl** —

```
(defun |npDefaultDecl| ()
  (and
    (|npEqKey| 'colon)
    (or (|npType|) (|npTrap|))
    (|npPush| (|pfSpread| (|pfParts| (|npPop2|)) (|npPop1|)))))
```

—————

7.0.303 defun npStatement

[npExpress p179]
 [npLoop p175]
 [npIterate p174]
 [npReturn p178]
 [npBreak p174]
 [npFree p173]
 [npImport p180]
 [npInline p174]
 [npLocal p173]
 [npExport p171]
 [npTyping p168]
 [npVoid p179]

— **defun npStatement** —

```
(defun |npStatement| ()
  (or
    (|npExpress|)
    (|npLoop|)
    (|npIterate|)
    (|npReturn|)
    (|npBreak|)
    (|npFree|)
```

```
(|npImport|)
(|npInline|)
(|npLocal|)
(|npExport|)
(|npTyping|)
(|npVoid|)))
```

7.0.304 defun npExport

```
[npEqKey p145]
[npLocalItemlist p171]
[npTrap p212]
[npPush p143]
[pfExport p264]
[npPop1 p144]
```

— defun npExport —

```
(defun |npExport| ()
  (and
    (|npEqKey| 'export)
    (or (|npLocalItemlist|) (|npTrap|))
    (|npPush| (|pfExport| (|npPop1|)))))
```

7.0.305 defun npLocalItemlist

```
[npPC p??]
[npSLocalItem p172]
[npPush p143]
[pfUnSequence p293]
[npPop1 p144]
```

— defun npLocalItemlist —

```
(defun |npLocalItemlist| ()
  (and
    (|npPC| #'|npSLocalItem|)
    (|npPush| (|pfUnSequence| (|npPop1|)))))
```

7.0.306 defun npSLocalItem

```

[npListing p155]
[npLocalItem p172]
[npPush p143]
[pfAppend p255]
[pfParts p249]
[npPop1 p144]

— defun npSLocalItem —

(defun |npSLocalItem| ()
  (and
    (|npListing| #'|npLocalItem|)
    (|npPush| (|pfAppend| (|pfParts| (|npPop1|))))))

```

7.0.307 defun npLocalItem

```

[npTypeVariable p156]
[npLocalDecl p172]

— defun npLocalItem —

(defun |npLocalItem| ()
  (and
    (|npTypeVariable|)
    (|npLocalDecl|))))

```

7.0.308 defun npLocalDecl

```

[npEqKey p145]
[npType p149]
[npTrap p212]
[npPush p143]
[pfSpread p239]
[pfParts p249]
[npPop2 p144]
[npPop1 p144]
[pfNothing p245]

```


— defun npLocalDecl —

```
(defun |npLocalDecl| ()
  (or
    (and
      (|npEqKey| 'colon)
      (or (|npType|) (|npTrap|))
      (|npPush| (|pfSpread| (|pfParts| (|npPop2|)) (|npPop1|))))
      (|npPush| (|pfSpread| (|pfParts| (|npPop1|)) (|pfNothing|)))))
```

—————

7.0.309 defun npLocal

```
[npEqKey p145]
[npLocalItemList p171]
[npTrap p212]
[npPush p143]
[pfLocal p274]
[npPop1 p144]
```

— defun npLocal —

```
(defun |npLocal| ()
  (and
    (|npEqKey| '|local|)
    (or (|npLocalItemList|) (|npTrap|))
    (|npPush| (|pfLocal| (|npPop1|)))))
```

—————

7.0.310 defun npFree

```
[npEqKey p145]
[npLocalItemList p171]
[npTrap p212]
[npPush p143]
[pfFree p265]
[npPop1 p144]
```

— defun npFree —

```
(defun |npFree| ()
```

```
(and
  (|npEqKey| 'free)
  (or (|npLocalItemList|) (|npTrap|))
  (|npPush| (|pfFree| (|npPop1|))))))
```

7.0.311 defun npInline

[npAndOr p181]
 [npQualTypelist p180]
 [pfInline p272]

— defun npInline —

```
(defun |npInline| ()
  (|npAndOr| 'inline #'|npQualTypelist| #'|pfInline|))
```

7.0.312 defun npIterate

[npEqKey p145]
 [npPush p143]
 [pfIterate p271]
 [pfNothing p245]

— defun npIterate —

```
(defun |npIterate| ()
  (and (|npEqKey| 'iterate) (|npPush| (|pfIterate| (|pfNothing|)))))
```

7.0.313 defun npBreak

[npEqKey p145]
 [npPush p143]
 [pfBreak p258]
 [pfNothing p245]

— defun npBreak —

```
(defun |npBreak| ()
  (and (|npEqKey| 'break) (|npPush| (|pfBreak| (|pfNothing|))))))
```

7.0.314 defun npLoop

```
[npIterators p175]
[npCompMissing p151]
[npAssign p216]
[npTrap p212]
[npPush p143]
[pfLp p276]
[npPop2 p144]
[npPop1 p144]
[npEqKey p145]
[pfLoop1 p275]
```

— defun npLoop —

```
(defun |npLoop| ()
  (or
    (and
      (|npIterators|)
      (|npCompMissing| 'repeat)
      (or (|npAssign|) (|npTrap|))
      (|npPush| (|pfLp| (|npPop2|) (|npPop1|))))))
    (and
      (|npEqKey| 'repeat)
      (or (|npAssign|) (|npTrap|))
      (|npPush| (|pfLoop1| (|npPop1|))))))
```

7.0.315 defun npIterators

```
[npForIn p177]
[npZeroOrMore p177]
[npIterator p176]
[npPush p143]
[npPop2 p144]
[npPop1 p144]
[npWhile p177]
[npIterators p175]
```

— defun npIterators —

```
(defun |npIterators| ()
  (or
    (and
      (|npForIn|)
      (|npZeroOrMore| #'|npIterator|)
      (|npPush| (cons (|npPop2|) (|npPop1|))))
    (and
      (|npWhile|)
      (or
        (and (|npIterators|) (|npPush| (cons (|npPop2|) (|npPop1|))))
        (|npPush| (list (|npPop1|)))))))
```

—————

7.0.316 defun npIterator

```
[npForIn p177]
[npSuchThat p176]
[npWhile p177]
```

— defun npIterator —

```
(defun |npIterator| ()
  (or
    (|npForIn|)
    (|npSuchThat|)
    (|npWhile|))))
```

—————

7.0.317 defun npSuchThat

```
[npAndOr p181]
[npLogical p197]
[pfSuchthat p288]
```

— defun npSuchThat —

```
(defun |npSuchThat| ()
  (|npAndOr| 'bar #'|npLogical| #'|pfSuchthat|))
```

—————

7.0.318 defun Apply argument 0 or more times

[npPush p143]
 [npPop2 p144]
 [npPop1 p144]
 [\$stack p??]

— defun npZeroOrMore —

```
(defun |npZeroOrMore| (f)
  (let (a)
    (declare (special |$stack|))
    (cond
      ((apply f nil)
       (setq a |$stack|)
       (setq |$stack| nil)
       (do () ((not (apply f nil)))) ; while .. do
       (setq |$stack| (cons (nreverse |$stack|) a))
       (|npPush| (cons (|npPop2|) (|npPop1|))))
      (t (progn (|npPush| nil) t)))))
```

7.0.319 defun npWhile

[npAndOr p181]
 [npLogical p197]
 [pfWhile p295]

— defun npWhile —

```
(defun |npWhile| ()
  (|npAndOr| 'while #'|npLogical| #'|pfWhile|))
```

7.0.320 defun npForIn

[npEqKey p145]
 [npVariable p213]
 [npTrap p212]
 [npCompMissing p151]
 [npBy p199]
 [npPush p143]

```
[pfForin p266]
[npPop2 p144]
[npPop1 p144]
```

— defun npForIn —

```
(defun |npForIn| ()
  (and
    (|npEqKey| 'for)
    (or (|npVariable|) (|npTrap|))
    (|npCompMissing| 'in)
    (or (|npBy|) (|npTrap|))
    (|npPush| (|pfForin| (|npPop2|) (|npPop1|)))))
```

7.0.321 defun npReturn

```
[npEqKey p145]
[npExpress p179]
[npPush p143]
[pfNothing p245]
[npEqKey p145]
[npName p204]
[npTrap p212]
[pfReturn p284]
[npPop2 p144]
[npPop1 p144]
[pfReturnNoName p285]
```

— defun npReturn —

```
(defun |npReturn| ()
  (and
    (|npEqKey| 'return)
    (or
      (|npExpress|)
      (|npPush| (|pfNothing|)))
    (or
      (and
        (|npEqKey| 'from)
        (or (|npName|) (|npTrap|))
        (|npPush| (|pfReturn| (|npPop2|) (|npPop1|)))))
      (|npPush| (|pfReturnNoName| (|npPop1|)))))
```

7.0.322 defun npVoid

[npAndOr p181]
 [npStatement p170]
 [pfNovalue p279]

— defun npVoid —

```
(defun |npVoid| ()
  (|npAndOr| 'do #'|npStatement| #'|pfNovalue|))
```

—————

7.0.323 defun npExpress

[npExpress1 p179]
 [npIterators p175]
 [npPush p143]
 [pfCollect p260]
 [npPop2 p144]
 [pfListOf p245]
 [npPop1 p144]

— defun npExpress —

```
(defun |npExpress| ()
  (and
    (|npExpress1|)
    (or
      (and
        (|npIterators|)
        (|npPush| (|pfCollect| (|npPop2|) (|pfListOf| (|npPop1|)))))
      t)))
```

—————

7.0.324 defun npExpress1

[npConditionalStatement p180]
 [npADD p158]

— defun npExpress1 —

```
(defun |npExpress1| ()
```

```
(or (|npConditionalStatement|) (|npADD|)))
```

7.0.325 defun npConditionalStatement

[npConditional p195]
[npQualifiedDefinition p147]

— defun npConditionalStatement —

```
(defun |npConditionalStatement| ()
  (|npConditional| #'|npQualifiedDefinition|))
```

7.0.326 defun npImport

[npAndOr p181]
[npQualTypelist p180]
[pfImport p271]

— defun npImport —

```
(defun |npImport| ()
  (|npAndOr| 'import #'|npQualTypelist| #'|pfImport|))
```

7.0.327 defun npQualTypelist

[npPC p??]
[npSQualTypelist p181]
[npPush p143]
[pfUnSequence p293]
[npPop1 p144]

— defun npQualTypelist —

```
(defun |npQualTypelist| ()
  (and
    (|npPC| #'|npSQualTypelist|)
```



```
(|npPush| (|pfUnSequence| (|npPop1|))))))
```

7.0.328 defun npSQualTypelist

```
[npListing p155]
[npQualType p181]
[npPush p143]
[pfParts p249]
[npPop1 p144]
```

— defun npSQualTypelist —

```
(defun |npSQualTypelist| ()
  (and
    (|npListing| #'|npQualType|)
    (|npPush| (|pfParts| (|npPop1|))))))
```

7.0.329 defun npQualType

```
[npType p149]
[npPush p143]
[pfQualType p282]
[npPop1 p144]
[pfNothing p245]
```

— defun npQualType —

```
(defun |npQualType| ()
  (and
    (|npType|)
    (|npPush| (|pfQualType| (|npPop1|) (|pfNothing|))))))
```

7.0.330 defun npAndOr

```
[npEqKey p145]
[npTrap p212]
```

```
[npPush p143]
[npPop1 p144]
```

— defun npAndOr —

```
(defun |npAndOr| (keyword p f)
  (and
    (|npEqKey| keyword)
    (or (apply p nil) (|npTrap|))
    (|npPush| (funcall f (|npPop1|)))))
```

7.0.331 defun npEncAp

```
[npAnyNo p162]
[npEncl p182]
[npFromdom p202]
```

— defun npEncAp —

```
(defun |npEncAp| (f)
  (and (apply f nil) (|npAnyNo| #'|npEncl|) (|npFromdom|)))
```

7.0.332 defun npEncl

```
[npBDefinition p185]
[npPush p143]
[pfApplication p253]
[npPop2 p144]
[npPop1 p144]
```

— defun npEncl —

```
(defun |npEncl| ()
  (and
    (|npBDefinition|)
    (|npPush| (|pfApplication| (|npPop2|) (|npPop1|)))))
```

7.0.333 defun npAtom1

[npPDefinition p183]
 [npName p204]
 [npConstTok p184]
 [npDollar p183]
 [npBDefinition p185]
 [npFromdom p202]

— defun npAtom1 —

```
(defun |npAtom1| ()
  (or
    (|npPDefinition|)
    (and
      (or (|npName|) (|npConstTok|) (|npDollar|) (|npBDefinition|))
      (|npFromdom|))))
```

—————

7.0.334 defun npPDefinition

[npParenthesized p214]
 [npDefinitionlist p193]
 [npPush p143]
 [pfEnSequence p263]
 [npPop1 p144]

— defun npPDefinition —

```
(defun |npPDefinition| ()
  (and
    (|npParenthesized| #'|npDefinitionlist|)
    (|npPush| (|pfEnSequence| (|npPop1|)))))
```

—————

7.0.335 defun npDollar

[npEqPeek p152]
 [npPush p143]
 [tokConstruct p411]
 [tokPosn p413]
 [npNext p145]

[\$tok p??]

— defun npDollar —

```
(defun |npDollar| ()
  (declare (special |$tok|))
  (and (|npEqPeek| '$)
    (progn
      (|npPush| (|tokConstruct| 'id| '$ (|tokPosn| |$tok|)))
      (|npNext|))))
```

7.0.336 defun npConstTok

[tokType p413]
 [npPush p143]
 [npNext p145]
 [npEqPeek p152]
 [npState p212]
 [npPrimary1 p164]
 [pfSymb p251]
 [npPop1 p144]
 [tokPosn p413]
 [npRestore p152]
 [\$tok p??]

— defun npConstTok —

```
(defun |npConstTok| ()
  (let (b a)
    (declare (special |$tok|))
    (cond
      ((member (|tokType| |$tok|) '(|integer| |string| |char| |float| |command|))
        (|npPush| |$tok|)
        (|npNext|))
      ((|npEqPeek| '|')
        (setq a |$tok|)
        (setq b (|npState|))
        (|npNext|)
        (cond
          ((and (|npPrimary1|)
            (|npPush| (|pfSymb| (|npPop1|) (|tokPosn| a))))
            t)
          (t (|npRestore| b) nil)))
      (t nil))))
```

7.0.337 defun npBDefinition

[npPDefinition p183]
 [npBracketed p185]
 [npDefinitionlist p193]

— defun npBDefinition —

```
(defun |npBDefinition| ()
  (or
   (|npPDefinition|)
   (|npBracketed| #'|npDefinitionlist|)))
```

7.0.338 defun npBracketed

[npParened p185]
 [npBracked p186]
 [npBraced p186]
 [npAngleBared p186]

— defun npBracketed —

```
(defun |npBracketed| (f)
  (or
   (|npParened| f)
   (|npBracked| f)
   (|npBraced| f)
   (|npAngleBared| f)))
```

7.0.339 defun npParened

[npEnclosed p211]
 [pfParen p281]

— defun npParened —

```
(defun |npParened| (f)
```

```
(or (|npEnclosed| '(| ')| #'|pfParen| f)
    (|npEnclosed| '(\| | '\|)| #'|pfParen| f)))
```

7.0.340 defun npBracked

```
[npEnclosed p211]
[pfBracket p257]
[pfBracketBar p257]
```

— defun npBracked —

```
(defun |npBracked| (f)
  (or (|npEnclosed| '[' '] #'|pfBracket| f)
      (|npEnclosed| '[\| | '\|]| #'|pfBracketBar| f)))
```

7.0.341 defun npBraced

```
[npEnclosed p211]
[pfBrace p257]
[pfBraceBar p257]
```

— defun npBraced —

```
(defun |npBraced| (f)
  (or (|npEnclosed| '{ '}' #'|pfBrace| f)
      (|npEnclosed| '{\| | '\|}| #'|pfBraceBar| f)))
```

7.0.342 defun npAngleBared

```
[npEnclosed p211]
[pfHide p269]
```

— defun npAngleBared —

```
(defun |npAngleBared| (f)
  (|npEnclosed| '<| | '>| #'|pfHide| f))
```

7.0.343 defun npDefn

[npEqKey p145]
 [npPP p209]
 [npDef p187]

— defun npDefn —

```
(defun |npDefn| ()
  (and
    (|npEqKey| 'defn)
    (|npPP| #'|npDef|)))
```

7.0.344 defun npDef

[npMatch p150]
 [pfCheckItOut p239]
 [npPop1 p144]
 [npDefTail p194]
 [npTrap p212]
 [npPop1 p144]
 [npPush p143]
 [pfDefinition p261]
 [pfPushBody p249]

— defun npDef —

```
(defun |npDef| ()
  (let (body rt arg op tmp1)
    (when (|npMatch|)
      ; [op,arg,rt]:= pfCheckItOut(npPop1())
      (setq tmp1 (|pfCheckItOut| (|npPop1|)))
      (setq op (car tmp1))
      (setq arg (cadr tmp1))
      (setq rt (caddr tmp1))
      (or (|npDefTail|) (|npTrap|))
      (setq body (|npPop1|))
      (if (null arg)
        (|npPush| (|pfDefinition| op body))
        (|npPush| (|pfDefinition| op (|pfPushBody| rt arg body)))))))
```

7.0.345 defun npBPileDefinition

[npPileBracketed p188]
 [npPileDefinitionlist p189]
 [npPush p143]
 [pfSequence p287]
 [pfListOf p245]
 [npPop1 p144]

— defun npBPileDefinition —

```
(defun |npBPileDefinition| ()
  (and
    (|npPileBracketed| #'|npPileDefinitionlist|)
    (|npPush| (|pfSequence| (|pfListOf| (|npPop1|))))))
```

7.0.346 defun npPileBracketed

[npEqKey p145]
 [npPush p143]
 [pfNothing p245]
 [npMissing p151]
 [pfPile p249]
 [npPop1 p144]

— defun npPileBracketed —

```
(defun |npPileBracketed| (f)
  (cond
    ((|npEqKey| 'settab)
     (cond
       ((|npEqKey| 'backtab) (|npPush| (|pfNothing|))) ; never happens
       ((and (apply f nil)
              (or (|npEqKey| 'backtab) (|npMissing| 'backtab))))
         (|npPush| (|pfPile| (|npPop1|))))
       (t nil)))
    (t nil)))
```

7.0.347 defun npPileDefinitionlist

[npListAndRecover p189]
 [npDefinitionlist p193]
 [npPush p143]
 [pfAppend p255]
 [npPop1 p144]

— defun npPileDefinitionlist —

```
(defun |npPileDefinitionlist| ()
  (and
    (|npListAndRecover| #'|npDefinitionlist|)
    (|npPush| (|pfAppend| (|npPop1|))))))
```

—————

7.0.348 defun npListAndRecover

[trappoint p??]
 [npRecoverTrap p190]
 [syGeneralErrorHere p192]
 [npEqKey p145]
 [npEqPeek p152]
 [npNext p145]
 [npPop1 p144]
 [npPush p143]
 [\$inputStream p??]
 [\$stack p??]

— defun npListAndRecover —

```
(defun |npListAndRecover| (f)
  (let (found c done b savestack)
    (declare (special |$inputStream| |$stack|))
    (setq savestack |$stack|)
    (setq |$stack| nil)
    (setq c |$inputStream|)
    (do ()
      (done)
      (setq found (catch 'trappoint (apply f nil)))
      (cond
        ((eq found 'trapped)
         (setq |$inputStream| c)
         (|npRecoverTrap|))
        ((null found)
```

```

    (setq |$inputStream| c)
    (|syGeneralErrorHere|) (|npRecoverTrap|)))
(cond
  ((|npEqKey| 'backset) (setq c |$inputStream|))
  ((|npEqPeek| 'backtab) (setq done t))
  (t
    (setq |$inputStream| c)
    (|syGeneralErrorHere|)
    (|npRecoverTrap|)
    (cond
      ((|npEqPeek| 'backtab) (setq done t))
      (t
        (|npNext|)
        (setq c |$inputStream|))))))
(setq b (cons (|npPop1|) b)))
(setq |$stack| savestack)
(|npPush| (nreverse b)))

```

7.0.349 defun npRecoverTrap

[npFirstTok p143]
 [tokPosn p413]
 [npMoveTo p191]
 [syIgnoredFromTo p191]
 [npPush p143]
 [pfWrong p296]
 [pfDocument p246]
 [pfListOf p245]
 [\$stok p??]

— defun npRecoverTrap —

```

(defun |npRecoverTrap| ()
  (let (pos2 pos1)
    (declare (special |$stok|))
    (|npFirstTok|)
    (setq pos1 (|tokPosn| |$stok|))
    (|npMoveTo| 0)
    (setq pos2 (|tokPosn| |$stok|))
    (|syIgnoredFromTo| pos1 pos2)
    (|npPush|
      (list (|pfWrong| (|pfDocument| (list "pile syntax error")))
            (|pfListOf| nil))))))

```

7.0.350 defun npMoveTo

[npEqPeek p152]
 [npNext p145]
 [npMoveTo p191]
 [npEqKey p145]
 [\$inputStream p??]

— defun npMoveTo —

```
(defun |npMoveTo| (|n|)
  (declare (special |$inputStream|))
  (cond
    ((null |$inputStream|) t)
    ((|npEqPeek| 'backtab)
      (cond
        ((eq1 |n| 0) t)
        (t (|npNext|) (|npMoveTo| (1- |n|)))))
    ((|npEqPeek| 'backset)
      (cond
        ((eq1 |n| 0) t)
        (t (|npNext|) (|npMoveTo| |n|))))
    ((|npEqKey| 'settab) (|npMoveTo| (+ |n| 1)))
    (t (|npNext|) (|npMoveTo| |n|))))
```

7.0.351 defun syIgnoredFromTo

[pfGlobalLinePosn p235]
 [ncSoftError p351]
 [FromTo p380]
 [From p380]
 [To p380]

— defun syIgnoredFromTo —

```
(defun |syIgnoredFromTo| (pos1 pos2)
  (cond
    ((equal (|pfGlobalLinePosn| pos1) (|pfGlobalLinePosn| pos2))
      (|ncSoftError| (|FromTo| pos1 pos2) 'S2CY0005 nil))
    (t
      (|ncSoftError| (|From| pos1) 'S2CY0003 nil)
      (|ncSoftError| (|To| pos2) 'S2CY0004 nil))))
```

7.0.352 defun syGeneralErrorHere

[sySpecificErrorHere p192]

— defun syGeneralErrorHere —

```
(defun |syGeneralErrorHere| ()
  (|sySpecificErrorHere| 'S2CY0002 nil))
```

7.0.353 defun sySpecificErrorHere

[sySpecificErrorAtToken p192]
 [\$stok p??]

— defun sySpecificErrorHere —

```
(defun |sySpecificErrorHere| (key args)
  (declare (special |$stok|))
  (|sySpecificErrorAtToken| |$stok| key args))
```

7.0.354 defun sySpecificErrorAtToken

[ncSoftError p351]
 [tokPosn p413]

— defun sySpecificErrorAtToken —

```
(defun |sySpecificErrorAtToken| (tok key args)
  (|ncSoftError| (|tokPosn| tok) key args))
```

7.0.355 defun npDefinitionlist

[npSemiListing p193]
 [npQualDef p145]

— **defun npDefinitionlist** —

```
(defun |npDefinitionlist| ()
  (|npSemiListing| #'|npQualDef|))
```

—————

7.0.356 defun npSemiListing

[npListofFun p221]
 [npSemiBackSet p193]
 [pfAppend p255]

— **defun npSemiListing** —

```
(defun |npSemiListing| (p)
  (|npListofFun| p #'|npSemiBackSet| #'|pfAppend|))
```

—————

7.0.357 defun npSemiBackSet

[npEqKey p145]

— **defun npSemiBackSet** —

```
(defun |npSemiBackSet| ()
  (and (|npEqKey| 'semicolon) (or (|npEqKey| 'backset) t)))
```

—————

7.0.358 defun npRule

[npEqKey p145]
 [npPP p209]
 [npSingleRule p194]

— **defun npRule** —

```
(defun |npRule| ()
  (and
    (|npEqKey| 'rule)
    (|npPP| #'|npSingleRule|)))
```

7.0.359 defun npSingleRule

```
[npQuiver p198]
[npDefTail p194]
[npTrap p212]
[npPush p143]
[pfRule p285]
[npPop2 p144]
[npPop1 p144]
```

— defun npSingleRule —

```
(defun |npSingleRule| ()
  (when (|npQuiver|)
    (or (|npDefTail|) (|npTrap|)
      (|npPush| (|pfRule| (|npPop2|) (|npPop1|))))))
```

7.0.360 defun npDefTail

```
[npEqKey p145]
[npDefinitionOrStatement p147]
```

— defun npDefTail —

```
(defun |npDefTail| ()
  (and
    (or (|npEqKey| 'def) (|npEqKey| 'mdef))
    (|npDefinitionOrStatement|)))
```

7.0.361 defun npDefaultValue

```
[npEqKey p145]
[npDefinitionOrStatement p147]
```

```
[npTrap p212]
[npPush p143]
[pfAdd p252]
[pfNothing p245]
[npPop1 p144]
```

— **defun npDefaultValue** —

```
(defun |npDefaultValue| ()
  (and
    (|npEqKey| 'default)
    (or (|npDefinitionOrStatement|) (|npTrap|))
    (|npPush| (list (|pfAdd| (|pfNothing|) (|npPop1|) (|pfNothing|))))))
```

—————

7.0.362 **defun npWConditional**

```
[npConditional p195]
[npPush p143]
[pfTweakIf p290]
[npPop1 p144]
```

— **defun npWConditional** —

```
(defun |npWConditional| (f)
  (when (|npConditional| f) (|npPush| (|pfTweakIf| (|npPop1|)))))
```

—————

7.0.363 **defun npConditional**

```
[npEqKey p145]
[npLogical p197]
[npTrap p212]
[npMissing p151]
[npElse p196]
```

— **defun npConditional** —

```
(defun |npConditional| (f)
  (cond
    ((and (|npEqKey| 'IF)
          (or (|npLogical|) (|npTrap|))
```

```

      (or (|npEqKey| 'backset) t))
    (cond
      ((|npEqKey| 'settab)
        (cond
          ((|npEqKey| 'then)
            (and (or (apply f nil) (|npTrap|))
              (|npElse| f)
              (|npEqKey| 'backtab)))
          (t (|npMissing| 'then))))
      ((|npEqKey| 'then)
        (and (or (apply f nil) (|npTrap|)) (|npElse| f)))
      (t (|npMissing| 'then))))
    (t nil)))

```

7.0.364 defun npElse

```

[npState p212]
[npBacksetElse p197]
[npTrap p212]
[npPush p143]
[pfIf p269]
[npPop3 p144]
[npPop2 p144]
[npPop1 p144]
[npRestore p152]
[pfIfThenOnly p270]

```

— defun npElse —

```

(defun |npElse| (f)
  (let (a)
    (setq a (|npState|))
    (cond
      ((|npBacksetElse|)
        (and
          (or (apply f nil) (|npTrap|))
          (|npPush| (|pfIf| (|npPop3|) (|npPop2|) (|npPop1|)))))
      (t
        (|npRestore| a)
        (|npPush| (|pfIfThenOnly| (|npPop2|) (|npPop1|)))))

```

7.0.365 defun npBacksetElse

TPDHERE: Well this makes no sense. [npEqKey p145]

— defun npBacksetElse —

```
(defun |npBacksetElse| ()
  (if (|npEqKey| 'backset)
      (|npEqKey| 'else)
      (|npEqKey| 'else)))
```

—————

7.0.366 defun npLogical

[npLeftAssoc p206]

[npDisjand p197]

— defun npLogical —

```
(defun |npLogical| ()
  (|npLeftAssoc| '(or) #'|npDisjand|))
```

—————

7.0.367 defun npDisjand

[npLeftAssoc p206]

[npDiscrim p197]

— defun npDisjand —

```
(defun |npDisjand| ()
  (|npLeftAssoc| '(and) #'|npDiscrim|))
```

—————

7.0.368 defun npDiscrim

[npLeftAssoc p206]

[npQuiver p198]

— defun npDiscrim —

```
(defun |npDiscrim| ()
  (|npLeftAssoc| '(case has) #'|npQuiver|))
```

7.0.369 defun npQuiver

```
[npRightAssoc p206]
[npRelation p198]
```

— defun npQuiver —

```
(defun |npQuiver| ()
  (|npRightAssoc| '(arrow larrow) #'|npRelation|))
```

7.0.370 defun npRelation

```
[npLeftAssoc p206]
[npSynthetic p198]
```

— defun npRelation —

```
(defun |npRelation| ()
  (|npLeftAssoc| '(equal notequal lt le gt ge oangle cangle) #'|npSynthetic|))
```

7.0.371 defun npSynthetic

```
[npBy p199]
[npAmpersandFrom p202]
[npPush p143]
[pfApplication p253]
[npPop2 p144]
[npPop1 p144]
[pfInfApplication p271]
```

— defun npSynthetic —

```
(defun |npSynthetic| ()
```

```

(cond
  ((|npBy|)
   (lambda ()
    (loop
     (cond
      ((not (and (|npAmpersandFrom|)
                  (or (|npBy|)
                      (progn
                       (|npPush| (|pfApplication| (|npPop2|) (|npPop1|))))
                      nil))))
      (return nil))
     (t
      (|npPush| (|pfInfApplication| (|npPop2|) (|npPop2|) (|npPop1|)))))))
    (t nil)))

```

7.0.372 defun npBy

[npLeftAssoc p206]
 [npInterval p199]

— defun npBy —

```

(defun |npBy| ()
  (|npLeftAssoc| '(by) #'|npInterval|))

```

7.0.373 defun

[npArith p200]
 [npSegment p200]
 [npEqPeek p152]
 [npPush p143]
 [pfApplication p253]
 [npPop1 p144]
 [pfInfApplication p271]
 [npPop2 p144]

— defun npInterval —

```

(defun |npInterval| ()

```

```

(and
  (|npArith|)
  (or
    (and
      (|npSegment|)
      (or
        (and
          (|npEqPeek| 'bar)
          (|npPush| (|pfApplication| (|npPop1|) (|npPop1|))))
        (and
          (|npArith|)
          (|npPush| (|pfInfApplication| (|npPop2|) (|npPop2|) (|npPop1|))))
          (|npPush| (|pfApplication| (|npPop1|) (|npPop1|))))
      t)))

```

7.0.374 defun npSegment

```

[|npEqPeek| p152]
[|npPushId| p209]
[|npFromdom| p202]

```

— defun npSegment —

```

(defun |npSegment| ()
  (and (|npEqPeek| 'seg) (|npPushId|) (|npFromdom|)))

```

7.0.375 defun npArith

```

[|npLeftAssoc| p206]
[|npSum| p201]

```

— defun npArith —

```

(defun |npArith| ()
  (|npLeftAssoc| '(mod) #'|npSum|))

```

7.0.376 defun npSum

[npLeftAssoc p206]
[npTerm p201]

— **defun npSum** —

```
(defun |npSum| ()
  (|npLeftAssoc| '(plus minus) #'|npTerm|))
```

—————

7.0.377 defun npTerm

[npInfGeneric p207]
[npRemainder p201]
[npPush p143]
[pfApplication p253]
[npPop2 p144]
[npPop1 p144]

— **defun npTerm** —

```
(defun |npTerm| ()
  (or
    (and
      (|npInfGeneric| '(minus plus))
      (or
        (and (|npRemainder|) (|npPush| (|pfApplication| (|npPop2|) (|npPop1|))))
        t))
      (|npRemainder|)))
```

—————

7.0.378 defun npRemainder

[npLeftAssoc p206]
[npProduct p202]

— **defun npRemainder** —

```
(defun |npRemainder| ()
  (|npLeftAssoc| '(rem quo) #'|npProduct|))
```

—————

7.0.379 defun npProduct

[npLeftAssoc p206]
 [npPower p202]

— **defun npProduct** —

```
(defun |npProduct| ()
  (|npLeftAssoc|
    '(times slash backslash slashslash backslashbackslash
        slashbackslash backslashslash)
    #'|npPower|))
```

—————

7.0.380 defun npPower

[npRightAssoc p206]
 [npColon p217]

— **defun npPower** —

```
(defun |npPower| ()
  (|npRightAssoc| '(power carat) #'|npColon|))
```

—————

7.0.381 defun npAmpersandFrom

[npAmpersand p204]
 [npFromdom p202]

— **defun npAmpersandFrom** —

```
(defun |npAmpersandFrom| ()
  (and (|npAmpersand|) (|npFromdom|)))
```

—————

7.0.382 defun npFromdom

[npEqKey p145]
 [npApplication p162]

```
[npTrap p212]
[npFromdom1 p203]
[npPop1 p144]
[npPush p143]
[pfFromDom p267]
```

— **defun npFromdom** —

```
(defun |npFromdom| ()
  (or
    (and
      (|npEqKey| '$)
      (or (|npApplication|) (|npTrap|))
      (|npFromdom1| (|npPop1|))
      (|npPush| (|pfFromDom| (|npPop1|) (|npPop1|))))
    t))
```

—————

7.0.383 **defun npFromdom1**

```
[npEqKey p145]
[npApplication p162]
[npTrap p212]
[npFromdom1 p203]
[npPop1 p144]
[npPush p143]
[pfFromDom p267]
```

— **defun npFromdom1** —

```
(defun |npFromdom1| (c)
  (or
    (and
      (|npEqKey| '$)
      (or (|npApplication|) (|npTrap|))
      (|npFromdom1| (|npPop1|))
      (|npPush| (|pfFromDom| (|npPop1|) c)))
    (|npPush| c))))
```

—————

7.0.384 defun npAmpersand

[npEqKey p145]
 [npName p204]
 [npTrap p212]

— defun npAmpersand —

```
(defun |npAmpersand| ()
  (and
    (|npEqKey| 'ampersand)
    (or (|npName|) (|npTrap|))))
```

—————

7.0.385 defun npName

[npId p204]
 [npSymbolVariable p205]

— defun npName —

```
(defun |npName| ()
  (or (|npId|) (|npSymbolVariable|)))
```

—————

7.0.386 defvar \$npPParg

— initvars —

```
(defvar |$npTokToNames| (list '~ '|#| '[] '{|'|\|}|'|{\|}|))
```

—————

7.0.387 defun npId

[npPush p143]
 [npNext p145]
 [tokConstruct p411]
 [tokPosn p413]


```

[npTokToNames p??]
[ttok p??]
[stok p??]

```

— defun npId —

```

(defun |npId| ()
  (declare (special |$npTokToNames| |$ttok| |$stok|))
  (cond
    ((eq (caar |$stok|) '|id|)
      (|npPush| |$stok|)
      (|npNext|))
    ((and (eq (caar |$stok|) '|key|) (member |$ttok| |$npTokToNames|))
      (|npPush| (|tokConstruct| '|id| |$ttok| (|tokPosn| |$stok|))
        (|npNext|))
      (t nil)))

```

7.0.388 defun npSymbolVariable

```

[npState p212]
[npEqKey p145]
[npId p204]
[npPop1 p144]
[npPush p143]
[tokConstruct p411]
[tokPart p413]
[tokPosn p413]
[npRestore p152]

```

— defun npSymbolVariable —

```

(defun |npSymbolVariable| ()
  (let (a)
    (setq a (|npState|))
    (cond
      ((and (|npEqKey| 'backquote) (|npId|))
        (setq a (|npPop1|))
        (|npPush| (|tokConstruct| '|idsy| (|tokPart| a) (|tokPosn| a))))
      (t (|npRestore| a) nil)))

```

7.0.389 defun npRightAssoc

```

[npState p212]
[npInfGeneric p207]
[npRightAssoc p206]
[npPush p143]
[pfApplication p253]
[npPop2 p144]
[npPop1 p144]
[pfInfApplication p271]
[npRestore p152]

```

— defun npRightAssoc —

```

(defun |npRightAssoc| (o p)
  (let (a)
    (setq a (|npState|))
    (cond
      ((apply p nil)
        ((lambda ()
          (loop
            (cond
              ((not
                (and
                  (|npInfGeneric| o)
                  (or
                    (|npRightAssoc| o p)
                    (progn (|npPush| (|pfApplication| (|npPop2|) (|npPop1|))) nil))))
              (return nil))
            (t
              (|npPush| (|pfInfApplication| (|npPop2|) (|npPop2|) (|npPop1|)))))))
        t)
      (t
        (|npRestore| a)
        nil))))

```

7.0.390 defun p o p o p o p = (((p o p) o p) o p)

```

p o p o p o p = (((p o p) o p) o p)
p o p o = (p o p) o
;npLeftAssoc(operations,parser)==
;  if APPLY(parser,nil)
;  then
;    while npInfGeneric(operations)
;    and (APPLY(parser,nil) or

```

```

;      (npPush pfApplication(npPop2(),npPop1());false))
;      repeat
;      npPush pfInfApplication(npPop2(),npPop2(),npPop1())
;      true
;      else false

```

```

[npInfGeneric p207]
[npPush p143]
[pfApplication p253]
[npPop2 p144]
[npPop1 p144]
[pfInfApplication p271]

```

— defun npLeftAssoc —

```

(defun |npLeftAssoc| (operations parser)
  (when (apply parser nil)
    ((lambda nil
      (loop
        (cond
          ((not
            (and
              (|npInfGeneric| operations)
              (or
                (apply parser nil)
                (progn (|npPush| (|pfApplication| (|npPop2|) (|npPop1|))) nil))))
            (return nil))
          (t
            (|npPush| (|pfInfApplication| (|npPop2|) (|npPop2|) (|npPop1|)))))))
      t))

```

—

7.0.391 defun npInfGeneric

```

[npDDInfKey p208]
[npEqKey p145]

```

— defun npInfGeneric —

```

(defun |npInfGeneric| (s)
  (and
    (|npDDInfKey| s)
    (or (|npEqKey| 'backset) t)))

```

—

7.0.392 defun npDDInfKey

```
[npInfKey p208]
[npState p212]
[npEqKey p145]
[npPush p143]
[pfSymb p251]
[npPop1 p144]
[tokPosn p413]
[npRestore p152]
[tokConstruct p411]
[tokPart p413]
[$stok p??]
```

— defun npDDInfKey —

```
(defun |npDDInfKey| (s)
  (let (b a)
    (declare (special |$stok|))
    (or
      (|npInfKey| s)
      (progn
        (setq a (|npState|))
        (setq b |$stok|)
        (cond
          ((and (|npEqKey| '|'|) (|npInfKey| s))
            (|npPush| (|pfSymb| (|npPop1|) (|tokPosn| b))))
          (t
            (|npRestore| a)
            (cond
              ((and (|npEqKey| 'backquote) (|npInfKey| s))
                (setq a (|npPop1|))
                (|npPush| (|tokConstruct| '|idsy| (|tokPart| a) (|tokPosn| a))))
              (t
                (|npRestore| a)
                nil))))))))))
```

—————

7.0.393 defun npInfKey

```
[npPushId p209]
[$stok p??]
[$ttok p??]
```

— defun npInfKey —

```
(defun |npInfKey| (s)
  (declare (special |$ttok| |$stok|))
  (and (eq (caar |$stok|) '|key|) (member |$ttok| s) (|npPushId|)))
```

7.0.394 defun npPushId

```
[tokConstruct p411]
[tokPosn p413]
[npNext p145]
[$stack p??]
[$stok p??]
[$ttok p??]
```

— defun npPushId —

```
(defun |npPushId| ()
  (let (a)
    (declare (special |$stack| |$stok| |$ttok|))
    (setq a (get |$ttok| 'infgeneric))
    (when a (setq |$ttok| a))
    (setq |$stack|
      (cons (|tokConstruct| '|id| |$ttok| (|tokPosn| |$stok|)) |$stack|))
    (|npNext|)))
```

7.0.395 defvar \$npPParg

— initvars —

```
(defvar *npPParg* nil "rewrite npPP without flets, using global scoping")
```

7.0.396 defun npPP

This was rewritten by NAG to remove flet. [npParened p185]
 [npPPf p211]
 [npPileBracketed p188]

[npPPg p210]
 [npPush p143]
 [pfEnSequence p263]
 [npPop1 p144]
 [npPParg p209]

— defun npPP —

```
(defun |npPP| (f)
  (declare (special *npPParg*))
  (setq *npPParg* f)
  (or
    (|npParened| #'npPPf)
    (and (|npPileBracketed| #'npPPg) (|npPush| (|pfEnSequence| (|npPop1|))))
    (funcall f)))
```

—————

7.0.397 defun npPPff

[npPop1 p144]
 [npPush p143]
 [\$npPParg p209]

— defun npPPff —

```
(defun npPPff ()
  (and (funcall *npPParg*) (|npPush| (list (|npPop1|)))))
```

—————

7.0.398 defun npPPg

[npListAndRecover p189]
 [npPPf p211]
 [npPush p143]
 [pfAppend p255]
 [npPop1 p144]

— defun npPPg —

```
(defun npPPg ()
  (and (|npListAndRecover| #'npPPf)
    (|npPush| (|pfAppend| (|npPop1|)))))
```

7.0.399 defun npPPf

[npSemiListing p193]
 [npPPff p210]

— defun npPPf —

```
(defun npPPf ()
  (|npSemiListing| #'npPPff))
```

7.0.400 defun npEnclosed

[npEqKey p145]
 [npPush p143]
 [pfTuple p292]
 [pfListOf p245]
 [npMissingMate p215]
 [pfEnSequence p263]
 [npPop1 p144]
 [\$stok p??]

— defun npEnclosed —

```
(defun |npEnclosed| (open close fn f)
  (let (a)
    (declare (special |$stok|))
    (setq a |$stok|)
    (when (|npEqKey| open)
      (cond
        ((|npEqKey| close)
         (|npPush| (funcall fn a (|pfTuple| (|pfListOf| NIL))))))
        ((and (apply f nil)
              (or (|npEqKey| close)
                  (|npMissingMate| close a)))
         (|npPush| (funcall fn a (|pfEnSequence| (|npPop1|))))))
        ('t nil))))
```

7.0.401 defun npState

```
[ $stack p?? ]
[ $inputStream p?? ]
```

— defun npState —

```
(defun |npState| ()
  (declare (special |$stack| |$inputStream|))
  (cons |$inputStream| |$stack|))
```

—————

7.0.402 defun npTrap

```
[ trappoint p?? ]
[ tokPosn p413 ]
[ ncSoftError p351 ]
[ $stok p?? ]
```

— defun npTrap —

```
(defun |npTrap| ()
  (declare (special |$stok|))
  (|ncSoftError| (|tokPosn| |$stok|) 'S2CY0002 nil)
  (throw 'trappoint 'trapped))
```

—————

7.0.403 defun npTrapForm

```
[ trappoint p?? ]
[ pfSourceStok p243 ]
[ syGeneralErrorHere p192 ]
[ ncSoftError p351 ]
[ tokPosn p413 ]
```

— defun npTrapForm —

```
(defun |npTrapForm| (x)
  (let (a)
    (setq a (|pfSourceStok| x))
    (cond
      ((eq a ' |NoToken|)
```



```

(|syGeneralErrorHere|)
(throw 'trappoint 'trapped))
(t
  (|ncSoftError| (|tokPosn| a) 'S2CY0002 nil)
  (throw 'trappoint 'trapped))))))

```

7.0.404 defun npVariable

```

[npParenthesized p214]
[npVariablelist p213]
[npVariableName p213]
[npPush p143]
[pfListOf p245]
[npPop1 p144]

```

— defun npVariable —

```

(defun |npVariable| ()
  (or
    (|npParenthesized| #'|npVariablelist|)
    (and (|npVariableName|) (|npPush| (|pfListOf| (list (|npPop1|)))))))

```

7.0.405 defun npVariablelist

```

[npListing p155]
[npVariableName p213]

```

— defun npVariablelist —

```

(defun |npVariablelist| ()
  (|npListing| #'|npVariableName|))

```

7.0.406 defun npVariableName

```

[npName p204]
[npDecl p214]

```

```
[npPush p143]
[pfTyped p290]
[npPop1 p144]
[pfNothing p245]
```

— defun npVariableName —

```
(defun |npVariableName| ()
  (and
    (|npName|)
    (or (|npDecl|) (|npPush| (|pfTyped| (|npPop1|) (|pfNothing|)))))
```

—————

7.0.407 defun npDecl

```
[npEqKey p145]
[npType p149]
[npTrap p212]
[npPush p143]
[pfTyped p290]
[npPop2 p144]
[npPop1 p144]
```

— defun npDecl —

```
(defun |npDecl| ()
  (and
    (|npEqKey| 'colon)
    (or (|npType|) (|npTrap|))
    (|npPush| (|pfTyped| (|npPop2|) (|npPop1|)))))
```

—————

7.0.408 defun npParenthesized

```
[npParenthesize p215]
```

— defun npParenthesized —

```
(defun |npParenthesized| (f)
  (or (|npParenthesize| '(| ')| f) (|npParenthesize| '(\|| '|\)| f)))
```

—————

7.0.409 defun npParenthesize

[npEqKey p145]
 [npMissingMate p215]
 [npPush p143]
 [\$stok p??]

— defun npParenthesize —

```
(defun |npParenthesize| (open close f)
  (let (a)
    (declare (special |$stok|))
    (setq a |$stok|)
    (cond
      ((|npEqKey| open)
       (cond
         ((and (apply f nil)
              (or (|npEqKey| close)
                  (|npMissingMate| close a))))
         t)
       ((|npEqKey| close) (|npPush| nil))
       (t (|npMissingMate| close a))))
    (t nil))))
```

7.0.410 defun npMissingMate

[ncSoftError p351]
 [tokPosn p413]
 [npMissing p151]

— defun npMissingMate —

```
(defun |npMissingMate| (close open)
  (|ncSoftError| (|tokPosn| open) 'S2CY0008 nil)
  (|npMissing| close))
```

7.0.411 defun npExit

[npBackTrack p148]
 [npAssign p216]

[npPileExit p216]

— defun npExit —

```
(defun |npExit| ()
  (|npBackTrack| #'|npAssign| 'exit #'|npPileExit|))
```

—————

7.0.412 defun npPileExit

```
[npAssign p216]
[npEqKey p145]
[npStatement p170]
[npPush p143]
[pfExit p263]
[npPop2 p144]
[npPop1 p144]
```

— defun npPileExit —

```
(defun |npPileExit| ()
  (and
    (|npAssign|)
    (or (|npEqKey| 'exit) (|npTrap|))
    (or (|npStatement|) (|npTrap|))
    (|npPush| (|pfExit| (|npPop2|) (|npPop1|)))))
```

—————

7.0.413 defun npAssign

```
[npBackTrack p148]
[npMDEF p165]
[npAssignment p217]
```

— defun npAssign —

```
(defun |npAssign| ()
  (|npBackTrack| #'|npMDEF| 'becomes #'|npAssignment|))
```

—————

7.0.414 defun npAssignment

[npAssignVariable p217]
 [npEqKey p145]
 [npTrap p212]
 [npGives p148]
 [npPush p143]
 [pfAssign p255]
 [npPop2 p144]
 [npPop1 p144]

— **defun npAssignment** —

```
(defun |npAssignment| ()
  (and
    (|npAssignVariable|)
    (or (|npEqKey| 'becomes) (|npTrap|))
    (or (|npGives|) (|npTrap|))
    (|npPush| (|pfAssign| (|npPop2|) (|npPop1|)))))
```

—————

7.0.415 defun npAssignVariable

[npColon p217]
 [npPush p143]
 [pfListOf p245]
 [npPop1 p144]

— **defun npAssignVariable** —

```
(defun |npAssignVariable| ()
  (and (|npColon|) (|npPush| (|pfListOf| (list (|npPop1|))))))
```

—————

7.0.416 defun npColon

[npTypified p218]
 [npAnyNo p162]
 [npTagged p218]

— **defun npColon** —

```
(defun |npColon| ()
  (and (|npTypified|) (|npAnyNo| #'|npTagged|)))
```

7.0.417 defun npTagged

```
[npTypedForm1 p218]
[pfTagged p288]
```

— defun npTagged —

```
(defun |npTagged| ()
  (|npTypedForm1| 'colon #'|pfTagged|))
```

7.0.418 defun npTypedForm1

```
[npEqKey p145]
[npType p149]
[npTrap p212]
[npPush p143]
[npPop2 p144]
[npPop1 p144]
```

— defun npTypedForm1 —

```
(defun |npTypedForm1| (sy fn)
  (and
    (|npEqKey| sy)
    (or (|npType|) (|npTrap|))
    (|npPush| (funcall fn (|npPop2|) (|npPop1|)))))
```

7.0.419 defun npTypified

```
[npApplication p162]
[npAnyNo p162]
[npTypeStyle p219]
```

— defun npTypified —

```
(defun |npTypified| ()
  (and (|npApplication|) (|npAnyNo| #'|npTypeStyle|)))
```

7.0.420 defun npTypeStyle

```
[npCoerceTo p220]
[npRestrict p220]
[npPretend p219]
[npColonQuery p219]
```

— defun npTypeStyle —

```
(defun |npTypeStyle| ()
  (or (|npCoerceTo|) (|npRestrict|) (|npPretend|) (|npColonQuery|)))
```

7.0.421 defun npPretend

```
[npTypedForm p220]
[pfPretend p281]
```

— defun npPretend —

```
(defun |npPretend| ()
  (|npTypedForm| 'pretend #'|pfPretend|))
```

7.0.422 defun npColonQuery

```
[npTypedForm p220]
[pfRetractTo p284]
```

— defun npColonQuery —

```
(defun |npColonQuery| ()
  (|npTypedForm| 'atat #'|pfRetractTo|))
```

7.0.423 defun npCoerceTo

[npTypedForm p220]
 [pfCoerceto p259]

— defun npCoerceTo —

```
(defun |npCoerceTo| ()
  (|npTypedForm| 'coerce #'|pfCoerceto|))
```

—————

7.0.424 defun npTypedForm

[npEqKey p145]
 [npApplication p162]
 [npTrap p212]
 [npPush p143]
 [npPop2 p144]
 [npPop1 p144]

— defun npTypedForm —

```
(defun |npTypedForm| (sy fn)
  (and
    (|npEqKey| sy)
    (or (|npApplication|) (|npTrap|))
    (|npPush| (funcall fn (|npPop2|) (|npPop1|))))))
```

—————

7.0.425 defun npRestrict

[npTypedForm p220]
 [pfRestrict p283]

— defun npRestrict —

```
(defun |npRestrict| ()
  (|npTypedForm| 'at #'|pfRestrict|))
```

—————

7.0.426 defun npListofFun

```
[npTrap p212]
[npPush p143]
[npPop3 p144]
[npPop2 p144]
[npPop1 p144]
[$stack p??]
```

— **defun npListofFun** —

```
(defun |npListofFun| (f h g)
  (let (a)
    (declare (special |$stack|))
    (cond
      ((apply f nil)
       (cond
         ((and (apply h nil) (or (apply f nil) (|npTrap|)))
          (setq a |$stack|)
          (setq |$stack| nil)
          (do ()
              ((not (and (apply h nil)
                        (or (apply f nil) (|npTrap|))))))
          (setq |$stack| (cons (nreverse |$stack|) a))
          (|npPush| (funcall g (cons (|npPop3|) (cons (|npPop2|) (|npPop1|))))))
          (t t)))
       (t nil))))
```

7.1 Macro handling**7.1.1 defun phMacro**

TPDHERE: The pform function has a leading percent sign. fix this

```
carrier[ptree,...] -> carrier[ptree, ptreePremacro,...]
```

```
[ncEltQ p416]
[ncPutQ p416]
[macroExpanded p222]
[pform p??]
```

— **defun phMacro** —

```
(defun |phMacro| (carrier)
```

```
(let (ptree)
  (setq ptree (|ncEltQ| carrier '|ptree|))
  (|ncPutQ| carrier '|ptreePremacro| ptree)
  (setq ptree (|macroExpanded| ptree))
  (|ncPutQ| carrier '|ptree| ptree)
  'ok))
```

7.1.2 defun macroExpanded

\$macActive is a list of the bodies being expanded. \$posActive is a list of the parse forms where the bodies came from. [macExpand p222]

[\$posActive p??]

[\$macActive p??]

— defun macroExpanded —

```
(defun |macroExpanded| (pf)
  (let (|$posActive| |$macActive|)
    (declare (special |$posActive| |$macActive|))
    (setq |$macActive| nil)
    (setq |$posActive| nil)
    (|macExpand| pf)))
```

7.1.3 defun macExpand

[pfWhere? p294]
 [macWhere p228]
 [pfLambda? p273]
 [macLambda p228]
 [pfMacro? p277]
 [macMacro p229]
 [pfId? p246]
 [macId p227]
 [pfApplication? p255]
 [macApplication p223]
 [pfMapParts p236]
 [macExpand p222]

— defun macExpand —

```
(defun |macExpand| (pf)
  (cond
    ((|pfWhere?| pf)      (|macWhere| pf))
    ((|pfLambda?| pf)     (|macLambda| pf))
    ((|pfMacro?| pf)      (|macMacro| pf))
    ((|pfId?| pf)         (|macId| pf))
    ((|pfApplication?| pf) (|macApplication| pf))
    (t                    (|pfMapParts| #'|macExpand| pf))))
```

7.1.4 defun macApplication

```
[pfMapParts p236]
[macExpand p222]
[pfApplicationOp p254]
[pfMLambda? p278]
[pf0ApplicationArgs p237]
[mac0MLambdaApply p223]
[$pfMacros p98]
```

— defun macApplication —

```
(defun |macApplication| (pf)
  (let (args op)
    (declare (special |$pfMacros|))
    (setq pf (|pfMapParts| #'|macExpand| pf))
    (setq op (|pfApplicationOp| pf))
    (cond
      ((null (|pfMLambda?| op)) pf)
      (t
       (setq args (|pf0ApplicationArgs| pf))
       (|mac0MLambdaApply| op args pf |$pfMacros|))))
```

7.1.5 defun mac0MLambdaApply

TPDHERE: The pform function has a leading percent sign. fix this [pf0MLambdaArgs p278]

```
[pfMLambdaBody p279]
[pfSourcePosition p238]
[ncHardError p352]
[pfId? p246]
```

```
[pform p??]
[mac0Define p230]
[mac0ExpandBody p224]
[$pfMacros p98]
[$posActive p??]
[$macActive p??]
```

— **defun mac0MLambdaApply** —

```
(defun |mac0MLambdaApply| (mlambda args opf |$pfMacros|)
  (declare (special |$pfMacros|))
  (let (pos body params)
    (declare (special |$posActive| |$macActive|))
    (setq params (|pf0MLambdaArgs| mlambda))
    (setq body (|pfMLambdaBody| mlambda))
    (cond
      ((not (eql (length args) (length params)))
       (setq pos (|pfSourcePosition| opf))
       (|incHardError| pos 'S2CM0003 (list (length params) (length args))))
      (t
       (lambda (parms p arrgs a) ; for p in params for a in args repeat
         (loop
          (cond
            ((or (atom parms)
                 (progn (setq p (car parms)) nil)
                 (atom arrgs)
                 (progn (setq a (CAR arrgs)) nil))
             (return nil))
            (t
             (cond
              ((null (|pfId?| p))
               (setq pos (|pfSourcePosition| opf))
               (|incHardError| pos 'S2CM0004 (list (|%pform| p))))
              (t
               (|mac0Define| (|pfIdSymbol| p) '|mparam| a))))
             (setq parms (cdr parms))
             (setq arrgs (cdr arrgs))))
          params nil args nil)
       (|mac0ExpandBody| body opf |$macActive| |$posActive|))))))
```

—————

7.1.6 defun mac0ExpandBody

```
[pfSourcePosition p238]
[mac0InfiniteExpansion p225]
[macExpand p222]
```

```
[$posActive p??]
[$macActive p??]
```

— defun mac0ExpandBody —

```
(defun |mac0ExpandBody| (body opf |$macActive| |$posActive|)
  (declare (special |$macActive| |$posActive|))
  (let (posn pf)
    (cond
      ((member body |$macActive|)
       (setq pf (cadr |$posActive|))
       (setq posn (|pfSourcePosition| pf))
       (|mac0InfiniteExpansion| posn body |$macActive|))
      (t
       (setq |$macActive| (cons body |$macActive|))
       (setq |$posActive| (cons opf |$posActive|))
       (|macExpand| body))))))
```

7.1.7 defun mac0InfiniteExpansion

TPDHERE: The pform function has a leading percent sign. fix this [mac0InfiniteExpansion,name p226]

```
[ncSoftError p351]
[pform p??]
```

— defun mac0InfiniteExpansion —

```
(defun |mac0InfiniteExpansion| (posn body active)
  (let (rnames fname tmp1 blist result)
    (setq blist (cons body active))
    (setq tmp1 (mapcar #'|mac0InfiniteExpansion,name| blist))
    (setq fname (car tmp1)) ;[fname, :rnames] := [name b for b in blist]
    (setq rnames (cdr tmp1))
    (|ncSoftError| posn 'S2CM0005
      (list
        (dolist (n (reverse rnames) (nreverse result))
          (setq result (append (reverse (list n "==">)) result)))
        fname (|%pform| body)))
    body))
```

7.1.8 defun mac0InfiniteExpansion,name

[mac0GetName p226]
[pname p1047]

— defun mac0InfiniteExpansion,name 0 —

```
(defun |mac0InfiniteExpansion,name| (b)
  (let (st sy got)
    (setq got (|mac0GetName| b))
    (cond
      ((null got) "??")
      (t
       (setq sy (car got))
       (setq st (cadr got))
       (if (eq st '|mlambda|)
           (concat (pname sy) "...")
           (pname sy))))))
```

7.1.9 defun mac0GetName

Returns [state, body] or NIL. Returns [sy, state] or NIL. [pfMLambdaBody p279]
[\$pfMacros p98]

— defun mac0GetName —

```
(defun |mac0GetName| (body)
  (let (bd tmp1 st tmp2 sy name)
    (declare (special |$pfMacros|))
    ; for [sy,st,bd] in $pfMacros while not name repeat
    ((lambda (macros tmplist)
      (loop
        (cond
          ((or (atom macros)
               (progn (setq tmplist (car macros)) nil)
               name)
           (return nil))
          (t
           (and (consp tmplist)
                (progn
                  (setq sy (car tmplist))
                  (setq tmp2 (cdr tmplist))
                  (and (consp tmp2)
                       (progn
                        (setq st (car tmp2))

```

```

      (setq tmp1 (cdr tmp2))
      (and (consp tmp1)
            (eq (cdr tmp1) nil)
            (progn
              (setq bd (car tmp1))
              t))))))
    (progn
      (when (eq st 'mlambda) (setq bd (|pfMLambdaBody| bd)))
      (when (eq bd body) (setq name (list sy st))))))
    (setq macros (cdr macros)))
  |$pfMacros| nil)
  name))

```

7.1.10 defun macId

```

[pfIdSymbol p247]
[mac0Get p228]
[pfCopyWithPos p236]
[pfSourcePosition p238]
[mac0ExpandBody p224]
[$posActive p??]
[$macActive p??]

```

— defun macId —

```

(defun |macId| (pf)
  (let (body state got sy)
    (declare (special |$posActive| |$macActive|))
    (setq sy (|pfIdSymbol| pf))
    (cond
      ((null (setq got (|mac0Get| sy))) pf)
      (t
       (setq state (car got))
       (setq body (cadr got))
       (cond
         ((eq state 'mparam) body)
         ((eq state 'mlambda) (|pfCopyWithPos| body (|pfSourcePosition| pf)))
         (t
          (|pfCopyWithPos|
           (|mac0ExpandBody| body pf |$macActive| |$posActive|)
           (|pfSourcePosition| pf)))))))

```

7.1.11 defun mac0Get

[ifcdr p??]
 [\$pfMacros p98]

— defun mac0Get —

```
(defun |mac0Get| (sy)
  (declare (special |$pfMacros|))
  (ifcdr (assoc sy |$pfMacros|)))
```

—————

7.1.12 defun macWhere

[macWhere,mac p228]
 [\$pfMacros p98]

— defun macWhere —

```
(defun |macWhere| (pf)
  (declare (special |$pfMacros|))
  (|macWhere,mac| pf |$pfMacros|))
```

—————

7.1.13 defun macWhere,mac

[pfMapParts p236]
 [macExpand p222]
 [\$pfMacros p98]

— defun macWhere,mac —

```
(defun |macWhere,mac| (pf |$pfMacros|)
  (declare (special |$pfMacros|))
  (|pfMapParts| #'|macExpand| pf))
```

—————

7.1.14 defun macLambda

[macLambda,mac p229]
 [\$pfMacros p98]

— defun macLambda —

```
(defun |macLambda| (pf)
  (declare (special |$pfMacros|))
  (|macLambda,mac| pf |$pfMacros|))
```

—————

7.1.15 defun macLambda,mac

[pfMapParts p236]
 [macExpand p222]
 [\$pfMacros p98]

— defun macLambda,mac —

```
(defun |macLambda,mac| (pf |$pfMacros|)
  (declare (special |$pfMacros|))
  (|pfMapParts| #'|macExpand| pf))
```

—————

7.1.16 defun Add appropriate definition the a Macro pform

This function adds the appropriate definition and returns the original Macro pform. **TPDHERE:**
The pform function has a leading percent sign. fix this [pfMacroLhs p277]

[pfMacroRhs p277]
 [pfId? p246]
 [ncSoftError p351]
 [pfSourcePosition p238]
 [pfIdSymbol p247]
 [mac0Define p230]
 [pform p??]
 [pfMLambda? p278]
 [macSubstituteOuter p230]
 [pfNothing? p245]
 [pfMacro p277]
 [pfNothing p245]

— defun macMacro —

```
(defun |macMacro| (pf)
  (let (sy rhs lhs)
```

```

(setq lhs (|pfMacroLhs| pf))
(setq rhs (|pfMacroRhs| pf))
(cond
  ((null (|pfId?| lhs))
    (|ncSoftError| (|pfSourcePosition| lhs) 'S2CM0001 (list (|%pform| lhs)))
    pf)
  (t
    (setq sy (|pfIdSymbol| lhs))
    (|mac0Define| sy
      (cond
        ((|pfMLambda?| rhs) 'mlambda|)
        (t 'mbody|))
      (|macSubstituteOuter| rhs))
    (cond
      ((|pfNothing?| rhs) pf)
      (t (|pfMacro| lhs (|pfNothing|))))))))

```

7.1.17 defun Add a macro to the global pfMacros list

[|\$pfMacros| p98]

— defun mac0Define 0 —

```

(defun |mac0Define| (sy state body)
  (declare (special |$pfMacros|))
  (setq |$pfMacros| (cons (list sy state body) |$pfMacros|)))

```

7.1.18 defun macSubstituteOuter

[|mac0SubstituteOuter| p231]
 [|macLambdaParameterHandling| p231]

— defun macSubstituteOuter —

```

(defun |macSubstituteOuter| (pform)
  (|mac0SubstituteOuter| (|macLambdaParameterHandling| nil pform) pform))

```

7.1.19 defun mac0SubstituteOuter

[pfId? p246]
 [macSubstituteId p232]
 [pfLeaf? p247]
 [pfLambda? p273]
 [macLambdaParameterHandling p231]
 [mac0SubstituteOuter p231]
 [pfParts p249]

— **defun mac0SubstituteOuter** —

```
(defun |mac0SubstituteOuter| (replist pform)
  (let (tmplist)
    (cond
      ((|pfId?| pform) (|macSubstituteId| replist pform))
      ((|pfLeaf?| pform) pform)
      ((|pfLambda?| pform)
       (setq tmplist (|macLambdaParameterHandling| replist pform))
       (dolist (p (|pfParts| pform)) (|mac0SubstituteOuter| tmplist p))
       pform)
      (t
       (dolist (p (|pfParts| pform)) (|mac0SubstituteOuter| replist p))
       pform))))
```

—————

7.1.20 defun macLambdaParameterHandling

[pfLeaf? p247]
 [pfLambda? p273]
 [pfTypedId p291]
 [pf0LambdaArgs p274]
 [pfIdSymbol p247]
 [pfMLambda? p278]
 [pf0MLambdaArgs p278]
 [pfLeaf p247]
 [pfAbSynOp p412]
 [pfLeafPosition p248]
 [pfParts p249]
 [macLambdaParameterHandling p231]

— **defun macLambdaParameterHandling** —

```
(defun |macLambdaParameterHandling| (replist pform)
  (let (parlist symlist result)
```

```

(cond
  ((|pfLeaf?| pform) nil)
  ((|pfLambda?| pform) ; remove ( identifier . replacement ) from assoclist
   (setq parlist (mapcar #'|pfTypedId| (|pf0LambdaArgs| pform)))
   (setq symlist (mapcar #'|pfIdSymbol| parlist))
   (dolist (par symlist)
     (setq replist
       (let ((pr (assoc par replist :test #'equal)))
         (when pr (remove par replist :test #'equal))))))
   replist)
  ((|pfMLambda?| pform) ;construct assoclist ( identifier . replacement )
   (setq parlist (|pf0MLambdaArgs| pform)) ; extract parameter list
   (dolist (par parlist (nreverse result))
     (push
      (cons (|pfIdSymbol| par)
            (|pfLeaf| (|pfAbSynOp| par) (gensym) (|pfLeafPosition| par)))
      result)))
  (t
   (dolist (p (|pfParts| pform))
     (|macLambdaParameterHandling| replist p))))))

```

7.1.21 defun macSubstituteId

[pfIdSymbol p247]

— defun macSubstituteId —

```

(defun |macSubstituteId| (repllist pform)
  (let (ex)
    (setq ex (assoc (|pfIdSymbol| pform) replist :test #'eq))
    (cond
      (ex
       (rplaca pform (cadr ex))
       (rplacd pform (caddr ex))
       pform)
      (t pform))))

```

Chapter 8

Pftrees

8.1 Abstract Syntax Trees Overview

Th functions create and examine abstract syntax trees. These are called pforms, for short.

The pform data structure

- Leaves: [hd, tok, pos] where pos is optional
- Trees: [hd, tree, tree, ...]
- hd is either an id or (id . alist)

The leaves are:

char	:=	('char expr position)
Document	:=	('Document expr position)
error	:=	('error expr position)
expression	:=	('expression expr position)
float	:=	('float expr position)
id	:=	('id expr position)
idsy	:=	('idsy expr position)
integer	:=	('integer expr position)
string	:=	('string expr position)
symbol	:=	('symbol expr position)

The special nodes:

ListOf	:=	('listOf items)
Nothing	:=	('nothing)
SemiColon	:=	('SemiColon (Body: Expr))

The expression nodes:

Add	:= ('Add (Base: [Typed], Addin: Expr))
And	:= ('And left right)
Application	:= ('Application (Op: Expr, Arg: Expr))
Assign	:= ('Assign (LhsItems: [AssLhs], Rhs: Expr))
Attribute	:= ('Attribute (Expr: Primary))
Break	:= ('Break (From: ? Id))
Coerceto	:= ('Coerceto (Expr: Expr, Type: Type))
Collect	:= ('Collect (Body: Expr, Iterators: [Iterator]))
ComDefinition	:= ('ComDefinition (Doc: Document, Def: Definition))
DeclPart	
Definition	:= ('Definition (LhsItems: [Typed], Rhs: Expr))
DefinitionSequence	:= (Args: [DeclPart])
Do	:= ('Do (Body: Expr))
Document	:= ('Document strings)
DWhere	:= ('DWhere (Context: [DeclPart], Expr: [DeclPart]))
EnSequence	:=
Exit	:= ('Exit (Cond: ? Expr, Expr: ? Expr))
Export	:= ('Export (Items: [Typed]))
Forin	:= ('Forin (Lhs: [AssLhs], Whole: Expr))
Free	:= ('Free (Items: [Typed]))
Fromdom	:= ('Fromdom (What: Id, Domain: Type))
Hide	:= ('hide, arg)
If	:= ('If (Cond: Expr, Then: Expr, Else: ? Expr))
Import	:= ('Import (Items: [QualType]))
Inline	:= ('Inline (Items: [QualType]))
Iterate	:= ('Iterate (From: ? Id))
Lambda	:= ('Lambda (Args: [Typed], Rets: ReturnedTyped, Body: Expr))
Literal	
Local	:= ('Local (Items: [Typed]))
Loop	:= ('Loop (Iterators: [Iterator]))
Macro	:= ('Macro (Lhs: Id, Rhs: ExprorNot))
MLambda	:= ('MLambda (Args: [Id], Body: Expr))
Not	:= ('Not arg)
Novalue	:= ('Novalue (Expr: Expr))
Or	:= ('Or left right)
Pretend	:= ('Pretend (Expr: Expr, Type: Type))
QualType	:= ('QualType (Type: Type, Qual: ? Type))
Restrict	:= ('Restrict (Expr: Expr, Type: Type))
Retract	:= ('RetractTo (Expr: Expr, Type: Type))
Return	:= ('Return (Expr: ? Expr, From: ? Id))
ReturnTyped	:= ('returntyuped (type body))
Rule	:= ('Rule (lhsitems, rhsitems))
Sequence	:= ('Sequence (Args: [Expr]))
Suchthat	:= ('Suchthat (Cond: Expr))
Symb	:= if leaf then symbol else expression
Tagged	:= ('Tagged (Tag: Expr, Expr: Expr))
TLambda	:= ('TLambda (Args: [Typed], Rets: ReturnedTyped Type, Body: Expr))
Tuple	:= ('Tuple (Parts: [Expr]))
Typed	:= ('Typed (Id: Id, Type: ? Type))
Typing	:= ('Typing (Items: [Typed]))
Until	:= ('Until (Cond: Expr)) NOT USED
WDeclare	:= ('WDeclare (Signature: Typed, Doc: ? Document))
Where	:= ('Where (Context: [DeclPart], Expr: Expr))
While	:= ('While (Cond: Expr))
With	:= ('With (Base: [Typed], Within: [WithPart]))

Special cases of expression nodes are:

- Application. The Op parameter is one of `and`, `or`, `Y`, `|`, `{}`, `[]`, `{|}|`, `[|]|`
- DeclPart. The comment is attached to all signatutres in Typing, Import, Definition, Sequence, DWhere, Macro nodes
- EnSequence. This is either a Tuple or Sequence depending on the argument
- Literal. One of integer symbol expression one zero char string float of the form ('expression expr position)

8.2 Structure handlers

8.2.1 defun pfGlobalLinePosn

[poGlobalLinePosn p72]

— defun pfGlobalLinePosn —

```
(defun |pfGlobalLinePosn| (posn)
  (|poGlobalLinePosn| posn))
```

—————

8.2.2 defun pfCharPosn

[poCharPosn p377]

— defun pfCharPosn —

```
(defun |pfCharPosn| (posn)
  (|poCharPosn| posn))
```

—————

8.2.3 defun pfLinePosn

[poLinePosn p361]

— defun pfLinePosn —

```
(defun |pfLinePosn| (posn)
  (|poLinePosn| posn))
```

8.2.4 defun pfFileName

[poFileName p360]

— defun pfFileName —

```
(defun |pfFileName| (posn)
  (|poFileName| posn))
```

8.2.5 defun pfCopyWithPos

[pfLeaf? p247]
 [pfLeaf p247]
 [pfAbSynOp p412]
 [tokPart p413]
 [pfTree p252]
 [pfParts p249]
 [pfCopyWithPos p236]

— defun pfCopyWithPos —

```
(defun |pfCopyWithPos| (pform pos)
  (if (|pfLeaf?| pform)
      (|pfLeaf| (|pfAbSynOp| pform) (|tokPart| pform) pos)
      (|pfTree| (|pfAbSynOp| pform)
                (loop for p in (|pfParts| pform)
                      collect (|pfCopyWithPos| p pos))))))
```

8.2.6 defun pfMapParts

[pfLeaf? p247]
 [pfParts p249]
 [pfTree p252]

[pfAbSynOp p412]

— defun pfMapParts —

```
(defun |pfMapParts| (f pform)
  (let (parts1 parts0)
    (if (|pfLeaf?| pform)
        pform
        (progn
         (setq parts0 (|pfParts| pform))
         (setq parts1 (loop for p in parts0 collect (funcall f p)))
         (if (reduce #'(lambda (u v) (and u v)) (mapcar #'eq parts0 parts1))
             pform
             (|pfTree| (|pfAbSynOp| pform) parts1))))))
```

—————

8.2.7 defun pf0ApplicationArgs

[pf0FlattenSyntacticTuple p237]

[pfApplicationArg p254]

— defun pf0ApplicationArgs —

```
(defun |pf0ApplicationArgs| (pform)
  (|pf0FlattenSyntacticTuple| (|pfApplicationArg| pform)))
```

—————

8.2.8 defun pf0FlattenSyntacticTuple

[pfTuple? p292]

[pf0FlattenSyntacticTuple p237]

[pf0TupleParts p293]

— defun pf0FlattenSyntacticTuple —

```
(defun |pf0FlattenSyntacticTuple| (pform)
  (if (null (|pfTuple?| pform))
      (list pform)
      ; [:pf0FlattenSyntacticTuple p for p in pf0TupleParts pform]
      ((lambda (arg0 arg1 p)
         (loop
          (cond
           ((or (atom arg1) (progn (setq p (car arg1)) nil))
```

```

      (return (nreverse arg0)))
    (t
      (setq arg0 (append (reverse (|pf0FlattenSyntacticTuple| p)) arg0)))
      (setq arg1 (cdr arg1)))
    nil (|pf0TupleParts| pform) nil)))

```

8.2.9 defun pfSourcePosition

```

[pfLeaf? p247]
[pfLeafPosition p248]
[poNoPosition? p413]
[pfSourcePosition p238]
[pfParts p249]
[$nopos p28]

```

— defun pfSourcePosition —

```

(defun |pfSourcePosition| (form)
  (let (pos)
    (declare (special |$nopos|))
    (cond
      ((|pfLeaf?| form) (|pfLeafPosition| form))
      (t
        (setq pos |$nopos|)
        ((lambda (theparts p) ; for p in parts while poNoPosition? pos repeat
          (loop
            (cond
              ((or (atom theparts)
                (progn (setq p (car theparts)) nil)
                (not (|poNoPosition?| pos))))
              (return nil))
            (t (setq pos (|pfSourcePosition| p))))
          (setq theparts (cdr theparts))))
        (|pfParts| form) nil)
        pos))))

```

8.2.10 defun Convert a Sequence node to a list

```

[pfSequence? p287]
[pfSequenceArgs p287]
[pfListOf p245]

```

— defun pfSequenceToList —

```
(defun |pfSequenceToList| (x)
  (if (|pfSequence?| x)
      (|pfSequenceArgs| x)
      (|pfListOf| (list x))))
```

—————

8.2.11 defun pfSpread

[pfTyped p290]

— defun pfSpread —

```
(defun |pfSpread| (arg1 arg2)
  (mapcar #'(lambda (i) (|pfTyped| i arg2)) arg1))
```

—————

8.2.12 defun Deconstruct nodes to lists

```
[pfTagged? p289]
[pfTaggedExpr p289]
[pfNothing p245]
[pfTaggedTag p289]
[pfId? p246]
[pfListOf p245]
[pfTyped p290]
[pfCollect1? p242]
[pfCollectVariable1 p242]
[pfTuple? p292]
[pf0TupleParts p293]
[pfTaggedToTyped p289]
[pfDefinition? p261]
[pfApplication? p255]
[pfFlattenApp p241]
[pfTaggedToTyped1 p244]
[pfTransformArg p244]
[npTrapForm p212]
```

— defun pfCheckItOut —

```

(defun |pfCheckItOut| (x)
  (let (args op ls form rt result)
    (if (|pfTagged?| x)
      (setq rt (|pfTaggedExpr| x))
      (setq rt (|pfNothing|)))
    (if (|pfTagged?| x)
      (setq form (|pfTaggedTag| x))
      (setq form x))
    (cond
      ((|pfId?| form)
       (list (|pfListOf| (list (|pfTyped| form rt))) nil rt))
      ((|pfCollect1?| form)
       (list (|pfListOf| (list (|pfCollectVariable1| form))) nil rt))
      ((|pfTuple?| form)
       (list (|pfListOf|
        (dolist (part (|pf0TupleParts| form) (nreverse result))
          (push (|pfTaggedToTyped| part) result)))
        nil rt))
      ((|pfDefinition?| form)
       (list (|pfListOf| (list (|pfTyped| form (|pfNothing|)))) nil rt))
      ((|pfApplication?| form)
       (setq ls (|pfFlattenApp| form))
       (setq op (|pfTaggedToTyped1| (car ls)))
       (setq args
        (dolist (part (cdr ls) (nreverse result))
          (push (|pfTransformArg| part) result)))
       (list (|pfListOf| (list op)) args rt))
      (t (|npTrapForm| form)))))

```

8.2.13 defun pfCheckMacroOut

[pfId? p246]
 [pfApplication? p255]
 [pfFlattenApp p241]
 [pfCheckId p241]
 [pfCheckArg p241]
 [npTrapForm p212]

— defun pfCheckMacroOut —

```

(defun |pfCheckMacroOut| (form)
  (let (args op ls)
    (cond
      ((|pfId?| form) (list form nil))
      ((|pfApplication?| form)

```

```

(setq ls (|pfFlattenApp| form))
(setq op (|pfCheckId| (car ls)))
(setq args (mapcar #'|pfCheckArg| (cdr ls)))
(list op args))
(t (|npTrapForm| form))))

```

8.2.14 defun pfCheckArg

[pfTuple? p292]
 [pf0TupleParts p293]
 [pfListOf p245]
 [pfCheckId p241]

— defun pfCheckArg —

```

(defun |pfCheckArg| (args)
  (let (arg1)
    (if (|pfTuple?| args)
        (setq arg1 (|pf0TupleParts| args))
        (setq arg1 (list args)))
    (|pfListOf| (mapcar #'|pfCheckId| arg1))))

```

8.2.15 defun pfCheckId

[pfId? p246]
 [npTrapForm p212]

— defun pfCheckId —

```

(defun |pfCheckId| (form)
  (if (null (|pfId?| form))
      (|npTrapForm| form)
      form))

```

8.2.16 defun pfFlattenApp

[pfApplication? p255]
 [pfCollect1? p242]

[pfFlattenApp p241]
 [pfApplicationOp p254]
 [pfApplicationArg p254]

— defun pfFlattenApp —

```
(defun |pfFlattenApp| (x)
  (cond
    ((|pfApplication?| x)
     (cond
       ((|pfCollect1?| x) (LIST x))
       (t
        (append (|pfFlattenApp| (|pfApplicationOp| x))
                  (|pfFlattenApp| (|pfApplicationArg| x))))))
    (t (list x))))
```

—————

8.2.17 defun pfCollect1?

[pfApplication? p255]
 [pfApplicationOp p254]
 [pfId? p246]
 [pfIdSymbol p247]

— defun pfCollect1? —

```
(defun |pfCollect1?| (x)
  (let (a)
    (when (|pfApplication?| x)
      (setq a (|pfApplicationOp| x))
      (when (|pfId?| a) (eq (|pfIdSymbol| a) '|\\|))))))
```

—————

8.2.18 defun pfCollectVariable1

[pfApplicationArg p254]
 [pf0TupleParts p293]
 [pfTaggedToTyped p289]
 [pfTyped p290]
 [pfSuch p244]
 [pfTypedId p291]
 [pfTypedType p291]

— defun pfCollectVariable1 —

```
(defun |pfCollectVariable1| (x)
  (let (id var a)
    (setq a (|pfApplicationArg| x))
    (setq var (car (|pf0TupleParts| a)))
    (setq id (|pfTaggedToTyped| var))
    (|pfTyped|
     (|pfSuch| (|pfTypedId| id) (cadr (|pf0TupleParts| a)))
     (|pfTypedType| id))))
```

8.2.19 defun pfPushMacroBody

[pfMLambda p278]
[pfPushMacroBody p243]

— defun pfPushMacroBody —

```
(defun |pfPushMacroBody| (args body)
  (if (null args)
      body
      (|pfMLambda| (car args) (|pfPushMacroBody| (cdr args) body))))
```

8.2.20 defun pfSourceStok

[pfLeaf? p247]
[pfParts p249]
[pfSourceStok p243]
[pfFirst p264]

— defun pfSourceStok —

```
(defun |pfSourceStok| (x)
  (cond
   ((|pfLeaf?| x) x)
   ((null (|pfParts| x)) '|NoToken|)
   (t (|pfSourceStok| (|pfFirst| x)))))
```

8.2.21 defun pfTransformArg

[pfTuple? p292]
 [pf0TupleParts p293]
 [pfListOf p245]
 [pfTaggedToTyped1 p244]

— defun pfTransformArg —

```
(defun |pfTransformArg| (args)
  (let (arglist result)
    (if (|pfTuple?| args)
        (setq arglist (|pf0TupleParts| args))
        (setq arglist (list args)))
    (|pfListOf|
     (dolist (|i| arglist (nreverse result))
       (push (|pfTaggedToTyped1| |i|) result))))))
```

—————→

8.2.22 defun pfTaggedToTyped1

[pfCollect1? p242]
 [pfCollectVariable1 p242]
 [pfDefinition? p261]
 [pfTyped p290]
 [pfNothing p245]
 [pfTaggedToTyped p289]

— defun pfTaggedToTyped1 —

```
(defun |pfTaggedToTyped1| (arg)
  (cond
    ((|pfCollect1?| arg) (|pfCollectVariable1| arg))
    ((|pfDefinition?| arg) (|pfTyped| arg (|pfNothing|)))
    (t (|pfTaggedToTyped| arg))))
```

—————→

8.2.23 defun pfSuch

[pfInfApplication p271]
 [pfId p246]

— defun pfSuch —


```
(defun |pfSuch| (x y)
  (|pfInfApplication| (|pfId| '|\|) x y))
```

8.3 Special Nodes

8.3.1 defun Create a Listof node

[pfTree p252]

— defun pfListOf —

```
(defun |pfListOf| (x)
  (|pfTree| 'listOf x))
```

8.3.2 defun pfNothing

[pfTree p252]

— defun pfNothing —

```
(defun |pfNothing| ()
  (|pfTree| 'nothing nil))
```

8.3.3 defun Is this a Nothing node?

[pfAbSynOp? p412]

— defun pfNothing? —

```
(defun |pfNothing?| (form)
  (|pfAbSynOp?| form 'nothing))
```

8.4 Leaves

8.4.1 defun Create a Document node

[pfLeaf p247]

— defun pfDocument —

```
(defun |pfDocument| (strings)
  (|pfLeaf| '|Document| strings))
```

—————

8.4.2 defun Construct an Id node

[pfLeaf p247]

— defun pfId —

```
(defun |pfId| (expr)
  (|pfLeaf| '|id| expr))
```

—————

8.4.3 defun Is this an Id node?

[pfAbSynOp? p412]

— defun pfId? —

```
(defun |pfId?| (form)
  (or (|pfAbSynOp?| form '|id|) (|pfAbSynOp?| form '|idsy|)))
```

—————

8.4.4 defun Construct an Id leaf node

[pfLeaf p247]

— defun pfIdPos —

```
(defun |pfIdPos| (expr pos)
  (|pfLeaf| ' |id| expr pos))
```

8.4.5 defun Return the Id part

```
[tokPart p413]
```

— defun pfIdSymbol —

```
(defun |pfIdSymbol| (form)
  (|tokPart| form))
```

8.4.6 defun Construct a Leaf node

```
[tokConstruct p411]
```

```
[ifcar p??]
```

```
[pfNoPosition p414]
```

— defun pfLeaf —

```
(defun |pfLeaf| (x y &rest z)
  (|tokConstruct| x y (or (ifcar z) (|pfNoPosition|))))
```

8.4.7 defun Is this a leaf node?

```
[pfAbSynOp p412]
```

— defun pfLeaf? —

```
(defun |pfLeaf?| (form)
  (member (|pfAbSynOp| form)
    '(|id| |idsy| |symbol| |string| |char| |float| |expression|
      |integer| |Document| |error|)))
```

8.4.8 defun Return the token position of a leaf node

[tokPosn p413]

— defun pfLeafPosition —

```
(defun |pfLeafPosition| (form)
  (|tokPosn| form))
```

—————

8.4.9 defun Return the Leaf Token

[tokPart p413]

— defun pfLeafToken —

```
(defun |pfLeafToken| (form)
  (|tokPart| form))
```

—————

8.4.10 defun Is this a Literal node?

[pfAbSynOp p412]

— defun pfLiteral? 0 —

```
(defun |pfLiteral?| (form)
  (member (|pfAbSynOp| form)
    '(|integer| |symbol| |expression| |one| |zero| |char| |string| |float|)))
```

—————

8.4.11 defun Create a LiteralClass node

[pfAbSynOp p412]

— defun pfLiteralClass —

```
(defun |pfLiteralClass| (form)
  (|pfAbSynOp| form))
```

—————

8.4.12 defun Return the LiteralString

[tokPart p413]

— defun pfLiteralString —

```
(defun |pfLiteralString| (form)
  (|tokPart| form))
```

—————

8.4.13 defun Return the parts of a tree node

— defun pfParts 0 —

```
(defun |pfParts| (form)
  (cdr form))
```

—————

8.4.14 defun Return the argument unchanged

— defun pfPile 0 —

```
(defun |pfPile| (part)
  part)
```

—————

8.4.15 defun pfPushBody

[pfLambda p273]

[pfNothing p245]

[pfPushBody p249]

— defun pfPushBody —

```
(defun |pfPushBody| (rt args body)
  (cond
    ((null args) body)
```

```

((null (cdr args)) (|pfLambda| (car args) rt body))
(t
  (|pfLambda| (car args) (|pfNothing|)
    (|pfPushBody| rt (cdr args) body))))

```

8.4.16 defun An S-expression which people can read.

[pfSexpr,strip p250]

— defun pfSexpr —

```

(defun |pfSexpr| (pform)
  (|pfSexpr,strip| pform))

```

8.4.17 defun Create a human readable S-expression

[pfId? p246]
 [pfIdSymbol p247]
 [pfLiteral? p248]
 [pfLiteralString p249]
 [pfLeaf? p247]
 [tokPart p413]
 [pfApplication? p255]
 [pfApplicationArg p254]
 [pfTuple? p292]
 [pf0TupleParts p293]
 [pfApplicationOp p254]
 [pfSexpr,strip p250]
 [pfAbSynOp p412]
 [pfParts p249]

— defun pfSexpr,strip —

```

(defun |pfSexpr,strip| (pform)
  (let (args a result)
    (cond
      ((|pfId?| pform)      (|pfIdSymbol| pform))
      ((|pfLiteral?| pform) (|pfLiteralString| pform))
      ((|pfLeaf?| pform)    (|tokPart| pform))
      ((|pfApplication?| pform)

```

```

(setq a (|pfApplicationArg| pform))
(if (|pfTuple?| a)
    (setq args (|pf0TupleParts| a))
    (setq args (list a)))
(dolist (p (cons (|pfApplicationOp| pform) args) (nreverse result))
  (push (|pfSexpr,strip| p) result)))
(t
  (cons (|pfAbSynOp| pform)
    (dolist (p (|pfParts| pform) (nreverse result))
      (push (|pfSexpr,strip| p) result))))))

```

8.4.18 defun Construct a Symbol or Expression node

```

[pfLeaf? p247]
[pfSymbol p251]
[tokPart p413]
[ifcar p??]
[pfExpression p264]
[pfSexpr p250]

```

— defun pfSymb —

```

(defun |pfSymb| (expr &REST optpos)
  (if (|pfLeaf?| expr)
      (|pfSymbol| (|tokPart| expr) (ifcar optpos))
      (|pfExpression| (|pfSexpr| expr) (ifcar optpos))))

```

8.4.19 defun Construct a Symbol leaf node

```

[pfLeaf p247]
[ifcar p??]

```

— defun pfSymbol —

```

(defun |pfSymbol| (expr &rest optpos)
  (|pfLeaf| '|symbol| expr (ifcar optpos)))

```

8.4.20 defun Is this a Symbol node?

[pfAbSynOp? p412]

— defun pfSymbol? —

```
(defun |pfSymbol?| (form)
  (|pfAbSynOp?| form '|symbol|))
```

8.4.21 defun Return the Symbol part

[tokPart p413]

— defun pfSymbolSymbol —

```
(defun |pfSymbolSymbol| (form)
  (|tokPart| form))
```

8.5 Trees**8.5.1 defun Construct a tree node**

— defun pfTree 0 —

```
(defun |pfTree| (x y)
  (cons x y)))
```

8.5.2 defun Construct an Add node

[pfNothing p245]

[pfTree p252]

— defun pfAdd —


```
(defun |pfAdd| (pfbase pfaddin &rest addon)
  (let (lhs)
    (if addon
      (setq lhs addon)
      (setq lhs (|pfNothing|)))
    (|pfTree| '|Add| (list pfbase pfaddin lhs))))
```

8.5.3 defun Construct an And node

[pfTree p252]

— defun pfAnd —

```
(defun |pfAnd| (pflleft pfright)
  (|pfTree| '|And| (list pflleft pfright)))
```

8.5.4 defun pfAttribute

[pfTree p252]

— defun pfAttribute —

```
(defun |pfAttribute| (pfexpr)
  (|pfTree| '|Attribute| (list pfexpr)))
```

8.5.5 defun Return an Application node

[pfTree p252]

— defun pfApplication —

```
(defun |pfApplication| (pfop pfarg)
  (|pfTree| '|Application| (list pfop pfarg)))
```

8.5.6 defun Return the Arg part of an Application node

— defun pfApplicationArg 0 —

```
(defun |pfApplicationArg| (pf)
  (caddr pf))
```

—————

8.5.7 defun Return the Op part of an Application node

— defun pfApplicationOp 0 —

```
(defun |pfApplicationOp| (pf)
  (cadr pf))
```

—————

8.5.8 defun Is this an And node?

[pfAbSynOp? p412]

— defun pfAnd? —

```
(defun |pfAnd?| (pf)
  (|pfAbSynOp?| pf '|And|))
```

—————

8.5.9 defun Return the Left part of an And node

— defun pfAndLeft 0 —

```
(defun |pfAndLeft| (pf)
  (cadr pf))
```

—————

8.5.10 defun Return the Right part of an And node

— defun pfAndRight 0 —

```
(defun |pfAndRight| (pf)
  (caddr pf))
```

—————

8.5.11 defun Flatten a list of lists

— defun pfAppend 0 —

```
(defun |pfAppend| (list)
  (apply #'append list))
```

—————

8.5.12 defun Is this an Application node?

[pfAbSynOp? p412]

— defun pfApplication? —

```
(defun |pfApplication?| (pf)
  (|pfAbSynOp?| pf '|Application|))
```

—————

8.5.13 defun Create an Assign node

[pfTree p252]

— defun pfAssign —

```
(defun |pfAssign| (pflhsitems pfrhs)
  (|pfTree| '|Assign| (list pflhsitems pfrhs)))
```

—————

8.5.14 defun Is this an Assign node?

[pfAbSynOp? p412]

— defun pfAssign? —

```
(defun |pfAssign?| (pf)
  (|pfAbSynOp?| pf '|Assign|))
```

—————

8.5.15 defun Return the parts of an LhsItem of an Assign node

[pfParts p249]

[pfAssignLhsItems p256]

— defun pf0AssignLhsItems 0 —

```
(defun |pf0AssignLhsItems| (pf)
  (|pfParts| (|pfAssignLhsItems| pf)))
```

—————

8.5.16 defun Return the LhsItem of an Assign node

— defun pfAssignLhsItems 0 —

```
(defun |pfAssignLhsItems| (pf)
  (cadr pf))
```

—————

8.5.17 defun Return the RHS of an Assign node

— defun pfAssignRhs 0 —

```
(defun |pfAssignRhs| (pf)
  (caddr pf))
```

—————

8.5.18 defun Construct an application node for a brace

```
[pfApplication p253]
[pfIdPos p246]
[tokPosn p413]
```

— defun pfBrace —

```
(defun |pfBrace| (a part)
  (|pfApplication| (|pfIdPos| '{' (|tokPosn| a)) part))
```

—————

8.5.19 defun Construct an Application node for brace-bars

```
[pfApplication p253]
[pfIdPos p246]
[tokPosn p413]
```

— defun pfBraceBar —

```
(defun |pfBraceBar| (a part)
  (|pfApplication| (|pfIdPos| '|{\|\\|}' (|tokPosn| a)) part))
```

—————

8.5.20 defun Construct an Application node for a bracket

```
[pfApplication p253]
[pfIdPos p246]
[tokPosn p413]
```

— defun pfBracket —

```
(defun |pfBracket| (a part)
  (|pfApplication| (|pfIdPos| '[' (|tokPosn| a)) part))
```

—————

8.5.21 defun Construct an Application node for bracket-bars

```
[pfApplication p253]
[pfIdPos p246]
```

[tokPosn p413]

— defun pfBracketBar —

```
(defun |pfBracketBar| (a part)
  (|pfApplication| (|pfIdPos| '|\| | (|tokPosn| a)) part))
```

—————

8.5.22 defun Create a Break node

[pfTree p252]

— defun pfBreak —

```
(defun |pfBreak| (pffrom)
  (|pfTree| '|Break| (list pffrom)))
```

—————

8.5.23 defun Is this a Break node?

[pfAbSynOp? p412]

— defun pfBreak? —

```
(defun |pfBreak?| (pf)
  (|pfAbSynOp?| pf '|Break|))
```

—————

8.5.24 defun Return the From part of a Break node

— defun pfBreakFrom 0 —

```
(defun |pfBreakFrom| (pf)
  (cadr pf))
```

—————

8.5.25 defun Construct a Coerceto node

[pfTree p252]

— defun pfCoerceto —

```
(defun |pfCoerceto| (pfexpr pftype)
  (|pfTree| '|Coerceto| (list pfexpr pftype)))
```

8.5.26 defun Is this a CoerceTo node?

[pfAbSynOp? p412]

— defun pfCoerceto? —

```
(defun |pfCoerceto?| (pf)
  (|pfAbSynOp?| pf '|Coerceto|))
```

8.5.27 defun Return the Expression part of a CoerceTo node

— defun pfCoercetoExpr 0 —

```
(defun |pfCoercetoExpr| (pf)
  (cadr pf))
```

8.5.28 defun Return the Type part of a CoerceTo node

— defun pfCoercetoType 0 —

```
(defun |pfCoercetoType| (pf)
  (caddr pf))
```

8.5.29 defun Return the Body of a Collect node

— defun pfCollectBody 0 —

```
(defun |pfCollectBody| (pf)
  (cadr pf))
```

—————

8.5.30 defun Return the Iterators of a Collect node

— defun pfCollectIterators 0 —

```
(defun |pfCollectIterators| (pf)
  (caddr pf))
```

—————

8.5.31 defun Create a Collect node

[pfTree p252]

— defun pfCollect —

```
(defun |pfCollect| (pfbody pfiterators)
  (|pfTree| '|Collect| (list pfbody pfiterators)))
```

—————

8.5.32 defun Is this a Collect node?

[pfAbSynOp? p412]

— defun pfCollect? —

```
(defun |pfCollect?| (pf)
  (|pfAbSynOp?| pf '|Collect|))
```

—————

8.5.33 defun pfDefinition

[pfTree p252]

— defun pfDefinition —

```
(defun |pfDefinition| (pflhsitems pfrhs)
  (|pfTree| '|Definition| (list pflhsitems pfrhs)))
```

—————

8.5.34 defun Return the Lhs of a Definition node

— defun pfDefinitionLhsItems 0 —

```
(defun |pfDefinitionLhsItems| (pf)
  (cadr pf))
```

—————

8.5.35 defun Return the Rhs of a Definition node

— defun pfDefinitionRhs 0 —

```
(defun |pfDefinitionRhs| (pf)
  (caddr pf))
```

—————

8.5.36 defun Is this a Definition node?

[pfAbSynOp? p412]

— defun pfDefinition? —

```
(defun |pfDefinition?| (pf)
  (|pfAbSynOp?| pf '|Definition|))
```

—————

8.5.37 defun Return the parts of a Definition node

[pfParts p249]

[pfDefinitionLhsItems p261]

— defun pf0DefinitionLhsItems —

```
(defun |pf0DefinitionLhsItems| (pf)
  (|pfParts| (|pfDefinitionLhsItems| pf)))
```

—————

8.5.38 defun Create a Do node

[pfTree p252]

— defun pfDo —

```
(defun |pfDo| (pfbody)
  (|pfTree| '|Do| (list pfbody)))
```

—————

8.5.39 defun Is this a Do node?

[pfAbSynOp? p412]

— defun pfDo? —

```
(defun |pfDo?| (pf)
  (|pfAbSynOp?| pf '|Do|))
```

—————

8.5.40 defun Return the Body of a Do node

— defun pfDoBody 0 —

```
(defun |pfDoBody| (pf)
  (cadr pf))
```

—————

8.5.41 defun Construct a Sequence node

[pfTuple p292]
 [pfListOf p245]
 [pfSequence p287]

— defun pfEnSequence —

```
(defun |pfEnSequence| (a)
  (cond
    ((null a) (|pfTuple| (|pfListOf| a)))
    ((null (cdr a)) (car a))
    (t (|pfSequence| (|pfListOf| a)))))
```

—————

8.5.42 defun Construct an Exit node

[pfTree p252]

— defun pfExit —

```
(defun |pfExit| (pfcond pfexpr)
  (|pfTree| '|Exit| (list pfcond pfexpr)))
```

—————

8.5.43 defun Is this an Exit node?

[pfAbSynOp? p412]

— defun pfExit? —

```
(defun |pfExit?| (pf)
  (|pfAbSynOp?| pf '|Exit|))
```

—————

8.5.44 defun Return the Cond part of an Exit

— defun pfExitCond 0 —

```
(defun |pfExitCond| (pf)
  (cadr pf))
```

8.5.45 defun Return the Expression part of an Exit

```
— defun pfExitExpr 0 —

(defun |pfExitExpr| (pf)
  (caddr pf))
```

8.5.46 defun Create an Export node

```
[pfTree p252]

— defun pfExport —

(defun |pfExport| (pfitems)
  (|pfTree| '|Export| (list pfitems)))
```

8.5.47 defun Construct an Expression leaf node

```
[pfLeaf p247]
[ifcar p??]

— defun pfExpression —

(defun |pfExpression| (expr &rest optpos)
  (|pfLeaf| '|expression| expr (ifcar optpos)))
```

8.5.48 defun pfFirst

```
— defun pfFirst 0 —
```

```
(defun |pfFirst| (form)
  (cadr form))
```

8.5.49 defun Create an Application Fix node

```
[pfApplication p253]
[pfId p246]
```

— defun pfFix —

```
(defun |pfFix| (pf)
  (|pfApplication| (|pfId| 'Y) pf))
```

8.5.50 defun Create a Free node

```
[pfTree p252]
```

— defun pfFree —

```
(defun |pfFree| (pfitems)
  (|pfTree| '|Free| (list pfitems)))
```

8.5.51 defun Is this a Free node?

```
[pfAbSynOp? p412]
```

— defun pfFree? —

```
(defun |pfFree?| (pf)
  (|pfAbSynOp?| pf '|Free|))
```

8.5.52 defun Return the parts of the Items of a Free node

```
[pfParts p249]
[pfFreeItems p266]

— defun pf0FreeItems —

(defun |pf0FreeItems| (pf)
  (|pfParts| (|pfFreeItems| pf)))
```

8.5.53 defun Return the Items of a Free node

```
— defun pfFreeItems 0 —

(defun |pfFreeItems| (pf)
  (cadr pf))
```

8.5.54 defun Construct a Forin node

```
[pfTree p252]

— defun pfForin —

(defun |pfForin| (pflhs pfwhole)
  (|pfTree| '|Forin| (list pflhs pfwhole)))
```

8.5.55 defun Is this a ForIn node?

```
[pfAbSynOp? p412]

— defun pfForin? —

(defun |pfForin?| (pf)
  (|pfAbSynOp?| pf '|Forin|))
```

8.5.56 defun Return all the parts of the LHS of a ForIn node

[pfParts p249]
 [pfForinLhs p267]

— defun pf0ForinLhs —

```
(defun |pf0ForinLhs| (pf)
  (|pfParts| (|pfForinLhs| pf)))
```

—————

8.5.57 defun Return the LHS part of a ForIn node

— defun pfForinLhs 0 —

```
(defun |pfForinLhs| (pf)
  (cadr pf))
```

—————

8.5.58 defun Return the Whole part of a ForIn node

— defun pfForinWhole 0 —

```
(defun |pfForinWhole| (pf)
  (caddr pf))
```

—————

8.5.59 defun pfFromDom

[pfApplication? p255]
 [pfApplication p253]
 [pfApplicationOp p254]
 [pfApplicationArg p254]
 [pfFromdom p268]

— defun pfFromDom —

```
(defun |pfFromDom| (dom expr)
  (cond
    ((|pfApplication?| expr)
     (|pfApplication|
      (|pfFromDom| (|pfApplicationOp| expr) dom)
      (|pfApplicationArg| expr)))
    (t (|pfFromDom| expr dom))))
```

8.5.60 defun Construct a Fromdom node

[pfTree p252]

— defun pfFromdom —

```
(defun |pfFromdom| (pfwhat pfdomain)
  (|pfTree| '|Fromdom| (list pfwhat pfdomain)))
```

8.5.61 defun Is this a Fromdom mode?

[pfAbSynOp? p412]

— defun pfFromdom? —

```
(defun |pfFromdom?| (pf)
  (|pfAbSynOp?| pf '|Fromdom|))
```

8.5.62 defun Return the What part of a Fromdom node

— defun pfFromdomWhat 0 —

```
(defun |pfFromdomWhat| (pf)
  (cadr pf))
```

8.5.63 defun Return the Domain part of a Fromdom node

— defun pfFromdomDomain 0 —

```
(defun |pfFromdomDomain| (pf)
  (caddr pf))
```

8.5.64 defun Construct a Hide node

[pfTree p252]

— defun pfHide —

```
(defun |pfHide| (a part)
  (declare (ignore a))
  (|pfTree| '|Hide| (list part)))
```

8.5.65 defun pfIf

[pfTree p252]

— defun pfIf —

```
(defun |pfIf| (pfcond pfthen pfelse)
  (|pfTree| '|If| (list pfcond pfthen pfelse)))
```

8.5.66 defun Is this an If node?

[pfAbSynOp? p412]

— defun pfIf? —

```
(defun |pfIf?| (pf)
  (|pfAbSynOp?| pf '|If|))
```

8.5.67 defun Return the Cond part of an If

— defun pfIfCond 0 —

```
(defun |pfIfCond| (pf)
  (cadr pf))
```

—————

8.5.68 defun Return the Then part of an If

— defun pfIfThen 0 —

```
(defun |pfIfThen| (pf)
  (caddr pf))
```

—————

8.5.69 defun pfIfThenOnly

```
[pfIf p269]
[pfNothing p245]
```

— defun pfIfThenOnly —

```
(defun |pfIfThenOnly| (pred cararg)
  (|pfIf| pred cararg (|pfNothing|)))
```

—————

8.5.70 defun Return the Else part of an If

— defun pfIfElse 0 —

```
(defun |pfIfElse| (pf)
  (caddr pf))
```

—————

8.5.71 defun Construct an Import node

[pfTree p252]

— defun pfImport —

```
(defun |pfImport| (pfitems)
  (|pfTree| '|Import| (list pfitems)))
```

—————

8.5.72 defun Construct an Iterate node

[pfTree p252]

— defun pfIterate —

```
(defun |pfIterate| (pffrom)
  (|pfTree| '|Iterate| (list pffrom)))
```

—————

8.5.73 defun Is this an Iterate node?

[pfAbSynOp? p412]

— defun pfIterate? —

```
(defun |pfIterate?| (pf)
  (|pfAbSynOp?| pf '|Iterate|))
```

—————

8.5.74 defun Handle an infix application

[pfListOf p245]

[pfIdSymbol p247]

[pfAnd p253]

[pfOr p280]

[pfApplication p253]

[pfTuple p292]

— defun pfInfApplication —

```
(defun |pfInfApplication| (op left right)
  (cond
    ((eq (|pfIdSymbol| op) '|and|) (|pfAnd| left right))
    ((eq (|pfIdSymbol| op) '|or|) (|pfOr| left right))
    (t (|pfApplication| op (|pfTuple| (|pfListOf| (list left right)))))))
```

8.5.75 defun Create an Inline node

[pfTree p252]

— defun pfInline —

```
(defun |pfInline| (pfitems)
  (|pfTree| '|Inline| (list pfitems)))
```

8.5.76 defun pfLam

[pfAbSynOp? p412]
 [pfFirst p264]
 [pfNothing p245]
 [pfSecond p286]
 [pfLambda p273]

— defun pfLam —

```
(defun |pfLam| (variable body)
  (let (bdy rets)
    (if (|pfAbSynOp?| body '|returntyped|)
        (setq rets (|pfFirst| body))
        (setq rets (|pfNothing|)))
    (if (|pfAbSynOp?| body '|returntyped|)
        (setq bdy (|pfSecond| body))
        (setq bdy body))
    (|pfLambda| variable rets bdy)))
```

8.5.77 defun pfLambda

[pfTree p252]

— defun pfLambda —

```
(defun |pfLambda| (pfargs pfrets pfbody)
  (|pfTree| '|Lambda| (list pfargs pfrets pfbody)))
```

—————

8.5.78 defun Return the Body part of a Lambda node

— defun pfLambdaBody 0 —

```
(defun |pfLambdaBody| (pf)
  (caddr pf))
```

—————

8.5.79 defun Return the Rets part of a Lambda node

— defun pfLambdaRets 0 —

```
(defun |pfLambdaRets| (pf)
  (caddr pf))
```

—————

8.5.80 defun Is this a Lambda node?

[pfAbSynOp? p412]

— defun pfLambda? —

```
(defun |pfLambda?| (pf)
  (|pfAbSynOp?| pf '|Lambda|))
```

—————

8.5.81 defun Return the Args part of a Lambda node

— defun pfLambdaArgs 0 —

```
(defun |pfLambdaArgs| (pf)
  (cadr pf))
```

—————

8.5.82 defun Return the Args of a Lambda Node

[pfParts p249]
[pfLambdaArgs p274]

— defun pf0LambdaArgs —

```
(defun |pf0LambdaArgs| (pf)
  (|pfParts| (|pfLambdaArgs| pf)))
```

—————

8.5.83 defun Construct a Local node

[pfTree p252]

— defun pfLocal —

```
(defun |pfLocal| (pfitems)
  (|pfTree| '|Local| (list pfitems)))
```

—————

8.5.84 defun Is this a Local node?

[pfAbSynOp? p412]

— defun pfLocal? —

```
(defun |pfLocal?| (pf)
  (|pfAbSynOp?| pf '|Local|))
```

—————

8.5.85 defun Return the parts of Items of a Local node

```
[pfParts p249]
[pfLocalItems p275]

— defun pf0LocalItems —

(defun |pf0LocalItems| (pf)
  (|pfParts| (|pfLocalItems| pf)))
```

8.5.86 defun Return the Items of a Local node

```
— defun pfLocalItems 0 —

(defun |pfLocalItems| (pf)
  (cadr pf))
```

8.5.87 defun Construct a Loop node

```
[pfTree p252]

— defun pfLoop —

(defun |pfLoop| (pfiterators)
  (|pfTree| '|Loop| (list pfiterators)))
```

8.5.88 defun pfLoop1

```
[pfLoop p275]
[pfListOf p245]
[pfDo p262]

— defun pfLoop1 —

(defun |pfLoop1| (body)
  (|pfLoop| (|pfListOf| (list (|pfDo| body))))))
```

8.5.89 defun Is this a Loop node?

[pfAbSynOp? p412]

— defun pfLoop? —

```
(defun |pfLoop?| (pf)
  (|pfAbSynOp?| pf ' |Loop|))
```

8.5.90 defun Return the Iterators of a Loop node

— defun pfLoopIterators 0 —

```
(defun |pfLoopIterators| (pf)
  (cadr pf))
```

8.5.91 defun pf0LoopIterators

[pfParts p249]

[pf0LoopIterators p276]

— defun pf0LoopIterators —

```
(defun |pf0LoopIterators| (pf)
  (|pfParts| (|pfLoopIterators| pf)))
```

8.5.92 defun pfLp

[pfLoop p275]

[pfListOf p245]

[pfDo p262]

— defun pfLp —


```
(defun |pfLp| (iterators body)
  (|pfLoop| (|pfListOf| (append iterators (list (|pfDo| body))))))
```

8.5.93 defun Create a Macro node

[pfTree p252]

```
— defun pfMacro —

(defun |pfMacro| (pflhs pfrhs)
  (|pfTree| '|Macro| (list pflhs pfrhs)))
```

8.5.94 defun Is this a Macro node?

[pfAbSynOp? p412]

```
— defun pfMacro? —

(defun |pfMacro?| (pf)
  (|pfAbSynOp?| pf '|Macro|))
```

8.5.95 defun Return the Lhs of a Macro node

```
— defun pfMacroLhs 0 —

(defun |pfMacroLhs| (pf)
  (cadr pf))
```

8.5.96 defun Return the Rhs of a Macro node

```
— defun pfMacroRhs 0 —
```

```
(defun |pfMacroRhs| (pf)
  (caddr pf))
```

8.5.97 defun Construct an MLambda node

[pfTree p252]

— defun pfMLambda —

```
(defun |pfMLambda| (pfargs pfbody)
  (|pfTree| '|MLambda| (list pfargs pfbody)))
```

8.5.98 defun Is this an MLambda node?

[pfAbSynOp? p412]

— defun pfMLambda? —

```
(defun |pfMLambda?| (pf)
  (|pfAbSynOp?| pf '|MLambda|))
```

8.5.99 defun Return the Args of an MLambda

— defun pfMLambdaArgs 0 —

```
(defun |pfMLambdaArgs| (pf)
  (cadr pf))
```

8.5.100 defun Return the parts of an MLambda argument

[pfParts p249]

— defun pf0MLambdaArgs —

```
(defun |pf0MLambdaArgs| (pf)
  (|pfParts| (|pfMLambdaArgs| pf)))
```

8.5.101 defun pfMLambdaBody

— defun pfMLambdaBody 0 —

```
(defun |pfMLambdaBody| (pf)
  (caddr pf))
```

8.5.102 defun Is this a Not node?

[pfAbSynOp? p412]

— defun pfNot? —

```
(defun |pfNot?| (pf)
  (|pfAbSynOp?| pf '|Not|))
```

8.5.103 defun Return the Arg part of a Not node

— defun pfNotArg 0 —

```
(defun |pfNotArg| (pf)
  (cadr pf))
```

8.5.104 defun Construct a NoValue node

[pfTree p252]

— defun pfNovalue —

```
(defun |pfNovalue| (pfexpr)
  (|pfTree| '|Novalue| (list pfexpr)))
```

—————

8.5.105 defun Is this a Novalue node?

[pfAbSynOp? p412]

— defun pfNovalue? —

```
(defun |pfNovalue?| (pf)
  (|pfAbSynOp?| pf '|Novalue|))
```

—————

8.5.106 defun Return the Expr part of a Novalue node

— defun pfNovalueExpr 0 —

```
(defun |pfNovalueExpr| (pf)
  (cadr pf))
```

—————

8.5.107 defun Construct an Or node

[pfTree p252]

— defun pfOr —

```
(defun |pfOr| (pfleft pfright)
  (|pfTree| '|Or| (list pfleft pfright)))
```

—————

8.5.108 defun Is this an Or node?

[pfAbSynOp? p412]

— defun pfOr? —

```
(defun |pfOr?| (pf)
  (|pfAbSynOp?| pf '|Or|))
```

8.5.109 defun Return the Left part of an Or node

— defun pfOrLeft 0 —

```
(defun |pfOrLeft| (pf)
  (cadr pf))
```

8.5.110 defun Return the Right part of an Or node

— defun pfOrRight 0 —

```
(defun |pfOrRight| (pf)
  (caddr pf))
```

8.5.111 defun Return the part of a parenthesised expression

— defun pfParen —

```
(defun |pfParen| (a part)
  (declare (ignore a))
  part)
```

8.5.112 defun pfPretend

[pfTree p252]

— defun pfPretend —

```
(defun |pfPretend| (pfexpr pftype)
  (|pfTree| '|Pretend| (list pfexpr pftype)))
```

8.5.113 defun Is this a Pretend node?

[pfAbSynOp? p412]

— defun pfPretend? —

```
(defun |pfPretend?| (pf)
  (|pfAbSynOp?| pf '|Pretend|))
```

8.5.114 defun Return the Expression part of a Pretend node

— defun pfPretendExpr 0 —

```
(defun |pfPretendExpr| (pf)
  (cadr pf))
```

8.5.115 defun Return the Type part of a Pretend node

— defun pfPretendType 0 —

```
(defun |pfPretendType| (pf)
  (caddr pf))
```

8.5.116 defun Construct a QualType node

[pfTree p252]

— defun pfQualType —

```
(defun |pfQualType| (pftype pfqual)
  (|pfTree| '|QualType| (list pftype pfqual)))
```

8.5.117 defun Construct a Restrict node

[pfTree p252]

```
— defun pfRestrict —

(defun |pfRestrict| (pfexpr pftype)
  (|pfTree| '|Restrict| (list pfexpr pftype)))
```

8.5.118 defun Is this a Restrict node?

[pfAbSynOp? p412]

```
— defun pfRestrict? —

(defun |pfRestrict?| (pf)
  (|pfAbSynOp?| pf '|Restrict|))
```

8.5.119 defun Return the Expr part of a Restrict node

```
— defun pfRestrictExpr 0 —

(defun |pfRestrictExpr| (pf)
  (cadr pf))
```

8.5.120 defun Return the Type part of a Restrict node

```
— defun pfRestrictType 0 —
```

```
(defun |pfRestrictType| (pf)
  (caddr pf))
```

8.5.121 defun Construct a RetractTo node

[pfTree p252]

```
— defun pfRetractTo —

(defun |pfRetractTo| (pfexpr pftype)
  (|pfTree| '|RetractTo| (list pfexpr pftype)))
```

8.5.122 defun Construct a Return node

[pfTree p252]

```
— defun pfReturn —

(defun |pfReturn| (pfexpr pffrom)
  (|pfTree| '|Return| (list pfexpr pffrom)))
```

8.5.123 defun Is this a Return node?

[pfAbSynOp? p412]

```
— defun pfReturn? —

(defun |pfReturn?| (pf)
  (|pfAbSynOp?| pf '|Return|))
```

8.5.124 defun Return the Expr part of a Return node

```
— defun pfReturnExpr 0 —
```



```
(defun |pfReturnExpr| (pf)
  (cadr pf))
```

8.5.125 defun pfReturnNoName

[pfReturn p284]
[pfNothing p245]

— defun pfReturnNoName —

```
(defun |pfReturnNoName| (|value|)
  (|pfReturn| |value| (|pfNothing|)))
```

8.5.126 defun Construct a ReturnTyped node

[pfTree p252]

— defun pfReturnTyped —

```
(defun |pfReturnTyped| (type body)
  (|pfTree| '|returntyped| (list type body)))
```

8.5.127 defun Construct a Rule node

[pfTree p252]

— defun pfRule —

```
(defun |pfRule| (pflhsitems pfrhs)
  (|pfTree| '|Rule| (list pflhsitems pfrhs)))
```

8.5.128 defun Return the Lhs of a Rule node

— defun pfRuleLhsItems 0 —

```
(defun |pfRuleLhsItems| (pf)
  (cadr pf))
```

—————

8.5.129 defun Return the Rhs of a Rule node

— defun pfRuleRhs 0 —

```
(defun |pfRuleRhs| (pf)
  (caddr pf))
```

—————

8.5.130 defun Is this a Rule node?

[pfAbSynOp? p412]

— defun pfRule? —

```
(defun |pfRule?| (pf)
  (|pfAbSynOp?| pf '|Rule|))
```

—————

8.5.131 defun pfSecond

— defun pfSecond 0 —

```
(defun |pfSecond| (form)
  (caddr form))
```

—————

8.5.132 defun Construct a Sequence node

[pfTree p252]

— defun pfSequence —

```
(defun |pfSequence| (pfargs)
  (|pfTree| '|Sequence| (list pfargs)))
```

—————

8.5.133 defun Return the Args of a Sequence node

— defun pfSequenceArgs 0 —

```
(defun |pfSequenceArgs| (pf)
  (cadr pf))
```

—————

8.5.134 defun Is this a Sequence node?

[pfAbSynOp? p412]

— defun pfSequence? —

```
(defun |pfSequence?| (pf)
  (|pfAbSynOp?| pf '|Sequence|))
```

—————

8.5.135 defun Return the parts of the Args of a Sequence node

[pfParts p249]

[pfSequenceArgs p287]

— defun pf0SequenceArgs —

```
(defun |pf0SequenceArgs| (pf)
  (|pfParts| (|pfSequenceArgs| pf)))
```

—————

8.5.136 defun Create a Suchthat node

[pfTree p252]

— defun pfSuchthat —

```
(defun |pfSuchthat| (pfcond)
  (|pfTree| '|Suchthat| (list pfcond)))
```

—————

8.5.137 defun Is this a SuchThat node?

[pfAbSynOp? p412]

— defun pfSuchthat? —

```
(defun |pfSuchthat?| (pf)
  (|pfAbSynOp?| pf '|Suchthat|))
```

—————

8.5.138 defun Return the Cond part of a SuchThat node

— defun pfSuchthatCond 0 —

```
(defun |pfSuchthatCond| (pf)
  (cadr pf))
```

—————

8.5.139 defun Create a Tagged node

[pfTree p252]

— defun pfTagged —

```
(defun |pfTagged| (pftag pfexpr)
  (|pfTree| '|Tagged| (list pftag pfexpr)))
```

—————

8.5.140 defun Is this a Tagged node?

[pfAbSynOp? p412]

— defun pfTagged? —

```
(defun |pfTagged?| (pf)
  (|pfAbSynOp?| pf '|Tagged|))
```

—————

8.5.141 defun Return the Expression portion of a Tagged node

— defun pfTaggedExpr 0 —

```
(defun |pfTaggedExpr| (pf)
  (caddr pf))
```

—————

8.5.142 defun Return the Tag of a Tagged node

— defun pfTaggedTag 0 —

```
(defun |pfTaggedTag| (pf)
  (cadr pf))
```

—————

8.5.143 defun pfTaggedToTyped

```
[pfTagged? p289]
[pfTaggedExpr p289]
[pfNothing p245]
[pfTaggedTag p289]
[pfId? p246]
[pfId p246]
[pfTyped p290]
[pfSuch p244]
[pfInfApplication p271]
```

— defun pfTaggedToTyped —

```
(defun |pfTaggedToTyped| (arg)
  (let (a form rt)
    (if (|pfTagged?| arg)
        (setq rt (|pfTaggedExpr| arg))
        (setq rt (|pfNothing|)))
    (if (|pfTagged?| arg)
        (setq form (|pfTaggedTag| arg))
        (setq form arg))
    (cond
     ((null (|pfId?| form))
      (setq a (|pfId| (gensym)))
      (|pfTyped| (|pfSuch| a (|pfInfApplication| (|pfId| '=) a form)) rt))
     (t (|pfTyped| form rt)))))
```

—————

8.5.144 defun pfTweakIf

[pfIfElse p270]
 [pfNothing? p245]
 [pfListOf p245]
 [pfTree p252]
 [pfIfCond p270]
 [pfIfThen p270]

— defun pfTweakIf —

```
(defun |pfTweakIf| (form)
  (let (b a)
    (setq a (|pfIfElse| form))
    (setq b (if (|pfNothing?| a) (|pfListOf| NIL) a))
    (|pfTree| '|WIf| (list (|pfIfCond| form) (|pfIfThen| form) b))))
```

—————

8.5.145 defun Construct a Typed node

[pfTree p252]

— defun pfTyped —

```
(defun |pfTyped| (pfid pftype)
```

```
(|pfTree| ' |Typed| (list pfid pftype)))
```

8.5.146 defun Is this a Typed node?

```
[pfAbSynOp? p412]
```

— defun pfTyped? —

```
(defun |pfTyped?| (pf)
  (|pfAbSynOp?| pf ' |Typed|))
```

8.5.147 defun Return the Type of a Typed node

— defun pfTypedType 0 —

```
(defun |pfTypedType| (pf)
  (caddr pf))
```

8.5.148 defun Return the Id of a Typed node

— defun pfTypedId 0 —

```
(defun |pfTypedId| (pf)
  (cadr pf))
```

8.5.149 defun Construct a Typing node

```
[pfTree p252]
```

— defun pfTyping —

```
(defun |pfTyping| (pfitems)
  (|pfTree| '|Typing| (list pfitems)))
```

8.5.150 defun Return a Tuple node

[pfTree p252]

— defun pfTuple —

```
(defun |pfTuple| (pfparts)
  (|pfTree| '|Tuple| (list pfparts)))
```

8.5.151 defun Return a Tuple from a List

[pfTuple p292]
[pfListOf p245]

— defun pfTupleListOf —

```
(defun |pfTupleListOf| (pfparts)
  (|pfTuple| (|pfListOf| pfparts)))
```

8.5.152 defun Is this a Tuple node?

[pfAbSynOp? p412]

— defun pfTuple? —

```
(defun |pfTuple?| (pf)
  (|pfAbSynOp?| pf '|Tuple|))
```

8.5.153 defun Return the Parts of a Tuple node

— defun pfTupleParts 0 —

```
(defun |pfTupleParts| (pf)
  (cadr pf))
```

8.5.154 defun Return the parts of a Tuple

```
[pfParts p249]
[pfTupleParts p293]
```

— defun pf0TupleParts —

```
(defun |pf0TupleParts| (pf)
  (|pfParts| (|pfTupleParts| pf)))
```

8.5.155 defun Return a list from a Sequence node

```
[pfSequence? p287]
[pfAppend p255]
[pf0SequenceArgs p287]
[pfListOf p245]
```

— defun pfUnSequence —

```
(defun |pfUnSequence| (x)
  (if (|pfSequence?| x)
      (|pfListOf| (|pfAppend| (|pf0SequenceArgs| x)))
      (|pfListOf| x)))
```

8.5.156 defun The comment is attached to all signatutres

```
[pfWDeclare p294]
[pfParts p249]
```

— defun pfWDec —

```
(defun |pfWDec| (doc name)
  (mapcar #'(lambda (i) (|pfWDeclare| i doc)) (|pfParts| name)))
```

—————

8.5.157 defun Construct a WDeclare node

[pfTree p252]

— defun pfWDeclare —

```
(defun |pfWDeclare| (pfsignature pfdoc)
  (|pfTree| '|WDeclare| (list pfsignature pfdoc)))
```

—————

8.5.158 defun Construct a Where node

[pfTree p252]

— defun pfWhere —

```
(defun |pfWhere| (pfcontext pfexpr)
  (|pfTree| '|Where| (list pfcontext pfexpr)))
```

—————

8.5.159 defun Is this a Where node?

[pfAbSynOp? p412]

— defun pfWhere? —

```
(defun |pfWhere?| (pf)
  (|pfAbSynOp?| pf '|Where|))
```

—————

8.5.160 defun Return the parts of the Context of a Where node

[pfParts p249]

[pfWhereContext p295]

— defun pf0WhereContext —

```
(defun |pf0WhereContext| (pf)
  (|pfParts| (|pfWhereContext| pf)))
```

—————

8.5.161 defun Return the Context of a Where node

— defun pfWhereContext 0 —

```
(defun |pfWhereContext| (pf)
  (cadr pf))
```

—————

8.5.162 defun Return the Expr part of a Where node

— defun pfWhereExpr 0 —

```
(defun |pfWhereExpr| (pf)
  (caddr pf))
```

—————

8.5.163 defun Construct a While node

[pfTree p252]

— defun pfWhile —

```
(defun |pfWhile| (pfcond)
  (|pfTree| '|While| (list pfcond)))
```

—————

8.5.164 defun Is this a While node?

[pfAbSynOp? p412]

— defun pfWhile? —

```
(defun |pfWhile?| (pf)
  (|pfAbSynOp?| pf '|While|))
```

—————

8.5.165 defun Return the Cond part of a While node

— defun pfWhileCond 0 —

```
(defun |pfWhileCond| (pf)
  (cadr pf))
```

—————

8.5.166 defun Construct a With node

[pfTree p252]

— defun pfWith —

```
(defun |pfWith| (pfbase pfwithin pfwithon)
  (|pfTree| '|With| (list pfbase pfwithin pfwithon)))
```

—————

8.5.167 defun Create a Wrong node

[pfTree p252]

— defun pfWrong —

```
(defun |pfWrong| (pfwhy pfrubble)
  (|pfTree| '|Wrong| (list pfwhy pfrubble)))
```

—————

8.5.168 defun Is this a Wrong node?

[pfAbSynOp? p412]

— defun pfWrong? —

```
(defun |pfWrong?| (pf)
  (|pfAbSynOp?| pf '|Wrong|))
```

Chapter 9

Pftree to s-expression translation

Pftree to s-expression translation. Used to interface the new parser technology to the interpreter. The input is a parseTree and the output is an old-parser-style s-expression.

9.0.169 defun Pftree to s-expression translation

```
[pf2Sex1 p300]  
[$insideSEQ p??]  
[$insideApplication p??]  
[$insideRule p??]  
[$QuietCommand p47]
```

— defun pf2Sex —

```
(defun |pf2Sex| (pf)  
  (let (|$insideSEQ| |$insideApplication| |$insideRule|)  
    (declare (special |$insideSEQ| |$insideApplication| |$insideRule|  
                      |$QuietCommand|))  
    (setq |$QuietCommand| nil)  
    (setq |$insideRule| nil)  
    (setq |$insideApplication| nil)  
    (setq |$insideSEQ| nil)  
    (|pf2Sex1| pf)))
```

—————

9.0.170 defun Pftree to s-expression translation inner function

```

[pfNothing? p245]
[pfSymbol? p252]
[pfSymbolSymbol p252]
[pfLiteral? p248]
[pfLiteral2Sex p304]
[pfIdSymbol p247]
[pfApplication? p255]
[pfApplication2Sex p305]
[pfTuple? p292]
[pf2Sex1 p300]
[pf0TupleParts p293]
[pfIf? p269]
[pfIfCond p270]
[pfIfThen p270]
[pfIfElse p270]
[pfTagged? p289]
[pfTaggedTag p289]
[pfTaggedExpr p289]
[pfCoerceto? p259]
[pfCoercetoExpr p259]
[pfCoercetoType p259]
[pfPretend? p282]
[pfPretendExpr p282]
[pfPretendType p282]
[pfFromdom? p268]
[opTran p323]
[pfFromdomWhat p268]
[pfFromdomDomain p269]
[pfSequence? p287]
[pfSequence2Sex p310]
[pfExit? p263]
[pfExitCond p263]
[pfExitExpr p264]
[pfLoop? p276]
[loopIters2Sex p311]
[pf0LoopIterators p276]
[pfCollect? p260]
[pfCollect2Sex p314]
[pfForin? p266]
[pf0ForinLhs p267]
[pfForinWhole p267]
[pfWhile? p296]
[pfWhileCond p296]
[pfSuchthat? p288]

```


[keyedSystemError p??]
 [pfSuchthatCond p288]
 [pfDo? p262]
 [pfDoBody p262]
 [pfTyped? p291]
 [pfTypedType p291]
 [pfTypedId p291]
 [pfAssign? p256]
 [pf0AssignLhsItems p256]
 [pfAssignRhs p256]
 [pfDefinition? p261]
 [pfDefinition2Sex p315]
 [pfLambda? p273]
 [pfLambda2Sex p317]
 [pfMLambda? p278]
 [pfRestrict? p283]
 [pfRestrictExpr p283]
 [pfRestrictType p283]
 [pfFree? p265]
 [pf0FreeItems p266]
 [pfLocal? p274]
 [pf0LocalItems p275]
 [pfWrong? p297]
 [spadThrow p??]
 [pfAnd? p254]
 [pfAndLeft p254]
 [pfAndRight p255]
 [pfOr? p280]
 [pfOrLeft p281]
 [pfOrRight p281]
 [pfNot? p279]
 [pfNotArg p279]
 [pfNovalue? p280]
 [pfNovalueExpr p280]
 [pfRule? p286]
 [pfRule2Sex p318]
 [pfBreak? p258]
 [pfBreakFrom p258]
 [pfMacro? p277]
 [pfReturn? p284]
 [pfReturnExpr p284]
 [pfIterate? p271]
 [pfWhere? p294]
 [pf0WhereContext p295]
 [pfWhereExpr p295]
 [pfAbSynOp p412]

```
[tokPart p413]
[$insideSEQ p??]
[$insideRule p??]
[$QuietCommand p47]
```

— defun pf2Sex1 —

```
(defun |pf2Sex1| (pf)
  (let (args idList type op tagPart tag s)
    (declare (special |$insideSEQ| |$insideRule| |$QuietCommand|))
    (cond
      ((|pfNothing?| pf) '|noBranch|)
      ((|pfSymbol?| pf)
        (if (eq |$insideRule| '|left|)
          (progn
            (setq s (|pfSymbolSymbol| pf))
            (list '|constant| (list 'quote s)))
          (list 'quote (|pfSymbolSymbol| pf))))
      ((|pfLiteral?| pf) (|pfLiteral2Sex| pf))
      ((|pfId?| pf)
        (if |$insideRule|
          (progn
            (setq s (|pfIdSymbol| pf))
            (if (member s '(|%pi| |%e| |%i|))
              s
              (list 'quote s)))
          (|pfIdSymbol| pf))))
      ((|pfApplication?| pf) (|pfApplication2Sex| pf))
      ((|pfTuple?| pf) (cons '|Tuple| (mapcar #'|pf2Sex1| (|pf0TupleParts| pf))))
      ((|pfIf?| pf)
        (list 'if (|pf2Sex1| (|pfIfCond| pf))
              (|pf2Sex1| (|pfIfThen| pf))
              (|pf2Sex1| (|pfIfElse| pf))))
      ((|pfTagged?| pf)
        (setq tag (|pfTaggedTag| pf))
        (setq tagPart
          (if (|pfTuple?| tag)
            (cons '|Tuple| (mapcar #'|pf2Sex1| (|pf0TupleParts| tag)))
            (|pf2Sex1| tag)))
        (list '|:| tagPart (|pf2Sex1| (|pfTaggedExpr| pf))))
      ((|pfCoerceto?| pf)
        (list '|::| (|pf2Sex1| (|pfCoercetoExpr| pf))
              (|pf2Sex1| (|pfCoercetoType| pf))))
      ((|pfPretend?| pf)
        (list '|pretend| (|pf2Sex1| (|pfPretendExpr| pf))
              (|pf2Sex1| (|pfPretendType| pf))))
      ((|pfFromdom?| pf)
        (setq op (|opTran| (|pf2Sex1| (|pfFromdomWhat| pf))))
        (when (eq op '|braceFromCurly|) (setq op 'seq))
```

```

(list '$elt| (|pf2Sex1| (|pfFromdomDomain| pf)) op))
((|pfSequence?| pf) (|pfSequence2Sex| pf))
((|pfExit?| pf)
 (if |$insideSEQ|
  (list 'exit| (|pf2Sex1| (|pfExitCond| pf))
        (|pf2Sex1| (|pfExitExpr| pf)))
  (list 'if (|pf2Sex1| (|pfExitCond| pf))
        (|pf2Sex1| (|pfExitExpr| pf)) 'noBranch|)))
((|pfLoop?| pf) (cons 'repeat (|loopIters2Sex| (|pf0LoopIterators| pf))))
((|pfCollect?| pf) (|pfCollect2Sex| pf))
((|pfForin?| pf)
 (cons 'in
  (append (mapcar #'|pf2Sex1| (|pf0ForinLhs| pf))
    (list (|pf2Sex1| (|pfForinWhole| pf))))))
((|pfWhile?| pf) (list 'while (|pf2Sex1| (|pfWhileCond| pf))))
((|pfSuchthat?| pf)
 (if (eq |$insideRule| '|left|)
  (|keyedSystemError| "S2GE0017" (list "pf2Sex1: pfSuchThat"))
  (list '|\\| (|pf2Sex1| (|pfSuchthatCond| pf)))))
((|pfDo?| pf) (|pf2Sex1| (|pfDoBody| pf)))
((|pfTyped?| pf)
 (setq type (|pfTypedType| pf))
 (if (|pfNothing?| type)
  (|pf2Sex1| (|pfTypedId| pf))
  (list '|:| (|pf2Sex1| (|pfTypedId| pf)) (|pf2Sex1| (|pfTypedType| pf)))))
((|pfAssign?| pf)
 (setq idList (mapcar #'|pf2Sex1| (|pf0AssignLhsItems| pf)))
 (if (not (eql (length idList) 1))
  (setq idList (cons '|Tuple| idList))
  (setq idList (car idList)))
 (list 'let idList (|pf2Sex1| (|pfAssignRhs| pf))))
((|pfDefinition?| pf) (|pfDefinition2Sex| pf))
((|pfLambda?| pf) (|pfLambda2Sex| pf))
((|pfMLambda?| pf) '|/throwAway|)
((|pfRestrict?| pf)
 (list '@ (|pf2Sex1| (|pfRestrictExpr| pf))
        (|pf2Sex1| (|pfRestrictType| pf))))
((|pfFree?| pf) (cons '|free| (mapcar #'|pf2Sex1| (|pf0FreeItems| pf))))
((|pfLocal?| pf) (cons '|local| (mapcar #'|pf2Sex1| (|pf0LocalItems| pf))))
((|pfWrong?| pf) (|spadThrow|))
((|pfAnd?| pf)
 (list '|and| (|pf2Sex1| (|pfAndLeft| pf))
        (|pf2Sex1| (|pfAndRight| pf))))
((|pfOr?| pf)
 (list '|or| (|pf2Sex1| (|pfOrLeft| pf))
        (|pf2Sex1| (|pfOrRight| pf))))
((|pfNot?| pf) (list '|not| (|pf2Sex1| (|pfNotArg| pf))))
((|pfNovalue?| pf)
 (setq |$QuietCommand| t)
 (list 'seq (|pf2Sex1| (|pfNovalueExpr| pf))))

```

```

((|pfRule?| pf) (|pfRule2Sex| pf))
((|pfBreak?| pf) (list '|break| (|pfBreakFrom| pf)))
((|pfMacro?| pf) '|/throwAway|)
((|pfReturn?| pf) (list '|return| (|pf2Sex1| (|pfReturnExpr| pf))))
((|pfIterate?| pf) (list '|iterate|))
((|pfWhere?| pf)
 (setq args (mapcar #'|pf2Sex1| (|pf0WhereContext| pf)))
 (if (eql (length args) 1)
     (cons '|where| (cons (|pf2Sex1| (|pfWhereExpr| pf)) args))
     (list '|where| (|pf2Sex1| (|pfWhereExpr| pf)) (cons 'seq args))))
; -- under strange circumstances/piling, system commands can wind
; -- up in expressions. This just passes it through as a string for
; -- the user to figure out what happened.
((eq (|pfAbSynOp| pf) '|command|) (|tokPart| pf))
(t (|keyedSystemError| "S2GE0017" (list "pf2Sex1"))))

```

9.0.171 defun Convert a Literal to an S-expression

```

[|pfLiteralClass| p248]
[|pfLiteralString| p249]
[|float2Sex| p305]
[|pfSymbolSymbol| p252]
[|pfLeafToken| p248]
[|keyedSystemError| p??]
[|$insideRule| p??]

```

— defun `pfLiteral2Sex` —

```

(defun |pfLiteral2Sex| (pf)
  (let (s type)
    (declare (special |$insideRule|))
    (setq type (|pfLiteralClass| pf))
    (cond
      ((eq type '|integer|) (read-from-string (|pfLiteralString| pf)))
      ((or (eq type '|string|) (eq type '|char|))
       (|pfLiteralString| pf))
      ((eq type '|float|) (|float2Sex| (|pfLiteralString| pf)))
      ((eq type '|symbol|)
       (if |$insideRule|
          (progn
            (setq s (|pfSymbolSymbol| pf))
            (list 'quote s))
          (|pfSymbolSymbol| pf)))
      ((eq type '|expression|) (list 'quote (|pfLeafToken| pf)))
    )
    (t

```

```
(|keyedSystemError| 'S2GE0017 (list "pfLiteral2Sex: unexpected form"))))))
```

9.0.172 defun Convert a float to an S-expression

[*\$useBFasDefault* p??]

— defun float2Sex —

```
(defun |float2Sex| (num)
  (let (exp frac bfForm fracPartString intPart dotIndex expPart mantPart eIndex)
    (declare (special |$useBFasDefault|))
    (setq eIndex (search "e" num))
    (if eIndex
      (setq mantPart (subseq num 0 eIndex))
      (setq mantPart num))
    (if eIndex
      (setq expPart (read-from-string (subseq num (+ eIndex 1))))
      (setq expPart 0))
    (setq dotIndex (search "." mantPart))
    (if dotIndex
      (setq intPart (read-from-string (subseq mantPart 0 dotIndex)))
      (setq intPart (read-from-string mantPart)))
    (if dotIndex
      (setq fracPartString (subseq mantPart (+ dotIndex 1)))
      (setq fracPartString 0))
    (setq bfForm
      (make-float intPart (read-from-string fracPartString)
                  (length fracPartString) expPart))
    (if |$useBFasDefault|
      (progn
        (setq frac (cadr bfForm))
        (setq exp (caddr bfForm))
        (list (list '|$elt| (list '|Float|) '|float|) frac exp 10))
      bfForm)))
```

9.0.173 defun Change an Application node to an S-expression

[*pfOp2Sex* p308]

[*pfApplicationOp* p254]

[*opTran* p323]

[*pf0TupleParts* p293]

```
[pfApplicationArg p254]
[pfTuple? p292]
[pf2Sex1 p300]
[pf2Sex p299]
[pfSuchThat2Sex p307]
[hasOptArgs? p309]
[$insideApplication p??]
[$insideRule p??]
```

— defun pfApplication2Sex —

```
(defun |pfApplication2Sex| (pf)
  (let (|$insideApplication| x val realOp tmp1 qt argSex typeList args op)
    (declare (special |$insideApplication| |$insideRule|))
    (setq |$insideApplication| t)
    (setq op (|pfOp2Sex| (|pfApplicationOp| pf)))
    (setq op (|opTran| op))
    (cond
      ((eq op '->)
        (setq args (|pf0TupleParts| (|pfApplicationArg| pf)))
        (if (|pfTuple?| (car args))
          (setq typeList (mapcar #'|pf2Sex1| (|pf0TupleParts| (car args))))
          (setq typeList (list (|pf2Sex1| (car args)))))
        (setq args (cons (|pf2Sex1| (cadr args)) typeList))
        (cons '|Mapping| args))
      ((and (eq op '|:|) (eq |$insideRule| '|left|))
        (list '|multiple| (|pf2Sex| (|pfApplicationArg| pf))))
      ((and (eq op '|?|) (eq |$insideRule| '|left|))
        (list '|optional| (|pf2Sex| (|pfApplicationArg| pf))))
      (t
        (setq args (|pfApplicationArg| pf))
        (cond
          ((|pfTuple?| args)
            (if (and (eq op '|\\|') (eq |$insideRule| '|left|))
              (|pfSuchThat2Sex| args)
              (progn
                (setq argSex (cdr (|pf2Sex1| args)))
                (cond
                  ((eq op '>') (list '<' (cadr argSex) (car argSex)))
                  ((eq op '>=') (list '|not| (list '<' (car argSex) (cadr argSex))))
                  ((eq op '<=') (list '|not| (list '<' (cadr argSex) (car argSex))))
                  ((eq op '&') (list '|and| (car argSex) (cadr argSex)))
                  ((eq op '|or|) (list '|or| (car argSex) (cadr argSex)))
                  ((eq op '|Iterate|) (list '|iterate|))
                  ((eq op '|by|) (cons 'by argSex))
                  ((eq op '|braceFromCurly|)
                    (if (and (consp argSex) (eq (car argSex) 'seq))
                      argSex
                      (cons 'seq argSex))))
                (cons 'seq argSex))))
          (t
            (list '|multiple| (|pf2Sex| (|pfApplicationArg| pf))))
        ))
    ))
```

```

((and (consp op)
      (progn
        (setq qt (car op))
        (setq tmp1 (cdr op))
        (and (consp tmp1)
              (eq (cdr tmp1) nil)
              (progn
                (setq realOp (car tmp1))
                t)))
        (eq qt 'quote))
      (cons '|applyQuote| (cons op argSex)))
((setq val (|hasOptArgs?| argSex)) (cons op val))
(t (cons op argSex))))))
((and (consp op)
      (progn
        (setq qt (car op))
        (setq tmp1 (cdr op))
        (and (consp tmp1)
              (eq (cdr tmp1) NIL)
              (progn
                (setq realOp (car tmp1))
                t)))
        (eq qt 'quote))
      (list '|applyQuote| op (|pf2Sex1| args)))
((eq op '|braceFromCurly|)
 (setq x (|pf2Sex1| args))
 (if (and (consp x) (eq (car x) 'seq))
     x
     (list 'seq x)))
((eq op '|by|) (list 'by (|pf2Sex1| args)))
(t (list op (|pf2Sex1| args))))))

```

9.0.174 defun Convert a SuchThat node to an S-expression

[pf0TupleParts p293]
 [pf2Sex1 p300]
 [pf2Sex p299]
 [\$predicateList p??]

— defun pfSuchThat2Sex —

```

(defun |pfSuchThat2Sex| (args)
  (let (rhsSex lhsSex argList name)
    (declare (special |$predicateList|))
    (setq name (gentemp))

```

```

(setq argList (|pf0TupleParts| args))
(setq lhsSex (|pf2Sex1| (car argList)))
(setq rhsSex (|pf2Sex| (cadr argList)))
(setq |$predicateList|
  (cons (cons name (cons lhsSex rhsSex)) |$predicateList|))
name))

```

9.0.175 defun pfOp2Sex

```

[pf2Sex1 p300]
[pmDontQuote? p309]
[pfSymbol? p252]
[$quotedOpList p??]
[$insideRule p??]

```

— defun pfOp2Sex —

```

(defun |pfOp2Sex| (pf)
  (let (realOp tmp1 op alreadyQuoted)
    (declare (special |$quotedOpList| |$insideRule|))
    (setq alreadyQuoted (|pfSymbol?| pf))
    (setq op (|pf2Sex1| pf))
    (cond
      ((and (consp op)
            (eq (car op) 'quote)
            (progn
              (setq tmp1 (cdr op))
              (and (consp tmp1)
                    (eq (cdr tmp1) nil)
                    (progn
                     (setq realOp (car tmp1)) t))))
        (cond
          ((eq |$insideRule| '|left|) realOp)
          ((eq |$insideRule| '|right|)
            (cond
              ((|pmDontQuote?| realOp) realOp)
              (t
               (setq |$quotedOpList| (cons op |$quotedOpList|))
               op)))
          ((eq realOp '|\\|) realOp)
          ((eq realOp '|:|) realOp)
          ((eq realOp '|?) realOp)
          (t op)))
      (t op))))

```

9.0.176 defun pmDontQuote?

— defun pmDontQuote? 0 —

```
(defun |pmDontQuote?| (sy)
  (member sy
    '(+ - * ** ^ / |log| |exp| |pi| |sqrt| |ei| |li| |erf| |ci|
      |si| |dilog| |sin| |cos| |tan| |cot| |sec| |csc| |asin|
      |acos| |atan| |acot| |asec| |acsc| |sinh| |cosh| |tanh|
      |coth| |sech| |csch| |asinh| |acosh| |atanh| |acoth|
      |asech| |acsc|)))
```

9.0.177 defun hasOptArgs?

— defun hasOptArgs? 0 —

```
(defun |hasOptArgs?| (argSex)
  (let (rhs lhs opt nonOpt tmp1 tmp2)
    (dolist (arg argSex)
      (cond
        ((and (consp arg)
              (eq (car arg) 'optarg)
              (progn
                (setq tmp1 (cdr arg))
                (and (consp tmp1)
                     (progn
                      (setq lhs (car tmp1))
                      (setq tmp2 (cdr tmp1))
                      (and (consp tmp2)
                          (eq (cdr tmp2) nil)
                          (progn
                           (setq rhs (car tmp2))
                           t))))))
          (setq opt (cons (list lhs rhs) opt)))
        (t (setq nonOpt (cons arg nonOpt)))))
    (when opt
      (nconc (nreverse nonOpt) (list (cons '|construct| (nreverse opt)))))))
```

9.0.178 defun Convert a Sequence node to an S-expression

```
[pf2Sex1 p300]
[pf0SequenceArgs p287]
[$insideSEQ p??]

— defun pfSequence2Sex —

(defun |pfSequence2Sex| (pf)
  (let (|$insideSEQ| tmp1 ruleList seq)
    (declare (special |$insideSEQ|))
    (setq |$insideSEQ| t)
    (setq seq (|pfSequence2Sex0| (mapcar #'|pf2Sex1| (|pf0SequenceArgs| pf))))
    (cond
      ((and (consp seq)
            (eq (car seq) 'seq)
            (progn (setq ruleList (cdr seq)) 't)
            (consp ruleList)
            (progn
              (setq tmp1 (car ruleList))
              (and (consp tmp1) (eq (car tmp1) '|rule|))))
        (list '|ruleset| (cons '|construct| ruleList)))
      (t seq))))
```

9.0.179 defun pfSequence2Sex0

TPDHERE: rewrite this using (dolist (item seqList)...)

```
;pfSequence2Sex0 seqList ==
; null seqList => "noBranch"
; seqTranList := []
; while seqList ^= nil repeat
;   item := first seqList
;   item is ["exit", cond, value] =>
;     item := ["IF", cond, value, pfSequence2Sex0 rest seqList]
;   seqTranList := [item, :seqTranList]
;   seqList := nil
;   seqTranList := [item, :seqTranList]
;   seqList := rest seqList
; #seqTranList = 1 => first seqTranList
; ["SEQ", :nreverse seqTranList]
```

```
[pfSequence2Sex0 p310]
```

— defun pfSequence2Sex0 —

```

(defun |pfSequence2Sex0| (seqList)
  (let (value tmp2 cond tmp1 item seqTranList)
    (if (null seqList)
      '|noBranch|
      (progn
        ((lambda ()
          (loop
            (if (not seqList)
              (return nil)
              (progn
                (setq item (car seqList))
                (cond
                  ((and (consp item)
                       (eq (car item) '|exit|))
                   (progn
                     (setq tmp1 (cdr item))
                     (and (consp tmp1)
                          (progn
                            (setq cond (car tmp1))
                            (setq tmp2 (cdr tmp1))
                            (and (consp tmp2)
                                 (eq (cdr tmp2) nil)
                                 (progn
                                  (setq value (car tmp2))
                                  t)))))))
                  (t
                   (setq item
                        (list 'if cond value (|pfSequence2Sex0| (cdr seqList))))
                   (setq seqTranList (cons item seqTranList))
                   (setq seqList nil))
                  (t
                   (progn
                     (setq seqTranList (cons item seqTranList))
                     (setq seqList (cdr seqList))))))))))
            (if (eql (length seqTranList) 1)
              (car seqTranList)
              (cons 'seq (nreverse seqTranList)))))))

```

9.0.180 defun Convert a loop node to an S-expression

TPDHERE: rewrite using dsetq

```

;loopIters2Sex iterList ==
; result := nil
; for iter in iterList repeat
;   sex := pf2Sex1 iter
;   sex is ['IN, var, ['SEGMENT, i, ["BY", incr]] =>

```

[pf2Sex1 p300]

```
(defun |loopIters2Sex| (iterList)
(let (j incr i var sex result tmp1 tmp2 tmp3 tmp4 tmp5 tmp6 tmp7 tmp8)
(dolist (iter iterList (nreverse result))
(setq sex (|pf2Sex1| iter))
(cond
((and (consp sex)
(eq (car sex) 'in)
(progn
(setq tmp1 (cdr sex))
(and (consp tmp1)
(progn
(setq var (car tmp1))
(setq tmp2 (cdr tmp1))
(and (consp tmp2)
(eq (cdr tmp2) nil)
(progn
(setq tmp3 (car tmp2))
(and (consp tmp3)
(eq (car tmp3) 'segment)
(progn
(setq tmp4 (cdr tmp3))
(and (consp tmp4)
(progn
(setq i (car tmp4))
(setq tmp5 (cdr tmp4))
(and (consp tmp5)
(eq (cdr tmp5) nil)
(progn
(setq tmp6 (car tmp5))
(and (consp tmp6)
(eq (car tmp6) 'by)
(progn
(setq tmp7 (cdr tmp6))
(and (consp tmp7)
(eq (cdr tmp7) nil)
(progn
(setq incr (car tmp7))
t)))))))))))))))))))
```

```

(setq result (cons (list 'step var i incr) result)))
((and (consp sex)
      (eq (car sex) 'in)
      (progn
        (setq tmp1 (cdr sex))
        (and (consp tmp1)
              (progn
                (setq var (car tmp1))
                (setq tmp2 (cdr tmp1))
                (and (consp tmp2)
                      (eq (cdr tmp2) nil)
                      (progn
                        (setq tmp3 (car tmp2))
                        (and (consp tmp3)
                              (eq (car tmp3) 'by)
                              (progn
                                (setq tmp4 (cdr tmp3))
                                (and (consp tmp4)
                                      (progn
                                        (setq tmp5 (car tmp4))
                                        (and (consp tmp5)
                                              (eq (car tmp5) 'segment)
                                              (progn
                                                (setq tmp6 (cdr tmp5))
                                                (and (consp tmp6)
                                                      (progn
                                                        (setq i (car tmp6))
                                                        (setq tmp7 (cdr tmp6))
                                                        (and (consp tmp7)
                                                                (eq (cdr tmp7) nil)
                                                                (progn
                                                                  (setq j (car tmp7))
                                                                  t))))))))))
                                          (progn
                                            (setq tmp8 (cdr tmp4))
                                            (and (consp tmp8)
                                                  (eq (cdr tmp8) nil)
                                                  (progn
                                                    (setq incr (car tmp8))
                                                    t))))))))))))
      (setq result (cons (list 'step var i incr j) result)))
((and (consp sex)
      (eq (car sex) 'in)
      (progn
        (setq tmp1 (cdr sex))
        (and (consp tmp1)
              (progn
                (setq var (car tmp1))
                (setq tmp2 (cdr tmp1))
                (and (consp tmp2)

```

```

(eq (cdr tmp2) nil)
(progn
  (setq tmp3 (car tmp2))
  (and (consp tmp3)
    (eq (car tmp3) 'segment)
    (progn
      (setq tmp4 (cdr tmp3))
      (and (consp tmp4)
        (progn
          (setq i (car tmp4))
          (setq tmp5 (cdr tmp4))
          (and (consp tmp5)
            (eq (cdr tmp5) nil)
            (progn
              (setq j (car tmp5))
              t))))))))))
  (setq result (cons (list 'step var i 1 j) result)))
(t (setq result (cons sex result))))))

```

9.0.181 defun Change a Collect node to an S-expression

```

[loopIters2Sex p311]
[pfParts p249]
[pfCollectIterators p260]
[pf2Sex1 p300]
[pfCollectBody p260]

```

— defun pfCollect2Sex —

```

(defun |pfCollect2Sex| (pf)
  (let (var cond sex tmp1 tmp2 tmp3 tmp4)
    (setq sex
      (cons 'collect
        (append (|loopIters2Sex| (|pfParts| (|pfCollectIterators| pf)))
          (list (|pf2Sex1| (|pfCollectBody| pf))))))
    (cond
      ((and (consp sex)
        (eq (car sex) 'collect)
        (progn
          (setq tmp1 (cdr sex))
          (and (consp tmp1)
            (progn
              (setq tmp2 (car tmp1))
              (and (consp tmp2)
                (eq (car tmp2) '|\\|))

```

```

      (progn
        (setq tmp3 (cdr tmp2))
        (and (consp tmp3)
              (eq (cdr tmp3) nil)
              (progn
                (setq cond (car tmp3))
                t))))))
    (progn
      (setq tmp4 (cdr tmp1))
      (and (consp tmp4)
            (eq (cdr tmp4) nil)
            (progn (setq var (car tmp4)) t))))))
  (symbolp var))
(list '|\\| var cond))
(t sex))))

```

9.0.182 defun Convert a Definition node to an S-expression

```

[pf2Sex1 p300]
[pf0DefinitionLhsItems p262]
[pfDefinitionRhs p261]
[systemError p??]
[pfLambdaTran p316]
[$insideApplication p??]

```

— defun pfDefinition2Sex —

```

(defun |pfDefinition2Sex| (pf)
  (let (body argList tmp1 rhs id idList)
    (declare (special |$insideApplication|))
    (if |$insideApplication|
        (list 'optarg
              (|pf2Sex1| (car (|pf0DefinitionLhsItems| pf)))
              (|pf2Sex1| (|pfDefinitionRhs| pf)))
        (progn
          (setq idList (mapcar #'|pf2Sex1| (|pf0DefinitionLhsItems| pf)))
          (if (not (eql (length idList) 1))
              (|systemError|
               "lhs of definition must be a single item in the interpreter")
              (progn
                (setq id (car idList))
                (setq rhs (|pfDefinitionRhs| pf))
                (setq tmp1 (|pfLambdaTran| rhs))
                (setq argList (car tmp1))
                (setq body (cdr tmp1))

```

```
(cons 'def
  (cons
    (if (eq argList '|id|)
      id
      (cons id argList))
    body))))))
```

9.0.183 defun Convert a Lambda node to an S-expression

```
[pfLambda? p273]
[pf0LambdaArgs p274]
[pfTyped? p291]
[pfCollectArgTran p317]
[pfTypedId p291]
[pfNothing? p245]
[pfTypedType p291]
[pf2Sex1 p300]
[systemError p??]
[pfLambdaRets p273]
[pfLambdaBody p273]
```

— defun pfLambdaTran —

```
(defun |pfLambdaTran| (pf)
  (let (retType argList argTypeList)
    (cond
      ((|pfLambda?| pf)
       (dolist (arg (|pf0LambdaArgs| pf))
         (if (|pfTyped?| arg)
             (progn
              (setq argList
                (cons (|pfCollectArgTran| (|pfTypedId| arg)) argList))
              (if (|pfNothing?| (|pfTypedType| arg))
                  (setq argTypeList (cons nil argTypeList))
                  (setq argTypeList
                    (cons (|pf2Sex1| (|pfTypedType| arg)) argTypeList))))
              (|systemError| "definition args should be typed")))
         (setq argList (nreverse argList))
         (unless (|pfNothing?| (|pfLambdaRets| pf))
           (setq retType (|pf2Sex1| (|pfLambdaRets| pf))))
         (setq argTypeList (cons retType (nreverse argTypeList)))
         (cons argList
           (list argTypeList
             (mapcar #'(lambda (x) (declare (ignore x)) nil) argTypeList)
             (|pf2Sex1| (|pfLambdaBody| pf))))))
```



```
(t (cons '|id| (list '(nil) '(nil) (|pf2Sex1| pf))))))
```

9.0.184 defun pfCollectArgTran

```
[pfCollect? p260]
[|pf2sex1| p??]
[|pfParts| p249]
[|pfCollectIterators| p260]
[|pfCollectBody| p260]
```

— defun pfCollectArgTran —

```
(defun |pfCollectArgTran| (pf)
  (let (cond tmp2 tmp1 id conds)
    (cond
      ((|pfCollect?| pf)
       (setq conds (mapcar #'|pf2sex1| (|pfParts| (|pfCollectIterators| pf))))
       (setq id (|pf2Sex1| (|pfCollectBody| pf)))
       (cond
         ((and (consp conds) ; conds is [ "|", cond ]
               (eq (cdr conds) nil)
               (progn
                 (setq tmp1 (car conds))
                 (and (consp tmp1)
                      (eq (car tmp1) '|\\|)
                      (progn
                        (setq tmp2 (cdr tmp1))
                        (and (consp tmp2)
                             (eq (cdr tmp2) nil)
                             (progn
                               (setq cond (car tmp2))
                               t))))))
                  (list '|\\| id cond))
          (t (cons id conds))))
       (t (|pf2Sex1| pf))))))
```

9.0.185 defun Convert a Lambda node to an S-expression

```
[pfLambdaTran p316]
```

— defun pfLambda2Sex —

```
(defun |pfLambda2Sex| (pf)
  (let (body argList tmp1)
    (setq tmp1 (|pfLambdaTran| pf))
    (setq argList (car tmp1))
    (setq body (cdr tmp1))
    (cons 'adeft (cons argList body))))
```

9.0.186 defun Convert a Rule node to an S-expression

```
[pfLhsRule2Sex p318]
[pfRuleLhsItems p286]
[pfRhsRule2Sex p319]
[pfRuleRhs p286]
[ruleLhsTran p322]
[rulePredicateTran p319]
[$multiVarPredicateList p??]
[$predicateList p??]
[$quotedOpList p??]
```

— defun pfRule2Sex —

```
(defun |pfRule2Sex| (pf)
  (let (|$multiVarPredicateList| |$predicateList| |$quotedOpList| rhs lhs)
    (declare (special |$multiVarPredicateList| |$predicateList| |$quotedOpList|))
    (setq |$quotedOpList| nil)
    (setq |$predicateList| nil)
    (setq |$multiVarPredicateList| nil)
    (setq lhs (|pfLhsRule2Sex| (|pfRuleLhsItems| pf)))
    (setq rhs (|pfRhsRule2Sex| (|pfRuleRhs| pf)))
    (setq lhs (|ruleLhsTran| lhs))
    (|rulePredicateTran|
     (if |$quotedOpList|
        (list '|rule| lhs rhs (cons '|construct| |$quotedOpList|))
        (list '|rule| lhs rhs)))))
```

9.0.187 defun Convert the Lhs of a Rule to an S-expression

```
[pf2Sex1 p300]
[$insideRule p??]
```

— defun pfLhsRule2Sex —

```
(defun |pfLhsRule2Sex| (lhs)
  (let (|$insideRule|)
    (declare (special |$insideRule|))
    (setq |$insideRule| '|left|)
    (|pf2Sex1| lhs)))
```

9.0.188 defun Convert the Rhs of a Rule to an S-expression

```
[pf2Sex1 p300]
[$insideRule p??]
```

— defun pfRhsRule2Sex —

```
(defun |pfRhsRule2Sex| (rhs)
  (let (|$insideRule|)
    (declare (special |$insideRule|))
    (setq |$insideRule| '|right|)
    (|pf2Sex1| rhs)))
```

9.0.189 defun Convert a Rule predicate to an S-expression

```
;rulePredicateTran rule ==
; null $multiVarPredicateList => rule
; varList := patternVarsOf [rhs for [.,.,:rhs] in $multiVarPredicateList]
; predBody :=
;   CDR $multiVarPredicateList =>
;     ['AND, :[:pvarPredTran(rhs, varList) for [.,.,:rhs] in
;       $multiVarPredicateList]]
;   [ [.,.,:rhs],:] := $multiVarPredicateList
;   pvarPredTran(rhs, varList)
; ['suchThat, rule,
;   ['construct, :[ ["QUOTE", var] for var in varList]],
;   ['ADEF, '(predicateVariable),
;   '((Boolean) (List (Expression (Integer))))), '(() ()),
;   predBody]]
```

```
[patternVarsOf p321]
[pvarPredTran p322]
[$multiVarPredicateList p??]
```

— defun rulePredicateTran —

```
(defun |rulePredicateTran| (rule)
  (let (predBody varList rhs tmp1 result)
    (declare (special |$multiVarPredicateList|))
    (if (null |$multiVarPredicateList|)
        rule
        (progn
          (setq varList
                (|patternVarsOf|
                 ((lambda (t1 t2 t3)
                    (loop
                     (cond
                      ((or (atom t2)
                           (progn
                            (setq t3 (car t2))
                            nil))
                      (return (nreverse t1)))
                     (t
                      (and (consp t3)
                           (progn
                            (setq tmp1 (cdr t3))
                            (and (consp tmp1)
                                 (progn
                                  (setq rhs (cdr tmp1))
                                  t))))
                          (setq t1 (cons rhs t1))))
                      (setq t2 (cdr t2))))
                    nil |$multiVarPredicateList| nil)))
          (setq predBody
                (cond
                 ((cdr |$multiVarPredicateList|)
                  (cons 'and
                       ((lambda (t4 t5 t6)
                          (loop
                           (cond
                            ((or (atom t5)
                                 (progn
                                 (setq t6 (car t5))
                                 nil))
                           (return (nreverse t4)))
                           (t
                            (and (consp t6)
                                 (progn
                                  (setq tmp1 (cdr t6))
                                  (and (consp tmp1)
                                       (progn
                                        (setq rhs (cdr tmp1))
                                        t))))
                                  (setq t4
                                        (append (reverse (|pvarPredTran| rhs varList))
                                                t4))))))
                  ))
                 (t
                  (and (consp t6)
                       (progn
                        (setq tmp1 (cdr t6))
                        (and (consp tmp1)
                             (progn
                              (setq rhs (cdr tmp1))
                              t))))
                        (setq t4
                              (append (reverse (|pvarPredTran| rhs varList))
                                      t4))))))
          (return (nreverse t4))))))
```

```

      (setq t5 (cdr t5)))
    nil |$multiVarPredicateList| nil)))
  (t
   (progn
    (setq rhs (cddar |$multiVarPredicateList|))
    (|pvarPredTran| rhs varList))))))
  (dolist (var varList) (push (list 'quote var) result))
  (list '|suchThat| rule
   (cons '|construct| (nreverse result))
   (list 'adeft '(|predicateVariable|
                  '((|Boolean|
                     (|List| (|Expression| (|Integer|))))
                    '(nil nil) predBody))))))

```

9.0.190 defun patternVarsOf

[patternVarsOf1 p321]

— defun patternVarsOf —

```

(defun |patternVarsOf| (expr)
  (|patternVarsOf1| expr nil))

```

9.0.191 defun patternVarsOf1

[patternVarsOf1 p321]

— defun patternVarsOf1 —

```

(defun |patternVarsOf1| (expr varList)
  (let (arg1 op)
    (cond
     ((null expr) varList)
     ((atom expr)
      (cond
       ((null (symbolp expr)) varList)
       ((member expr varList) varList)
       (t (cons expr varList))))
     ((and (consp expr)
           (progn
            (setq op (car expr))

```

```

      (setq arg1 (cdr expr))
      t))
    (progn
      (dolist (arg arg1)
        (setq varList (|patternVarsOf1| arg varList)))
        varList))
    (t varList))))

```

9.0.192 defun pvarPredTran

— defun pvarPredTran —

```

(defun |pvarPredTran| (rhs varList)
  (let ((i 0))
    (dolist (var varList rhs)
      (setq rhs (nsbst (list '|elt| '|predicateVariable| (incf i)) var rhs)))))

```

9.0.193 defun Convert the Lhs of a Rule node to an S-expression

```

[patternVarsOf p321]
[nsbst p??]
[$predicateList p??]
[$multiVarPredicateList p??]

```

— defun ruleLhsTran —

```

(defun |ruleLhsTran| (ruleLhs)
  (let (predicate var vars predRhs predLhs name)
    (declare (special |$predicateList| |$multiVarPredicateList|))
    (dolist (pred |$predicateList|)
      (setq name (car pred))
      (setq predLhs (cadr pred))
      (setq predRhs (cddr pred))
      (setq vars (|patternVarsOf| predRhs))
      (cond
        ((cdr vars)
         (setq ruleLhs (nsbst predLhs name ruleLhs))
         (setq |$multiVarPredicateList| (cons pred |$multiVarPredicateList|)))
        (t
         (setq var (cadr predLhs))

```

```
(setq predicate
  (list '|suchThat| predLhs (list 'adef (list var)
    '((|Boolean|) (|Expression| (|Integer|))) '(nil nil) predRhs)))
(setq ruleLhs (nsubst predicate name ruleLhs))))
ruleLhs))
```

9.0.194 defvar \$dotdot

— initvars —

```
(defvar |$dotdot| '|..|)
```

9.0.195 defun Translate ops into internal symbols

[[\\$dotdot p323](#)]

— defun opTran 0 —

```
(defun |opTran| (op)
  (declare (special |$dotdot|))
  (cond
    ((equal op |$dotdot|) 'segment)
    ((eq op '[]) 'construct)
    ((eq op '{}') 'braceFromCurly)
    ((eq op 'is) 'is)
    (t op)))
```

Chapter 10

Keyed Message Handling

Throughout the interpreter there are messages printed using a symbol for a database lookup. This was done to enable translation of these messages languages other than English.

Axiom messages are read from a flat file database and returned as one long string. They are preceded in the database by a key and this is how they are referenced from code. For example, one key is S2IL0001 which means:

S2	Scratchpad II designation
I	from the interpreter
L	originally from LISPLIB BOOT
0001	a sequence number

Each message may contain formatting codes and and parameter codes. The formatting codes are:

%b	turn on bright printing
%ceoff	turn off centering
%ceon	turn on centering
%d	turn off bright printing
%f	user defined printing
%i	start indentation of 3 more spaces
%l	start a new line
%m	math-print an expression
%rjoff	turn off right justification (actually ragged left)
%rjon	turn on right justification (actually ragged left)
%s	pretty-print as an S-expression
%u	unindent 3 spaces
%x#	insert # spaces

The parameter codes look like %1, %2b, %3p, %4m, %5bp, %6s where the digit is the parameter number and the letters following indicate additional formatting. You can indicate as many additional formatting qualifiers as you like, to the degree they make sense.

- The “p” code means to call `prefix2String` on the parameter, a standard way of printing abbreviated types.
- The “P” operator maps `prefix2String` over its arguments.
- The “o” operation formats the argument as an operation name.
- The “b” means to print that parameter in a bold (bright) font.
- The “c” means to center that parameter on a new line.
- The “r” means to right justify (ragged left) the argument.
- The “f” means that the parameter is a list `[fn, :args]` and that “fn” is to be called on “args” to get the text.

Look in the file with the name defined in `$defaultMsgDatabaseName` above for examples.

10.0.196 `defvar $cacheMessages`

This is used for debugging

— `initvars` —

```
(defvar |$cacheMessages| t)
```

—————

10.0.197 `defvar $msgAlist`

— `initvars` —

```
(defvar |$msgAlist| nil)
```

—————

10.0.198 `defvar $msgDatabaseName`

— `initvars` —

```
(defvar |$msgDatabaseName| nil)
```

—————

10.0.199 defvar \$testingErrorPrefix

— initvars —

```
(defvar |$testingErrorPrefix| "Daly Bug")
```

—————

10.0.200 defvar \$texFormatting

— initvars —

```
(defvar |$texFormatting| nil)
```

—————

10.0.201 defvar \$*msghash*

— initvars —

```
(defvar *msghash* nil "hash table keyed by msg number")
```

—————

10.0.202 defvar \$msgdbPrims

— initvars —

```
(defvar |$msgdbPrims|
  '(|%b| |%d| |%l| |%i| |%u| %U |%n| |%x| |%ce| |%rj| "%U" "%b" "%d"
    "%l" "%i" "%u" "%U" "%n" "%x" "%ce" "%rj"))
```

—————

10.0.203 defvar \$msgdbPunct

— initvars —

```
(defvar |$msgdbPunct|
  '(|.| |,| ! |:| |;| | ? | |)| "." "," "!" ":" ";" "?" "]" " "))
```

10.0.204 defvar \$msgdbNoBlanksBeforeGroup

— initvars —

```
(defvar |$msgdbNoBlanksBeforeGroup|
  '(" " | | "%" % ,@|$msgdbPrims| ,@|$msgdbPunct|))
```

10.0.205 defvar \$msgdbNoBlanksAfterGroup

— initvars —

```
(defvar |$msgdbNoBlanksAfterGroup|
  '(" " | | "%" % ,@|$msgdbPrims| [ |(| "[" "("))
```

10.0.206 defun Fetch a message from the message database

If the `*msghash*` hash table is empty we call `cacheKeyedMsg` to fill the table, otherwise we do a key lookup in the hash table. [object2Identifier p??]

```
[cacheKeyedMsg p329]
[$defaultMsgDatabaseName p8]
[*msghash* p327]
```

— defun fetchKeyedMsg —

```
(defun |fetchKeyedMsg| (key ignore)
  (declare (ignore ignore) (special *msghash* |$defaultMsgDatabaseName|))
  (setq key (|object2Identifier| key))
  (unless *msghash*
    (setq *msghash* (make-hash-table))
    (cacheKeyedMsg |$defaultMsgDatabaseName|))
  (gethash key *msghash*))
```

10.0.207 defun Cache messages read from message database

```
[done p??]
[done p??]
[*msghash* p327]
```

— defun cacheKeyedMsg —

```
(defun cacheKeyedMsg (file)
  (let ((line "") (msg "") key)
    (declare (special *msghash*))
    (with-open-file (in file)
      (catch 'done
        (loop
          (setq line (read-line in nil nil))
          (cond
            ((null line)
             (when key (setf (gethash key *msghash*) msg))
             (throw 'done nil))
            ((= (length line) 0))
            ((char= (schar line 0) #\S)
             (when key (setf (gethash key *msghash*) msg))
             (setq key (intern line "BOOT"))
             (setq msg ""))
            ('else
             (setq msg (concatenate 'string msg line))))))))))
```

10.0.208 defun getKeyedMsg

```
[fetchKeyedMsg p328]
```

— defun getKeyedMsg —

```
(defun |getKeyedMsg| (key) (|fetchKeyedMsg| key nil))
```

10.0.209 defun Say a message using a keyed lookup

```
[sayKeyedMsgLocal p330]
[$texFormatting p327]
```

— defun sayKeyedMsg —

```
(defun |sayKeyedMsg| (key args)
  (let (|$texFormatting|)
    (declare (special |$texFormatting|))
    (setq |$texFormatting| nil)
    (|sayKeyedMsgLocal| key args)))
```

10.0.210 defun Handle msg formatting and print to file

```
[segmentKeyedMsg p330]
[getKeyedMsg p329]
[substituteSegmentedMsg p??]
[flowSegmentedMsg p??]
[sayMSG2File p331]
[sayMSG p331]
[$printMsgsToFile p737]
[$linelength p771]
[$margin p771]
[$displayMsgNumber p743]
```

— defun sayKeyedMsgLocal —

```
(defun |sayKeyedMsgLocal| (key args)
  (let (msg msgp)
    (declare (special |$printMsgsToFile| $linelength $margin |$displayMsgNumber|))
    (setq msg (|segmentKeyedMsg| (|getKeyedMsg| key)))
    (setq msg (|substituteSegmentedMsg| msg args))
    (when |$displayMsgNumber| (setq msg ("%b" ,key |:| "%d" . ,msg)))
    (setq msgp (|flowSegmentedMsg| msg $linelength $margin))
    (when |$printMsgsToFile| (|sayMSG2File| msgp))
    (|sayMSG| msgp)))
```

10.0.211 defun Break a message into words

```
[string2Words p??]
```

— defun segmentKeyedMsg —

```
(defun |segmentKeyedMsg| (msg) (|string2Words| msg))
```

10.0.212 defun Write a msg into spadmsg.listing file

```
[makePathname p1044]
[defiostream p980]
[sayBrightly1 p1051]
[shut p980]
```

— defun sayMSG2File —

```
(defun |sayMSG2File| (msg)
  (let (file str)
    (setq file (|makePathname| '|spadmsg| '|listing| 'a))
    (setq str (defiostream '((mode . output) (file . ,file)) 255 0))
    (sayBrightly1 msg str)
    (shut str)))
```

10.0.213 defun sayMSG

```
[saybrightly1 p??]
[$algebraOutputStream p760]
```

— defun sayMSG —

```
(defun |sayMSG| (x)
  (declare (special |$algebraOutputStream|))
  (when x (sayBrightly1 x |$algebraOutputStream|)))
```

Chapter 11

Stream Utilities

The input stream is parsed into a large s-expression by repeated calls to Delay. Delay takes a function `f` and an argument `x` and returns a list consisting of `("nonnullstream" f x)`. Eventually multiple calls are made and a large list structure is created that consists of `("nonnullstream" f x ("nonnullstream" f1 x1 ("nonnullstream" f2 x2...`

This delay structure is given to StreamNull which walks along the list looking at the head. If the head is “nonnullstream” then the function is applied to the argument.

So, in effect, the input is “zipped up” into a Delay data structure which is then evaluated by calling StreamNull. This ”zippered stream” parser was a research project at IBM and Axiom was the testbed (which explains the strange parsing technique).

11.0.214 defun npNull

[StreamNull p333]

— defun npNull —

```
(defun |npNull| (x) (|StreamNull| x))
```

11.0.215 defun StreamNull

[eqcar p??]

— defun StreamNull 0 —

```
(defun |StreamNull| (x)
```

```
(let (st)
  (cond
    ((or (null x) (eqcar x '|nullstream|)) t)
    (t
     ((lambda nil
        (loop
         (cond
           ((not (eqcar x '|nonnullstream|)) (return nil))
           (t
            (setq st (apply (cadr x) (cddr x)))
            (rplaca x (car st))
            (rplacd x (cdr st))))))
      (eqcar x '|nullstream|))))))
```

Chapter 12

Code Piles

The `insertpile` function converts a line-list to a line-forest where a line is a token-dequeue and has a column which is an integer. An A-forest is an A-tree-list. An A-tree has a root which is an A, and subtrees which is an A-forest.

A forest with more than one tree corresponds to a Scratchpad pile structure (t1;t2;t3;...;tn), and a tree corresponds to a pile item. The (; and) tokens are inserted into a `z1`-forest, otherwise the root of the first tree is concatenated with its forest. column t is the number of spaces before the first non-space in line t

12.0.216 defun insertpile

[npNull p333]

[pilePlusComment p336]

[pilePlusComments p336]

[pileTree p337]

[pileCforest p340]

— defun insertpile —

```
(defun |insertpile| (s)
  (let (stream a t1 h1 t2 h tmp1)
    (cond
      ((|npNull| s) (list nil 0 nil s))
      (t
       (setq tmp1 (list (car s) (cdr s)))
       (setq h (car tmp1))
       (setq t2 (cadr tmp1))
       (cond
         ((|pilePlusComment| h)
          (setq tmp1 (|pilePlusComments| s))
          (setq h1 (car tmp1))
```

```

      (setq t1 (cadr tmp1))
      (setq a (|pileTree| (- 1) t1))
      (cons (list (|pileCforest|
                  (append h1 (cons (elt a 2) nil))))
            (elt a 3)))
    (t
     (setq stream (cadar s))
     (setq a (|pileTree| -1 s))
     (cons (list (list (elt a 2) stream)) (elt a 3))))))

```

12.0.217 defun pilePlusComment

[tokType p413]
 [npNull p333]
 [pilePlusComment p336]
 [pilePlusComments p336]

— defun pilePlusComment —

```

(defun |pilePlusComment| (arg)
  (eq (|tokType| (caar arg)) '|comment|))

```

12.0.218 defun pilePlusComments

— defun pilePlusComments —

```

(defun |pilePlusComments| (s)
  (let (t1 h1 t2 h tmp1)
    (cond
      ((|npNull| s) (list nil s))
      (t
       (setq tmp1 (list (car s) (cdr s)))
       (setq h (car tmp1))
       (setq t2 (cadr tmp1))
       (cond
         ((|pilePlusComment| h)
          (setq tmp1 (|pilePlusComments| t2))
          (setq h1 (car tmp1))
          (setq t1 (cadr tmp1))
          (list (cons h h1) t1))

```

```
(t
  (list nil s))))))
```

12.0.219 defun pileTree

```
[npNull p333]
[pileColumn p337]
[pileForests p337]
```

— defun pileTree —

```
(defun |pileTree| (n s)
  (let (hh t1 h tmp1)
    (cond
      ((|npNull| s) (list nil n nil s))
      (t
       (setq tmp1 (list (car s) (cdr s)))
       (setq h (car tmp1))
       (setq t1 (cadr tmp1))
       (setq hh (|pileColumn| (car h)))
       (cond
         ((< n hh) (|pileForests| (car h) hh t1))
         (t (list nil n nil s)))))))
```

12.0.220 defun pileColumn

```
[tokPosn p413]
```

— defun pileColumn —

```
(defun |pileColumn| (arg)
  (cdr (|tokPosn| (caar arg))))
```

12.0.221 defun pileForests

```
[pileForest p338]
[npNull p333]
```

[pileForests p337]
 [pileCtree p340]

— **defun pileForests** —

```
(defun |pileForests| (h n s)
  (let (t1 h1 tmp1)
    (setq tmp1 (|pileForest| n s))
    (setq h1 (car tmp1))
    (setq t1 (cadr tmp1))
    (cond
     ((|npNull| h1) (list t n h s))
     (t (|pileForests| (|pileCtree| h h1) n t1))))))
```

—————

12.0.222 **defun pileForest**

[pileTree p337]
 [pileForest1 p338]

— **defun pileForest** —

```
(defun |pileForest| (n s)
  (let (t1 h1 t2 h hh b tmp)
    (setq tmp (|pileTree| n s))
    (setq b (car tmp))
    (setq hh (cadr tmp))
    (setq h (caddr tmp))
    (setq t2 (caddr tmp))
    (cond
     (b
      (setq tmp (|pileForest1| hh t2))
      (setq h1 (car tmp))
      (setq t1 (cadr tmp))
      (list (cons h h1) t1))
     (t
      (list nil s)))))
```

—————

12.0.223 **defun pileForest1**

[eqpileTree p339]
 [pileForest1 p338]

— defun pileForest1 —

```
(defun |pileForest1| (n s)
  (let (t1 h1 t2 h n1 b tmp)
    (setq tmp (|eqpileTree| n s))
    (setq b (car tmp))
    (setq n1 (cadr tmp))
    (setq h (caddr tmp))
    (setq t2 (cadddr tmp))
    (cond
     (b
      (setq tmp (|pileForest1| n t2))
      (setq h1 (car tmp))
      (setq t1 (cadr tmp))
      (list (cons h h1) t1))
     (t (list nil s)))))
```

—————

12.0.224 defun eqpileTree

[npNull p333]
 [pileColumn p337]
 [pileForests p337]

— defun eqpileTree —

```
(defun |eqpileTree| (n s)
  (let (hh t1 h tmp)
    (cond
     ((|npNull| s) (list nil n nil s))
     (t
      (setq tmp (list (car s) (cdr s)))
      (setq h (car tmp))
      (setq t1 (cadr tmp))
      (setq hh (|pileColumn| (car h)))
      (cond
       ((equal hh n) (|pileForests| (car h) hh t1))
       (t (list nil n nil s)))))))
```

—————

12.0.225 defun pileCtree

[dqAppend p344]
 [pileCforest p340]

— defun pileCtree —

```
(defun |pileCtree| (x y)
  (|dqAppend| x (|pileCforest| y)))
```

—————

12.0.226 defun pileCforest

Only enpiles forests with ≥ 2 trees [tokPart p413]
 [enPile p340]
 [separatePiles p341]

— defun pileCforest —

```
(defun |pileCforest| (x)
  (let (f)
    (cond
      ((null x) nil)
      ((null (cdr x)) (setq f (car x)))
      (cond
        ((eq (|tokPart| (caar f)) 'if) (|enPile| f))
        (t f)))
    (t (|enPile| (|separatePiles| x))))))
```

—————

12.0.227 defun enPile

[dqConcat p343]
 [dqUnit p343]
 [tokConstruct p411]
 [firstTokPosn p341]
 [lastTokPosn p341]

— defun enPile —

```
(defun |enPile| (x)
  (|dqConcat|
```



```
(list
  (|dqUnit| (|tokConstruct| 'key| 'settab (|firstTokPosn| x)))
  x
  (|dqUnit| (|tokConstruct| 'key| 'backtab (|lastTokPosn| x))))))
```

12.0.228 defun firstTokPosn

[tokPosn p413]

— defun firstTokPosn —

```
(defun |firstTokPosn| (arg) (|tokPosn| (caar arg)))
```

12.0.229 defun lastTokPosn

[tokPosn p413]

— defun lastTokPosn —

```
(defun |lastTokPosn| (arg) (|tokPosn| (cadr arg)))
```

12.0.230 defun separatePiles

[dqUnit p343]
 [tokConstruct p411]
 [lastTokPosn p341]
 [dqConcat p343]
 [separatePiles p341]

— defun separatePiles —

```
(defun |separatePiles| (x)
  (let (semicolon a)
    (cond
      ((null x) nil)
      ((null (cdr x)) (car x))
```

```
(t
  (setq a (car x))
  (setq semicolon
    (|dqUnit| (|tokConstruct| 'key| 'backset (|lastTokPosn| a))))
  (|dqConcat| (list a semicolon (|separatePiles| (cdr x))))))
```

—————→

Chapter 13

Dequeue Functions

The dqUnit makes a unit dq i.e. a dq with one item, from the item

13.0.231 defun dqUnit

— defun dqUnit 0 —

```
(defun |dqUnit| (s)
  (let (a)
    (setq a (list s))
    (cons a a)))
```

—————

13.0.232 defun dqConcat

The dqConcat function concatenates a list of dq's, destroying all but the last [dqAppend p344]

[dqConcat p343]

— defun dqConcat —

```
(defun |dqConcat| (ld)
  (cond
    ((null ld) nil)
    ((null (cdr ld)) (car ld))
    (t (|dqAppend| (car ld) (|dqConcat| (cdr ld))))))
```

—————

13.0.233 defun dqAppend

The dqAppend function appends 2 dq's, destroying the first

— **defun dqAppend 0** —

```
(defun |dqAppend| (x y)
  (cond
    ((null x) y)
    ((null y) x)
    (t
     (rplacd (cdr x) (car y))
     (rplacd x (cdr y)) x)))
```

—————

13.0.234 defun dqToList

— **defun dqToList 0** —

```
(defun |dqToList| (s)
  (when s (car s)))
```

—————

Chapter 14

Message Handling

14.1 The Line Object

14.1.1 defun Line object creation

This is called in only one place, the `incLine1` function.

— `defun lnCreate 0` —

```
(defun |lnCreate| (extraBlanks string globalNum &rest optFileStuff)
  (let ((localNum (first optFileStuff))
        (filename (second optFileStuff)))
    (unless localNum (setq localNum 0))
    (list extraBlanks string globalNum localNum filename)))
```

—————

14.1.2 defun Line element 0; Extra blanks

— `defun lnExtraBlanks 0` —

```
(defun |lnExtraBlanks| (lineObject) (elt lineObject 0))
```

—————

14.1.3 defun Line element 1; String

— `defun lnString 0` —

```
(defun |lnString| (lineObject) (elt lineObject 1))
```

14.1.4 defun Line element 2; Global number

— defun lnGlobalNum 0 —

```
(defun |lnGlobalNum| (lineObject) (elt lineObject 2))
```

14.1.5 defun Line element 2; Set Global number

— defun lnSetGlobalNum 0 —

```
(defun |lnSetGlobalNum| (lineObject num)
  (setf (elt lineObject 2) num))
```

14.1.6 defun Line elemnt 3; Local number

— defun lnLocalNum 0 —

```
(defun |lnLocalNum| (lineObject) (elt lineObject 3))
```

14.1.7 defun Line element 4; Place of origin

— defun lnPlaceOfOrigin 0 —

```
(defun |lnPlaceOfOrigin| (lineObject) (elt lineObject 4))
```

14.1.8 defun Line element 4: Is it a filename?

[lnFileName? p347]

— defun lnImmediate? 0 —

```
(defun |lnImmediate?| (lineObject) (null (|lnFileName?| lineObject)))
```

—————

14.1.9 defun Line element 4: Is it a filename?

— defun lnFileName? 0 —

```
(defun |lnFileName?| (lineObject)
  (let (filename)
    (when (consp (setq filename (elt lineObject 4))) filename)))
```

—————

14.1.10 defun Line element 4; Get filename

[lnFileName? p347]

[ncBug p368]

— defun lnFileName —

```
(defun |lnFileName| (lineObject)
  (let (fN)
    (if (setq fN (|lnFileName?| lineObject))
        fN
        (|ncBug| "there is no file name in %1" (list lineObject)))))
```

—————

14.2 Messages**14.2.1 defun msgCreate**

```
msgObject  tag -- catagory of msg
            -- attributes as a-list
```

```

'imPr => dont save for list processing
toWhere, screen or file
'norep => only display once in list
pos -- position with possible FROM/TO tag
key -- key for message database
argL -- arguments to be placed in the msg test
prefix -- things like "Error: "
text -- the actual text

```

```

[setMsgForcedAttrList p364]
[putDatabaseStuff p365]
[initImPr p367]
[initToWhere p368]

```

— defun msgCreate —

```

(defun |msgCreate| (tag posWTag key argL optPre &rest optAttr)
  (let (msg)
    (when (consp key) (setq tag '|old|))
    (setq msg (list tag posWTag key argL optPre nil))
    (when (car optAttr) (|setMsgForcedAttrList| msg (car optAttr)))
    (|putDatabaseStuff| msg)
    (|initImPr| msg)
    (|initToWhere| msg)
    msg))

```

14.2.2 defun getMsgPosTagOb

— defun getMsgPosTagOb 0 —

```

(defun |getMsgPosTagOb| (msg) (elt msg 1))

```

14.2.3 defun getMsgKey

— defun getMsgKey 0 —

```

(defun |getMsgKey| (msg) (elt msg 2))

```

14.2.4 defun getMsgArgL

— defun getMsgArgL 0 —

```
(defun |getMsgArgL| (msg) (elt msg 3))
```

—————

14.2.5 defun getMsgPrefix

— defun getMsgPrefix 0 —

```
(defun |getMsgPrefix| (msg) (elt msg 4))
```

—————

14.2.6 defun setMsgPrefix

— defun setMsgPrefix 0 —

```
(defun |setMsgPrefix| (msg val) (setf (elt msg 4) val))
```

—————

14.2.7 defun getMsgText

— defun getMsgText 0 —

```
(defun |getMsgText| (msg) (elt msg 5))
```

—————

14.2.8 defun setMsgText

— defun setMsgText 0 —

```
(defun |setMsgText| (msg val)
  (setf (elt msg 5) val))
```

14.2.9 defun getMsgPrefix?

— defun getMsgPrefix? 0 —

```
(defun |getMsgPrefix?| (msg)
  (let ((pre (|getMsgPrefix| msg)))
    (unless (eq pre '|noPre|) pre)))
```

14.2.10 defun getMsgTag

The valid message tags are: line, old, error, warn, bug, unimple, remark, stat, say, debug
[ncTag p415]

— defun getMsgTag 0 —

```
(defun |getMsgTag| (msg) (|ncTag| msg))
```

14.2.11 defun getMsgTag?

```
[IFCAR p??]  
[getMsgTag p350]
```

— defun getMsgTag? 0 —

```
(defun |getMsgTag?| (|msg|)
  (ifcar (member (|getMsgTag| |msg|)
    (list '|line| '|old| '|error| '|warn| '|bug|
      '|unimple| '|remark| '|stat| '|say| '|debug|))))
```

14.2.12 defun line?

[getMsgTag p350]

— **defun line?** —

```
(defun |line?| (msg) (eq (|getMsgTag| msg) '|line|))
```

14.2.13 defun leader?

[getMsgTag p350]

— **defun leader?** —

```
(defun |leader?| (msg) (eq (|getMsgTag| msg) '|leader|))
```

14.2.14 defun toScreen?

[getMsgToWhere p363]

— **defun toScreen?** —

```
(defun |toScreen?| (msg) (not (eq (|getMsgToWhere| msg) '|fileOnly|)))
```

14.2.15 defun ncSoftError

Messages for the USERS of the compiler. The program being compiled has a minor error.
Give a message and continue processing. [desiredMsg p352]

[processKeyedError p353]

[msgCreate p347]

[\$newcompErrorCount p28]

— **defun ncSoftError** —

```
(defun |ncSoftError| (pos erMsgKey erArgL &rest optAttr)
  (declare (special |$newcompErrorCount|))
```

```
(setq |$newcompErrorCount| (+ |$newcompErrorCount| 1))
(when (|desiredMsg| erMsgKey)
  (|processKeyedError|
    (|msgCreate| '|error| pos erMsgKey erArgL
      "Error" optAttr))))
```

14.2.16 defun ncHardError

The program being compiled is seriously incorrect. Give message and throw to a recovery point. [desiredMsg p352]

[processKeyedError p353]

[msgCreate p347]

[ncError p69]

[\$newcompErrorCount p28]

— defun ncHardError —

```
(defun |ncHardError| (pos erMsgKey erArgL &rest optAttr)
  (let (erMsg)
    (declare (special |$newcompErrorCount|))
    (setq |$newcompErrorCount| (+ |$newcompErrorCount| 1))
    (if (|desiredMsg| erMsgKey)
      (setq erMsg
        (|processKeyedError|
          (|msgCreate| '|error| pos erMsgKey erArgL "Error" optAttr)))
      (|ncError|))))
```

14.2.17 defun desiredMsg

— defun desiredMsg 0 —

```
(defun |desiredMsg| (erMsgKey &rest optCatFlag)
  (declare (ignore erMsgKey))
  (cond
    ((null (null optCatFlag)) (car optCatFlag))
    (t t)))
```

14.2.18 defun processKeyedError

```
[getMsgTag? p350]
[getMsgKey p348]
[getMsgPrefix? p350]
[sayBrightly p??]
[CallerName p??]
[msgImPr? p358]
[msgOutputter p353]
[$ncMsgList p27]
```

— **defun processKeyedError** —

```
(defun |processKeyedError| (msg)
  (prog (pre erMsg)
    (declare (special |$ncMsgList|))
    (cond
      ((eq (|getMsgTag?| msg) 'old)
        (setq erMsg (|getMsgKey| msg))
        (cond
          ((setq pre (|getMsgPrefix?| msg))
            (setq erMsg (cons '|%b| (cons pre (cons '|%d| erMsg))))))
          (|sayBrightly| (cons "old msg from " (cons (|CallerName| 4) erMsg))))
        (|msgImPr?| msg) (|msgOutputter| msg))
      (t (setq |$ncMsgList| (cons msg |$ncMsgList|))))))
```

—————

14.2.19 defun msgOutputter

```
[getStFromMsg p354]
[leader? p351]
[line? p351]
[toScreen? p351]
[flowSegmentedMsg p??]
[sayBrightly p??]
[toFile? p363]
[alreadyOpened? p363]
[$linelength p771]
```

— **defun msgOutputter** —

```
(defun |msgOutputter| (msg)
  (let (alreadyOpened shouldFlow st)
    (declare (special $linelength))
    (setq st (|getStFromMsg| msg))
```

```
(setq shouldFlow (null (or (|leader?| msg) (|line?| msg))))
(when (|toScreen?| msg)
  (when shouldFlow (setq st (|flowSegmentedMsg| st $linelength 0)))
  (|sayBrightly| st))
(when (|toFile?| msg)
  (when shouldFlow (setq st (|flowSegmentedMsg| st (- $linelength 6) 0)))
  (setq alreadyOpened (|alreadyOpened?| msg)))))
```

14.2.20 defun listOutputter

[msgOutputter p353]

— defun listOutputter —

```
(defun |listOutputter| (outputList)
  (dolist (msg outputList)
    (|msgOutputter| msg)))
```

14.2.21 defun getStFromMsg

[getPreStL p355]
 [getMsgPrefix? p350]
 [getMsgTag p350]
 [getMsgText p349]
 [getPosStL p356]
 [getMsgKey? p362]
 [pname p1047]
 [getMsgLitSym p362]
 [tabbing p362]

— defun getStFromMsg —

```
(defun |getStFromMsg| (msg)
  (let (st posStL preStL)
    (setq preStL (|getPreStL| (|getMsgPrefix?| msg)))
    (cond
      ((eq (|getMsgTag| msg) '|line|)
        (cons ""
          (cons "%x1" (append preStL (cons (|getMsgText| msg) nil))))))
    (t
```

```
(setq posStL (|getPosStL| msg))
(setq st
  (cons posStL
    (cons (|getMsgLitSym| msg)
      (cons ""
        (append preStL
          (cons (|tabbing| msg)
            (|getMsgText| msg))))))))))
```

14.2.22 defvar \$preLength

— initvars —

```
(defvar |$preLength| 11)
```

14.2.23 defun getPreStL

```
[size p1047]
[$preLength p355]
```

— defun getPreStL 0 —

```
(defun |getPreStL| (optPre)
  (let (spses extraPlaces)
    (declare (special |$preLength|))
    (cond
      ((null optPre) (list " "))
      (t
        (setq spses
          (cond
            ((< 0 (setq extraPlaces (- (- |$preLength| (size optPre)) 3)))
            (make-string extraPlaces)
            (t "")))
          (list '|%b| optPre spses ":" '|%d|))))))
```

14.2.24 defun getPosStL

```
[showMsgPos? p357]
[getMsgPos p359]
[msgImPr? p358]
[decideHowMuch p359]
[listDecideHowMuch p361]
[ppos p357]
[remLine p362]
[remFile p357]
[$lastPos p??]
```

— defun getPosStL —

```
(defun |getPosStL| (msg)
  (let (printedOrigin printedLineNum printedFileName fullPrintedPos howMuch
        msgPos)
    (declare (special |$lastPos|))
    (cond
      ((null (|showMsgPos?| msg)) "")
      (t
       (setq msgPos (|getMsgPos| msg))
       (setq howMuch
         (if (|msgImPr?| msg)
             (|decideHowMuch| msgPos |$lastPos|)
             (|listDecideHowMuch| msgPos |$lastPos|)))
       (setq |$lastPos| msgPos)
       (setq fullPrintedPos (|ppos| msgPos))
       (setq printedFileName
         (cons "%x2" (cons "[" (append (|remLine| fullPrintedPos) (cons "]" nil))))))
       (setq printedLineNum
         (cons "%x2" (cons "[" (append (|remFile| fullPrintedPos) (cons "]" nil))))))
       (setq printedOrigin
         (cons "%x2" (cons "[" (append fullPrintedPos (cons "]" nil))))))
      (cond
        ((eq howMuch 'org)
         (cons "" (append printedOrigin (cons '|%l| nil))))
        ((eq howMuch 'line)
         (cons "" (append printedLineNum (cons '|%l| nil))))
        ((eq howMuch 'file)
         (cons "" (append printedFileName (cons '|%l| nil))))
        ((eq howMuch 'all)
         (cons ""
          (append printedFileName
                   (cons '|%l|
                    (cons ""
                     (append printedLineNum
                              (cons '|%l| nil))))))))
      (t ""))))))
```

14.2.25 defun ppos

```
[pfNoPosition? p412]
[pfImmediate? p??]
[pfCharPosn p235]
[pfLinePosn p235]
[porigin p88]
[pfFileName p236]
```

— defun ppos —

```
(defun |ppos| (p)
  (let (org lpos cpos)
    (cond
      ((|pfNoPosition?| p) (list "no position"))
      ((|pfImmediate?| p) (list "console"))
      (t
       (setq cpos (|pfCharPosn| p))
       (setq lpos (|pfLinePosn| p))
       (setq org (|porigin| (|pfFileName| p)))
       (list org " " "line" " " lpos))))))
```

14.2.26 defun remFile

```
[IFCDR p??]
[IFCAR p??]
```

— defun remFile —

```
(defun |remFile| (positionList) (ifcdr (ifcdr positionList)))
```

14.2.27 defun showMsgPos?

```
[msgImPr? p358]
[leader? p351]
```

```
[serMsgToss p??]
```

```
— defun showMsgPos? 0 —
```

```
(defun |showMsgPos?| (msg)
  (declare (special |serMsgToss|))
  (or |serMsgToss| (and (null (|msgImPr?| msg)) (null (|leader?| msg))))))
```

```
—————
```

14.2.28 defvar \$imPrGuys

```
— initvars —
```

```
(defvar |$imPrGuys| (list '|imPr|))
```

```
—————
```

14.2.29 defun msgImPr?

```
[getMsgCatAttr p358]
```

```
— defun msgImPr? —
```

```
(defun |msgImPr?| (msg)
  (eq (|getMsgCatAttr| msg '|$imPrGuys|) '|imPr|))
```

```
—————
```

14.2.30 defun getMsgCatAttr

```
[ifcdr p??]
[qassq p??]
[ncAlist p415]
```

```
— defun getMsgCatAttr —
```

```
(defun |getMsgCatAttr| (msg cat)
  (ifcdr (qassq cat (|ncAlist| msg))))
```

```
—————
```

14.2.31 defun getMsgPos

```
[getMsgFTTag? p359]
[getMsgPosTagOb p348]
```

— defun getMsgPos —

```
(defun |getMsgPos| (msg)
  (if (|getMsgFTTag?| msg)
      (cadr (|getMsgPosTagOb| msg))
      (|getMsgPosTagOb| msg)))
```

—————

14.2.32 defun getMsgFTTag?

```
[ifcar p??]
[getMsgPosTagOb p348]
```

— defun getMsgFTTag? —

```
(defun |getMsgFTTag?| (msg)
  (ifcar (member (ifcar (|getMsgPosTagOb| msg)) (list 'from 'to 'fromto))))
```

—————

14.2.33 defun decideHowMuch

When printing a msg, we wish not to show pos information that was shown for a previous msg with identical pos info. org prints out the word noposition or console [poNopos? p360]

```
[poPosImmediate? p360]
[poFileName p360]
[poLinePosn p361]
```

— defun decideHowMuch —

```
(defun |decideHowMuch| (pos oldPos)
  (cond
    ((or (and (|poNopos?| pos) (|poNopos?| oldPos))
         (and (|poPosImmediate?| pos) (|poPosImmediate?| oldPos)))
      'none)
    ((or (|poNopos?| pos) (|poPosImmediate?| pos)) 'org)
    ((or (|poNopos?| oldPos) (|poPosImmediate?| oldPos)) 'all)
    ((not (equal (|poFileName| oldPos) (|poFileName| pos))) 'all))
```

```
((not (equal (|poLinePosn| oldPos) (|poLinePosn| pos))) 'line)
(t 'none)))
```

14.2.34 defun poNopos?

— defun poNopos? 0 —

```
(defun |poNopos?| (posn)
  (equal posn (list '|no-position|)))
```

14.2.35 defun poPosImmediate?

```
[poNopos? p360]
[lnImmediate? p347]
[poGetLineObject p361]
```

— defun poPosImmediate? —

```
(defun |poPosImmediate?| (txp)
  (unless (|poNopos?| txp) (|lnImmediate?| (|poGetLineObject| txp))))
```

14.2.36 defun poFileName

```
[lnFileName p347]
[poGetLineObject p361]
```

— defun poFileName —

```
(defun |poFileName| (posn)
  (if posn
    (|lnFileName| (|poGetLineObject| posn))
    (caar posn)))
```

14.2.37 defun poGetLineObject

— defun poGetLineObject 0 —

```
(defun |poGetLineObject| (posn)
  (car posn))
```

—

14.2.38 defun poLinePosn

```
[lnLocalNum p346]
[poGetLineObject p361]
```

— defun poLinePosn —

```
(defun |poLinePosn| (posn)
  (if posn
    (|lnLocalNum| (|poGetLineObject| posn))
    (cdar posn)))
```

—

14.2.39 defun listDecideHowMuch

```
[poNopos? p360]
[poPosImmediate? p360]
[poGlobalLinePosn p72]
```

— defun listDecideHowMuch —

```
(defun |listDecideHowMuch| (pos oldPos)
  (cond
    ((or (and (|poNopos?| pos) (|poNopos?| oldPos))
         (and (|poPosImmediate?| pos) (|poPosImmediate?| oldPos)))
     'none)
    ((|poNopos?| pos) 'org)
    ((|poNopos?| oldPos) 'none)
    ((< (|poGlobalLinePosn| pos) (|poGlobalLinePosn| oldPos))
     (if (|poPosImmediate?| pos) 'org 'line))
    (t 'none)))
```

—

14.2.40 defun remLine

— defun remLine 0 —

```
(defun |remLine| (positionList) (list (ifcar positionList)))
```

—————

14.2.41 defun getMsgKey?

[identp p1048]

— defun getMsgKey? 0 —

```
(defun |getMsgKey?| (msg)
  (let ((val (|getMsgKey| msg)))
    (when (identp val) val)))
```

—————

14.2.42 defun getMsgLitSym

[getMsgKey? p362]

— defun getMsgLitSym —

```
(defun |getMsgLitSym| (msg)
  (if (|getMsgKey?| msg) " " "*"))
```

—————

14.2.43 defun tabbing

[getMsgPrefix? p350]

[\$preLength p355]

— defun tabbing —

```
(defun |tabbing| (msg)
  (let (chPos)
    (declare (special |$preLength|)))
```

```
(setq chPos 2)
(when (|getMsgPrefix?| msg) (setq chPos (- (+ chPos |$preLength|) 1)))
(cons '|%t| chPos))
```

14.2.44 defvar \$toWhereGuys

— initvars —

```
(defvar |$toWhereGuys| (list '|fileOnly| '|screenOnly|))
```

14.2.45 defun getMsgToWhere

[getMsgCatAttr p358]

— defun getMsgToWhere —

```
(defun |getMsgToWhere| (msg) (|getMsgCatAttr| msg '|$toWhereGuys|))
```

14.2.46 defun toFile?

[getMsgToWhere p363]

[\$fn p??]

— defun toFile? —

```
(defun |toFile?| (msg)
  (declare (special |$fn|))
  (and (consp |$fn|) (not (eq (|getMsgToWhere| msg) '|screenOnly|))))
```

14.2.47 defun alreadyOpened?

[msgImPr? p358]

— defun alreadyOpened? —

```
(defun |alreadyOpened?| (msg) (null (|msgImPr?| msg)))
```

14.2.48 defun setMsgForcedAttrList

```
[setMsgForcedAttr p364]
[whichCat p365]
```

— defun setMsgForcedAttrList —

```
(defun |setMsgForcedAttrList| (msg attrlist)
  (dolist (attr attrlist)
    (|setMsgForcedAttr| msg (|whichCat| attr) attr)))
```

14.2.49 defun setMsgForcedAttr

```
[setMsgCatlessAttr p365]
[ncPutQ p416]
```

— defun setMsgForcedAttr —

```
(defun |setMsgForcedAttr| (msg cat attr)
  (if (eq cat '|catless|)
    (|setMsgCatlessAttr| msg attr)
    (|ncPutQ| msg cat attr)))
```

14.2.50 defvar \$attrCats

— initvars —

```
(defvar |$attrCats| (list '|$imPrGuys| '|$toWhereGuys| '|$repGuys|))
```

14.2.51 defun whichCat

[ListMember? p??]
 [\$attrCats p364]

— defun whichCat —

```
(defun |whichCat| (attr)
  (let ((found '|catless|) done)
    (declare (special |$attrCats|))
    (loop for cat in |$attrCats| do
      (when (|ListMember?| attr (eval cat))
        (setq found cat)
        (setq done t))
      until done)
    found))
```

—————

14.2.52 defun setMsgCatlessAttr

TPDHERE: Changed from —catless— to '—catless— [ncPutQ p416]
 [ifcdr p??]
 [qassq p??]
 [ncAlist p415]

— defun setMsgCatlessAttr —

```
(defun |setMsgCatlessAttr| (msg attr)
  (|ncPutQ| msg '|catless|
    (cons attr (ifcdr (qassq |catless| (|ncAlist| msg))))))
```

—————

14.2.53 defun putDatabaseStuff

TPDHERE: The variable al is undefined [getMsgInfoFromKey p366]
 [setMsgUnforcedAttrList p366]
 [setMsgText p349]

— defun putDatabaseStuff —

```
(defun |putDatabaseStuff| (msg)
  (let (attributes text tmp)
```

```
(setq tmp (|getMsgInfoFromKey| msg))
(setq text (car tmp))
(setq attributes (cadr tmp))
(when attributes (|setMsgUnforcedAttrList| msg al))
(|setMsgText| msg text)))
```

14.2.54 defun getMsgInfoFromKey

```
[getMsgKey? p362]
[getErFromDbL p??]
[getMsgKey p348]
[segmentKeyedMsg p330]
[removeAttributes p??]
[substituteSegmentedMsg p??]
[getMsgArgL p349]
[$msgDatabaseName p326]
```

— defun getMsgInfoFromKey —

```
(defun |getMsgInfoFromKey| (msg)
  (let (|$msgDatabaseName| attributes tmp msgText msgKey)
    (declare (special |$msgDatabaseName|))
    (setq |$msgDatabaseName| nil)
    (setq msgText
      (cond
        ((setq msgKey (|getMsgKey?| msg))
         (|fetchKeyedMsg| msgKey nil))
        (t (|getMsgKey| msg))))
    (setq msgText (|segmentKeyedMsg| msgText))
    (setq tmp (|removeAttributes| msgText))
    (setq msgText (car tmp))
    (setq attributes (cadr tmp))
    (setq msgText (|substituteSegmentedMsg| msgText (|getMsgArgL| msg)))
    (list msgText attributes)))
```

14.2.55 defun setMsgUnforcedAttrList

```
[setMsgUnforcedAttr p367]
[whichCat p365]
```

— defun setMsgUnforcedAttrList —

```
(defun |setMsgUnforcedAttrList| (msg attrlist)
  (dolist (attr attrlist)
    (|setMsgUnforcedAttr| msg (|whichCat| attr) attr)))
```

14.2.56 defun setMsgUnforcedAttr

```
[setMsgCatlessAttr p365]
[qassq p??]
[ncAlist p415]
[ncPutQ p416]
```

— defun setMsgUnforcedAttr —

```
(defun |setMsgUnforcedAttr| (msg cat attr)
  (cond
    ((eq cat '|catless|) (|setMsgCatlessAttr| msg attr))
    ((null (qassq cat (|ncAlist| msg))) (|ncPutQ| msg cat attr))))
```

14.2.57 defvar \$imPrTagGuys

— initvars —

```
(defvar |$imPrTagGuys| (list '|unimple| '|bug| '|debug| '|say| '|warn|))
```

14.2.58 defun initImPr

```
[getMsgTag p350]
[setMsgUnforcedAttr p367]
[$imPrTagGuys p367]
[$erMsgToss p??]
```

— defun initImPr —

```
(defun |initImPr| (msg)
  (declare (special |$imPrTagGuys| |$erMsgToss|)))
```

```
(when (or |$erMsgToss| (member (|getMsgTag| msg) |$imPrTagGuys|))
      (|setMsgUnforcedAttr| msg '|$imPrGuys| '|imPr|)))
```

14.2.59 defun initToWhere

```
[getMsgCatAttr p358]
[setMsgUnforcedAttr p367]
```

— defun initToWhere —

```
(defun |initToWhere| (msg)
  (if (member '|trace| (|getMsgCatAttr| msg '|catless|))
      (|setMsgUnforcedAttr| msg '|$toWhereGuys| '|screenOnly|)))
```

14.2.60 defun ncBug

Bug in the compiler: something which shouldn't have happened did. [processKeyedError p353]

```
[msgCreate p347]
[enable-backtrace p??]
[ncAbort p??]
[$nopus p28]
[$newcompErrorCount p28]
```

— defun ncBug —

```
(defun |ncBug| (erMsgKey erArgL &rest optAttr)
  (let (erMsg)
    (declare (special |$nopus| |$newcompErrorCount|))
    (setq |$newcompErrorCount| (+ |$newcompErrorCount| 1))
    (setq erMsg
      (|processKeyedError|
        (|msgCreate| '|bug| |$nopus| erMsgKey erArgL "Bug!" optAttr)))
    (break)
    (|ncAbort|)))
```

14.2.61 defun processMsgList

```
[erMsgSort p369]
[makeMsgFromLine p371]
[poGlobalLinePosn p72]
[getMsgPos p359]
[queueUpErrors p372]
[listOutputter p354]
[$noRepList p??]
[$outputList p??]
```

— defun processMsgList —

```
(defun |processMsgList| (erMsgList lineList)
  (let (|$noRepList| |$outputList| st globalNumOfLine msgLine)
    (declare (special |$noRepList| |$outputList|))
    (setq |$outputList| nil)
    (setq |$noRepList| nil)
    (setq erMsgList (|erMsgSort| erMsgList))
    (dolist (line lineList)
      (setq msgLine (|makeMsgFromLine| line))
      (setq |$outputList| (cons msgLine |$outputList|))
      (setq globalNumOfLine (|poGlobalLinePosn| (|getMsgPos| msgLine)))
      (setq erMsgList (|queueUpErrors| globalNumOfLine erMsgList)))
    (setq |$outputList| (append erMsgList |$outputList|))
    (setq st "-----SOURCE-TEXT-&-ERRORS-----")
    (|listOutputter| (reverse |$outputList|))))
```

—————

14.2.62 defun erMsgSort

```
[erMsgSep p370]
[listSort p??]
```

— defun erMsgSort —

```
(defun |erMsgSort| (erMsgList)
  (let (msgWOPos msgWPos tmp)
    (setq tmp (|erMsgSep| erMsgList))
    (setq msgWPos (car tmp))
    (setq msgWOPos (cadr tmp))
    (setq msgWPos (|listSort| #'|erMsgCompare| msgWPos))
    (setq msgWOPos (reverse msgWOPos))
    (append msgWPos msgWOPos)))
```

14.2.63 defun erMsgCompare

[compareposns p370]
[getMsgPos p359]

— defun erMsgCompare —

```
(defun |erMsgCompare| (ob1 ob2)
  (|compareposns| (|getMsgPos| ob2) (|getMsgPos| ob1)))
```

14.2.64 defun compareposns

[poGlobalLinePosn p72]
[poCharPosn p377]

— defun compareposns —

```
(defun |compareposns| (a b)
  (let (c d)
    (setq c (|poGlobalLinePosn| a))
    (setq d (|poGlobalLinePosn| b))
    (if (equal c d)
        (not (< (|poCharPosn| a) (|poCharPosn| b)))
        (not (< c d)))))
```

14.2.65 defun erMsgSep

[poNopos? p360]
[getMsgPos p359]

— defun erMsgSep —

```
(defun |erMsgSep| (erMsgList)
  (let (msgWOPos msgWPos)
    (dolist (msg erMsgList)
      (if (|poNopos?| (|getMsgPos| msg))
          (setq msgWOPos (cons msg msgWOPos))
```

```
(setq msgWPos (cons msg msgWPos))))
(list msgWPos msgWOPos))
```

14.2.66 defun makeMsgFromLine

```
[getLinePos p372]
[getLineText p372]
[poGlobalLinePosn p72]
[poLinePosn p361]
[strconc p??]
[rep p371]
[char p??]
[size p1047]
[$preLength p355]
```

— defun makeMsgFromLine —

```
(defun |makeMsgFromLine| (line)
  (let (localNumOfLine stNum globalNumOfLine textOfLine posOfLine)
    (declare (special |$preLength|))
    (setq posOfLine (|getLinePos| line))
    (setq textOfLine (|getLineText| line))
    (setq globalNumOfLine (|poGlobalLinePosn| posOfLine))
    (setq stNum (princ-to-string (|poLinePosn| posOfLine)))
    (setq localNumOfLine
      (strconc (|rep| #\space (- |$preLength| 7 (size stNum))) stNum))
    (list '|line| posOfLine nil nil (strconc "Line" localNumOfLine) textOfLine)))
```

14.2.67 defun rep

TPDHERE: This function should be replaced by fillerspaces

— defun rep 0 —

```
(defun |rep| (c n)
  (if (< 0 n)
    (make-string n :initial-element (character c))
    ""))
```

14.2.68 defun getLinePos

```

— defun getLinePos 0 —

(defun |getLinePos| (line) (car line))

```

14.2.69 defun getLineText

```

— defun getLineText 0 —

(defun |getLineText| (line) (cdr line))

```

14.2.70 defun queueUpErrors

```

;queueUpErrors(globalNumOfLine,msgList)==
;  thisPosMsgs := []
;  notThisLineMsgs := []
;  for msg in msgList _
;    while thisPosIsLess(getMsgPos msg,globalNumOfLine) repeat
;      --these are msgs that refer to positions from earlier compilations
;      if not redundant (msg,notThisPosMsgs) then
;        notThisPosMsgs := [msg,:notThisPosMsgs]
;      msgList := rest msgList
;  for msg in msgList _
;    while thisPosIsEqual(getMsgPos msg,globalNumOfLine) repeat
;      if not redundant (msg,thisPosMsgs) then
;        thisPosMsgs := [msg,:thisPosMsgs]
;      msgList := rest msgList
;  if thisPosMsgs then
;    thisPosMsgs := processChPosesForOneLine thisPosMsgs
;    $outputList := NCONC(thisPosMsgs,$outputList)
;  if notThisPosMsgs then
;    $outputList := NCONC(notThisPosMsgs,$outputList)
;  msgList

```

```

[processChPosesForOneLine p376]
[$outputList p??]

```

```

— defun queueUpErrors —

```



```

(DEFUN |queueUpErrors| (|globalNumOfLine| |msgList|)
  (PROG (|notThisPosMsgs| |notThisLineMsgs| |thisPosMsgs|)
    (DECLARE (SPECIAL |$outputList|))
    (RETURN
      (PROGN
        (SETQ |thisPosMsgs| NIL)
        (SETQ |notThisLineMsgs| NIL)
        ((LAMBDA (|bfVar#7| |msg|)
          (LOOP
            (COND
              ((OR (ATOM |bfVar#7|)
                (PROGN (SETQ |msg| (CAR |bfVar#7|)) NIL)
                (NOT (|thisPosIsLess| (|getMsgPos| |msg|)
                                      |globalNumOfLine|)))
              (RETURN NIL))
            'T
            (PROGN
              (COND
                ((NULL (|redundant| |msg| |notThisPosMsgs|))
                 (SETQ |notThisPosMsgs|
                       (CONS |msg| |notThisPosMsgs|))))
                (SETQ |msgList| (CDR |msgList|))))
              (SETQ |bfVar#7| (CDR |bfVar#7|))))
          |msgList| NIL)
        ((LAMBDA (|bfVar#8| |msg|)
          (LOOP
            (COND
              ((OR (ATOM |bfVar#8|)
                (PROGN (SETQ |msg| (CAR |bfVar#8|)) NIL)
                (NOT (|thisPosIsEqual| (|getMsgPos| |msg|)
                                      |globalNumOfLine|)))
              (RETURN NIL))
            'T
            (PROGN
              (COND
                ((NULL (|redundant| |msg| |thisPosMsgs|))
                 (SETQ |thisPosMsgs| (CONS |msg| |thisPosMsgs|))))
                (SETQ |msgList| (CDR |msgList|))))
              (SETQ |bfVar#8| (CDR |bfVar#8|))))
          |msgList| NIL)
        (COND
          (|thisPosMsgs|
            (SETQ |thisPosMsgs|
                  (|processChPosesForOneLine| |thisPosMsgs|))
            (SETQ |$outputList| (NCONC |thisPosMsgs| |$outputList|))))
          (COND
            (|notThisPosMsgs|
              (SETQ |$outputList|
                    (NCONC |notThisPosMsgs| |$outputList|))))
            |msgList|))))

```

14.2.71 defun thisPosIsLess

```
[poNopos? p360]
[poGlobalLinePosn p72]
```

— defun thisPosIsLess —

```
(defun |thisPosIsLess| (pos num)
  (unless (|poNopos?| pos) (< (|poGlobalLinePosn| pos) num)))
```

14.2.72 defun thisPosIsEqual

```
[poNopos? p360]
[poGlobalLinePosn p72]
```

— defun thisPosIsEqual —

```
(defun |thisPosIsEqual| (pos num)
  (unless (|poNopos?| pos) (equal (|poGlobalLinePosn| pos) num)))
```

14.2.73 defun redundant

```
redundant(msg,thisPosMsgs) ==
  found := NIL
  if msgNoRep? msg then
    for item in $noRepList repeat
      sameMsg?(msg,item) => return (found := true)
    $noRepList := [msg,$noRepList]
  found or MEMBER(msg,thisPosMsgs)
```

```
[msgNoRep? p375]
[sameMsg? p376]
[$noRepList p??]
```

— defun redundant —

```

(defun |redundant| (msg thisPosMsgs)
  (prog (found)
    (declare (special |$noRepList|))
    (return
      (progn
        (cond
          ((|msgNoRep?| msg)
            ((lambda (Var9 item)
              (loop
                (cond
                  ((or (atom Var9) (progn (setq item (car Var9)) nil))
                    (return nil))
                  (t
                     (cond
                       ((|sameMsg?| msg item) (return (setq found t))))
                    (setq Var9 (cdr Var9))))
                |$noRepList| nil)
              (setq |$noRepList| (list msg |$noRepList|)))
            (or found (member msg thisPosMsgs))))))

```

14.2.74 defvar \$repGuys

— initvars —

```

(defvar |$repGuys| (list '|noRep| '|rep|))

```

14.2.75 defun msgNoRep?

[getMsgCatAttr p358]

— defun msgNoRep? —

```

(defun |msgNoRep?| (msg) (eq (|getMsgCatAttr| msg '|$repGuys|) '|noRep|))

```

14.2.76 defun sameMsg?

```
[getMsgKey p348]
[getMsgArgL p349]
```

— defun sameMsg? —

```
(defun |sameMsg?| (msg1 msg2)
  (and (equal (|getMsgKey| msg1) (|getMsgKey| msg2))
        (equal (|getMsgArgL| msg1) (|getMsgArgL| msg2))))
```

14.2.77 defun processChPosesForOneLine

```
[posPointers p378]
[getMsgFTTag? p359]
[putFTText p379]
[poCharPosn p377]
[getMsgPos p359]
[getMsgPrefix p349]
[setMsgPrefix p349]
[strconc p??]
[size p1047]
[makeLeaderMsg p377]
[$preLength p355]
```

— defun processChPosesForOneLine —

```
(defun |processChPosesForOneLine| (msgList)
  (let (leaderMsg oldPre posLetter chPosList)
    (declare (special |$preLength|))
    (setq chPosList (|posPointers| msgList))
    (dolist (msg msgList)
      (when (|getMsgFTTag?| msg) (|putFTText| msg chPosList))
      (setq posLetter (cdr (assoc (|poCharPosn| (|getMsgPos| msg)) chPosList)))
      (setq oldPre (|getMsgPrefix| msg))
      (|setMsgPrefix| msg
        (strconc oldPre
          (make-string (- |$preLength| 4 (size oldPre)) posLetter)))
      (setq leaderMsg (|makeLeaderMsg| chPosList))
      (nconc msgList (list leaderMsg))))
```

14.2.78 defun poCharPosn

— defun poCharPosn 0 —

```
(defun |poCharPosn| (posn)
  (cdr posn))
```

—————

14.2.79 defun makeLeaderMsg

```
makeLeaderMsg chPosList ==
  st := MAKE_-FULL_-CVEC ($preLength- 3)
  oldPos := -1
  for [posNum, posLetter] in reverse chPosList repeat
    st := STRCONC(st, _
      rep(char ".", (posNum - oldPos - 1)), posLetter)
    oldPos := posNum
  ['leader, $nopus, 'nokey, NIL, NIL, [st] ]
```

```
[$nopus p28]
[$preLength p355]
```

— defun makeLeaderMsg —

```
(defun |makeLeaderMsg| (chPosList)
  (let (posLetter posNum oldPos st)
    (declare (special |$nopus| |$preLength|))
    (setq st (make-string (- |$preLength| 3)))
    (setq oldPos -1)
    ((lambda (Var15 Var14)
      (loop
        (cond
          ((or (atom Var15) (progn (setq Var14 (car Var15)) nil))
            (return nil))
          (t
            (and (consp Var14)
              (progn
                (setq posNum (car Var14))
                (setq posLetter (cdr Var14))
                t)
              (progn
                (setq st
                  (strconc st (|rep| (|char| '|.|) (- posNum oldPos 1)) posLetter))
                (setq oldPos posNum))))))
      (setq Var15 (cdr Var15))))))
```

```
(reverse chPosList) nil)
(list '|leader| |$nopus| '|nokey| nil nil (list st))))
```

14.2.80 defun posPointers

TPDHERE: getMsgFTTag is nonsense [poCharPosn p377]
 [getMsgPos p359]
 [IFCAR p??]
 [getMsgPos2 p378]
 [insertPos p379]
 [getMsgFTTag p??]

— defun posPointers —

```
(defun |posPointers| (msgList)
  (let (posLetterList pos ftPosList posList increment pointers)
    (declare (special |getMsgFTTag|))
    (setq pointers "ABCDEFGHJKLMNOPQRS")
    (setq increment 0)
    (dolist (msg msgList)
      (setq pos (|poCharPosn| (|getMsgPos| msg)))
      (unless (equal pos (ifcar posList))
        (setq posList (cons pos posList)))
      ; this should probably read TPDHERE
      ; (when (eq (|getMsgPosTagOb| msg) 'fromto)
      (when (eq |getMsgFTTag| 'fromto)
        (setq ftPosList (cons (|poCharPosn| (|getMsgPos2| msg)) ftPosList))))
      (dolist (toPos ftPosList)
        (setq posList (|insertPos| toPos posList)))
      (dolist (pos posList)
        (setq posLetterList
          (cons (cons pos (elt pointers increment)) posLetterList))
        (setq increment (+ increment 1)))
      posLetterList)))
```

14.2.81 defun getMsgPos2

[getMsgFTTag? p359]
 [getMsgPosTagOb p348]
 [ncBug p368]

— defun getMsgPos2 —

```
(defun |getMsgPos2| (msg)
  (if (|getMsgFTTag?| msg)
      (caddr (|getMsgPosTag0b| msg))
      (|ncBug| "not a from to" nil)))
```

14.2.82 defun insertPos

This function inserts a position in the proper place of a position list. This is used for the 2nd pos of a fromto [done p??]

— defun insertPos 0 —

```
(defun |insertPos| (newPos posList)
  (let (pos top bot done)
    (setq bot (cons 0 posList))
    (do () (done)
      (setq top (cons (car bot) top))
      (setq bot (cdr bot))
      (setq pos (car bot))
      (setq done
        (cond
         ((< pos newPos) nil)
         ((equal pos newPos) t)
         ((< newPos pos)
          (setq top (cons newPos top))
          t))))
    (cons (cdr (reverse top)) bot)))
```

14.2.83 defun putFTText

```
[getMsgFTTag? p359]
[poCharPosn p377]
[getMsgPos p359]
[setMsgText p349]
[getMsgText p349]
[getMsgPos2 p378]
```

— defun putFTText —

```
(defun |putFTText| (msg chPosList)
  (let (charMarker2 pos2 markingText charMarker pos tag)
    (setq tag (|getMsgFTTag?| msg))
    (setq pos (|poCharPosn| (|getMsgPos| msg)))
    (setq charMarker (cdr (assoc pos chPosList)))
    (cond
      ((eq tag 'from)
        (setq markingText (list "(from " charMarker " and on) "))
        (|setMsgText| msg (append markingText (|getMsgText| msg))))
      ((eq tag 'to)
        (setq markingText (list "(up to " charMarker " )"))
        (|setMsgText| msg (append markingText (|getMsgText| msg))))
      ((eq tag 'fromto)
        (setq pos2 (|poCharPosn| (|getMsgPos2| msg)))
        (setq charMarker2 (cdr (assoc pos2 chPosList)))
        (setq markingText (list "(from " charMarker " up to " charMarker2 " )"))
        (|setMsgText| msg (append markingText (|getMsgText| msg)))))))
```

14.2.84 defun From

This is called from parameter list of nc message functions

— **defun From 0** —

```
(defun |From| (pos) (list 'from pos))
```

14.2.85 defun To

This is called from parameter list of nc message functions

— **defun To 0** —

```
(defun |To| (pos) (list 'to pos))
```

14.2.86 defun FromTo

This is called from parameter list of nc message functions

— **defun FromTo 0** —


```
(defun |FromTo| (pos1 pos2) (list 'fromto pos1 pos2))
```

Chapter 15

The Interpreter Syntax

15.1 syntax assignment

— assignment.help —

Immediate, Delayed, and Multiple Assignment

=====

Immediate Assignment

=====

A variable in Axiom refers to a value. A variable has a name beginning with an uppercase or lowercase alphabetic character, "%", or "!". Successive characters (if any) can be any of the above, digits, or "?". Case is distinguished. The following are all examples of valid, distinct variable names:

a	tooBig?	a1B2c3%!?
A	%j	numberOfPoints
beta6	%J	numberofpoints

The "!=" operator is the immediate assignment operator. Use it to associate a value with a variable. The syntax for immediate assignment for a single variable is:

variable := expression

The value returned by an immediate assignment is the value of expression.

a := 1
1

Type: PositiveInteger

The right-hand side of the expression is evaluated, yielding 1. The value is then assigned to a.

```
b := a
1
```

Type: PositiveInteger

The right-hand side of the expression is evaluated, yielding 1. This value is then assigned to b. Thus a and b both have the value 1 after the sequence of assignments.

```
a := 2
2
```

Type: PositiveInteger

What is the value of b if a is assigned the value 2?

```
b
1
```

Type: PositiveInteger

The value of b is left unchanged.

This is what we mean when we say this kind of assignment is immediate. The variable b has no dependency on a after the initial assignment. This is the usual notion of assignment in programming languages such as C, Pascal, and Fortran.

```
=====
Delayed Assignment
=====
```

Axiom provides delayed assignment with "==". This implements a delayed evaluation of the right-hand side and dependency checking. The syntax for delayed assignment is

```
variable == expression
```

The value returned by a delayed assignment is the unique value of Void.

```
a == 1
Type: Void
```

```
b == a
Type: Void
```

Using a and b as above, these are the corresponding delayed assignments.

```

a
  Compiling body of rule a to compute value of type PositiveInteger
  1
    Type: PositiveInteger

```

The right-hand side of each delayed assignment is left unevaluated until the variables on the left-hand sides are evaluated.

```

b
  Compiling body of rule b to compute value of type PositiveInteger
  1
    Type: PositiveInteger

```

This gives the same results as before. But if we change a to 2

```

a == 2
  Compiled code for a has been cleared.
  Compiled code for b has been cleared.
  1 old definition(s) deleted for function or rule a
    Type: Void

```

Then a evaluates to 2, as expected

```

a
  Compiling body of rule a to compute value of type PositiveInteger
  2
    Type: PositiveInteger

```

but the value of b reflects the change to a

```

b
  Compiling body of rule b to compute value of type PositiveInteger
  2
    Type: PositiveInteger

```

Multiple Immediate Assignments

It is possible to set several variables at the same time by using a tuple of variables and a tuple of expressions. A tuple is a collection of things separated by commas, often surrounded by parentheses. The syntax for multiple immediate assignment is

```
( var1, var2, ..., varN ) := ( expr1, expr2, ..., exprN )
```

The value returned by an immediate assignment is the value of exprN.

```
( x, y ) := ( 1, 2 )
2
```

Type: PositiveInteger

This sets *x* to 1 and *y* to 2. Multiple immediate assignments are parallel in the sense that the expressions on the right are all evaluated before any assignments on the left are made. However, the order of evaluation of these expressions is undefined.

```
( x, y ) := ( y, x )
```

1

Type: PositiveInteger

x

2

Type: PositiveInteger

The variable *x* now has the previous value of *y*.

y

1

Type: PositiveInteger

The variable *y* now has the previous value of *x*.

There is no syntactic form for multiple delayed assignments.

15.2 syntax blocks

— blocks.help —

```
=====
Blocks
=====
```

A block is a sequence of expressions evaluated in the order that they appear, except as modified by control expressions such as `leave`, `return`, `iterate`, and `if-then-else` constructions. The value of a block is the value of the expression last evaluated in the block.

To leave a block early, use `"=>"`. For example,

```
i < 0 => x
```

The expression before the `"=>"` must evaluate to true or false. The expression following the `"=>"` is the return value of the block.

A block can be constructed in two ways:

1. the expressions can be separated by semicolons and the resulting expression surrounded by parentheses, and
 2. the expressions can be written on succeeding lines with each line indented the same number of spaces (which must be greater than zero).
- A block entered in this form is called a pile

Only the first form is available if you are entering expressions directly to Axiom. Both forms are available in .input files. The syntax for a simple block of expressions entered interactively is

```
( expression1 ; expression2 ; ... ; expressionN )
```

The value returned by a block is the value of an "=>" expression, or expressionN if no "=>" is encountered.

In .input files, blocks can also be written in piles. The examples given here are assumed to come from .input files.

```
a :=
  i := gcd(234,672)
  i := 2*i**5 - i + 1
  1 / i

      1
      ----
    23323

Type: Fraction Integer
```

In this example, we assign a rational number to a using a block consisting of three expressions. This block is written as a pile. Each expression in the pile has the same indentation, in this case two spaces to the right of the first line.

```
a := ( i := gcd(234,672); i := 2*i**5 - i + 1; 1 / i )

      1
      ----
    23323

Type: Fraction Integer
```

Here is the same block written on one line. This is how you are required to enter it at the input prompt.

```
( a := 1; b := 2; c := 3; [a,b,c] )
[1,2,3]

Type: List PositiveInteger
```

AAxiom gives you two ways of writing a block and the preferred way in an .input file is to use a pile. Roughly speaking, a pile is a block whose constituent expressions are indented the same amount. You begin a pile by starting a new line for the first expression, indenting it to the right of the previous line. You then enter the second expression on a new line, vertically aligning it with the first line. And so on. If you need to enter an inner pile, further indent its lines to the right of the outer pile. Axiom knows where a pile ends. It ends when a subsequent line is indented to the left of the pile or the end of the file.

Also See:

- o)help if
- o)help repeat
- o)help while
- o)help for
- o)help suchthat
- o)help parallel
- o)help lists

1

15.3 system clef

— clef.help —

Entering printable keys generally inserts new text into the buffer (unless in overwrite mode, see below). Other special keys can be used to modify the text in the buffer. In the description of the keys below, `^n` means Control-n, or holding the CONTROL key down while pressing "n". Errors will ring the terminal bell.

- `^A/^E` : Move cursor to beginning/end of the line.
- `^F/^B` : Move cursor forward/backward one character.
- `^D` : Delete the character under the cursor.
- `^H, DEL` : Delete the character to the left of the cursor.
- `^K` : Kill from the cursor to the end of line.
- `^L` : Redraw current line.
- `^O` : Toggle overwrite/insert mode. Initially in insert mode. Text added in overwrite mode (including yanks) overwrite existing text, while insert mode does not overwrite.
- `^P/^N` : Move to previous/next item on history list.

¹ "if" (15.6 p 395) "repeat" (15.10 p 402) "while" (69.1.2 p 1041) "for" (15.5 p 391) "suchthat" (15.11 p 406) "parallel" (15.9 p 399) "lists" (?? p ??)

`^R/^S` : Perform incremental reverse/forward search for string on the history list. Typing normal characters adds to the current search string and searches for a match. Typing `^R/^S` marks the start of a new search, and moves on to the next match. Typing `^H` or `DEL` deletes the last character from the search string, and searches from the starting location of the last search. Therefore, repeated `DEL`'s appear to unwind to the match nearest the point at which the last `^R` or `^S` was typed. If `DEL` is repeated until the search string is empty the search location begins from the start of the history list. Typing `ESC` or any other editing character accepts the current match and loads it into the buffer, terminating the search.
`^T` : Toggle the characters under and to the left of the cursor.
`^Y` : Yank previously killed text back at current location. Note that this will overwrite or insert, depending on the current mode.
`^U` : Show help (this text).
`TAB` : Perform command completion based on word to the left of the cursor. Words are deemed to contain only the alphanumeric and the `% ! ? _` characters.
`NL, CR` : returns current buffer to the program.

DOS and ANSI terminal arrow key sequences are recognized, and act like:

`up` : same as `^P`
`down` : same as `^N`
`left` : same as `^B`
`right` : same as `^F`

15.4 syntax collection

— collection.help —

```
=====
Collection -- Creating Lists and Streams with Iterators
=====
```

All of the loop expressions which do not use the `repeat` `leave` or `iterate` words can be used to create lists and streams. For example:

This creates a simple list of the integers from 1 to 10:

```
list := [i for i in 1..10]
[1,2,3,4,5,6,7,8,9,10]
Type: List PositiveInteger
```

Create a stream of the integers greater than or equal to 1:

```
stream := [i for i in 1..]
[1,2,3,4,5,6,7,...]
Type: Stream PositiveInteger
```

This is a list of the prime numbers between 1 and 10, inclusive:

```
[i for i in 1..10 | prime? i]
[2,3,5,7]
Type: List PositiveInteger
```

This is a stream of the prime integers greater than or equal to 1:

```
[i for i in 1.. | prime? i]
[2,3,5,7,11,13,17,...]
Type: Stream PositiveInteger
```

This is a list of the integers between 1 and 10, inclusive, whose squares are less than 700:

```
[i for i in 1..10 while i*i < 700]
[1,2,3,4,5,6,7,8,9,10]
Type: List PositiveInteger
```

This is a stream of the integers greater than or equal to 1 whose squares are less than 700:

```
[i for i in 1.. while i*i < 700]
[1,2,3,4,5,6,7,...]
Type: Stream PositiveInteger
```

The general syntax of a collection is

```
[ collectExpression iterator1 iterator2 ... iteratorN ]
```

where each iterator is either a for or a while clause. The loop terminates immediately when the end test of any iterator succeeds or when a return expression is evaluated in collectExpression. The value returned by the collection is either a list or a stream of elements, one for each iteration of the collectExpression.

Be careful when you use while to create a stream. By default Axiom tries to compute and display the first ten elements of a stream. If the while condition is not satisfied quickly, Axiom can spend a long (potentially infinite) time trying to compute the elements. Use

```
)set streams calculate
```

to change the defaults to something else. This also affects the number of terms computed and displayed for power series. For the purposes of these examples we have use this system command to display fewer than ten terms.

15.5 syntax for

— for.help —

```
=====
for loops
=====
```

Axiom provide the `for` and `in` keywords in repeat loops, allowing you to integrate across all elements of a list, or to have a variable take on integral values from a lower bound to an upper bound. We shall refer to these modifying clauses of repeat loops as `for` clauses. These clauses can be present in addition to `while` clauses (See `)help while`). As with all other types of repeat loops, `leave` (see `)help leave`) can be used to prematurely terminate evaluation of the loop.

The syntax for a simple loop using `for` is

```
for iterator repeat loopbody
```

The iterator has several forms. Each form has an end test which is evaluated before `loopbody` is evaluated. A `for` loop terminates immediately when the end test succeeds (evaluates to true) or when a `leave` or `return` expression is evaluated in `loopbody`. The value returned by the loop is the unique value of `Void`.

```
=====
for i in n..m repeat
=====
```

If `for` is followed by a variable name, the `in` keyword and then an integer segment of the form `n..m`, the end test for this loop is the predicate `i > m`. The body of the loop is evaluated `m-n+1` times if this number is greater than 0. If this number is less than or equal to 0, the loop body is not evaluated at all.

The variable `i` has the value `n`, `n+1`, ..., `m` for successive iterations of the loop body. The loop variable is a local variable within the loop body. Its value is not available outside the loop body and its value and

type within the loop body completely mask any outer definition of a variable with the same name.

```
for i in 10..12 repeat output(i**3)
1000
1331
1728
```

Type: Void

The loop prints the values of 10^3 , 11^3 , and 12^3 .

```
a := [1,2,3]
[1,2,3]
```

Type: List PositiveInteger

```
for i in 1..#a repeat output(a.i)
1
2
3
```

Type: Void

Iterate across this list using "." to access the elements of a list and the # operation to count its elements.

This type of iteration is applicable to anything that uses ".". You can also use it with functions that use indices to extract elements.

```
m := matrix [ [1,2],[4,3],[9,0] ]
+-      +-
| 1  2 |
| 4  3 |
| 9  0 |
+-      +-

```

Type: Matrix Integer

Define m to be a matrix.

```
for i in 1..nrows(m) repeat output row(m.i)
[1,2]
[4,3]
[9,0]
```

Type: Void

Display the rows of m.

You can iterate with for-loops.

```
for i in 1..5 repeat
  if odd?(i) then iterate
  output(i)
```

```
2
4
```

Type: Void

Display the even integers in a segment.

```
=====
for i in n..m by s repeat
=====
```

By default, the difference between values taken on by a variable in loops such as

```
for i in n..m repeat ...
```

is 1. It is possible to supply another, possibly negative, step value by using the `by` keyword along with `for` and `in`. Like the upper and lower bounds, the step value following the `by` keyword must be an integer. Note that the loop

```
for i in 1..2 by 0 repeat output(i)
```

will not terminate by itself, as the step value does not change the index from its initial value of 1.

```
for i in 1..5 by 2 repeat output(i)
1
3
5
```

Type: Void

This expression displays the odd integers between two bounds.

```
for i in 5..1 by -2 repeat output(i)
5
3
1
```

Type: Void

Use this to display the numbers in reverse order.

```
=====
for i in n.. repeat
=====
```

If the value after the `".."` is omitted, the loop has no end test. A potentially infinite loop is thus created. The variable is given the successive values `n`, `n+1`, `n+2`, ... and the loop is terminated only if a `leave` or `return` expression is evaluated in the loop body. However, you may also add some other modifying clause on the `repeat`, for example,

a while clause, to stop the loop.

```
for i in 15.. while not prime?(i) repeat output(i)
15
16
```

Type: Void

This loop displays the integers greater than or equal to 15 and less than the first prime number greater than 15.

```
=====
for x in l repeat
=====
```

Another variant of the for loop has the form:

```
for x in list repeat loopbody
```

This form is used when you want to iterate directly over the elements of a list. In this form of the for loop, the variable *x* takes on the value of each successive element in *l*. The end test is most simply stated in English: "are there no more *x* in *l*?"

```
l := [0, -5, 3]
[0, -5, 3]
```

Type: List Integer

```
for x in l repeat output(x)
0
-5
3
```

Type: Void

This displays all of the elements of the list *l*, one per line.

Since the list constructing expression

```
expand [n..m]
```

creates the list

```
[n, n+1, ..., m]
```

you might be tempted to think that the loops

```
for i in n..m repeat output(i)
```

and

```
for x in expand [n..m] repeat output(x)
```

are equivalent. The second form first creates the expanded list (no matter how large it might be) and then does the iteration. The first form potentially runs in much less space, as the index variable `i` is simply incremented once per loop and the list is not actually created. Using the first form is much more efficient.

Of course, sometimes you really want to iterate across a specific list. This displays each of the factors of 2400000:

```
for f in factors(factor(2400000)) repeat output(f)
[factor= 2, exponent= 8]
[factor= 3, exponent= 1]
[factor= 5, exponent= 5]
Type: Void
```

15.6 syntax if

— if.help —

```
=====
If-then-else
=====
```

Like many other programming languages, Axiom uses the three keywords `if`, `then`, and `else` to form conditional expressions. The `else` part of the conditional is optional. The expression between the `if` and `then` keywords is a predicate: an expression that evaluates to or is convertible to either true or false, that is, a Boolean.

The syntax for conditional expressions is

```
if predicate then expression1 else expression2
```

where the "else expression2" part is optional. The value returned from a conditional expression is expression1 if the predicate evaluates to true and expression2 otherwise. If no else clause is given, the value is always the unique value of Void.

An if-then-else expression always returns a value. If the else clause is missing then the entire expression returns the unique value of Void. If both clauses are present, the type of the value returned by if is obtained by resolving the types of the values of the two clauses.

The predicate must evaluate to, or be convertible to, an object of type Boolean: true or false. By default, the equal sign "=" creates an equation.

```
x + 1 = y
x + 1 = y
```

Type: Equation Polynomial Integer

This is an equation, not a boolean condition. In particular, it is an object of type Equation Polynomial Integer.

However, for predicates in if expressions, Axiom places a default target type of Boolean on the predicate and equality testing is performed. Thus you need not qualify the "=" in any way. In other contexts you may need to tell Axiom that you want to test for equality rather than create an equation. In these cases, use "@" and a target type of Boolean.

The compound symbol meaning "not equal" in Axiom is "~=". This can be used directly without a package call or a target specification. The expression "a ~= b" is directly translated to "not(a = b)".

Many other functions have return values of type Boolean. These include <, <=, >, >=, ~=, and member?. By convention, operations with names ending in "?" return Boolean values.

The usual rules for files are suspended for conditional expressions. In .input files, the then and else keywords can begin in the same column as the corresponding if by may also appear to the right. Each of the following styles of writing if-then-else expressions is acceptable:

```
if i>0 then output("positive") else output("nonpositive")
```

```
if i>0 then output("positive")
    else output("nonpositive")
```

```
if i>0 then output("positive")
else output("nonpositive")
```

```
if i>0
then output("positive")
else output("nonpositive")
```

```
if i>0
    then output("positive")
    else output("nonpositive")
```

A block can follow the then or else keywords. In the following two assignments to a, the then and else clauses each are followed by two line piles. The value returned in each is the value of the second line.

```
a :=
```



```

    if i > 0 then
      j := sin(i * pi())
      exp(j + 1/j)
    else
      j := cos(i * 0.5 * pi())
      log(abs(j)**5 + i)

a :=
  if i > 0
  then
    j := sin(i * pi())
    exp(j + 1/j)
  else
    j := cos(i * 0.5 * pi())
    log(abs(j)**5 + i)

```

These are both equivalent to the following:

```

a :=
  if i > 0 then (j := sin(i * pi()); exp(j + 1/j))
  else (j := cos(i * 0.5 * pi()); log(abs(j)**5 + i))

```

15.7 syntax iterate

— iterate.help —

```

=====
iterate in loops
=====

```

Axiom provides an `iterate` expression that skips over the remainder of a loop body and starts the next loop execution. We first initialize a counter.

```

i := 0
0
                                     Type: NonNegativeInteger

```

Display the even integers from 2 to 5:

```

repeat
  i := i + 1
  if i > 5 then leave

```

```

    if odd?(i) then iterate
    output(i)
  2
  4

```

Type: Void

15.8 syntax leave

— leave.help —

```

=====
leave in loops
=====

```

The leave keyword is often more useful in terminating a loop. A leave causes control to transfer to the expression immediately following the loop. As loops always return the unique value of Void, you cannot return a value with leave. That is, leave takes no argument.

```

f() ==
  i := 1
  repeat
    if factorial(i) > 1000 then leave
    i := i + 1
  i

```

Type: Void

This example is a modification of the last example in the previous section. Instead of using return we'll use leave.

```

f()
7

```

Type: PositiveInteger

The loop terminates when factorial(i) gets big enough. The last line of the function evaluates to the corresponding "good" value of i and the function terminates, returning that value.

You can only use leave to terminate the evaluation of one loop. Lets consider a loop within a loop, that is, a loop with a nested loop. First, we initialize two counter variables.

```

(i,j) := (1,1)
1

```

Type: PositiveInteger

```
repeat
  repeat
    if (i + j) > 10 then leave
    j := j + 1
  if (i + j) > 10 then leave
  i := i + 1
```

Type: Void

Nested loops must have multiple leave expressions at the appropriate nesting level. How would you rewrite this so $(i + j) > 10$ is only evaluated once?

```
=====
leave vs => in loop bodies
=====
```

Compare the following two loops:

<pre>i := 1 repeat i := i + 1 i > 3 => i output(i)</pre>	<pre>i := 1 repeat i := i + 1 if i > 3 then leave output(i)</pre>
--	--

In the example on the left, the values 2 and 3 for i are displayed but then the " \Rightarrow " does not allow control to reach the call to output again. The loop will not terminate until you run out of space or interrupt the execution. The variable i will continue to be incremented because the " \Rightarrow " only means to leave the block, not the loop.

In the example on the right, upon reaching 4, the leave will be executed, and both the block and the loop will terminate. This is one of the reasons why both " \Rightarrow " and leave are provided. Using a while clause with the " \Rightarrow " lets you simulate the action of leave.

—

15.9 syntax parallel

— parallel.help —

```
=====
parallel iteration
=====
```

Sometimes you want to iterate across two lists in parallel, or perhaps you want to traverse a list while incrementing a variable.

The general syntax of a repeat loop is

```
iterator1, iterator2, ..., iteratorN repeat loopbody
```

where each iterator is either a for or a while clause. The loop terminates immediately when the end test of any iterator succeeds or when a leave or return expression is evaluated in loopbody. The value returned by the loop is the unique value of Void.

```
l := [1,3,5,7]
    [1,3,5,7]
                                     Type: List PositiveInteger

m := [100,200]
    [100,200]
                                     Type: List PositiveInteger

sum := 0
    0
                                     Type: NonNegativeInteger
```

Here we write a loop to iterate across two lists, computing the sum of the pairwise product of the elements:

```
for x in l for y in m repeat
    sum := sum + x*y
                                     Type: Void
```

The last two elements of `l` are not used in the calculation because `m` has two fewer elements than `l`.

```
sum
700
                                     Type: NonNegativeInteger
```

This is the "dot product".

Next we write a loop to compute the sum of the products of the loop elements with their positions in the loop.

```
l := [2,3,5,7,11,13,17,19,23,29,31,37]
    [2,3,5,7,11,13,17,19,23,29,31,37]
                                     Type: List PositiveInteger

sum := 0
    0
```

Type: NonNegativeInteger

```
for i in 0.. for x in l repeat sum := i * x
Type: Void
```

Here looping stops when the list `l` is exhausted, even though the `for i in 0..` specifies no terminating condition.

```
sum
407
Type: NonNegativeInteger
```

When `"|"` is used to qualify any of the `for` clauses in a parallel iteration, the variables in the predicates can be from an outer scope or from a `for` clause in or to the left of the modified clause.

This is correct:

```
for i in 1..10 repeat
  for j in 200..300 | odd? (i+j) repeat
    output [i,j]
```

But this is not correct. The variable `j` has not been defined outside the inner loop:

```
for i in 1..10 | odd? (i+j) repeat -- wrong, j not defined
  for j in 200..300 repeat
    output [i,j]
```

It is possible to mix several of repeat modifying clauses on a loop:

```
for i in 1..10
  for j in 151..160 | odd? j
    while i + j < 160 repeat
      output [i,j]
[1,151]
[3,153]
Type: Void
```

Here are useful rules for composing loop expressions:

1. while predicates can only refer to variables that are global (or in an outer scope) or that are defined in `for` clauses to the left of the predicate.
2. A "such that" predicate (something following `"|"`) must directly follow a `for` clause and can only refer to variables that are global (or in an outer scope) or defined in the modified `for` clause or any `for` clause to the left.

15.10 syntax repeat

— repeat.help —

```
=====
Repeat Loops
=====
```

A loop is an expression that contains another expression, called the loop body, which is to be evaluated zero or more times. All loops contain the repeat keyword and return the unique value of Void. Loops can contain inner loops to any depth.

The most basic loop is of the form

```
repeat loopbody
```

Unless loopbody contains a leave or return expression, the loop repeats forever. The value returned by the loop is the unique value of Void.

Axiom tries to determine completely the type of every object in a loop and then to translate the loop body to Lisp or even to machine code. This translation is called compilation.

If Axiom decides that it cannot compile the loop, it issues a message stating the problem and then the following message:

```
We will attempt to step through and interpret the code
```

It is still possible that Axiom can evaluate the loop but in interpret-code mode.

```
=====
Return in Loops
=====
```

A return expression is used to exit a function with a particular value. In particular, if a return is in a loop within the function, the loop is terminated whenever the return is evaluated.

```
f() ==
  i := 1
  repeat
    if factorial(i) > 1000 then return i
  i := i + 1
```

Type: Void

f()

Type: Void

When factorial(i) is big enough, control passes from inside the loop all the way outside the function, returning the value of i (so we think). What went wrong? Isn't it obvious that this function should return an integer? Well, Axiom makes no attempt to analyze the structure of a loop to determine if it always returns a value because, in general, this is impossible. So Axiom has this simple rule: the type of the function is determined by the type of its body, in this case a block. The normal value of a block is the value of its last expression, in this case, a loop. And the value of every loop is the unique value of Void. So the return type of f is Void.

There are two ways to fix this. The best way is for you to tell Axiom what the return type of f is. You do this by giving f a declaration

```
f:() -> Integer
```

prior to calling for its value. This tells Axiom "trust me -- an integer is returned". Another way is to add a dummy expression as follows.

```
f() ==
  i := 1
  repeat
    if factorial(i) > 1000 then return i
    i := i + 1
  0
```

Type: Void

Note that the dummy expression will never be evaluated but it is the last expression in the function and will determine the return type.

```
f()
7
```

Type: PositiveInteger

```
=====
leave in loops
=====
```

The leave keyword is often more useful in terminating a loop. A leave causes control to transfer to the expression immediately following the loop. As loops always return the unique value of Void, you cannot return a value with leave. That is, leave takes no argument.

```
f() ==
  i := 1
```

```

repeat
  if factorial(i) > 1000 then leave
  i := i + 1
i

```

Type: Void

This example is a modification of the last example in the previous section. Instead of using return we'll use leave.

```

f()
7

```

Type: PositiveInteger

The loop terminates when factorial(i) gets big enough. The last line of the function evaluates to the corresponding "good" value of i and the function terminates, returning that value.

You can only use leave to terminate the evaluation of one loop. Lets consider a loop within a loop, that is, a loop with a nested loop. First, we initialize two counter variables.

```

(i,j) := (1,1)
1

```

Type: PositiveInteger

```

repeat
  repeat
    if (i + j) > 10 then leave
    j := j + 1
  if (i + j) > 10 then leave
  i := i + 1

```

Type: Void

Nested loops must have multiple leave expressions at the appropriate nesting level. How would you rewrite this so (i + j) > 10 is only evaluated once?

```

=====
leave vs => in loop bodies
=====

```

Compare the following two loops:

<pre> i := 1 repeat i := i + 1 i > 3 => i output(i) </pre>	<pre> i := 1 repeat i := i + 1 if i > 3 then leave output(i) </pre>
--	--

In the example on the left, the values 2 and 3 for i are displayed but

then the "`=>`" does not allow control to reach the call to output again. The loop will not terminate until you run out of space or interrupt the execution. The variable `i` will continue to be incremented because the "`=>`" only means to leave the block, not the loop.

In the example on the right, upon reaching 4, the leave will be executed, and both the block and the loop will terminate. This is one of the reasons why both "`=>`" and `leave` are provided. Using a `while` clause with the "`=>`" lets you simulate the action of `leave`.

```
=====
iterate in loops
=====
```

Axiom provides an `iterate` expression that skips over the remainder of a loop body and starts the next loop execution. We first initialize a counter.

```
i := 0
0
                                     Type: NonNegativeInteger
```

Display the even integers from 2 to 5:

```
repeat
  i := i + 1
  if i > 5 then leave
  if odd?(i) then iterate
  output(i)
2
4
                                     Type: Void
```

Also See:

```
o )help blocks
o )help if
o )help while
o )help for
o )help suchthat
o )help parallel
o )help lists
```

15.11 syntax suchthat

— suchthat.help —

```
=====
Such that predicates
=====
```

A for loop can be followed by a "|" and then a predicate. The predicate qualifies the use of the values from the iterator that follows the for. Think of the vertical bar "|" as the phrase "such that".

```
for n in 0..4 | odd? n repeat output n
1
3
```

Type: Void

This loop expression prints out the integers n in the given segment such that n is odd.

A for loop can also be written

```
for iterator | predicate repeat loopbody
```

which is equivalent to:

```
for iterator repeat if predicate then loopbody else iterate
```

The predicate need not refer only to the variable in the for clause. Any variable in an outer scope can be part of the predicate.

```
for i in 1..50 repeat
  for j in 1..50 | factorial(i+j) < 25 repeat
    output [i,j]
[1,1]
[1,2]
[1,3]
[2,1]
[2,2]
[3,1]
```

Type: Void

15.12 syntax syntax

— syntax.help —

The Axiom Interactive Language has the following features documented here.

More information is available by typing

```
)help feature
```

where feature is one of:

```
assignment -- Immediate and delayed assignments
blocks      -- Blocks of expressions
collection  -- creating lists with iterators
for         -- for loops
if          -- If-then-else statements
iterate     -- using iterate in loops
leave       -- using leave in loops
parallel    -- parallel iterations
repeat      -- repeat loops
suchthat    -- suchthat predicates
while       -- while loops
```

—

15.13 syntax while

— while.help —

```
=====
while loops
=====
```

The repeat in a loop can be modified by adding one or more while clauses. Each clause contains a predicate immediately following the while keyword. The predicate is tested before the evaluation of the body of the loop. The loop body is evaluated whenever the predicate in a while clause is true.

The syntax for a simple loop using while is

```
while predicate repeat loopbody
```

The predicate is evaluated before loopbody is evaluated. A while loop terminates immediately when predicate evaluates to false or when a leave or return expression is evaluated. See `)help repeat` for more information on leave and return.

Here is a simple example of using while in a loop. We first initialize the counter.

```
i := 1
1
                                     Type: PositiveInteger

while i < 1 repeat
  output "hello"
  i := i + 1
                                     Type: Void
```

The steps involved in computing this example are

- (1) set i to 1
- (2) test the condition `i < 1` and determine that it is not true
- (3) do not evaluate the loop body and therefore do not display "hello"

```
(x, y) := (1, 1)
1
                                     Type: PositiveInteger
```

If you have multiple predicates to be tested use the logical and operation to separate them. Axiom evaluates these predicates from left to right.

```
while x < 4 and y < 10 repeat
  output [x,y]
  x := x + 1
  y := y + 2
[1,1]
[2,3]
[3,5]
                                     Type: Void
```

A leave expression can be included in a loop body to terminate a loop even if the predicate in any while clauses are not false.

```
(x, y) := (1, 1)
1
                                     Type: PositiveInteger
```

```
while x < 4 and y < 10 repeat
  if x + y > 7 then leave
```

```
output [x,y]
x := x + 1
y := y + 2
[1,1]
[2,3]
```

Type: Void

Chapter 16

Abstract Syntax Trees (ptrees)

Abstract Syntax Trees

These functions create and examine abstract syntax trees. These are called pform, for short.

!! This file also contains constructors for concrete syntax, although
!! they should be somewhere else.

THE PFORM DATA STRUCTURE

Leaves: [hd, tok, pos]
Trees: [hd, tree, tree, ...]
hd is either an id or (id . alist)

16.0.1 defun Construct a leaf token

The tokConstruct function is a constructor and selectors for leaf tokens. A leaf token looks like [head, token, position] where head is either an id or (id . alist) [ifcar p??]

[pfNoPosition? p412]

[ncPutQ p416]

— defun tokConstruct —

```
(defun |tokConstruct| (head token &rest position)
  (let (result)
    (setq result (cons head token))
    (cond
      ((ifcar position)
       (cond
         ((|pfNoPosition?| (car position)) result)
         (t (|ncPutQ| result '|posn| (car position)) result)))
```

```
(t result))))
```

16.0.2 defun Return a part of a node

```
[ifcar p??]
```

— defun pfAbSynOp —

```
(defun |pfAbSynOp| (form)
  (let (hd)
    (setq hd (car form))
    (or (ifcar hd) hd)))
```

16.0.3 defun Compare a part of a node

```
[eqcar p??]
```

— defun pfAbSynOp? —

```
(defun |pfAbSynOp?| (form op)
  (let (hd)
    (setq hd (car form))
    (or (eq hd op) (eqcar hd op))))
```

16.0.4 defun pfNoPosition?

```
[poNoPosition? p413]
```

— defun pfNoPosition? —

```
(defun |pfNoPosition?| (pos)
  (|poNoPosition?| pos))
```

16.0.5 defun poNoPosition?

[eqcar p??]

— defun poNoPosition? 0 —

```
(defun |poNoPosition?| (pos)
  (eqcar pos '|noPosition|))
```

—————

16.0.6 defun tokType

[ncTag p415]

— defun tokType —

```
(defun |tokType| (x) (|ncTag| x))
```

—————

16.0.7 defun tokPart

— defun tokPart 0 —

```
(defun |tokPart| (x) (cdr x))
```

—————

16.0.8 defun tokPosn

[qassq p??]

[ncAlist p415]

[pfNoPosition p414]

— defun tokPosn —

```
(defun |tokPosn| (x)
  (let (a)
    (setq a (qassq '|posn| (|ncAlist| x)))
    (cond
```

```
(a (cdr a))
(t (lpfNoPosition|))))))
```

16.0.9 defun pfnNoPosition

[poNoPosition p414]

— defun pfnNoPosition —

```
(defun |pfnNoPosition| () (lpNoPosition|))
```

16.0.10 defun poNoPosition

[\$npos p28]

— defun poNoPosition 0 —

```
(defun |poNoPosition| ()
  (declare (special |$npos|))
  |$npos|)
```

Chapter 17

Attributed Structures

For objects which are pairs where the CAR field is either just a tag (an identifier) or a pair which is the tag and an association list.

17.0.11 defun ncTag

Pick off the tag [ncBug p368]

[qcar p??]

[identp p1048]

— defun ncTag —

```
(defun |ncTag| (x)
  (cond
    ((null (consp x)) (|ncBug| 's2cb0031 nil))
    (t
     (setq x (qcar x))
     (cond
      ((identp x) x)
      ((null (consp x)) (|ncBug| 's2cb0031 nil))
      (t (qcar x))))))
```

—————

17.0.12 defun ncAlist

Pick off the property list [ncBug p368]

[qcar p??]

[identp p1048]

[qcdr p??]

— defun ncAlist —

```
(defun |ncAlist| (x)
  (cond
    ((null (consp x)) (|ncBug| 's2cb0031 nil))
    (t
     (setq x (qcar x))
     (cond
       ((identp x) nil)
       ((null (consp x)) (|ncBug| 's2cb0031 nil))
       (t (qcdr x))))))
```

17.0.13 defun ncEltQ

Get the entry for key k on x's association list [qassq p??]

[ncAlist p415]

[ncBug p368]

— defun ncEltQ —

```
(defun |ncEltQ| (x k)
  (let (r)
    (setq r (qassq k (|ncAlist| x)))
    (cond
      ((null r) (|ncBug| 's2cb0007 (list k)))
      (t (cdr r)))))
```

17.0.14 defun ncPutQ

```
-- Put (k . v) on the association list of x and return v
-- case1: ncPutQ(x,k,v) where k is a key (an identifier), v a value
--       put the pair (k . v) on the association list of x and return v
-- case2: ncPutQ(x,k,v) where k is a list of keys, v a list of values
--       equivalent to [ncPutQ(x,key,val) for key in k for val in v]
ncPutQ(x,k,v) ==
;   LISTP k =>
;     for key in k for val in v repeat ncPutQ(x,key,val)
;     v
;   r := QASSQ(k,ncAlist x)
;   if NULL r then
```

```

;      r := CONS( CONS(k,v), ncAlist x)
;      RPLACA(x,CONS(ncTag x,r))
;    else
;      RPLACD(r,v)
;    v

```

```

[qassq p??]
[ncAlist p415]
[ncTag p415]

```

— defun ncPutQ —

```

(defun |ncPutQ| (x k v)
  (let (r)
    (cond
      ((listp k)
       ((lambda (Var1 key Var2 val)
          (loop
            (cond
              ((or (atom Var1)
                   (progn (setq key (car Var1)) nil)
                   (atom Var2)
                   (progn (setq val (car Var2)) nil))
               (return nil))
              (t
               (|ncPutQ| x key val)))
            (setq Var1 (cdr Var1))
            (setq Var2 (cdr Var2))))
        k nil v nil)
       v)
      (t
       (setq r (qassq k (|ncAlist| x)))
       (cond
         ((null r)
          (setq r (cons (cons k v) (|ncAlist| x)))
          (rplaca x (cons (|ncTag| x) r)))
         (t
          (rplacd r v)))
       v))))

```

Chapter 18

Function Selection

New Selection of Modemaps

selection of applicable modemaps is done in two steps:

first it tries to find a modemap inside an argument domain, and if this fails, by evaluation of pattern modemaps the result is a list of functions with signatures, which have the following form:

[sig,elt,cond] where

sig is the signature gained by evaluating the modemap condition

elt is the slot number to get the implementation

cond are runtime checks which are the results of evaluating the modemap condition

the following flags are used:

\$Coerce is NIL, if function selection is done which requires exact matches (e.g. for coercion functions)

if \$SubDom is true, then runtime checks have to be compiled

18.0.15 defun ofCategory

[identp p1048]

[ofCategory p419]

[hasCaty p420]

[\$Subst p??]

[\$hope p??]

— defun ofCategory —

```
(defun |ofCategory| (dom cat)
  (let (|$Subst| |$hope|)
    (declare (special |$Subst| |$hope|))
```

```
(cond
  ((identp dom) nil)
  ((and (listp cat) (eq (car cat) '|Join|))
   (every #'(lambda (c) (|ofCategory| dom c)) (cdr cat)))
  (t (not (eq (|hasCaty| dom cat nil) '|failed|))))))
```

18.0.16 defun isPartialMode

The `isPartialMode` function tests whether `m` contains `$EmptyMode`. The constant `$EmptyMode` evaluates to `|$EmptyMode|`. This constant is inserted in a modemap during compile time if the modemap is not yet complete. [contained p??]
`[$EmptyMode p??]`

— defun isPartialMode —

```
(defun |isPartialMode| (m)
  (declare (special |$EmptyMode|))
  (contained |$EmptyMode| m))
```

18.0.17 defun hasCaty

This calls `hasCat`, which looks up a hashtable and returns:

1. T, NIL or a (has x1 x2) condition, if `cat` is not parameterized
2. a list of pairs (argument to `cat`, condition) otherwise

then the substitution `sl` is augmented, or the result is 'failed [hasAttSig p426]

```
[subCopy p??]
[constructSubst p434]
[hasSig p423]
[hasAtt p424]
[hasCat p??]
[opOf p??]
[kdr p??]
[mkDomPvar p432]
[domArg p422]
[augmentSub p??]
[domArg2 p422]
[unifyStruct p428]
[hasCaty1 p431]
```



```

(defun |hasCat| (d cat s1)
  (let (x y S z cond sp dom zp s1 ncond i)
    (declare (special |$domPvar|))
    (cond
      ((and (consp cat) (eq (qcar cat) 'category) (consp (qcdr cat))
        (|hasAttSig| d (|subCopy| (qcddr cat) (|constructSubst| d)) s1))
        ((and (consp cat) (eq (qcar cat) 'signature) (consp (qcdr cat))
          (consp (qcddr cat)) (eq (qcdddr cat) nil))
          (|hasSig| d (qcadr cat) (|subCopy| (qcaddr cat) (|constructSubst| d)) s1))
        ((and (consp cat) (eq (qcar cat) 'attribute)
          (consp (qcdr cat)) (eq (qcddr cat) nil))
          (|hasAtt| d (|subCopy| (qcadr cat) (|constructSubst| d)) s1))
        ((setq x (|hasCat| (|opOf| d) (|opOf| cat)))
          (cond
            ((setq y (kdr cat))
              (setq s (|constructSubst| d))
              (do ((next x (cdr next)) (endtest nil (null (eq s1 '|failed|))))
                ((or (atom next) endtest) nil)
                (setq z (caar next))
                (setq cond (cdar next))
                (setq sp
                  (loop for item in s
                    collect (cons (car item) (|mkDomPvar| (car item) (cdr item) z y))))
              (when |$domPvar|
                (setq i -1)
                (setq dom
                  (cons (car d)
                    (loop for arg in (rest d)
                      collect (|domArg| arg (incf i) z y))))
                (setq s1 (|augmentSub| |$domPvar| dom (copy s1))))
              (setq zp
                (loop for a in z
                  collect (|domArg2| a s sp)))
              (setq s1 (|unifyStruct| y zp (copy s1)))
              (cond
                ((null (eq s1 '|failed|))
                  (setq s1
                    (cond
                      ((atom cond) s1)
                      (t
                       (setq ncond (|subCopy| cond s))
                       (cond
                         ((and (consp ncond) (eq (qcar ncond) '|has|)
                          (consp (qcdr ncond)) (equal (qcaddr ncond) d)
                          (consp (qcddr ncond)) (eq (qcdddr ncond) nil)
                          (equal (qcaddr ncond) cat))

```

```

      '|failed|)
      (t (|hasCaty1| ncond s1))))))
    (t nil)))
  s1)
((atom x) s1)
(t
 (setq ncond (|subCopy| x (|constructSubst| d)))
 (cond
  ((and (consp ncond) (eq (qcar ncond) '|has|) (consp (qcdr ncond))
        (equal (qcadr ncond) d) (consp (qcddr ncond))
        (eq (qcdddr ncond) nil) (equal (qcaddr ncond) cat))
   '|failed|)
   (t (|hasCaty1| ncond s1))))))
(t '|failed|)))

```

18.0.18 defun domArg

[*\$FormalMapVariableList* *p??*]

— defun domArg —

```

(defun |domArg| (type i subs y)
  (let (p)
    (declare (special |$FormalMapVariableList|))
    (if (setq p (member (elt |$FormalMapVariableList| i) subs))
        (elt y (- (|#| subs) (|#| p)))
        type)))

```

18.0.19 defun domArg2

[*isSharpVar* *p884*]
 [*subCopy* *p??*]
 [*\$domPvar* *p49*]

— defun domArg2 —

```

(defun |domArg2| (arg s11 s12)
  (declare (special |$domPvar|))
  (cond
   ((|isSharpVar| arg) (|subCopy| arg s11))
   ((and (eq arg '$) |$domPvar|) |$domPvar|)

```

```
(t (|subCopy| arg s12)))
```

18.0.20 defun hasSig

The function hasSig tests whether domain dom has function foo with signature sig under substitution sl. [constructor? p??]

```
[constructSubst p??]
[assq p1052]
[getOperationAlistFromLisplib p??]
[hasCate p433]
[subCopy p??]
[hasSigAnd p425]
[hasSigOr p426]
[keyedSystemError p??]
[unifyStruct p428]
[$domPvar p49]
```

— defun hasSig —

```
(defun |hasSig| (dom foo sig sl)
  (let (|$domPvar| fun s0 p x cond s)
    (declare (special |$domPvar|))
    (cond
      ((setq fun (|constructor?| (car dom)))
       (setq s0 (|constructSubst| dom))
       (cond
         ((setq p (assq foo (|getOperationAlistFromLisplib| (car dom))))
          (do ((next (cdr p) (cdr next))
              (endtest nil (null (eq s '|failed|))))
              ((or (atom next) endtest) nil)
              (setq x (caar next))
              (setq cond (caddr next))
              (setq s
                (cond
                  ((atom cond) (copy sl))
                  ((and (consp cond) (eq (qcar cond) '|has|)
                     (consp (qcdr cond)) (consp (qcddr cond))
                     (eq (qcdr (qcddr cond)) nil))
                   (|hasCate| (|subCopy| (qcadr cond) s0)
                              (|subCopy| (qcaddr cond) s0)
                              (copy sl)))
                  ((and (consp cond)
                     (or (eq (qcar cond) '|and|) (eq (qcar cond) '|and|)))
                   (|hasSigAnd| (qcdr cond) s0 sl))
                  ((and (consp cond)
```

```

      (or (eq (qcar cond) 'or) (eq (qcar cond) 'lor)))
    (|hasSigOr| (qcdr cond) s0 sl))
  (t
    (|keyedSystemError| 'S2GE0016
      (list "hasSig" "unexpected condition for signature"))))
  (unless (eq s '|failed|)
    (setq s (|unifyStruct| (|subCopy| x s0) sig s)))
  s)
(t '|failed|)))
(t '|failed|)))

```

18.0.21 defun hasAtt

The hasAtt function tests whether dom has attribute att under sl needs s0 similar to hasSig.

[subCopy p??]
 [getdatabase p1009]
 [constructSubst p434]
 [getInfovec p??]
 [unifyStruct p428]
 [hasCatExpression p427]
 [\$domPvar p49]

— defun hasAtt —

```

(defun |hasAtt| (dom att sl)
  (let (|$domPvar| fun atts u x cond s)
    (declare (special |$domPvar|))
    (cond
      ((setq fun (car dom))
        (cond
          ((setq atts
            (|subCopy| (getdatabase fun 'attributes) (|constructSubst| dom)))
            (cond
              ((consp (setq u (|getInfovec| (car dom))))
                (do ((next atts (cdr next))
                    (endtest nil (null (eq s '|failed|))))
                  ((or (atom next) endtest) nil)
                  (setq x (caar next))
                  (setq cond (cdar next))
                  (setq s (|unifyStruct| x att (copy sl)))
                  (cond
                    ((and (null (atom cond)) (null (eq s '|failed|)))
                     (setq s (|hasCatExpression| cond s))))
                s)
              (t

```

```

      (do ((next atts (cdr next))
            (endtest nil (null (eq s '|failed|))))
          ((or (atom next) endtest) nil)
          (setq x (caar next))
          (setq cond (cadar next))
          (setq s (|unifyStruct| x att (copy sl)))
          (cond
            ((and (null (atom cond)) (null (eq s '|failed|)))
              (setq s (|hasCatExpression| cond s))))
          s)))
    (t '|failed|)))
  (t '|failed|)))

```

18.0.22 defun hasSigAnd

[hasCate p433]
 [subCopy p??]
 [keyedSystemError p??]

— defun hasSigAnd —

```

(defun |hasSigAnd| (andCls s0 sl)
  (let (sa dead)
    (setq sa '|failed|)
    (loop for cls in andCls
      do
        (when dead (return))
        (setq sa
          (cond
            ((atom cls) (copy sl))
            ((and (consp cls) (eq (qcar cls) '|has|) (consp (qcdr cls))
                  (consp (qcddr cls)) (eq (qcdddr cls) nil))
              (|hasCate| (|subCopy| (qcadr cls) s0)
                          (|subCopy| (qcaddr cls) s0)
                          (copy sl)))
            (t
              (|keyedSystemError| 'S2GE0016
                (list "hasSigAnd" "unexpected condition for signature")))))
          (when (eq sa '|failed|) (setq dead t)))
    sa))

```

18.0.23 defun hasSigOr

[hasCate p433]
 [hasSigAnd p425]
 [keyedSystemError p??]

— defun hasSigOr —

```
(defun |hasSigOr| (orCls s0 s1)
  (let (sa found)
    (setq sa '|failed|)
    (loop for cls in orCls
      until found
      do
        (setq sa
          (cond
            ((atom cls) (copy s1))
            ((and (consp cls) (eq (qcar cls) '|has|) (consp (qcdr cls))
              (consp (qcddr cls)) (eq (qcdddr cls) nil))
              (|hasCate| (|subCopy| (qcadr cls) s0)
                (|subCopy| (qcaddr cls) s0)
                (copy s1)))
            ((and (consp cls)
              (or (eq (qcar cls) '|and|) (eq (qcar cls) '|and|)))
              (|hasSigAnd| (qcdr cls) s0 s1)))
            (t
              (|keyedSystemError| 'S2GE0016
                (list "hasSigOr" "unexpected condition for signature")))))
          (unless (eq sa '|failed|) (setq found t)))
    sa))
```

—————

18.0.24 defun hasAttSig

The argument d is domain, x is a list of attributes and signatures. The result is an augmented SL, if d has x, 'failed otherwise. [hasAtt p424]

[hasSig p423]
 [keyedSystemError p??]

— defun hasAttSig —

```
(defun |hasAttSig| (d x s1)
  (loop for y in x
    until (eq s1 '|failed|)
    do
      (setq s1
```

```

(cond
  ((and (consp y) (eq (qcar y) 'attribute)
        (consp (qcdr y)) (eq (qcddr y) nil))
    (|hasAtt| d (qcadr y) sl))
  ((and (consp y) (eq (qcar y) 'signature)
        (consp (qcdr y)) (consp (qcddr y)) (eq (qcdddr y) nil))
    (|hasSig| d (qcadr y) (qcaddr y) sl))
  (t
   (|keyedSystemError| 'S2GE0016
    (list "hasAttSig" "unexpected form of unnamed category")))))
sl)

```

18.0.25 defun hasCate1

```

[hasCate p433]
[$domPvar p49]

```

— defun hasCate1 —

```

(defun |hasCate1| (dom cat sl domPvar)
  (let (|$domPvar|)
    (declare (special |$domPvar|))
    (setq |$domPvar| domPvar)
    (|hasCate| dom cat sl)))

```

18.0.26 defun hasCatExpression

```

[hasCatExpression p427]
[hasCate p433]
[keyedSystemError p??]

```

— defun hasCatExpression —

```

(defun |hasCatExpression| (cond sl)
  (let (y)
    (cond
      ((and (consp cond) (eq (qcar cond) 'or))
       (when
        (let (result)
          (loop for x in (qcdr cond)
                do (setq result

```

```

      (or result
        (not (eq (setq y (|hasCatExpression| x s1)) '|failed|))))
    result)
  y))
((and (consp cond) (eq (qcar cond) 'and))
 (when
  (let ((result t))
    (loop for x in (qcdr cond)
      do (setq result
        (and result
          (not (eq (setq s1 (|hasCatExpression| x s1)) '|failed|))))))
    result)
  s1))
((and (consp cond) (eq (qcar cond) '|has|)
  (consp (qcdr cond)) (consp (qcddr cond)) (eq (qcdddr cond) nil))
 (|hasCate| (qcadr cond) (qcaddr cond) s1))
(t
 (|keyedSystemError| 'S2GE0016
  (list "hasSig" "unexpected condition for attribute")))))

```

18.0.27 defun unifyStruct

[isPatternVar p??]
 [unifyStructVar p429]
 [unifyStruct p428]

— defun unifyStruct —

```

(defun |unifyStruct| (s1 s2 s1)
  (declare (special |$domPvar| |$hope| |$Coerce| |$Subst|))
  (cond
    ((equal s1 s2) s1)
    (t
     (when (and (consp s1) (eq (qcar s1) '|:|)
       (consp (qcdr s1)) (consp (qcddr s1)) (eq (qcdddr s1) nil))
       (setq s1 (qcadr s1)))
     (when (and (consp s2) (eq (qcar s2) '|:|)
       (consp (qcdr s2)) (consp (qcddr s2)) (eq (qcdddr s2) nil))
       (setq s2 (qcadr s2)))
     (when (and (null (atom s1)) (eq (car s1) '|#|))
       (setq s1 (length (cadr s1))))
     (when (and (null (atom s2)) (eq (car s2) '|#|))
       (setq s2 (length (cadr s2))))
     (cond
       ((equal s1 s2) s1)

```



```

((|isPatternVar| s1) (|unifyStructVar| s1 s2 s1))
((|isPatternVar| s2) (|unifyStructVar| s2 s1 s1))
((or (atom s1) (atom s2)) '|failed|)
(t
 (loop until (or (null s1) (null s2) (eq s1 '|failed|))
  do
    (setq s1 (|unifyStruct| (car s1) (car s2) s1))
    (setq s1 (cdr s1))
    (setq s2 (cdr s2)))
 (if (or s1 s2) '|failed| s1))))))

```

18.0.28 defun unifyStructVar

The first argument is a pattern variable, which is not substituted by `sl` [contained `p??`]

```

[lassoc p??]
[unifyStruct p428]
[constructor? p??]
[subCopy p??]
[containsVars p430]
[canCoerce p??]
[resolveTT p??]
[isPatternVar p??]
[augmentSub p??]
[$domPvar p49]
[$Coerce p??]
[$Subst p??]
[$hope p??]

```

— defun unifyStructVar —

```

(defun |unifyStructVar| (v ss sl)
  (let (ps s1 s0 s ns0 ns1 s3)
    (declare (special |$domPvar| |$hope| |$Coerce| |$Subst|))
    (cond
      ((contained v ss) '|failed|)
      (t
       (setq ps (lassoc ss sl))
       (setq s1 (if ps ps ss))
       (cond
         ((or (setq s0 (lassoc v sl)) (setq s0 (lassoc v |$Subst|)))
          (setq s (|unifyStruct| s0 s1 (copy sl)))
          (cond
            ((eq s '|failed|)
             (cond

```

```

((and |$Coerce| (null (atom s0)) (|constructor?| (car s0)))
 (cond
  ((or (|containsVars| s0) (|containsVars| s1))
   (setq ns0 (|subCopy| s0 s1))
   (setq ns1 (|subCopy| s1 s1))
   (cond
    ((or (|containsVars| ns0) (|containsVars| ns1))
     (setq |$hope| t)
     '|failed|)
    (t
     (cond
      ((|canCoerce| ns0 ns1) (setq s3 s1))
      ((|canCoerce| ns1 ns0) (setq s3 s0))
      (t (setq s3 nil)))
     (cond
      (s3
       (cond
        ((not (equal s3 s0))
         (setq s1 (|augmentSub| v s3 s1))))
       (cond
        ((and (not (equal s3 s1)) (|isPatternVar| ss))
         (setq s1 (|augmentSub| ss s3 s1))))
        s1)
        (t '|failed|))))))
  (|$domPvar|
   (setq s3 (|resolveTT| s0 s1))
   (cond
    (s3
     (cond
      ((not (equal s3 s0))
       (setq s1 (|augmentSub| v s3 s1))))
     (cond
      ((and (not (equal s3 s1)) (|isPatternVar| ss))
       (setq s1 (|augmentSub| ss s3 s1))))
      s1)
     (t '|failed|)))
   (t '|failed|)))
 (t '|failed|)))
 (t (|augmentSub| v ss s))))
 (t (|augmentSub| v ss s1))))))

```

18.0.29 defun containsVars

The function containsVars tests whether term t contains a * variable. [isPatternVar p??]
[containsVars1 p431]

— defun containsVars —

```
(defun |containsVars| (arg)
  (if (atom arg)
      (|isPatternVar| arg)
      (|containsVars1| arg)))
```

—————

18.0.30 defun containsVars1

The function containsVars1 tests whether term t contains a * variable. This is a recursive version, which works on a list. [isPatternVar p??]
[containsVars1 p431]

— defun containsVars1 —

```
(defun |containsVars1| (arg)
  (let ((t1 (car arg)) (t2 (cdr arg)))
    (if (atom t1)
        (or (|isPatternVar| t1)
            (if (atom t2) (|isPatternVar| t2) (|containsVars1| t2)))
        (or (|containsVars1| t1)
            (if (atom t2) (|isPatternVar| t2) (|containsVars1| t2))))))
```

—————

18.0.31 defun hasCaty1

The cond is either a (has a b) or an OR clause of such conditions. SL is augmented, if cond is true, otherwise the result is 'failed [hasCate p433]
[hasCaty1 p431]
[keyedSystemError p??]
[\$domPvar p49]

— defun hasCaty1 —

```
(defun |hasCaty1| (cond sl)
  (let (|$domPvar| a s)
    (declare (special |$domPvar|))
    (setq |$domPvar| nil)
    (cond
      ((and (consp cond) (eq (qcar cond) '|has|))
```

```

      (consp (qcdr cond)) (consp (qcddr cond)) (eq (qcdddr cond) nil))
    (|hasCate| (qcadr cond) (qcaddr cond) sl))
  ((and (consp cond) (EQ (qcar cond) 'and))
   (loop for x in (qcdr cond)
         while (not (eq s '|failed|))
         do
           (setq s
            (cond
              ((and (consp x) (eq (qcar x) '|has|)
                    (consp (qcdr x)) (consp (qcddr x)) (eq (qcdr (qcddr x)) nil))
               (|hasCate| (qcadr x) (qcaddr x) sl))
              ((and (consp x) (eq (qcdr x) nil)
                    (consp (qcar x)) (eq (qcaar x) '|has|)
                    (consp (qcdar x)) (consp (qcddar x))
                    (eq (qcdr (qcddar x)) nil))
               (|hasCate| a (qcaddar x) sl))
              (t (|hasCaty1| x sl))))))
    s)
  ((and (consp cond) (eq (qcar cond) 'or))
   (do ((next (qcdr cond) (cdr next)) (x nil)
        (nextitem nil (null (eq s '|failed|))))
       ((or (atom next)
            (progn (setq x (car next)) nil)
            nextitem)
        nil)
    (setq s
      (cond
        ((and (consp x) (eq (qcar x) '|has|)
              (consp (qcdr x)) (consp (qcddr x)) (eq (qcdddr x) nil))
         (|hasCate| (qcadr x) (qcaddr x) (copy sl)))
        ((and (consp x) (eq (qcdr x) nil) (consp (qcar x))
              (eq (qcaar x) '|has|) (consp (qcdar x)) (consp (qcddar x))
              (eq (qcdddar x) nil))
         (|hasCate| (qcadar x) (qcaddar x) (copy sl)))
        (t (|hasCaty1| x (copy sl))))))
    s)
  (t
   (|keyedSystemError| 'S2GE0016
    (list "hasCaty1" "unexpected condition from category table"))))

```

18.0.32 defun mkDomPvar

```

[domArg p422]
[length p??]
[$FormalMapVariableList p??]

```

— defun mkDomPvar —

```
(defun |mkDomPvar| (p d subs y)
  (let (l)
    (declare (special |$FormalMapVariableList|))
    (if (setq l (member p |$FormalMapVariableList|))
      (|domArg| d (- (|#| |$FormalMapVariableList|) (|#| l)) subs y)
      d)))
```

18.0.33 defun hasCate

```
[isPatternVar p??]
[hasCate1 p427]
[hasCateSpecial p434]
[containsVariables p??]
[subCopy p??]
[hasCaty p420]
[$EmptyMode p??]
[$Subst p??]
[$hope p??]
```

— defun hasCate —

```
(defun |hasCate| (dom cat sl)
  (let (nsl p s sl1)
    (declare (special |$hope| |$Subst| |$EmptyMode|))
    (cond
      ((equal dom |$EmptyMode|) nil)
      ((|isPatternVar| dom)
       (cond
         ((and (setq p (assq dom sl))
              (not (eq (setq nsl (|hasCate| (cdr p) cat sl)) '|failed|)))
          nsl)
         ((or (setq p (assq dom |$Subst|)) (setq p (assq dom sl)))
          (setq s (|hasCate1| (cdr p) cat sl dom))
          (cond
            ((null (eq s '|failed|)) s)
            (t (|hasCateSpecial| dom (cdr p) cat sl))))))
      (t
       (when (not (eq sl '|failed|)) (setq |$hope| t))
       '|failed|)))
  (t
   (setq sl1
    (loop for item in sl
```

```

      when (null (|containsVariables| (cdr item)))
      collect item))
  (when s1 (setq cat (|subCopy| cat s1)))
  (|hasCaty| dom cat s1))))

```

18.0.34 defun constructSubst

```

[internal p??]
[stringimage p??]

```

— defun constructSubst —

```

(defun |constructSubst| (d)
  (let (s1 (i 0))
    (setq s1 (list (cons '$ d)))
    (when (listp d)
      (dolist (x (cdr d))
        (setq i (1+ i))
        (setq s1 (cons (cons (internal "#" (stringimage i)) x) s1))))
    s1))

```

18.0.35 defun hasCateSpecial

The variable *v* is a pattern variable, *dom* is its binding under `$Subst`. We try to change *dom* so that it has category *cat* under *s1*. The result is a substitution list or 'failed. [eqcar p??]

```

[isSubDomain p??]
[canCoerceFrom p??]
[containsVars p430]
[augmentSub p??]
[hasCate p433]
[hasCaty p420]
[hasCateSpecialNew p435]
[$Integer p??]
[$QuotientField p??]

```

— defun hasCateSpecial —

```

(defun |hasCateSpecial| (v dom cat s1)
  (let (arg d domp ns1)
    (declare (special |$Integer| |$QuotientField|))

```

```

(cond
  ((and (consp dom) (eq (qcar dom) '|FactoredForm|)
        (consp (qcdr dom)) (eq (qcddr dom) nil))
    (setq arg (qcadr dom))
    (when (|isSubDomain| arg |$Integer|) (setq arg |$Integer|))
    (setq d (list '|FactoredRing| arg))
    (setq sl (|hasCate| arg '|Ring|) (|augmentSub| v d sl)))
    (if (eq sl '|failed|)
        '|failed|
        (|hasCaty| d cat sl)))
  ((or (eqcar cat '|Field|) (eqcar cat '|DivisionRing|))
    (when (|isSubDomain| dom |$Integer|) (setq dom |$Integer|))
    (setq d (list |$QuotientField| dom))
    (|hasCaty| dom '|IntegralDomain|) (|augmentSub| v d sl)))
  ((and (consp cat) (eq (qcar cat) '|PolynomialCategory|)
        (consp (qcdr cat)))
    (setq domp (cons '|Polynomial| (list (qcadr cat))))
    (and (or (|containsVars| (qcadr cat)) (|canCoerceFrom| dom domp))
         (|hasCaty| domp cat (|augmentSub| v domp sl))))
  ((|isSubDomain| dom |$Integer|)
    (setq nsl (|hasCate| |$Integer| cat (|augmentSub| v |$Integer| sl)))
    (if (eq nsl '|failed|)
        (|hasCateSpecialNew| v dom cat sl)
        (|hasCaty| |$Integer| cat nsl)))
  (t
    (|hasCateSpecialNew| v dom cat sl))))

```

18.0.36 defun hasCateSpecialNew

```

[member p1050]
[eqcar p??]
[augmentSub p??]
[defaultTargetFE p437]
[isEqualOrSubDomain p438]
[underDomainOf p??]
[hasCaty p420]
[$Integer p??]
[$ComplexInteger p??]
[$RationalNumber p??]

```

— defun hasCateSpecialNew —

```

(defun |hasCateSpecialNew| (v dom cat sl)
  (let (fe alg fefull d partialResult)
    (declare (special |$RationalNumber| |$ComplexInteger| |$Integer|))

```

```

(setq fe
  (|member| (qcar cat)
    '(|ElementaryFunctionCategory|
      |TrigonometricFunctionCategory|
      |ArcTrigonometricFunctionCategory|
      |HyperbolicFunctionCategory|
      |ArcHyperbolicFunctionCategory|
      |PrimitiveFunctionCategory|
      |SpecialFunctionCategory|
      |Evalable|
      |CombinatorialOpsCategory|
      |TranscendentalFunctionCategory|
      |AlgebraicallyClosedFunctionSpace|
      |ExpressionSpace|
      |LiouvillianFunctionCategory|
      |FunctionSpace|)))
(setq alg
  (|member| (qcar cat)
    '(|RadicalCategory|
      |AlgebraicallyClosedField|)))
(setq fefull
  (or fe alg (eqcar cat ' |CombinatorialFunctionCategory|)))
(setq partialResult
  (cond
    ((or (eqcar dom ' |Variable|) (eqcar dom ' |Symbol|))
      (cond
        ((|member| (car cat)
          '(|SemiGroup|
            |AbelianSemiGroup|
            |Monoid|
            |AbelianGroup|
            |AbelianMonoid|
            |PartialDifferentialRing|
            |Ring|
            |InputForm|)))
          (setq d (list ' |Polynomial| |$Integer|))
          (|augmentSub| v d sl))
        ((eqcar cat ' |Group|)
          (setq d (list ' |Fraction| (list ' |Polynomial| |$Integer|)))
          (|augmentSub| v d sl))
        (fefull
          (setq d (|defaultTargetFE| dom))
          (|augmentSub| v d sl))
        (t ' |failed|)))
    ((|isEqualOrSubDomain| dom |$Integer|)
      (cond
        (fe
          (setq d (|defaultTargetFE| |$Integer|))
          (|augmentSub| v d sl))
        (alg

```



```

      (setq d '(|AlgebraicNumber|))
      (|augmentSub| v d sl))
    (t '|failed|)))
  ((equal (|underDomainOf| dom) |$ComplexInteger|)
   (setq d (|defaultTargetFE| |$ComplexInteger|))
   (|hasCaty| d cat (|augmentSub| v d sl)))
  ((and (equal dom |$RationalNumber|) alg)
   (setq d '(|AlgebraicNumber|))
   (|augmentSub| v d sl))
  (fefull
   (setq d (|defaultTargetFE| dom))
   (|augmentSub| v d sl))
  (t '|failed|)))
(if (eq partialResult '|failed|)
    '|failed|
    (|hasCaty| d cat partialResult))))

```

18.0.37 defun defaultTargetFE

```

[typeIsASmallInteger p??]
[isEqualOrSubDomain p438]
[ifcar p??]
[defaultTargetFE p437]
[$FunctionalExpression p??]
[$Integer p??]
[$Symbol p??]
[$RationalNumber p??]

```

— defun defaultTargetFE —

```

(defun |defaultTargetFE| (&rest dom)
  (let (a options)
    (declare (special |$FunctionalExpression| |$Integer| |$Symbol|
                      |$RationalNumber|))
    (setq a (car dom))
    (setq options (cdr dom))
    (cond
     ((or (and (consp a) (eq (qcar a) '|Variable|)
               (consp (qcdr a)) (eq (qcddr a) nil))
          (equal a |$RationalNumber|)
          (member (qcar a) (list (qcar |$Symbol|) '|RationalRadicals| '|Pi)))
      (|typeIsASmallInteger| a)
      (|isEqualOrSubDomain| a |$Integer|)
      (equal a '(|AlgebraicNumber|)))
     (if (ifcar options)

```

```

      (list |$FunctionalExpression| (list '|Complex| |$Integer|))
      (list |$FunctionalExpression| |$Integer|)))
    ((and (consp a) (eq (qcar a) '|Complex|)
      (consp (qcdr a)) (eq (qcddr a) nil))
      (|defaultTargetFE| (qcadr a) t))
    ((and (consp a) (consp (qcdr a)) (eq (qcddr a) nil)
      (member (qcar a) '(|Polynomial| |RationalFunction| |Fraction|)))
      (|defaultTargetFE| (qcadr a) (ifcar options)))
    ((and (consp a) (equal (qcar a) |$FunctionalExpression|)
      (consp (qcdr a)) (eq (qcddr a) nil))
      a)
    ((ifcar options)
      (list |$FunctionalExpression| (list '|Complex| a)))
    (t
      (list |$FunctionalExpression| a))))

```

18.0.38 defun isEqualOrSubDomain

[isSubDomain p??]

— defun isEqualOrSubDomain —

```

(defun |isEqualOrSubDomain| (d1 d2)
  (or (equal d1 d2)
      (|isSubDomain| d1 d2)
      (and (atom d1)
        (or (and (consp d2) (eq (qcar d2) '|Variable|)
          (consp (qcdr d2)) (eq (qcddr d2) nil)
          (equal (qcadr d2) d1))
          (and (consp d2) (eq (qcdr d2) nil)
            (equal (qcar d2) d1))))
      (and (atom d2)
        (or (and (consp d1) (eq (qcar d1) '|Variable|)
          (consp (qcdr d1)) (eq (qcddr d1) nil)
          (equal (qcadr d1) d2))
          (and (consp d1) (eq (qcdr d1) nil)
            (equal (qcar d1) d2))))))

```

Chapter 19

System Command Handling

The system commands are the top-level commands available in Axiom that can all be invoked by prefixing the symbol with a closed-paren. Thus, to see they copyright you type:

```
)copyright
```

New commands need to be added to this table. The command invoked will be the first entry of the pair and the “user level” of the command will be the second entry.

See:

- The “abbreviations” (20.2.1 p 481) command
- The “boot” (5.1.8 p 25) command
- The “browse” (?? p ??) command
- The “cd” (?? p ??) command
- The “clear” (24.3.1 p 497) command
- The “close” (25.2.2 p 508) command
- The “compile” (?? p ??) command
- The “copyright” (27.2.1 p 520) command
- The “credits” (28.3.1 p 523) command
- The “display” (30.2.1 p 533) command
- The “edit” (31.2.1 p 542) command
- The “fin” (32.1.1 p 546) command

- The “frame” (33.5.16 p 563) command
- The “help” (34.2.1 p 570) command
- The “history” (35.4.7 p 580) command
- The “lisp” (?? p ??) command
- The “library” (67.1.34 p 1013) command
- The “load” (39.1.1 p 627) command
- The “ltrace” (40.1.1 p 630) command
- The “pquit” (41.2.1 p 632) command
- The “quit” (42.2.1 p 636) command
- The “read” (43.1.1 p 640) command
- The “regress” (?? p ??) command
- The “savesystem” (45.1.1 p 648) command
- The “set” (46.36.1 p 805) command
- The “show” (47.1.1 p 812) command
- The “spool” (?? p ??) command
- The “summary” (49.1.1 p 828) command
- The “synonym” (50.1.1 p 830) command
- The “system” (?? p ??) command
- The “tangle” (?? p ??) command
- The “trace” (53.1.7 p 845) command
- The “trademark” (27.2.2 p 521) command
- The “undo” (54.4.6 p 920) command
- The “what” (55.1.2 p 937) command
- The “with” (56.1.1 p 945) command
- The “workfiles” (57.1.1 p 947) command
- The “zsystemdevelopment” (58.1.1 p 951) command

19.1 Variables Used

19.1.1 defvar \$systemCommands

— initvars —

```
(defvar |$systemCommands| nil)
```

—————

— postvars —

```
(eval-when (eval load)
  (setq |$systemCommands|
    '(
      (|abbreviations| . |compiler| )
      (|boot| . |development|)
      (|browse| . |development|)
      (|cd| . |interpreter|)
      (|clear| . |interpreter|)
      (|close| . |interpreter|)
      (|compiler| . |compiler| )
      (|copyright| . |interpreter|)
      (|credits| . |interpreter|)
      (|describe| . |interpreter|)
      (|display| . |interpreter|)
      (|edit| . |interpreter|)
      (|fin| . |development|)
      (|frame| . |interpreter|)
      (|help| . |interpreter|)
      (|history| . |interpreter|)
      (|lisp| . |development|)
      (|library| . |interpreter|)
      (|load| . |interpreter|)
      (|ltrace| . |interpreter|)
      (|pquit| . |interpreter|)
      (|quit| . |interpreter|)
      (|read| . |interpreter|)
      (|regress| . |interpreter|)
      (|savesystem| . |interpreter|)
      (|set| . |interpreter|)
      (|show| . |interpreter|)
      (|spool| . |interpreter|)
      (|summary| . |interpreter|)
      (|synonym| . |interpreter|)
      (|system| . |interpreter|)
```

```

(|tangle| . |interpreter|)
(|trace| . |interpreter|)
(|trademark| . |interpreter|)
(|undo| . |interpreter|)
(|what| . |interpreter|)
(|with| . |interpreter|)
(|workfiles| . |development|)
(|zsystemdevelopment| . |interpreter|)
)))

```

19.1.2 defvar \$syscommands

This table is used to look up a symbol to see if it might be a command.

— **initvars** —

```
(defvar $syscommands nil)
```

— **postvars** —

```

(eval-when (eval load)
  (setq $syscommands (mapcar #'car |$systemCommands|)))

```

19.1.3 defvar \$noParseCommands

This is a list of the commands which have their arguments passed verbatim. Certain functions, such as the lisp function need to be able to handle all kinds of input that will not be acceptable to the interpreter.

— **initvars** —

```
(defvar |$noParseCommands| nil)
```

— **postvars** —

```
(eval-when (eval load)
  (setq |$noParseCommands|
    '(|boot| |copyright| |credits| |fin| |lisp| |pquit| |quit|
      |synonym| |system| |trademark| )))
```

19.2 Functions

19.2.1 defun handleNoParseCommands

The system commands given by the global variable `$noParseCommands` require essentially no preprocessing/parsing of their arguments. Here we dispatch the functions which implement these commands.

There are four standard commands which receive arguments

- boot
- lisp
- synonym
- system

There are six standard commands which do not receive arguments –

- quit
- fin
- pquit
- credits
- copyright
- trademark

As these commands do not necessarily exhaust those mentioned in `$noParseCommands`, we provide a generic dispatch based on two conventions: commands which do not require an argument name themselves, those which do have their names prefixed by “np”. This makes it possible to dynamically define new system commands provided you handle the argument parsing.

19.2.2 defun Handle a top level command

```
[concat p1049]
[expand-tabs p??]
[processSynonyms p33]
[substring p??]
[getFirstWord p467]
[unAbbreviateKeyword p467]
[member p1050]
[handleNoParseCommands p443]
[splitIntoOptionBlocks p445]
[handleTokenSizeSystemCommands p445]
[handleParsedSystemCommands p466]
[$tokenCommands p473]
[$noParseCommands p442]
[line p??]
```

— defun doSystemCommand —

```
(defun |doSystemCommand| (string)
  (let (line tok unab optionList)
    (declare (special line |$tokenCommands| |$noParseCommands|))
    (setq string (concat ") " (expand-tabs string)))
    (setq line string)
    (|processSynonyms|)
    (setq string line)
    (setq string (substring string 1 nil))
    (cond
      ((string= string "") nil)
      (t
       (setq tok (|getFirstWord| string))
       (cond
         (tok
          (setq unab (|unAbbreviateKeyword| tok))
          (cond
            ((|member| unab |$noParseCommands|)
             (|handleNoParseCommands| unab string))
            (t
             (setq optionList (|splitIntoOptionBlocks| string))
             (cond
               ((|member| unab |$tokenCommands|)
                (|handleTokenSizeSystemCommands| unab optionList))
               (t
                (|handleParsedSystemCommands| unab optionList)
                nil))))))
          (t nil))))))
```


19.2.3 defun Split block into option block

[stripSpaces p469]

— defun splitIntoOptionBlocks —

```
(defun |splitIntoOptionBlocks| (str)
  (let (inString block (blockStart 0) (parenCount 0) blockList)
    (dotimes (i (1- (|#| str)))
      (cond
        ((char= (elt str i) #"\" ) (setq inString (null inString)))
        (t
         (when (and (char= (elt str i) #\" ) (null inString))
           (incf parenCount))
         (when (and (char= (elt str i) #\" ) (null inString))
           (decf parenCount))
         (when
          (and (char= (elt str i) #\" )
               (null inString)
               (= parenCount -1))
           (setq block (|stripSpaces| (subseq str blockStart i)))
           (setq blockList (cons block blockList))
           (setq blockStart (1+ i))
           (setq parenCount 0))))))
    (setq blockList (cons (|stripSpaces| (subseq str blockStart)) blockList))
    (nreverse blockList)))
```

—————

19.2.4 defun Tokenize a system command

[dumbTokenize p465]

[tokTran p465]

[systemCommand p446]

— defun handleTokenizeSystemCommands —

```
(defun |handleTokenizeSystemCommands| (unabr optionList)
  (declare (ignore unabr))
  (let (parcmd)
    (setq optionList (mapcar #'(lambda (x) (|dumbTokenize| x)) optionList))
    (setq parcmd
      (mapcar #'(lambda (opt) (mapcar #'(lambda (tok) (|tokTran| tok)) opt))
              optionList))
    (when parcmd (|systemCommand| parcmd))))
```

—————

19.2.5 defun Handle system commands

You can type “)?” and see trivial help information. You can type “)? compile” and see compiler related information [selectOptionLC p477]

```
[helpSpad2Cmd p570]
[selectOption p477]
[commandsForUserLevel p446]
[$options p??]
[$e p??]
[$systemCommands p441]
[$syscommands p442]
[$CategoryFrame p??]
```

— defun systemCommand —

```
(defun |systemCommand| (cmd)
  (let (|options| |$e| op argl options fun)
    (declare (special |options| |$e| |$systemCommands| $syscommands
                      |$CategoryFrame|))
    (setq op (caar cmd))
    (setq argl (cdar cmd))
    (setq options (cdr cmd))
    (setq |options| options)
    (setq |$e| |$CategoryFrame|)
    (setq fun (|selectOptionLC| op $syscommands '|commandError|))
    (if (and argl (eq (elt argl 0) '?)) (not (eq fun '|synonym|)))
        (|helpSpad2Cmd| (cons fun nil))
    (progn
      (setq fun
        (|selectOption| fun (|commandsForUserLevel| |$systemCommands|
                          '|commandUserLevelError|))
      (funcall fun argl))))
```

—————→

19.2.6 defun Select commands matching this user level

The `$UserLevel` variable contains one of three values: `compiler`, `development`, or `interpreter`. This variable is used to select a subset of commands from the list stored in `$systemCommands`, representing all of the commands that are valid for this level. [satisfiesUserLevel p449]

— defun commandsForUserLevel —

```
(defun |commandsForUserLevel| (arg)
  (let (c)
    (dolist (pair arg)
```

```
(when (|satisfiesUserLevel| (cdr pair))
  (setq c (cons (car pair) c)))
(nreverse c))
```

19.2.7 defun No command begins with this string

[commandErrorMessage p447]

— defun commandError —

```
(defun |commandError| (x u)
  (|commandErrorMessage| ' |command| x u))
```

19.2.8 defun No option begins with this string

[commandErrorMessage p447]

— defun optionError —

```
(defun |optionError| (x u)
  (|commandErrorMessage| ' |option| x u))
```

19.2.9 defvar \$oldline

— initvars —

```
(defvar $oldline nil "used to output command lines")
```

19.2.10 defun No command/option begins with this string

[commandAmbiguityError p450]
 [sayKeyedMsg p329]

```
[terminateSystemCommand p450]
[$oldline p447]
[line p??]
```

— **defun commandErrorMessage** —

```
(defun |commandErrorMessage| (kind x u)
  (declare (special $oldline line))
  (setq $oldline line)
  (if u
    (|commandAmbiguityError| kind x u)
    (progn
      (|sayKeyedMsg| 'S2IZ0008 (list kind x))
      (|terminateSystemCommand|))))
```

—————

19.2.11 defun Option not available at this user level

```
[userLevelErrorMessage p448]
```

— **defun optionUserLevelError** —

```
(defun |optionUserLevelError| (x u)
  (|userLevelErrorMessage| 'option x u))
```

—————

19.2.12 defun Command not available at this user level

```
[userLevelErrorMessage p448]
```

— **defun commandUserLevelError** —

```
(defun |commandUserLevelError| (x u)
  (|userLevelErrorMessage| 'command x u))
```

—————

19.2.13 defun Command not available error message

```
[commandAmbiguityError p450]
[sayKeyedMsg p329]
```

```
[terminateSystemCommand p450]
[$UserLevel p804]
```

— **defun userLevelErrorMessage** —

```
(defun |userLevelErrorMessage| (kind x u)
  (declare (special |$UserLevel|))
  (if u
    (|commandAmbiguityError| kind x u)
    (progn
      (|sayKeyedMsg| 'S2IZ0007 (list |$UserLevel| kind))
      (|terminateSystemCommand|))))
```

19.2.14 **defun satisfiesUserLevel**

```
[$UserLevel p804]
```

— **defun satisfiesUserLevel 0** —

```
(defun |satisfiesUserLevel| (x)
  (declare (special |$UserLevel|))
  (cond
    ((eq x '|interpreter|) t)
    ((eq |$UserLevel| '|interpreter|) nil)
    ((eq x '|compiler|) t)
    ((eq |$UserLevel| '|compiler|) nil)
    (t t)))
```

19.2.15 **defun hasOption**

```
[stringPrefix? p??]
[pname p1047]
```

— **defun hasOption** —

```
(defun |hasOption| (al opt)
  (let ((optPname (pname opt)) found)
    (loop for pair in al do
      (when (|stringPrefix?| (pname (car pair)) optPname) (setq found pair))
      until found)
    found))
```

19.2.16 defun terminateSystemCommand

[tersyscommand p450]

— **defun terminateSystemCommand** —

```
(defun |terminateSystemCommand| nil (tersyscommand))
```

19.2.17 defun Terminate a system command

[spadThrow p??]

— **defun tersyscommand** —

```
(defun tersyscommand ()
  (fresh-line)
  (setq chr 'endoflinechr)
  (setq tok 'end_unit)
  (|spadThrow|))
```

19.2.18 defun commandAmbiguityError

[sayKeyedMsg p329]

[sayMSG p331]

[bright p??]

[terminateSystemCommand p450]

— **defun commandAmbiguityError** —

```
(defun |commandAmbiguityError| (kind x u)
  (|sayKeyedMsg| 's2iz0009 (list kind x))
  (dolist (a u) (|sayMSG| (cons " " (|bright| a))))
  (|terminateSystemCommand|))
```

19.2.19 defun getParserMacroNames

The `$pfMacros` is a list of all of the user-defined macros. [`$pfMacros` p98]

— **defun getParserMacroNames 0** —

```
(defun |getParserMacroNames| ()
  (declare (special |$pfMacros|))
  (remove-duplicates (mapcar #'car |$pfMacros|)))
```

19.2.20 defun clearParserMacro

Note that if a macro is defined twice this will clear the last instance. Thus:

```
a ==> 3
a ==> 4
)d macros
a ==> 4
)clear prop a
)d macros
a ==> 3
)clear prop a
)d macros
nil
```

```
[ifcdr p??]
[assoc p??]
[remalist p??]
[$pfMacros p98]
```

— **defun clearParserMacro** —

```
(defun |clearParserMacro| (macro)
  (declare (special |$pfMacros|))
  (when (ifcdr (|assoc| macro |$pfMacros|))
    (setq |$pfMacros| (remalist |$pfMacros| macro))))
```

19.2.21 defun displayMacro

```
[isInterpMacro p??]
[sayBrightly p??]
```

```
[bright p??]
[strconc p??]
[object2String p??]
[mathprint p??]
[$op p??]
```

— **defun displayMacro** —

```
(defun |displayMacro| (name)
  (let (|$op| m body args)
    (declare (special |$op|))
    (setq m (|isInterpMacro| name))
    (cond
      ((null m)
        (|sayBrightly|
          (cons " " (append (|bright| name)
                           (cons "is not an interpreter macro." nil))))))
      (t
        (setq |$op| (strconc "macro " (|object2String| name)))
        (setq args (car m))
        (setq body (cdr m))
        (setq args
          (cond
            ((null args) nil)
            ((null (cdr args)) (car args))
            (t (cons '|Tuple| args))))
        (|mathprint| (cons 'map (cons (cons args body) nil)))))))
```

—————

19.2.22 defun displayWorkspaceNames

```
[getInterpMacroNames p??]
[getParserMacroNames p451]
[sendMessage p??]
[msort p??]
[getWorkspaceNames p453]
[sayAsManyPerLineAsPossible p??]
[sayBrightly p??]
[setdifference p??]
```

— **defun displayWorkspaceNames** —

```
(defun |displayWorkspaceNames| ()
  (let (pmacs names imacs)
    (setq imacs (|getInterpMacroNames|))
```



```
(setq pmacs (|getParserMacroNames|))
(|sayMessage| "Names of User-Defined Objects in the Workspace:")
(setq names (msort (append (|getWorkspaceNames|) pmacs)))
(if names
  (|sayAsManyPerLineAsPossible| (mapcar #'|object2String| names))
  (|sayBrightly| " * None *"))
(setq imacs (setdifference imacs pmacs))
(when imacs
  (|sayMessage| "Names of System-Defined Objects in the Workspace:")
  (|sayAsManyPerLineAsPossible| (mapcar #'|object2String| imacs))))
```

19.2.23 defun getWorkspaceNames

```
;getWorkspaceNames() ==
; NMSORT [n for [n,::] in CAAR $InteractiveFrame |
;   (n ^= "--macros--" and n^= "--flags--")]
```

```
[seq p??]
[nmsort p??]
[exit p??]
[$InteractiveFrame p??]
```

— defun getWorkspaceNames —

```
(defun |getWorkspaceNames| ()
  (PROG (n)
    (declare (special |$InteractiveFrame|))
    (return
      (seq (nmsort (PROG (G166322)
        (setq G166322 NIL)
        (RETURN
          (DO ((G166329 (CAAR |$InteractiveFrame|)
            (CDR G166329))
              (G166313 NIL))
            ((OR (ATOM G166329)
              (PROGN
                (SETQ G166313 (CAR G166329))
                NIL)
              (PROGN
                (PROGN
                  (setq n (CAR G166313))
                  G166313)
                NIL))
            (NREVERSEO G166322))
          (SEQ (EXIT (COND
```

```
((AND (not (eq n '--macros--|))
      (not (eq n '--flags--|)))
  (SETQ G166322
    (CONS n G166322)))))))))
```

19.2.24 defun fixObjectForPrinting

The \$msgdbPrims variable is set to:

```
(|%b| |%d| |%l| |%i| |%u| %U |%n| |%x| |%ce| |%rj|
 "%U" "%b" "%d" "%l" "%i" "%u" "%U" "%n" "%x" "%ce" "%rj")
```

```
[object2Identifier p??]
[member p1050]
[strconc p??]
[pname p1047]
[$msgdbPrims p327]
```

— defun fixObjectForPrinting —

```
(defun |fixObjectForPrinting| (v)
  (let (vp)
    (declare (special |$msgdbPrims|))
    (setq vp (|object2Identifier| v))
    (cond
      ((eq vp '%) "\\%")
      ((|member| vp |$msgdbPrims|) (strconc "\\\" (pname vp)))
      (t v))))
```

19.2.25 defun displayProperties,sayFunctionDeps

```
;displayProperties(option,l) ==
; $dependentAlist : local := nil
; $dependeeAlist : local := nil
; [opt,:vl]:= (l or ['properties])
; imacs := getInterpMacroNames()
; pmacs := getParserMacroNames()
; macros := REMDUP append(imacs, pmacs)
; if vl is ['all] or null vl then
;   vl := MSORT append(getWorkspaceNames(),macros)
; if $frameMessages then sayKeyedMsg("S2IZ0065",[$interpreterFrameName])
```

```

; null v1 =>
;   null $frameMessages => sayKeyedMsg("S2IZ0066",NIL)
;   sayKeyedMsg("S2IZ0067",[$interpreterFrameName])
; interpFunctionDepAlists()
; for v in v1 repeat
;   isInternalMapName(v) => 'iterate
;   pl := getIProplist(v)
;   option = 'flags =>      getAndSay(v,"flags")
;   option = 'value =>      displayValue(v,getI(v,'value),nil)
;   option = 'condition => displayCondition(v,getI(v,"condition"),nil)
;   option = 'mode =>       displayMode(v,getI(v,'mode),nil)
;   option = 'type =>       displayType(v,getI(v,'value),nil)
;   option = 'properties =>
;     v = "--flags--" => nil
;     pl is [ ['cacheInfo,:.],:.] => nil
;     v1 := fixObjectForPrinting(v)
;     sayMSG ["Properties of",:bright prefix2String v1,':""]
;     null pl =>
;       v in pmacs =>
;         sayMSG '"      This is a user-defined macro.'
;         displayParserMacro v
;       isInterpMacro v =>
;         sayMSG '"      This is a system-defined macro.'
;         displayMacro v
;       sayMSG '"      none"
; propsSeen:= nil
; for [prop,:val] in pl | ^MEMQ(prop,propsSeen) and val repeat
;   prop in '(alias generatedCode IS_-GENSYM mapBody localVars) =>
;     nil
;   prop = 'condition =>
;     displayCondition(prop,val,true)
;   prop = 'recursive =>
;     sayMSG '"      This is recursive.'
;   prop = 'isInterpreterFunction =>
;     sayMSG '"      This is an interpreter function.'
;     sayFunctionDeps v where
;       sayFunctionDeps x ==
;         if dependents := GETALIST($dependentAlist,x) then
;           null rest dependents =>
;             sayMSG ["      The following function or rule ",
;               '"depends on this:",:bright first dependents]
;             sayMSG
;               '"      The following functions or rules depend on this:"
;             msg := ["%b",'"      "]
;             for y in dependents repeat msg := ['" ",y,:msg]
;             sayMSG [:nreverse msg,"%d"]
;         if dependees := GETALIST($dependeeAlist,x) then
;           null rest dependees =>
;             sayMSG ["      This depends on the following function ",
;               '"or rule:",:bright first dependees]

```

```

;          sayMSG
;          ' " This depends on the following functions or rules:"
;          msg := ["%b"," "]
;          for y in dependees repeat msg := ['" ",y,:msg]
;          sayMSG [:nreverse msg,"%d"]
;      prop = 'isInterpreterRule =>
;          sayMSG ' " This is an interpreter rule."
;          sayFunctionDeps v
;      prop = 'localModemap =>
;          displayModemap(v,val,true)
;      prop = 'mode =>
;          displayMode(prop,val,true)
;      prop = 'value =>
;          val => displayValue(v,val,true)
;          sayMSG ['" ",prop,'": ',val]
;      propsSeen:= [prop,:propsSeen]
;      sayKeyedMsg("S2IZ0068",[option])
;      terminateSystemCommand()

```

```

[seq p??]
[getalist p??]
[exit p??]
[sayMSG p331]
[bright p??]
[$dependeeAlist p??]
[$dependentAlist p??]

```

— defun displayProperties,sayFunctionDeps —

```

(defun |displayProperties,sayFunctionDeps| (x)
  (prog (dependents dependees msg)
    (declare (special |$dependeeAlist| |$dependentAlist|))
    (return
      (seq
        (if (setq dependents (getalist |$dependentAlist| x))
          (seq
            (if (null (cdr dependents))
              (exit
                (|sayMSG| (cons " The following function or rule "
                              (cons "depends on this:" (|bright| (car dependents)))))))
            (|sayMSG| " The following functions or rules depend on this:")
            (setq msg (cons '|%b| (cons " " nil)))
            (do ((G166397 dependents (cdr G166397)) (y nil))
              ((or (atom G166397) (progn (setq y (car G166397)) nil)) nil)
              (seq (exit (setq msg (cons " " (cons y msg))))))
            (exit (|sayMSG| (append (nreverse msg) (cons '|%d| nil))))))
          nil)
        (exit
          (if (setq dependees (getalist |$dependeeAlist| x))

```

```
(seq
  (if (null (cdr dependees))
    (exit
      (|sayMSG| (cons "    This depends on the following function "
                     (cons "or rule:" (|bright| (car dependees))))))
    (|sayMSG| "    This depends on the following functions or rules:")
    (setq msg (cons '|%b| (cons "    " nil)))
    (do ((G166406 dependees (cdr G166406)) (y nil))
        ((or (atom G166406) (progn (setq y (car G166406)) nil)) nil)
        (seq (exit (setq msg (cons " " (cons y msg))))))
    (exit (|sayMSG| (append (nreverse msg) (cons '|%d| nil))))
    nil))))))
```

19.2.26 defun displayValue

```
[sayMSG p331]
[fixObjectForPrinting p454]
[pname p1047]
[objValUnwrap p??]
[objMode p??]
[displayRule p??]
[strconc p??]
[prefix2String p??]
[objMode p??]
[getdatabase p1009]
[concat p1049]
[form2String p??]
[mathprint p??]
[outputFormat p??]
[objMode p??]
[$op p??]
[$EmptyMode p??]
```

— defun displayValue —

```
(defun |displayValue| (|$op| u omitVariableNameIfTrue)
  (declare (special |$op|))
  (let (expr op rhs label labmode)
    (declare (special |$EmptyMode|))
    (if (null u)
      (|sayMSG|
        (list '|    Value of | (|fixObjectForPrinting| (pname |$op|)) ": (none)"))
      (progn
        (setq expr (|objValUnwrap| u))
```

```

(if (or (and (consp expr) (progn (setq op (qcar expr)) t) (eq op 'map))
      (equal (|objMode| u) |$EmptyMode|))
  (|displayRule| |$op| expr)
  (progn
    (cond
      (omitVariableNameIfTrue
       (setq rhs ": ")
       (setq label "Value (has type ")
      (t
       (setq rhs ": ")
       (setq label (strconc "Value of " (pname |$op|) ": "))))
    (setq labmode (|prefix2String| (|objMode| u)))
    (when (atom labmode) (setq labmode (list labmode)))
    (if (eq (getdatabase expr 'constructorkind) '|domain|)
        (|sayMSG| (|concat| " " label labmode rhs (|form2String| expr)))
        (|mathprint|
         (cons 'concat
          (cons label
           (append labmode
            (cons rhs
             (cons (|outputFormat| expr (|objMode| u)) nil))))))
        nil))))))

```

19.2.27 defun displayType

```

[sayMSG p331]
[fixObjectForPrinting p454]
[pname p1047]
[prefix2String p??]
[objMode p??]
[concat p1049]
[$op p??]

```

— defun displayType —

```

(defun |displayType| (|$op| u omitVariableNameIfTrue)
  (declare (special |$op|) (ignore omitVariableNameIfTrue))
  (let (type)
    (if (null u)
        (|sayMSG|
         (list " Type of value of " (|fixObjectForPrinting| (pname |$op|))
              ": (none)"))
        (progn
         (setq type (|prefix2String| (|objMode| u)))
         (when (atom type) (setq type (list type)))

```

```
(|sayMSG|
  (|concat|
    (cons "    Type of value of "
      (cons (|fixObjectForPrinting| (pname |$op|))
        (cons ": " type))))))
nil)))))
```

19.2.28 defun getAndSay

```
[getI p??]
[sayMSG p331]
```

— defun getAndSay —

```
(defun |getAndSay| (v prop)
  (let (val)
    (if (setq val (|getI| v prop))
      (|sayMSG| (cons '|    | (cons val (cons '|%1| nil))))
      (|sayMSG| (cons '|    none| (cons '|%1| nil))))))
```

19.2.29 defun displayProperties

```
[getInterpMacroNames p??]
[getParserMacroNames p451]
[remdup p??]
[qcdr p??]
[qcar p??]
[msort p??]
[getWorkspaceNames p453]
[sayKeyedMsg p329]
[interpFunctionDepAlists p463]
[isInternalMapName p??]
[getIProplist p??]
[getAndSay p459]
[displayValue p457]
[getI p??]
[displayCondition p463]
[displayMode p464]
[displayType p458]
[fixObjectForPrinting p454]
```

```

[sayMSG p331]
[bright p??]
[prefix2String p??]
[member p1050]
[displayParserMacro p462]
[isInterpMacro p??]
[displayMacro p451]
[displayProperties,sayFunctionDeps p454]
[displayModemap p464]
[exit p??]
[seq p??]
[terminateSystemCommand p450]
[$dependentAlist p??]
[$dependeeAlist p??]
[$frameMessages p738]
[$interpreterFrameName p??]

```

— defun displayProperties —

```

(defun |displayProperties| (option al)
  (let (|$dependentAlist| |$dependeeAlist| tmp1 opt imacs pmacs macros v1 pl
        tmp2 vone prop val propsSeen)
    (declare (special |$dependentAlist| |$dependeeAlist| |$frameMessages|
                      |$interpreterFrameName|))
    (setq |$dependentAlist| nil)
    (setq |$dependeeAlist| nil)
    (setq tmp1 (or al (cons '|properties| nil)))
    (setq opt (car tmp1))
    (setq v1 (cdr tmp1))
    (setq imacs (|getInterpMacroNames|))
    (setq pmacs (|getParserMacroNames|))
    (setq macros (remdup (append imacs pmacs)))
    (when (or
            (and (consp v1) (eq (qcdr v1) nil) (eq (qcar v1) '|all|))
            (null v1))
      (setq v1 (msort (append (|getWorkspaceNames|) macros))))
    (when |$frameMessages|
      (|sayKeyedMsg| 'S2IZ0065 (cons |$interpreterFrameName| nil)))
    (cond
      ((null v1)
       (if (null |$frameMessages|)
           (|sayKeyedMsg| 'S2IZ0066 nil))
          (|sayKeyedMsg| 'S2IZ0067 (cons |$interpreterFrameName| nil)))
      (t
       (|interpFunctionDepAlists|)
       (do ((G166440 v1 (cdr G166440)) (v nil))
           ((or (atom G166440) (progn (setq v (car G166440)) nil)) nil)
         (seq (exit

```



```

(cond
  ((|isInternalMapName| v) '|iterate|)
  (t
    (setq pl (|getIProplist| v))
    (cond
      ((eq option '|flags|)
        (|getAndSay| v '|flags|))
      ((eq option '|value|)
        (|displayValue| v (|getI| v '|value|) nil))
      ((eq option '|condition|)
        (|displayCondition| v (|getI| v '|condition|) nil))
      ((eq option '|mode|)
        (|displayMode| v (|getI| v '|mode|) nil))
      ((eq option '|type|)
        (|displayType| v (|getI| v '|value|) nil))
      ((eq option '|properties|)
        (cond
          ((eq v '|--flags--|)
            nil)
          ((and (consp pl)
                (progn
                  (setq tmp2 (qcar pl))
                  (and (consp tmp2) (eq (qcar tmp2) '|cacheInfo|))))
            nil)
          (t
            (setq vone (|fixObjectForPrinting| v))
            (|sayMSG|
              (cons "Properties of"
                    (append (|bright| (|prefix2String| vone)) (cons ":" nil))))
            (cond
              ((null pl)
                (cond
                  ((|member| v pmacs)
                    (|sayMSG| " This is a user-defined macro.")
                    (|displayParserMacro| v))
                  ((|isInterpMacro| v)
                    (|sayMSG| " This is a system-defined macro.")
                    (|displayMacro| v))
                  (t
                    (|sayMSG| " none")))))
              (t
                (setq propsSeen nil)
                (do ((G166451 pl (cdr G166451)) (G166425 nil))
                    ((or (atom G166451)
                        (progn (setq G166425 (car G166451)) nil)
                        (progn
                          (setq prop (car G166425))
                          (setq val (cdr G166425))
                          G166425))

```

```

        nil))
      nil)
    (seq (exit
      (cond
        ((and (null (member prop propsSeen)) val)
          (cond
            ((|member| prop
              '(|alias| |generatedCode| IS-GENSYM
                |mapBody| |localVars|))
              nil)
            ((eq prop '|condition|)
              (|displayCondition| prop val t))
            ((eq prop '|recursive|)
              (|sayMSG| "   This is recursive."))
            ((eq prop '|isInterpreterFunction|)
              (|sayMSG| "   This is an interpreter function."))
              (|displayProperties,sayFunctionDeps| v))
            ((eq prop '|isInterpreterRule|)
              (|sayMSG| "   This is an interpreter rule."))
              (|displayProperties,sayFunctionDeps| v))
            ((eq prop '|localModemap|)
              (|displayModemap| v val t))
            ((eq prop '|model|)
              (|displayModel| prop val t))
            (t
              (when (eq prop '|value|)
                (exit
                  (when val
                    (exit (|displayValue| v val t))))))
                (|sayMSG| (list "   " prop ": " val))
                (setq propsSeen (cons prop propsSeen))))))))))
      (t
        (|sayKeyedMsg| 'S2IZ0068 (cons option nil))))))
    (|terminateSystemCommand|))))

```

19.2.30 defun displayParserMacro

```

[pfPrintSrcLines p??]
[$pfMacros p98]

```

— defun displayParserMacro —

```

(defun |displayParserMacro| (m)
  (let ((m (assq m |$pfMacros|)))
    (declare (special |$pfMacros|)

```

```
(when m (|pfPrintSrcLines| (caddr m))))
```

19.2.31 defun displayCondition

```
[bright p??]
[sayBrightly p??]
[concat p1049]
[pred2English p??]
```

— defun displayCondition —

```
(defun |displayCondition| (v condition giveVariableIfNil)
  (let (varPart condPart)
    (when giveVariableIfNil (setq varPart (cons ' | of| (|bright| v))))
    (setq condPart (or condition '|true|))
    (|sayBrightly|
     (|concat| '| condition| varPart '|: | (|pred2English| condPart)))))
```

19.2.32 defun interpFunctionDepAlists

```
[putalist p??]
[getalist p??]
[getFlag p??]
[$e p??]
[$dependeeAlist p??]
[$dependentAlist p??]
[$InteractiveFrame p??]
```

— defun interpFunctionDepAlists —

```
(defun |interpFunctionDepAlists| ()
  (let (|$e|)
    (declare (special |$e| |$dependeeAlist| |$dependentAlist|
                      |$InteractiveFrame|))
    (setq |$e| |$InteractiveFrame|)
    (setq |$dependentAlist| (cons (cons nil nil) nil))
    (setq |$dependeeAlist| (cons (cons nil nil) nil))
    (mapcar #'(lambda (dep)
      (let (dependee dependent)
        (setq dependee (first dep))
```

```

(setq dependent (second dep))
(setq |$dependentAlist|
  (putalist |$dependentAlist| dependee
    (cons dependent (getalist |$dependentAlist| dependee))))
(spadlet |$dependeeAlist|
  (putalist |$dependeeAlist| dependent
    (cons dependee (getalist |$dependeeAlist| dependent)))))
(|getFlag| '$dependencies|)))

```

19.2.33 defun displayModemap

```

[bright p??]
[sayBrightly p??]
[concat p1049]
[formatSignature p??]

```

— defun displayModemap —

```

(defun |displayModemap| (v val giveVariableIfNil)
  (labels (
    (g (v mm giveVariableIfNil)
      (let (local signature fn varPart prefix)
        (setq local (caar mm))
        (setq signature (cdar mm))
        (setq fn (cadr mm))
        (unless (eq local '|interpOnly|)
          (spadlet varPart (unless giveVariableIfNil (cons " of" (|bright| v))))
          (spadlet prefix
            (cons '| Compiled function type| (append varPart (cons '|: | nil)))))
          (|sayBrightly| (|concat| prefix (|formatSignature| signature))))))
    (mapcar #'(lambda (x) (g v x giveVariableIfNil)) val)))

```

19.2.34 defun displayMode

```

[bright p??]
[fixObjectForPrinting p454]
[sayBrightly p??]
[concat p1049]
[prefix2String p??]

```

— defun displayMode —

```
(defun |displayMode| (v mode giveVariableIfNil)
  (let (varPart)
    (when mode
      (unless giveVariableIfNil
        (setq varPart (cons '| of| (|bright| (|fixObjectForPrinting| v)))))
      (|sayBrightly|
        (|concat| '| Declared type or mode| varPart '|: |
          (|prefix2String| mode))))))
```

—————

19.2.35 defun Split into tokens delimited by spaces

[stripSpaces p469]

— defun dumbTokenize —

```
(defun |dumbTokenize| (str)
  (let (inString token (tokenStart 0) previousSpace tokenList)
    (dotimes (i (1- (|#| str)))
      (cond
        ((char= (elt str i) #"") ; don't split strings
          (setq inString (null inString))
          (setq previousSpace nil))
        ((and (char= (elt str i) #"space) (null inString))
          (unless previousSpace
            (setq token (|stripSpaces| (subseq str tokenStart i)))
            (setq tokenList (cons token tokenList))
            (setq tokenStart (1+ i))
            (setq previousSpace t)))
        (t
          (setq previousSpace nil))))
    (setq tokenList (cons (|stripSpaces| (subseq str tokenStart)) tokenList))
    (nreverse tokenList))
```

—————

19.2.36 defun Convert string tokens to their proper type

[isIntegerString p466]

— defun tokTran —

```
(defun |tokTran| (tok)
  (let (tmp)
    (if (stringp tok)
      (cond
        ((eq1 (|#| tok) 0) nil)
        ((setq tmp (|isIntegerString| tok)) tmp)
        ((char= (elt tok 0) #" ") (subseq tok 1 (1- (|#| tok))))
        (t (intern tok)))
      tok)))
```

19.2.37 defun Is the argument string an integer?

— defun isIntegerString 0 —

```
(defun |isIntegerString| (tok)
  (multiple-value-bind (int len) (parse-integer tok :junk-allowed t)
    (when (and int (= len (length tok))) int)))
```

19.2.38 defun Handle parsed system commands

[dumbTokenize p465]
 [parseSystemCmd p467]
 [tokTran p465]
 [systemCommand p446]

— defun handleParsedSystemCommands —

```
(defun |handleParsedSystemCommands| (unabr optionList)
  (declare (ignore unabr))
  (let (restOptionList parcmd trail)
    (setq restOptionList (mapcar #'|dumbTokenize| (cdr optionList)))
    (setq parcmd (|parseSystemCmd| (car optionList)))
    (setq trail
      (mapcar #'(lambda (opt)
        (mapcar #'(lambda (tok) (|tokTran| tok)) opt)) restOptionList))
    (|systemCommand| (cons parcmd trail))))
```

19.2.39 defun Parse a system command

[tokTran p465]
 [stripSpaces p469]
 [parseFromString p48]
 [dumbTokenize p465]

— defun parseSystemCmd —

```
(defun |parseSystemCmd| (opt)
  (let (spaceIndex)
    (if (setq spaceIndex (search " " opt))
      (list
        (|tokTran| (|stripSpaces| (subseq opt 0 spaceIndex)))
        (|parseFromString| (|stripSpaces| (subseq opt spaceIndex))))
      (mapcar #'|tokTran| (|dumbTokenize| opt)))))
```

19.2.40 defun Get first word in a string

[subseq p??]
 [stringSpaces p??]

— defun getFirstWord —

```
(defun |getFirstWord| (string)
  (let (spaceIndex)
    (setq spaceIndex (search " " string))
    (if spaceIndex
      (|stripSpaces| (subseq string 0 spaceIndex))
      string)))
```

19.2.41 defun Unabbreviate keywords in commands

[selectOptionLC p477]
 [selectOption p477]
 [commandsForUserLevel p446]
 [\$systemCommands p441]
 [\$currentLine p??]
 [\$syscommands p442]
 [line p??]

— defun unAbbreviateKeyword —

```
(defun |unAbbreviateKeyword| (x)
  (let (xp)
    (declare (special |$systemCommands| |$currentLine| $syscommands line))
    (setq xp (|selectOptionLC| x $syscommands '|commandErrorIfAmbiguous|))
    (cond
      ((null xp)
        (setq xp '|system|)
        (setq line (concat ")system " (substring line 1 (1- (|#| line)))))
      (spadlet |$currentLine| line)))
    (|selectOption| xp (|commandsForUserLevel| |$systemCommands|)
      '|commandUserLevelError|)))
```

19.2.42 defun The command is ambiguous error

```
[commandAmbiguityError p450]
[$oldline p447]
[line p??]
```

— defun commandErrorIfAmbiguous —

```
(defun |commandErrorIfAmbiguous| (x u)
  (declare (special $oldline line))
  (when u
    (setq $oldline line)
    (|commandAmbiguityError| '|command| x u)))
```

```
[stripSpaces p469]
[nplisp p470]
[stripLisp p469]
[sayKeyedMsg p329]
[npboot p470]
[npsystem p470]
[npsynonym p471]
[member p1050]
[concat p1049]
```

— defun handleNoParseCommands —

```
(defun |handleNoParseCommands| (unab string)
```



```

(let (spaceindex funname)
  (setq string (|stripSpaces| string))
  (setq spaceindex (search " " string))
  (cond
    ((eq unab '|lisp|)
     (if spaceindex
      (|nplisp| (|stripLisp| string))
      (|sayKeyedMsg| 's2iv0005 nil)))
    ((eq unab '|boot|)
     (if spaceindex
      (|npboot| (subseq string (1+ spaceindex)))
      (|sayKeyedMsg| 's2iv0005 nil)))
    ((eq unab '|system|)
     (if spaceindex
      (|npsystem| unab string)
      (|sayKeyedMsg| 's2iv0005 nil)))
    ((eq unab '|synonym|)
     (if spaceindex
      (|npsynonym| unab (subseq string (1+ spaceindex)))
      (|npsynonym| unab "")))
    ((null spaceindex)
     (funcall unab))
    ((|member| unab '(|quit| |fin| |pquit| |credits| |copyright| |trademark|))
     (|sayKeyedMsg| 's2iv0005 nil))
    (t
     (setq funname (intern (concat "np" (string unab))))
     (funcall funname (subseq string (1+ spaceindex))))))

```

19.2.43 defun Remove the spaces surrounding a string

TPDHERE: This should probably be a macro or eliminated

— defun stripSpaces 0 —

```

(defun |stripSpaces| (str)
  (string-trim '(#\space) str))

```

19.2.44 defun Remove the lisp command prefix

— defun stripLisp 0 —

```

(defun |stripLisp| (str)

```

```
(if (string= (subseq str 0 4) "lisp")
    (subseq str 4)
    str))
```

19.2.45 defun Handle the)lisp command

[\$ans p??]

— defun nplisp 0 —

```
(defun |nplisp| (str)
  (declare (special |$ans|))
  (setq |$ans| (eval (read-from-string str)))
  (format t "~&Value = ~S~%" |$ans|))
```

19.2.46 defun The)boot command is no longer supported

TPDHERE: Remove all boot references from top level

— defun npboot 0 —

```
(defun |npboot| (str)
  (declare (ignore str))
  (format t "The )boot command is no longer supported~%"))
```

19.2.47 defun Handle the)system command

Note that unAbbreviateKeyword returns the word “system” for unknown words so we have to search for this case. This complication may never arrive in practice. [sayKeyedMsg p329]

— defun npsystem —

```
(defun |npsystem| (unab str)
  (let (spaceIndex sysPart)
    (setq spaceIndex (search " " str))
    (cond
      ((null spaceIndex) (|sayKeyedMsg| 'S2IZ0080 (list str)))
      (t
```

```
(setq sysPart (subseq str 0 spaceIndex))
(if (search sysPart (string unab))
    (obey (subseq str (1+ spaceIndex)))
    (|sayKeyedMsg| 'S2IZ0080 (list sysPart))))))
```

19.2.48 defun Handle the)synonym command

[npProcessSynonym p471]

— defun npsynonym —

```
(defun |npsynonym| (unab str)
  (declare (ignore unab))
  (|npProcessSynonym| str))
```

19.2.49 defun Handle the synonym system command

[printSynonyms p472]
 [processSynonymLine p833]
 [putalist p??]
 [terminateSystemCommand p450]
 [\$CommandSynonymAlist p476]

— defun npProcessSynonym —

```
(defun |npProcessSynonym| (str)
  (let (pair)
    (declare (special |$CommandSynonymAlist|))
    (if (= (length str) 0)
        (|printSynonyms| nil)
        (progn
          (setq pair (|processSynonymLine| str))
          (if |$CommandSynonymAlist|
              (putalist |$CommandSynonymAlist| (car pair) (cdr pair)))
              (setq |$CommandSynonymAlist| (cons pair nil))))
    (|terminateSystemCommand|)))
```

19.2.50 defun printSynonyms

[centerAndHighlight p??]
 [specialChar p978]
 [filterListOfStringsWithFn p941]
 [synonymsForUserLevel p831]
 [printLabelledList p472]
 [\$CommandSynonymAlist p476]
 [\$linelength p771]

— defun printSynonyms —

```
(defun |printSynonyms| (patterns)
  (prog (ls t1)
    (declare (special |$CommandSynonymAlist| $linelength))
    (|centerAndHighlight| ' |System Command Synonyms|
      $linelength (|specialChar| '|hbar|))

    (setq ls
      (|filterListOfStringsWithFn| patterns
        (do ((t2 (|synonymsForUserLevel| |$CommandSynonymAlist|) (cdr t2)))
          ((atom t2) (nreverse0 t1))
          (push (cons (princ-to-string (caar t2)) (cdar t2)) t1))
        (|function| car)))
      (|printLabelledList| ls "user" "synonyms" " " patterns)))
```

—————

19.2.51 defun Print a list of each matching synonym

The prefix goes before each element on each side of the list, eg, ")") [sayMessage p??]

[blankList p??]
 [substring p??]
 [entryWidth p??]
 [sayBrightly p??]
 [concat p1049]
 [fillerSpaces p20]

— defun printLabelledList —

```
(defun |printLabelledList| (ls label1 label2 prefix patterns)
  (let (comm syn wid)
    (if (null ls)
      (if (null patterns)
        (|sayMessage| (list " No " label1 "-defined " label2 " in effect."))
        (|sayMessage|
          ' (" No " ,label1 "-defined " ,label2 " satisfying patterns:"
```

```

    |%l| "      " |%b| ,@(append (|blankList| patterns) (list '|%d|'))))
(progn
  (when patterns
    (|sayMessage|
      '(',label1 "-defined " ,label2 " satisfying patterns:" |%l| "      "
        |%b| ,@(append (|blankList| patterns) (list '|%d|')))))
    (do ((t1 ls (cdr t1)))
      ((atom t1) nil)
      (setq syn (caar t1))
      (setq comm (cdar t1))
      (when (string= (substring syn 0 1) "|")
        (setq syn (substring syn 1 nil)))
      (when (string= syn "%i") (setq syn "%i "))
      (setq wid (max (- 30 (|entryWidth| syn)) 1))
      (|sayBrightly|
        (|concat| '|%b| prefix syn '|%d| (|fillerSpaces| wid ".")
          " " prefix comm)))
      (|sayBrightly| ""))))))

```

19.2.52 defvar \$tokenCommands

This is a list of the commands that expect the interpreter to parse their arguments. Thus the history command expects that Axiom will have tokenized and validated the input before calling the history function.

— **initvars** —

```
(defvar |$tokenCommands| nil)
```

— **postvars** —

```

(eval-when (eval load)
  (setq |$tokenCommands|
    '( |abbreviations|
      |cd|
      |clear|
      |close|
      |compiler|
      |depends|
      |display|
      |describe|
      |edit|

```

```

|frame|
|frame|
|help|
|history|
|input|
|library|
|load|
|ltrace|
|read|
|regress|
|savesystem|
|set|
|spool|
|tangle|
|undo|
|what|
|with|
|workfiles|
|zsystemdevelopment|
)))

```

19.2.53 defvar \$InitialCommandSynonymAlist

Axiom can create “synonyms” for commands. We create an initial table of synonyms which are in common use.

— initvars —

```
(defvar |$InitialCommandSynonymAlist| nil)
```

19.2.54 defun Print the current version information

```

[*yearweek* p??]
[*build-version* p??]

```

— defun axiomVersion 0 —

```

(defun axiomVersion ()
  (declare (special *build-version* *yearweek*))
  (concatenate 'string "Axiom " *build-version* " built on " *yearweek*))

```

— postvars —

```
(eval-when (eval load)
  (setq |$InitialCommandSynonymAlist|
    '(
      (|?|          . "what commands")
      (|ap|         . "what things")
      (|apr|        . "what things")
      (|apropos|    . "what things")
      (|cache|      . "set functions cache")
      (|cl|         . "clear")
      (|cls|        . "zsystemdevelopment )cls")
      (|cms|        . "system")
      (|col|        . "compiler")
      (|d|          . "display")
      (|depl|       . "display dependents")
      (|dependents| . "display dependents")
      (|e|          . "edit")
      (|expose|     . "set expose add constructor")
      (|fc|         . "zsystemdevelopment )c")
      (|fd|         . "zsystemdevelopment )d")
      (|fdt|        . "zsystemdevelopment )dt")
      (|fct|        . "zsystemdevelopment )ct")
      (|fctl|       . "zsystemdevelopment )ctl")
      (|fe|         . "zsystemdevelopment )e")
      (|fec|        . "zsystemdevelopment )ec")
      (|fect|       . "zsystemdevelopment )ect")
      (|fns|        . "exec spadfn")
      (|fortran|    . "set output fortran")
      (|h|          . "help")
      (|hd|         . "system hypertex &")
      (|kclam|      . "boot clearClams ( )")
      (|killcaches| . "boot clearConstructorAndLisplibCaches ( )")
      (|patch|      . "zsystemdevelopment )patch")
      (|pause|      . "zsystemdevelopment )pause")
      (|prompt|     . "set message prompt")
      (|recurrence| . "set functions recurrence")
      (|restore|    . "history )restore")
      (|save|       . "history )save")
      (|startGraphics| . "system $AXIOM/lib/viewman &")
      (|startNAGLink| . "system $AXIOM/lib/nagman &")
      (|stopGraphics| . "lisp (|sockSendSignal| 2 15)")
      (|stopNAGLink| . "lisp (|sockSendSignal| 8 15)")
      (|time|       . "set message time")
      (|type|       . "set message type")
      (|unexpose|   . "set expose drop constructor")
      (|up|         . "zsystemdevelopment )update")
    )
  )
```

```

(|version| . "lisp (axiomVersion)")
(|w| . "what")
(|wc| . "what categories")
(|wd| . "what domains")
(|who| . "lisp (pprint credits)")
(|wp| . "what packages")
(|ws| . "what synonyms")
)))

```

19.2.55 defvar \$CommandSynonymAlist

The actual list of synonyms is initialized to be the same as the above initial list of synonyms. The user synonyms that are added during a session are pushed onto this list for later lookup.

— **initvars** —

```
(defvar |$CommandSynonymAlist| nil)
```

— **postvars** —

```
(eval-when (eval load)
  (setq |$CommandSynonymAlist| (copy-alist |$InitialCommandSynonymAlist|)))
```

19.2.56 defun ncloopCommand

The `$systemCommandFunction` is set in `SpadInterpretStream` to point to the function `InterpExecuteSpadSystemCommand`. The system commands are handled by the function kept in the “hook” variable `$systemCommandFunction` which has the default function `InterpExecuteSpadSystemCommand`. Thus, when a system command is entered this function is called.

The only exception is the `)include` function which inserts the contents of a file inline in the input stream. This is useful for processing `)read` of input files. [ncloopPrefix? p477]

[ncloopInclude1 p619]

[\$systemCommandFunction p??]

[\$systemCommandFunction p??]

— **defun ncloopCommand** —


```
(defun |ncloopCommand| (line n)
  (let (a)
    (declare (special |$systemCommandFunction|))
    (if (setq a (|ncloopPrefix?| ")include" line))
        (|ncloopInclude1| a n)
      (progn
        (funcall |$systemCommandFunction| line)
        n))))
```

19.2.57 defun ncloopPrefix?

If we find the prefix string in the whole string starting at position zero we return the remainder of the string without the leading prefix.

— defun ncloopPrefix? 0 —

```
(defun |ncloopPrefix?| (prefix whole)
  (when (eql (search prefix whole) 0)
    (subseq whole (length prefix))))
```

19.2.58 defun selectOptionLC

```
[selectOption p477]
[downcase p??]
[object2Identifier p??]
```

— defun selectOptionLC —

```
(defun |selectOptionLC| (x l errorFunction)
  (|selectOption| (downcase (|object2Identifier| x)) l errorFunction))
```

19.2.59 defun selectOption

```
[member p1050]
[identp p1048]
[stringPrefix? p??]
[pname p1047]
```

```
[qcdr p??]
[qcar p??]
```

— defun selectOption —

```
(defun |selectOption| (x l errorfunction)
  (let (u y)
    (cond
      ((|member| x l) x)
      ((null (identp x))
       (cond
         (errorfunction (funcall errorfunction x u))
         (t nil)))
      (t
       (setq u
             (let (t0)
               (do ((t1 l (cdr t1)) (y nil))
                 ((or (atom t1) (progn (setq y (car t1)) nil)) (nreverse0 t0))
                 (if (|stringPrefix?| (pname x) (pname y))
                     (setq t0 (cons y t0)))))))
       (cond
         ((and (consp u) (eq (qcdr u) nil) (progn (setq y (qcar u)) t)) y)
         (errorfunction (funcall errorfunction x u))
         (t nil))))))
```

—————

Chapter 20

)abbreviations help page Command

20.1 abbreviations help page man page

— abbreviations.help —

```
=====
A.2. )abbreviation
=====
```

User Level Required: compiler

Command Syntax:

-)abbreviation query [nameOrAbbrev]
-)abbreviation category abbrev fullname [quiet]
-)abbreviation domain abbrev fullname [quiet]
-)abbreviation package abbrev fullname [quiet]
-)abbreviation remove nameOrAbbrev

Command Description:

This command is used to query, set and remove abbreviations for category, domain and package constructors. Every constructor must have a unique abbreviation. This abbreviation is part of the name of the subdirectory under which the components of the compiled constructor are stored. Furthermore, by issuing this command you let the system know what file to load automatically if you use a new constructor. Abbreviations must start with a letter and then be followed by up to seven letters or digits. Any letters appearing in the abbreviation must be in uppercase.

When used with the query argument, this command may be used to list the name associated with a particular abbreviation or the abbreviation for a constructor. If no abbreviation or name is given, the names and corresponding abbreviations for all constructors are listed.

The following shows the abbreviation for the constructor List:

```
)abbreviation query List
```

The following shows the constructor name corresponding to the abbreviation NNI:

```
)abbreviation query NNI
```

The following lists all constructor names and their abbreviations.

```
)abbreviation query
```

To add an abbreviation for a constructor, use this command with category, domain or package. The following add abbreviations to the system for a category, domain and package, respectively:

```
)abbreviation domain SET Set
)abbreviation category COMPCAT ComplexCategory
)abbreviation package LIST2MAP ListToMap
```

If the)quiet option is used, no output is displayed from this command. You would normally only define an abbreviation in a library source file. If this command is issued for a constructor that has already been loaded, the constructor will be reloaded next time it is referenced. In particular, you can use this command to force the automatic reloading of constructors.

To remove an abbreviation, the remove argument is used. This is usually only used to correct a previous command that set an abbreviation for a constructor name. If, in fact, the abbreviation does exist, you are prompted for confirmation of the removal request. Either of the following commands will remove the abbreviation VECTOR2 and the constructor name VectorFunctions2 from the system:

```
)abbreviation remove VECTOR2
)abbreviation remove VectorFunctions2
```

Also See:

- o)compile

20.2 Functions

20.2.1 defun abbreviations

[abbreviationsSpad2Cmd p481]

— defun abbreviations —

```
(defun |abbreviations| (l)
  (|abbreviationsSpad2Cmd| l))
```

—————

20.2.2 defun abbreviationsSpad2Cmd

[listConstructorAbbreviations p482]
 [abbreviation? p??]
 [abbQuery p534]
 [deldatabase p1009]
 [size p1047]
 [sayKeyedMsg p329]
 [mkUserConstructorAbbreviation p??]
 [setdatabase p1008]
 [seq p??]
 [exit p??]
 [opOf p??]
 [helpSpad2Cmd p570]
 [selectOptionLC p477]
 [qcar p??]
 [qcdr p??]
 [\$options p??]

— defun abbreviationsSpad2Cmd —

```
(defun |abbreviationsSpad2Cmd| (arg)
  (let (abopts quiet opt key type constructor t2 a b al)
    (declare (special |$options|))
    (if (null arg)
      (|helpSpad2Cmd| '(|abbreviations|))
      (progn
        (setq abopts '(|query| |domain| |category| |package| |remove|))
        (setq quiet nil)
        (do ((t0 |$options| (cdr t0)) (t1 nil))
          ((or (atom t0)
              (progn (setq t1 (car t0)) nil))
```

```

      (progn (progn (setq opt (car t1)) t1) nil))
    nil)
  (setq opt (|selectOptionLC| opt '(|quiet|) '|optionError|))
  (when (eq opt '|quiet|) (setq quiet t)))
(when
  (and (consp arg)
    (progn
      (setq opt (qcar arg))
      (setq al (qcdr arg))
      t))
    (setq key (|opOf| (car al)))
    (setq type (|selectOptionLC| opt abopts '|optionError|))
    (cond
      ((eq type '|query|)
        (cond
          ((null al) (|listConstructorAbbreviations|))
          ((setq constructor (|abbreviation?| key))
            (|abbQuery| constructor))
          (t (|abbQuery| key))))
        ((eq type '|remove|)
          (deldatabase key 'abbreviation))
        ((oddp (size al))
          (|sayKeyedMsg| 's2iz0002 (list type)))
        t
        (do () (nil nil)
          (seq
            (exit
              (cond
                ((null al) (return '|fromLoop|))
                (t
                  (setq t2 al)
                  (setq a (car t2))
                  (setq b (cadr t2))
                  (setq al (cddr t2))
                  (|mkUserConstructorAbbreviation| b a type)
                  (setdatabase b 'abbreviation a)
                  (setdatabase b 'constructorkind type))))))
            (unless quiet
              (|sayKeyedMsg| 's2iz0001 (list a type (|opOf| b))))))))))

```

20.2.3 defun listConstructorAbbreviations

```

[upcase p??]
[queryUserKeyedMsg p??]
[string2id-n p??]
[whatSpad2Cmd p938]

```

[sayKeyedMsg p329]

— defun listConstructorAbbreviations —

```
(defun |listConstructorAbbreviations| ()
  (let (x)
    (setq x (upcase (|queryUserKeyedMsg| 's2iz0056 nil)))
    (if (member (string2id-n x 1) '(Y YES))
        (progn
          (|whatSpad2Cmd| '(|categories|))
          (|whatSpad2Cmd| '(|domains|))
          (|whatSpad2Cmd| '(|packages|)))
        (|sayKeyedMsg| 's2iz0057 nil))))
```

—————

Chapter 21

)boot help page Command

21.1 boot help page man page

— boot.help —

```
=====
A.3. )boot
=====
```

User Level Required: development

Command Syntax:

-)boot bootExpression

Command Description:

This command is used by AXIOM system developers to execute expressions written in the BOOT language. For example,

```
)boot times3(x) == 3*x
```

creates and compiles the Lisp function ‘‘times3’’ obtained by translating the BOOT code.

Also See:

- o)fin
- o)lisp
- o)set
- o)system

1

21.2 Functions

This command is in the list of `$noParseCommands` 19.1.3 which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` 19.2.1

¹ “fin” (32.1.1 p 546) “lisp” (?? p ??) “set” (46.36.1 p 805) “system” (?? p ??)

Chapter 22

)browse help page Command

22.1 browse help page man page

— browse.help —

User Level Required: development

Command Syntax:

```
)browse
```

Command Description:

This command is used by Axiom system users to start the Axiom top level loop listening for browser connections.

—————

22.2 Overview

The Axiom book on the help browser is a complete rewrite of the hyperdoc mechanism. There are several components that were needed to make this function. Most of the web browser components are described in bookvol11.pamphlet. This portion describes some of the design issues needed to support the interface.

The axServer command takes a port (defaulting to 8085) and a program to handle the browser interaction (defaulting to multiServ). The axServer function opens the port, constructs the

stream, and passes the stream to multiServ. The multiServ loop processes one interaction at a time.

So the basic process is that the Axiom “)browse” command opens a socket and listens for http requests. Based on the type of request (either 'GET' or 'POST') and the content of the request, which is one of:

- command - algebra request/response
- lispcall - a lisp s-expression to be evaluated
- showcall - an Axiom)show command

the multiServ function will call a handler function to evaluate the command line and construct a response. GET requests result in a new browser page. POST requests result in an inline result.

Most responses contain the fields:

- stepnum - this is the Axiom step number
- command - this is the original command from the browser
- algebra - this is the Axiom 2D algebra output
- mathml - this is the MathML version of the Axiom algebra
- type - this is the type of the Axiom result

22.3 Browsers, MathML, and Fonts

This work has the Firefox browser as its target. Firefox has built-in support for MathML, javascript, and XMLHttpRequest handling. More details are available in bookvol11.pamphlet but the very basic machinery for communication with the browser involves a dance between the browser and the multiServ function (see the axserver.spad.pamphlet).

In particular, a simple request is embedded in a web page as:

```
<ul>
<li>
  <input type="submit" id="p3" class="subbut"
    onclick="makeRequest('p3');"
    value="sin(x)" />
  <div id="ansp3"><div></div></div>
</li>
</ul>
```

which says that this is an html “input” field of type “submit”. The CSS display class is “subbut” which is of a different color than the surrounding text to make it obvious that you can click on this field. Clickable fields that have no response text are of class “noresult”.

The javascript call to “makeRequest” gives the “id” of this input field, which must be unique in the page, as an argument. In this case, the argument is ‘p3’. The “value” field holds the display text which will be passed back to Axiom as a command.

When the result arrives the “showanswer” function will select out the mathml field of the response, construct the “id” of the html div to hold the response by concatenating the string “ans” (answer) to the “id” of the request resulting, in this case, as “ansp3”. The “showanswer” function will find this div and replace it with a div containing the mathml result.

The “makeRequest” function is:

```
function makeRequest(arg) {
  http_request = new XMLHttpRequest();
  var command = cmdline(arg);
  //alert(command);
  http_request.open('POST', '127.0.0.1:8085', true);
  http_request.onreadystatechange = handleResponse;
  http_request.setRequestHeader('Content-Type', 'text/plain');
  http_request.send("command="+command);
  return(false);
}
```

It contains a request to open a local server connection to Axiom, sets “handleResponse” as the function to call on reply, sets up the type of request, fills in the command field, and sends off the http request.

When a response is received, the “handleResponse” function checks for the correct reply state, strips out the important text, and calls “showanswer”.

```
function handleResponse() {
  if (http_request.readyState == 4) {
    if (http_request.status == 200) {
      showanswer(http_request.responseText, 'mathAns');
    } else
    {
      alert('There was a problem with the request.' + http_request.statusText);
    }
  }
}
```

See bookvol11.pamphlet for further details.

22.4 The axServer/multiServ loop

The basic call to start an Axiom browser listener is:

```
)set message autoload off
)set output mathml on
axServer(8085,multiServ)$AXSERV
```

This call sets the port, opens a socket, attaches it to a stream, and then calls “multiServ” with that stream. The “multiServ” function loops serving web responses to that port.

22.5 The `)browse` command

In order to make the whole process cleaner the function “`)browse`” handles the details. This code creates the command-line function for `)browse`

The browse function does the internal equivalent of the following 3 command line statments:

```
)set message autoload off
)set output mathml on
axServer(8085,multiServ)$AXSERV
```

which causes Axiom to start serving web pages on port 8085

For those unfamiliar with calling algebra from lisp there are a few points to mention.

The `loadLib` needs to be called to load the algebra code into the image. Normally this is automatic but we are not using the interpreter so we need to do this “by hand”.

Each algebra file contains a “constructor function” which builds the domain, which is a vector, and then caches the vector so that every call to the contructor returns an EQ vector, that is, the same vector. In this case, we call the constructor `|AxiomServer|`

The `axServer` function was mangled internally to `|AXSERV;axServer;IMV;2|`. The `multiServ` function was mangled to `|AXSERV;multiServ;SeV;3|` Note well that if you change `axserver.spad` these names might change which will generate the error message along the lines of:

```
System error:
The function $\vert$AXSERV;axServer;IMV;2$\vert$ is undefined.
```

To fix this you need to look at `int/algebra/AXSERV.nr/lib/code.lsp` and find the new mangled function name. A better solution would be to dynamically look up the surface names in the domain vector.

Each Axiom function expects the domain vector as the last argument. This is not obvious from the call as the interpreter supplies it. We must do that “by hand”.

We don’t call the `multiServ` function. We pass it as a parameter to the `axServer` function. When it does get called by the `SPADCALL` macro it needs to be a lisp pair whose car is the function and whose cdr is the domain vector. We construct that pair here as the second argument to `axServer`. The third, hidden, argument to `axServer` is the domain vector which we supply “by hand”.

The socket can be supplied on the command line but defaults to 8085. Axiom supplies the arguments as a list.

22.6 Variables Used

22.7 Functions

```
[set p805]
[loadLib p1037]
[AxiomServer p??]
[AXSERV;axServer;IMV;2 p??]
```

— defun browse —

```
(defun |browse| (socket)
  (let (axserv browser)
    (if socket
      (setq socket (car socket))
      (setq socket 8085))
    (|set| '(|mes| |auto| |off|))
    (|set| '(|out| |mathml| |on|))
    (|loadLib| '|AxiomServer|)
    (setq axserv (|AxiomServer|))
    (setq browser
      (|AXSERV;axServer;IMV;2| socket
        (cons #'|AXSERV;multiServ;SeV;3| axserv) axserv))))
```

Now we have to bolt it into Axiom. This involves two lookups.

We create the lisp pair

```
(|browse| . |development|)
```

and cons it into the \$systemCommands command table. This allows the command to be executed in development mode. This lookup decides if this command is allowed. It also has the side-effect of putting the command into the \$SYSCOMMANDS variable which is used to determine if the token is a command.

22.8 The server support code

Chapter 23

)cd help page Command

23.1 cd help page man page

— cd.help —

```
=====
A.4. )cd
=====
```

User Level Required: interpreter

Command Syntax:

-)cd directory

Command Description:

This command sets the AXIOM working current directory. The current directory is used for looking for input files (for)read), AXIOM library source files (for)compile), saved history environment files (for)history)restore), compiled AXIOM library files (for)library), and files to edit (for)edit). It is also used for writing spool files (via)spool), writing history input files (via)history)write) and history environment files (via)history)save), and compiled AXIOM library files (via)compile).

If issued with no argument, this command sets the AXIOM current directory to your home directory. If an argument is used, it must be a valid directory name. Except for the ‘)’ at the beginning of the command, this has the same syntax as the operating system cd command.

Also See:

o)compile

- o `)edit`
- o `)history`
- o `)library`
- o `)read`
- o `)spool`

1

23.2 Variables Used

23.3 Functions

¹ “edit” (31.2.1 p 542) “history” (35.4.7 p 580) “library” (67.1.34 p 1013) “read” (43.1.1 p 640) “spool” (?? p ??)

Chapter 24

)clear help page Command

24.1 clear help page man page

— clear.help —

```
=====
A.6. )clear
=====
```

User Level Required: interpreter

Command Syntax:

```
- )clear all
- )clear completely
- )clear properties all
- )clear properties obj1 [obj2 ...]
- )clear value      all
- )clear value      obj1 [obj2 ...]
- )clear mode       all
- )clear mode       obj1 [obj2 ...]
```

Command Description:

This command is used to remove function and variable declarations, definitions and values from the workspace. To empty the entire workspace and reset the step counter to 1, issue

```
)clear all
```

To remove everything in the workspace but not reset the step counter, issue

```
)clear properties all
```

To remove everything about the object `x`, issue

```
)clear properties x
```

To remove everything about the objects `x`, `y` and `f`, issue

```
)clear properties x y f
```

The word `properties` may be abbreviated to the single letter `'p'`.

```
)clear p all
```

```
)clear p x
```

```
)clear p x y f
```

All definitions of functions and values of variables may be removed by either

```
)clear value all
```

```
)clear v all
```

This retains whatever declarations the objects had. To remove definitions and values for the specific objects `x`, `y` and `f`, issue

```
)clear value x y f
```

```
)clear v x y f
```

To remove the declarations of everything while leaving the definitions and values, issue

```
)clear mode all
```

```
)clear m all
```

To remove declarations for the specific objects `x`, `y` and `f`, issue

```
)clear mode x y f
```

```
)clear m x y f
```

The `)display names` and `)display properties` commands may be used to see what is currently in the workspace.

The command

```
)clear completely
```

does everything that `)clear all` does, and also clears the internal system function and constructor caches.

Also See:

- o `)display`

```
o )history
o )undo
```

1

24.2 Variables Used

24.2.1 defvar \$clearOptions

— initvars —

```
(defvar |$clearOptions| '(|modes| |operations| |properties| |types| |values|))
```

24.3 Functions

24.3.1 defun clear

[clearSpad2Cmd p498]

— defun clear —

```
(defun |clear| (1)
  (|clearSpad2Cmd| 1))
```

24.3.2 defvar \$clearExcept

— initvars —

```
(defvar |$clearExcept| nil)
```

¹ “display” (30.2.1 p 533) “history” (35.4.7 p 580) “undo” (54.4.6 p 920)

24.3.3 defun clearSpad2Cmd

TPDHERE: Note that this function also seems to parse out)except)completely and)scaches which don't seem to be documented. [selectOptionLC p477]

```
[sayKeyedMsg p329]
[clearCmdAll p501]
[clearCmdCompletely p500]
[clearCmdSortedCaches p499]
[clearCmdExcept p502]
[clearCmdParts p503]
[updateCurrentInterpreterFrame p557]
[$clearExcept p497]
[$options p??]
[$clearOptions p497]
```

— defun clearSpad2Cmd —

```
(defun |clearSpad2Cmd| (l)
  (let (|$clearExcept| opt optlist arg)
    (declare (special |$clearExcept| |$options| |$clearOptions|))
    (cond
      (|$options|
        (setq |$clearExcept|
          (prog (t0)
            (setq t0 t)
            (return
              (do ((t1 nil (null t0))
                  (t2 |$options| (cdr t2))
                  (t3 nil))
                ((or t1
                  (atom t2)
                  (progn (setq t3 (car t2)) nil)
                  (progn (progn (setq opt (car t3)) t3) nil))
                 t0)
              (setq t0
                (and t0
                  (eq
                    (|selectOptionLC| opt '(|except|) '(|optionError|)
                    '|except|))))))))))
      (cond
        ((null l)
          (setq optlist
            (prog (t4)
              (setq t4 nil)
              (return
                (do ((t5 |$clearOptions| (cdr t5)) (x nil))
                  ((or (atom t5) (progn (setq x (car t5)) nil)) t4)
                  (setq t4 (append t4 '(|%1| " " ,x))))))
              (|sayKeyedMsg| 's2iz0010 (list optlist)))
```

```
(t
  (setq arg
    (|selectOptionLC| (car 1) '(|all| |completely| |scaches|) nil))
  (cond
    ((eq arg '|all|)      (|clearCmdAll|))
    ((eq arg '|completely|) (|clearCmdCompletely|))
    ((eq arg '|scaches|)   (|clearCmdSortedCaches|))
    (|$clearExcept|       (|clearCmdExcept| 1))
  )
  (t
    (|clearCmdParts| 1)
    (|updateCurrentInterpreterFrame|))))))
```

24.3.4 defun clearCmdSortedCaches

```
[compiledLookupCheck p499]
[spadcall p??]
[$lookupDefaults p??]
[$Void p??]
[$ConstructorCache p??]
```

— defun clearCmdSortedCaches —

```
(defun |clearCmdSortedCaches| ()
  (let (|$lookupDefaults| domain pair)
    (declare (special |$lookupDefaults| |$Void| |$ConstructorCache|))
    (do ((t0 (hget |$ConstructorCache| '|SortedCache|) (cdr t0))
        (t1 nil))
      ((or (atom t0)
          (progn
            (setq t1 (car t0))
            (setq domain (cddr t1))
            nil))
        nil)
      (setq pair (|compiledLookupCheck| '|clearCache| (list |$Void|) domain))
      (spadcall pair))))
```

24.3.5 defun compiledLookupCheck

```
[compiledLookup p1069]
[keyedSystemError p??]
[formatSignature p??]
```

— defun compiledLookupCheck —

```
(defun |compiledLookupCheck| (op sig dollar)
  (let (fn)
    (setq fn (|compiledLookup| op sig dollar))
    (cond
      ((and (null fn) (eq op '^))
        (setq fn (|compiledLookup| '** sig dollar)))
      ((and (null fn) (eq op '**))
        (setq fn (|compiledLookup| '^ sig dollar)))
      (t nil))
    (cond
      ((null fn)
        (|keyedSystemError| 'S2NR0001
          (list op (|formatSignature| sig) (elt dollar 0))))
      (t fn))))
```

—————

24.3.6 defvar \$functionTable

— initvars —

```
(defvar |$functionTable| nil)
```

—————

24.3.7 defun clearCmdCompletely

```
[clearCmdAll p501]
[sayKeyedMsg p329]
[clearClams p??]
[clearConstructorCaches p??]
[reclaim p39]
[$localExposureData p694]
[$xdatabase p??]
[$CatOfCatDatabase p??]
[$DomOfCatDatabase p??]
[$JoinOfCatDatabase p??]
[$JoinOfDomDatabase p??]
[$attributeDb p??]
[$functionTable p500]
```


[*\$existingFiles* p??]
 [*\$localExposureDataDefault* p694]

— **defun clearCmdCompletely** —

```
(defun |clearCmdCompletely| ()
  (declare (special |$localExposureData| |$xdatabase| |$CatOfCatDatabase|
    |$DomOfCatDatabase| |$JoinOfCatDatabase| |$JoinOfDomDatabase|
    |$attributeDb| |$functionTable| |$existingFiles|
    |$localExposureDataDefault|))
  (|clearCmdAll|)
  (setq |$localExposureData| (copy-seq |$localExposureDataDefault|))
  (setq |$xdatabase| nil)
  (setq |$CatOfCatDatabase| nil)
  (setq |$DomOfCatDatabase| nil)
  (setq |$JoinOfCatDatabase| nil)
  (setq |$JoinOfDomDatabase| nil)
  (setq |$attributeDb| nil)
  (setq |$functionTable| nil)
  (|sayKeyedMsg| 's2iz0013 nil)
  (|clearClams|)
  (|clearConstructorCaches|)
  (setq |$existingFiles| (make-hash-table :test #'equal))
  (|sayKeyedMsg| 's2iz0014 nil)
  (reclaim)
  (|sayKeyedMsg| 's2iz0015 nil))
```

24.3.8 defun clearCmdAll

[*clearCmdSortedCaches* p499]
 [*untraceMapSubNames* p871]
 [*resetInCoreHist* p586]
 [*deleteFile* p1044]
 [*histFileName* p578]
 [*updateCurrentInterpreterFrame* p557]
 [*clearMacroTable* p502]
 [*sayKeyedMsg* p329]
 [*\$frameRecord* p919]
 [*\$previousBindings* p919]
 [*\$variableNumberAlist* p??]
 [*\$InteractiveFrame* p??]
 [*\$useInternalHistoryTable* p577]
 [*\$internalHistoryTable* p??]
 [*\$frameMessages* p738]

```
[$interpreterFrameName p??]
[$currentLine p??]
```

— **defun clearCmdAll** —

```
(defun |clearCmdAll| ()
  (declare (special |$frameRecord| |$previousBindings| |$variableNumberAlist|
    |$InteractiveFrame| |$useInternalHistoryTable| |$internalHistoryTable|
    |$frameMessages| |$interpreterFrameName| |$currentLine|))
  (|clearCmdSortedCaches|)
  (setq |$frameRecord| nil)
  (setq |$previousBindings| nil)
  (setq |$variableNumberAlist| nil)
  (|untraceMapSubNames| /tracenames)
  (setq |$InteractiveFrame| (list (list nil)))
  (|resetInCoreHist|)
  (when |$useInternalHistoryTable|
    (setq |$internalHistoryTable| nil)
    (|deleteFile| (|histFileName|)))
  (setq |$IOindex| 1)
  (|updateCurrentInterpreterFrame|)
  (setq |$currentLine| ")clear all")
  (|clearMacroTable|)
  (when |$frameMessages|
    (|sayKeyedMsg| 's2iz0011 (list |$interpreterFrameName|))
    (|sayKeyedMsg| 's2iz0012 nil)))
```

—————

24.3.9 defun clearMacroTable

```
[$pfMacros p98]
```

— **defun clearMacroTable 0** —

```
(defun |clearMacroTable| ()
  (declare (special |$pfMacros|))
  (setq |$pfMacros| nil))
```

—————

24.3.10 defun clearCmdExcept

```
Clear all the options except the argument. [stringPrefix? p??]
[object2String p??]
```

[clearCmdParts p503]
 [\$clearOptions p497]

— **defun clearCmdExcept** —

```
(defun |clearCmdExcept| (arg)
  (let ((opt (car arg)) (vl (cdr arg)))
    (declare (special |$clearOptions|))
    (dolist (option |$clearOptions|)
      (unless (|stringPrefix?| (|object2String| opt) (|object2String| option))
        (|clearCmdParts| (cons option vl))))))
```

24.3.11 defun clearCmdParts

[selectOptionLC p477]
 [pname p1047]
 [types p??]
 [modes p??]
 [values p??]
 [boot-equal p??]
 [assocleft p??]
 [remdup p??]
 [assoc p??]
 [isMap p??]
 [get p??]
 [exit p??]
 [untraceMapSubNames p871]
 [seq p??]
 [recordOldValue p590]
 [recordNewValue p589]
 [deleteAssoc p??]
 [sayKeyedMsg p329]
 [getParserMacroNames p451]
 [getInterpMacroNames p??]
 [clearDependencies p??]
 [member p1050]
 [clearParserMacro p451]
 [sayMessage p??]
 [fixObjectForPrinting p454]
 [\$e p??]
 [\$InteractiveFrame p??]
 [\$clearOptions p497]

— defun clearCmdParts —

```
(defun |clearCmdParts| (arg)
  (let (|$e| (opt (car arg)) option pmacs imacs (vl (cdr arg)) p1 lm prop p2)
    (declare (special |$e| |$InteractiveFrame| |$clearOptions|))
    (setq option (|selectOptionLC| opt |$clearOptions| '|optionError|))
    (setq option (intern (pname option)))
    (setq option
      (case option
        (|types| '|mode|)
        (|modes| '|mode|)
        (|values| '|value|)
        (t option)))
    (if (null vl)
      (|sayKeyedMsg| 's2iz0055 nil)
      (progn
        (setq pmacs (|getParserMacroNames|))
        (setq imacs (|getInterpMacroNames|))
        (cond
          ((boot-equal vl '|all|))
          (setf vl (assocleft (caar |$InteractiveFrame|))
            (setf vl (remdup (append vl pmacs))))))
        (setf |$e| |$InteractiveFrame|)
        (do ((t0 vl (cdr t0)) (x nil))
          ((or (atom t0) (progn (setf x (car t0)) nil)) nil)
          (|clearDependencies| x t)
          (when (and (eq option '|properties|) (|member| x pmacs))
            (|clearParserMacro| x))
          (when (and (eq option '|properties|)
                    (|member| x imacs)
                    (null (|member| x pmacs)))
            (|sayMessage| (cons
                          " You cannot clear the definition of the system-defined macro "
                          (cons (|fixObjectForPrinting| x)
                                (cons (intern "." "BOOT") nil))))))
          (cond
            ((setf p1 (|assoc| x (caar |$InteractiveFrame|)))
              (cond
                ((eq option '|properties|)
                  (cond
                    ((|isMap| x)
                     (seq
                      (cond
                        ((setf lm
                          (|get| x '|localModemap| |$InteractiveFrame|))
                          (cond
                            ((consp lm)
                             (exit (|untraceMapSubNames| (cons (cadar lm) nil))))))
                        (t nil))))))
                  (dolist (p2 (cdr p1))
```

```
(setq prop (car p2))
(|recordOldValue| x prop (cdr p2))
(|recordNewValue| x prop nil))
(setf (caar |$InteractiveFrame|)
      (|deleteAssoc| x (caar |$InteractiveFrame|))))
((setq p2 (|assoc| option (cdr p1)))
(|recordOldValue| x option (cdr p2))
(|recordNewValue| x option nil)
(rplacd p2 nil))))))
nil)))))
```

Chapter 25

)close help page Command

25.1 close help page man page

— close.help —

```
=====
A.5. )close
=====
```

User Level Required: interpreter

Command Syntax:

-)close
-)close)quietly

Command Description:

This command is used to close down interpreter client processes. Such processes are started by HyperDoc to run AXIOM examples when you click on their text. When you have finished examining or modifying the example and you do not want the extra window around anymore, issue

)close

to the AXIOM prompt in the window.

If you try to close down the last remaining interpreter client process, AXIOM will offer to close down the entire AXIOM session and return you to the operating system by displaying something like

This is the last AXIOM session. Do you want to kill AXIOM?

Type "y" (followed by the Return key) if this is what you had in mind. Type "n" (followed by the Return key) to cancel the command.

You can use the)quietly option to force AXIOM to close down the interpreter client process without closing down the entire AXIOM session.

Also See:

- o)quit
- o)pquit

1

25.2 Functions

25.2.1 defun queryClients

Returns the number of active scratchpad clients [sockSendInt p??]

[sockGetInt p??]
 [\$SessionManager p??]
 [\$QueryClients p??]

— defun queryClients —

```
(defun |queryClients| ()
  (declare (special |$SessionManager| |$QueryClients|))
  (|sockSendInt| |$SessionManager| |$QueryClients|)
  (|sockGetInt| |$SessionManager|))
```

25.2.2 defun close

[throwKeyedMsg p??]
 [sockSendInt p??]
 [closeInterpreterFrame p560]
 [selectOptionLC p477]
 [upcase p??]
 [queryUserKeyedMsg p??]
 [string2id-n p??]

¹ "quit" (42.2.1 p 636) "pquit" (41.2.1 p 632)


```
[queryClients p508]
[$SpadServer p12]
[$SessionManager p??]
[$CloseClient p??]
[$currentFrameNum p43]
[$options p??]
```

— defun close —

```
(defun |close| (args)
  (declare (ignore args))
  (let (numClients opt fullopt quiet x)
    (declare (special |$SpadServer| |$SessionManager| |$CloseClient|
      |$currentFrameNum| |$options|))
    (if (null |$SpadServer|)
      (|throwKeyedMsg| 's2iz0071 nil))
    (progn
      (setq numClients (|queryClients|))
      (cond
        ((> numClients 1)
         (|sockSendInt| |$SessionManager| |$CloseClient|)
         (|sockSendInt| |$SessionManager| |$currentFrameNum|)
         (|closeInterpreterFrame| nil))
        (t
         (do ((t0 |$options| (cdr t0)) (t1 nil))
             ((or (atom t0)
                  (progn (setq t1 (car t0)) nil)
                  (progn (progn (setq opt (car t1)) t1) nil))
              nil)
          (setq fullopt (|selectOptionLC| opt '(|quiet|) '|optionError|))
          (unless quiet (setq quiet (eq fullopt '|quiet|))))
        (cond
          (quiet
           (|sockSendInt| |$SessionManager| |$CloseClient|)
           (|sockSendInt| |$SessionManager| |$currentFrameNum|)
           (|closeInterpreterFrame| nil))
          (t
           (setq x (upcase (|queryUserKeyedMsg| 's2iz0072 nil)))
           (when (member (string2id-n x 1) '(yes y)) (bye))))))))))
```

—————

Chapter 26

)compile help page Command

26.1 compile help page man page

— compile.help —

```
=====
A.7. )compile
=====
```

User Level Required: compiler

Command Syntax:

-)compile
-)compile fileName
-)compile fileName.spad
-)compile directory/fileName.spad
-)compile fileName)quiet
-)compile fileName)noquiet
-)compile fileName)break
-)compile fileName)nobreak
-)compile fileName)library
-)compile fileName)nolibrary
-)compile fileName)vartrace
-)compile fileName)constructor nameOrAbbrev

Command Description:

You use this command to invoke the AXIOM library compiler. This compiles files with file extension .spad with the AXIOM system compiler. The command first looks in the standard system directories for files with extension .spad.

Should you not want the `)library` command automatically invoked, call `)compile` with the `)nolibrary` option. For example,

```
)compile mycode )nolibrary
```

By default, the `)library` system command exposes all domains and categories it processes. This means that the AXIOM interpreter will consider those domains and categories when it is trying to resolve a reference to a function. Sometimes domains and categories should not be exposed. For example, a domain may just be used privately by another domain and may not be meant for top-level use. The `)library` command should still be used, though, so that the code will be loaded on demand. In this case, you should use the `)nolibrary` option on `)compile` and the `)noexpose` option in the `)library` command. For example,

```
)compile mycode.spad )nolibrary
)library mycode )noexpose
```

Once you have established your own collection of compiled code, you may find it handy to use the `)dir` option on the `)library` command. This causes `)library` to process all compiled code in the specified directory. For example,

```
)library )dir /u/jones/as/quantum
```

You must give an explicit directory after `)dir`, even if you want all compiled code in the current working directory processed.

```
)library )dir .
```

You can compile category, domain, and package constructors contained in files with file extension `.spad`. You can compile individual constructors or every constructor in a file.

The full filename is remembered between invocations of this command and `)edit` commands. The sequence of commands

```
)compile matrix.spad
)edit
)compile
```

will call the compiler, edit, and then call the compiler again on the file `matrix.spad`. If you do not specify a directory, the working current directory (see description of command `)cd`) is searched for the file. If the file is not found, the standard system directories are searched.

If you do not give any options, all constructors within a file are compiled. Each constructor should have an `)abbreviation` command in the file in which it is defined. We suggest that you place the `)abbreviation` commands at the top of the file in the order in which the constructors are defined. The list of

`commands` serves as a table of contents for the file.

The `)library` option causes directories containing the compiled code for each constructor to be created in the working current directory. The name of such a directory consists of the constructor abbreviation and the `.NRLIB` file extension. For example, the directory containing the compiled code for the `MATRIX` constructor is called `MATRIX.NRLIB`. The `)nolibrary` option says that such files should not be created.

The `)vartrace` option causes the compiler to generate extra code for the constructor to support conditional tracing of variable assignments. (see description of command `)trace`). Without this option, this code is suppressed and one cannot use the `)vars` option for the `trace` command.

The `)constructor` option is used to specify a particular constructor to compile. All other constructors in the file are ignored. The constructor name or abbreviation follows `)constructor`. Thus either

```
)compile matrix.spad )constructor RectangularMatrix
```

or

```
)compile matrix.spad )constructor RMATRIX
```

compiles the `RectangularMatrix` constructor defined in `matrix.spad`.

The `)break` and `)nobreak` options determine what the compiler does when it encounters an error. `)break` is the default and it indicates that processing should stop at the first error. The value of the `)set break` variable then controls what happens.

Also See:

- o `)abbreviation`
- o `)edit`
- o `)library`

1

26.2 Functions

26.2.1 `defvar $/editfile`

— `initvars` —

¹ “abbreviation” (?? p ??) “edit” (31.2.1 p 542) “library” (67.1.34 p 1013)

```
(defvar /editfile nil)
```

Chapter 27

)copyright help page Command

27.1 copyright help page man page

— copyright.help —

The term Axiom, in the field of computer algebra software, along with AXIOM and associated images are common-law trademarks. While the software license allows copies, the trademarks may only be used when referring to this project.

Axiom is distributed under terms of the Modified BSD license. Axiom was released under this license as of September 3, 2002. Source code is freely available at:
<http://savannah.nongnu.org/projects/axiom>
Copyrights remain with the original copyright holders. Use of this material is by permission and/or license. Individual files contain reference to these applicable copyrights. The copyright and license statements are collected here for reference.

Portions Copyright (c) 2003- The Axiom Team

The Axiom Team is the collective name for the people who have contributed to this project. Where no other copyright statement is noted in a file this copyright will apply.

Portions Copyright (c) 1991-2002, The Numerical ALgorithms Group Ltd. All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- Neither the name of The Numerical Algorithms Group Ltd. nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Portions Copyright (C) 1989-95 GROUPE BULL

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL GROUPE BULL BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

Except as contained in this notice, the name of GROUPE BULL shall not be used in advertising or otherwise to promote the sale, use or other dealings in this Software without prior written authorization from GROUPE BULL.

Portions Copyright (C) 2002, Codemist Ltd. All rights reserved.
acn@codemist.co.uk

CCL Public License 1.0

=====

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- (1) Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- (2) Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- (3) Neither the name of Codemist nor the names of other contributors may be used to endorse or promote products derived from this software without specific prior written permission.
- (4) If you distribute a modified form or either source or binary code
 - (a) you must make the source form of these modification available to Codemist;
 - (b) you grant Codemist a royalty-free license to use, modify or redistribute your modifications without limitation;
 - (c) you represent that you are legally entitled to grant these rights and that you are not providing Codemist with any code that violates any law or breaches any contract.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Portions Copyright (C) 1995-1997 Eric Young (eay@mincom.oz.au)
All rights reserved.

This package is an SSL implementation written
by Eric Young (eay@mincom.oz.au).
The implementation was written so as to conform with Netscapes SSL.

This library is free for commercial and non-commercial use as long as the following conditions are aheared to. The following conditions

apply to all code found in this distribution, be it the RC4, RSA, lhash, DES, etc., code; not just the SSL code. The SSL documentation included with this distribution is covered by the same copyright terms except that the holder is Tim Hudson (tjh@mincom.oz.au).

Copyright remains Eric Young's, and as such any Copyright notices in the code are not to be removed.
 If this package is used in a product, Eric Young should be given attribution as the author of the parts of the library used.
 This can be in the form of a textual message at program startup or in documentation (online or textual) provided with the package.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
3. All advertising materials mentioning features or use of this software must display the following acknowledgement:
 "This product includes cryptographic software written by
 Eric Young (eay@mincom.oz.au)"
 The word 'cryptographic' can be left out if the routines from the library being used are not cryptographic related :-).
4. If you include any Windows specific code (or a derivative thereof) from the apps directory (application code) you must include an acknowledgement:
 "This product includes software written by Tim Hudson (tjh@mincom.oz.au)"

THIS SOFTWARE IS PROVIDED BY ERIC YOUNG 'AS IS' AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE AUTHOR OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

The licence and distribution terms for any publically available version or derivative of this code cannot be changed. i.e. this code cannot simply be copied and put under another distribution licence [including the GNU Public Licence.]

Portions Copyright (C) 1988 by Leslie Lamport.

Portions Copyright (c) 1998 Free Software Foundation, Inc.

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, distribute with modifications, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE ABOVE COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

Except as contained in this notice, the name(s) of the above copyright holders shall not be used in advertising or otherwise to promote the sale, use or other dealings in this Software without prior written authorization.

Portions Copyright 1989-2000 by Norman Ramsey. All rights reserved.

Noweb is protected by copyright. It is not public-domain software or shareware, and it is not protected by a "copyleft" agreement like the one used by the Free Software Foundation.

Noweb is available free for any use in any field of endeavor. You may redistribute noweb in whole or in part provided you acknowledge its source and include this COPYRIGHT file. You may modify noweb and create derived works, provided you retain this copyright notice, but the result may not be called noweb without my written consent.

You may sell noweb if you wish. For example, you may sell a CD-ROM including noweb.

You may sell a derived work, provided that all source code for your derived work is available, at no additional charge, to anyone who buys your derived work in any form. You must give permission for said source code to be used and modified under the terms of this license. You must state clearly that your work uses or is based on noweb and that noweb is available free of charge. You must also request that bug reports on your work be reported to you.

Portions Copyright (c) 1987 The RAND Corporation. All rights reserved.

Portions Copyright 1988-1995 by Stichting Mathematisch Centrum, Amsterdam, The Netherlands.

All Rights Reserved

Permission to use, copy, modify, and distribute this software and its documentation for any purpose and without fee is hereby granted, provided that the above copyright notice appear in all copies and that both that copyright notice and this permission notice appear in supporting documentation, and that the names of Stichting Mathematisch Centrum or CWI not be used in advertising or publicity pertaining to distribution of the software without specific, written prior permission.

STICHTING MATHEMATISCH CENTRUM DISCLAIMS ALL WARRANTIES WITH REGARD TO THIS SOFTWARE, INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS, IN NO EVENT SHALL STICHTING MATHEMATISCH CENTRUM BE LIABLE FOR ANY SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.

Portions Copyright (c) Renaud Rioboo and the University Paris 6.

Portions Copyright (c) 2003-2010 Jocelyn Guidry

Portions Copyright (c) 2001-2010 Timothy Daly

27.2 Functions

27.2.1 defun copyright

```
[obey p??]
[concat p1049]
[getenvirom p31]
```

— defun copyright —

```
(defun |copyright| ()
  (obey (concat "cat " (getenvirom "AXIOM") "/doc/spadhelp/copyright.help")))
```

27.2.2 defun trademark

— defun trademark 0 —

```
(defun |trademark| ()  
  (format t "The term Axiom, in the field of computer algebra software, ~%")  
  (format t "along with AXIOM and associated images are common-law ~%")  
  (format t "trademarks. While the software license allows copies, the ~%")  
  (format t "trademarks may only be used when referring to this project ~%"))
```

This command is in the list of `$noParseCommands` 19.1.3 which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` 19.2.1

Chapter 28

)credits help page Command

28.1 credits help page man page

28.2 Variables Used

28.3 Functions

28.3.1 defun credits

[credits p523]

— defun credits 0 —

```
(defun |credits| ()  
  (declare (special credits))  
  (mapcar #'(lambda (x) (princ x) (terpri)) credits))
```

—————

This command is in the list of `$noParseCommands` 19.1.3 which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` 19.2.1

Chapter 29

)describe help page Command

29.1 describe help page man page

— describe.help —

```
=====
)describe
=====
```

User Level Required: interpreter

Command Syntax:

-)describe categoryName
-)describe domainName
-)describe packageName

Command Description:

This command is used to display the comments for the operation, category, domain or package. The comments are part of the algebra source code.

The commands

```
)describe <categoryName> [internal]
)describe <domainName> [internal]
)describe <packageName> [internal]
```

will show a properly formatted version of the "Description:" keyword from the comments in the algebra source for the category, domain, or package requested.

If 'internal' is requested, then the internal format of the domain or package is described. Categories do not have an internal representation.

29.1.1 defvar \$describeOptions

The current value of \$describeOptions is

— **initvars** —

```
(defvar $describeOptions '(|category| |domain| |package|))
```

29.2 Functions

29.2.1 defun Print comment strings from algebra libraries

This trivial function satisfies the standard pattern of making a user command match the name of the function which implements the command. That command immediatly invokes a “Spad2Cmd” version. [describepad2cmd p??]

— **defun describe** —

```
(defun |describe| (l)
  (describeSpad2Cmd l))
```

29.2.2 defun describeSpad2Cmd

The describe command prints cleaned-up comment strings from the algebra libraries. It can print strings associated with a category, domain, package, or by operation.

This implements command line options of the form:

```
)describe categoryName [internal]
)describe domainName   [internal]
)describe packageName   [internal]
```

The describeInternal function will either call the “dc” function to describe the internal representation of the argument or it will print a cleaned up version of the text for the

"Description" keyword in the Category, Domain, or Package source code. [selectOptionLC p477]

[flatten p529]
 [cleanline p527]
 [getdatabase p1009]
 [sayMessage p??]
 [\$e p??]
 [\$EmptyEnvironment p??]
 [\$describeOptions p526]

— defun describeSpad2Cmd —

```
(defun describeSpad2Cmd (l)
  (labels (
    (fullname (arg)
      "Convert abbreviations to the full constructor name"
      (let ((abb (getdatabase arg 'abbreviation)))
        (if abb arg (getdatabase arg 'constructor))))
    (describeInternal (cdp internal?)
      (if internal?
        (progn
          (unless (eq (getdatabase cdp 'constructorkind) '|category|) (|dc| cdp))
          (showdatabase cdp))
        (mapcar #'(lambda (x) (if (stringp x) (cleanline x)))
          (flatten (car (getdatabase (fullname cdp) 'documentation)))))))
    (let ((|$e| |$EmptyEnvironment|) (opt (second l)))
      (declare (special |$e| |$EmptyEnvironment| $describeOptions))
      (if (and (consp l) (not (eq opt '?)))
        (describeInternal (first l) (second l))
        (|sayMessage|
          (append
            '(" )describe keyword arguments are")
            (mapcar #'(lambda (x) (format nil "~%      ~a" x)) $describeOptions)
            (format nil "~% or abbreviations thereof"))))))))
```

—————

29.2.3 defun cleanline

— defun cleanline —

```
(defun cleanline (line)
  (labels (
    (replaceInLine (thing other line)
      (do ((mark (search thing line) (search thing line)))
          ((null mark) line)
```

```

(setq line
  (concatenate 'string (subseq line 0 mark) other
    (subseq line (+ mark (length thing))))))

(removeFromLine (thing line) (replaceInLine thing "" line))

(removeKeyword (str line)
  (do ((mark (search str line) (search str line)))
    ((null mark) line)
    (let (left point mid right)
      (setq left (subseq line 0 mark))
      (setq point (search "]" line :start2 mark))
      (setq mid (subseq line (+ mark (length str)) point))
      (setq right (subseq line (+ point 1)))
      (setq line (concatenate 'string left mid right))))))

(addSpaces (str line)
  (do ((mark (search str line) (search str line)) (cnt))
    ((null mark) line)
    (let (left point mid right)
      (setq left (subseq line 0 mark))
      (setq point (search "]" line :start2 mark))
      (setq mid (subseq line (+ mark (length str)) point))
      (if (setq cnt (parse-integer mid :junk-allowed t))
        (setq mid (make-string cnt :initial-element #\ ))
        (setq mid ""))
      (setq right (subseq line (+ point 1)))
      (setq line (concatenate 'string left mid right))))))

(splitAtNewline (line)
  (do ((mark (search "~%" line) (search "~%" line)) (lines))
    ((null mark)
      (push " " lines)
      (push line lines)
      (nreverse lines))
    (push (subseq line 0 mark) lines)
    (setq line (subseq line (+ mark 2))))))

(wrapOneLine (line margin result)
  (if (null line)
    (nreverse result)
    (if (< (length line) margin)
      (wrapOneLine nil margin (append (list line) result))
      (let (oneline spill aspace)
        (setq aspace (position #\space (subseq line 0 margin) :from-end t))
        (setq oneline (string-trim '(\space) (subseq line 0 aspace)))
        (setq spill (string-trim '(\space) (subseq line aspace)))
        (wrapOneLine spill margin (append (list oneline) result))))))

(reflowParagraph (line))

```

```

(let (lst1)
  (setq lst1 (splitAtNewLine line))
  (dolist (x lst1)
    (mapcar #'(lambda(y) (format t "~a%" y))
      (wrapOneLine x 70 nil))))))

(setq line (removeFromLine "{}" line))
(setq line (replaceInLine "\\blankline" "%~%" line))
(setq line (replaceInLine "\\br" "%~%" line))
(setq line (removeFromLine "\\\" line))
(dolist (str '("spad{" "spadtype{" "spadop{" "spadfun{" "spadatt{"
  "axiom{" "axiomType{" "spadignore{" "axiomFun{"
  "centerline{" "inputbitmap{" "axiomOp{" "spadgloss{"))
  (setq line (removeKeyword str line)))
(setq line (replaceInLine "{e.g.}" "e.g." line))
(dolist (str '("tab{" "indented{" ))
  (setq line (addSpaces str line)))
(reflowParagraph line))

```

29.2.4 defun flatten

— defun flatten 0 —

```

(defun flatten (x)
  (labels (
    (rec (x acc)
      (cond
        ((null x) acc)
        ((atom x) (cons x acc))
        (t (rec (car x) (rec (cdr x) acc))))))
    (rec x nil)))

```

Chapter 30

)display help page Command

30.1 display help page man page

— display.help —

```
=====
A.8. )display
=====
```

User Level Required: interpreter

Command Syntax:

-)display all
-)display properties
-)display properties all
-)display properties [obj1 [obj2 ...]]
-)display value all
-)display value [obj1 [obj2 ...]]
-)display mode all
-)display mode [obj1 [obj2 ...]]
-)display names
-)display operations opName

Command Description:

This command is used to display the contents of the workspace and signatures of functions with a given name. (A signature gives the argument and return types of a function.)

The command

`)display names`

lists the names of all user-defined objects in the workspace. This is useful if you do not wish to see everything about the objects and need only be reminded of their names.

The commands

```
)display all
)display properties
)display properties all
```

all do the same thing: show the values and types and declared modes of all variables in the workspace. If you have defined functions, their signatures and definitions will also be displayed.

To show all information about a particular variable or user functions, for example, something named `d`, issue

```
)display properties d
```

To just show the value (and the type) of `d`, issue

```
)display value d
```

To just show the declared mode of `d`, issue

```
)display mode d
```

All modemaps for a given operation may be displayed by using `)display operations`. A modemap is a collection of information about a particular reference to an operation. This includes the types of the arguments and the return value, the location of the implementation and any conditions on the types. The modemap may contain patterns. The following displays the modemaps for the operation `FromcomplexComplexCategory`:

```
)d op complex
```

Also See:

- o `)clear`
- o `)history`
- o `)set`
- o `)show`
- o `)what`

30.1.1 defvar \$displayOptions

The current value of \$displayOptions is

— **initvars** —

```
(defvar |$displayOptions|
  '(|abbreviations| |all| |macros| |modes| |names| |operations|
    |properties| |types| |values|))
```

—————

30.2 Functions

30.2.1 defun display

This trivial function satisfies the standard pattern of making a user command match the name of the function which implements the command. That command immediatly invokes a “Spad2Cmd” version. [displaySpad2cmd p??]

— **defun display** —

```
(defun |display| (l)
  (displaySpad2Cmd l))
```

—————

30.2.2 displaySpad2Cmd

We process the options to the command and call the appropriate display function. There are really only 4 display functions. All of the other options are just subcases.

There is a slight mismatch between the \$displayOptions list of symbols and the options this command accepts so we have a cond branch to clean up the option variable. This allows for the options to be plural.

If we fall all the way thru we use the \$displayOptions list to construct a list of strings for the sayMessage function and tell the user what options are available. [abbQuery p534]

```
[opOf p??]
[listConstructorAbbreviations p482]
[displayOperations p535]
[displayMacros p536]
[displayWorkspaceNames p452]
```

```
[displayProperties p459]
[selectOptionLC p477]
[sayMessage p??]
[$e p??]
[$EmptyEnvironment p??]
[$displayOptions p533]
```

— defun displaySpad2Cmd —

```
(defun displaySpad2Cmd (l)
  (let ((|$e| |$EmptyEnvironment|) (opt (car l)) (vl (cdr l)) option)
    (declare (special |$e| |$EmptyEnvironment| |$displayOptions|))
    (if (and (consp l) (not (eq opt '???)))
      (progn
        (setq option (|selectOptionLC| opt |$displayOptions| '|optionError|))
        (cond
          ((eq option '|all|)
            (setq l (list '|properties|))
            (setq option '|properties|))
          ((or (eq option '|modes|) (eq option '|types|))
            (setq l (cons '|type| vl))
            (setq option '|type|))
          ((eq option '|values|)
            (setq l (cons '|value| vl))
            (setq option '|value|)))
        (cond
          ((eq option '|abbreviations|)
            (if (null vl)
              (|listConstructorAbbreviations|)
              (dolist (v vl) (|abbQuery| (|opOf| v))))))
          ((eq option '|operations|) (|displayOperations| vl))
          ((eq option '|macros|) (|displayMacros| vl))
          ((eq option '|names|) (|displayWorkspaceNames|))
          (t (|displayProperties| option l))))
      (|sayMessage|
        (append
          '(" )display keyword arguments are")
          (mapcar #'(lambda (x) (format nil "~%      ~a" x)) |$displayOptions|)
          (format nil "~% or abbreviations thereof"))))))))
```

30.2.3 defun abbQuery

```
[getdatabase p1009]
[sayKeyedMsg p329]
```

— defun **abbQuery** —

```
(defun |abbQuery| (x)
  (let (abb)
    (cond
      ((setq abb (getdatabase x 'abbreviation))
        (|sayKeyedMsg| 's2iz0001 (list abb (getdatabase x 'constructorkind) x)))
      ((setq abb (getdatabase x 'constructor))
        (|sayKeyedMsg| 's2iz0001 (list x (getdatabase abb 'constructorkind) abb)))
      (t
        (|sayKeyedMsg| 's2iz0003 (list x))))))
```

—————

30.2.4 defun **displayOperations**

This function takes a list of operation names. If the list is null we query the user to see if they want all operations printed. Otherwise we print the information for the requested symbols. [reportOpSymbol p??]

[yesanswer p535]
[sayKeyedMsg p329]

— defun **displayOperations** —

```
(defun |displayOperations| (l)
  (if l
    (dolist (op l) (|reportOpSymbol| op))
    (if (yesanswer)
      (dolist (op (|allOperations|)) (|reportOpSymbol| op))
      (|sayKeyedMsg| 's2iz0059 nil))))
```

—————

30.2.5 defun **yesanswer**

This is a trivial function to simplify the logic of displaySpad2Cmd. If the user didn't supply an argument to the)display op command we ask if they wish to have all information about all Axiom operations displayed. If the answer is either Y or YES we return true else nil.

[string2id-n p??]
[upcase p??]
[queryUserKeyedMsg p??]

— defun **yesanswer** —

```
(defun yesanswer ()
  (member
    (string2id-n (upcase (|queryUserKeyedMsg| 's2iz0058 nil)) 1) '(y yes)))
```

30.2.6 defun displayMacros

```
[getInterpMacroNames p??]
[getParserMacroNames p451]
[remdup p??]
[sayBrightly p??]
[member p1050]
[displayParserMacro p462]
[seq p??]
[exit p??]
[displayMacro p451]
```

— defun displayMacros —

```
(defun |displayMacros| (names)
  (let (imacs pmacs macros first)
    (setq imacs (|getInterpMacroNames|))
    (setq pmacs (|getParserMacroNames|))
    (if names
      (setq macros names)
      (setq macros (append imacs pmacs)))
    (setq macros (remdup macros))
    (cond
      ((null macros) (|sayBrightly| "  There are no Axiom macros."))
      (t
       (setq first t)
       (do ((t0 macros (cdr t0)) (macro nil))
         ((or (atom t0) (progn (setq macro (car t0)) nil)) nil)
         (seq
          (exit
           (cond
            ((|member| macro pmacs)
             (cond
              (first (|sayBrightly|
                    (cons '|%l| (cons "User-defined macros:" nil))) (setq first nil)))
              (|displayParserMacro| macro))
            ((|member| macro imacs) '|iterate|)
            (t (|sayBrightly|
                (cons "  "
                  (cons '|%b|
                    (cons macro
```

```

      (cons '|%d| (cons " is not a known Axiom macro." nil)))))))))
(setq first t)
(do ((t1 macros (cdr t1)) (macro nil))
  ((or (atom t1) (progn (setq macro (car t1)) nil)) nil)
  (seq
   (exit
    (cond
     ((|member| macro imacs)
      (cond
       ((|member| macro pmacs) '|iterate|)
       (t
        (cond
         (first
          (|sayBrightly|
           (cons '|%l|
            (cons "System-defined macros:" nil))) (setq first nil)))
         (|displayMacro| macro))))
      ((|member| macro pmacs) '|iterate|))))
   nil))))

```

30.2.7 defun sayExample

This function expects 2 arguments, the documentation string and the name of the operation. It searches the documentation string for ++X lines. These lines are examples lines for functions. They look like ordinary ++ comments and fit into the ordinary comment blocks. So, for example, in the plot.spad.pamphlet file we find the following function signature:

```

plot: (F -> F,R) -> %
++ plot(f,a..b) plots the function \spad{f(x)}
++ on the interval \spad{[a,b]}.
++
++X fp:=(t:DFLOAT):DFLOAT +-> sin(t)
++X plot(fp,-1.0..1.0)$PLOT

```

This function splits out and prints the lines that begin with ++X.

A minor complication of printing the examples is that the lines have been processed into internal compiler format. Thus the lines that read:

```

++X fp:=(t:DFLOAT):DFLOAT +-> sin(t)
++X plot(fp,-1.0..1.0)$PLOT

```

are actually stored as one long line containing the example lines

```

"\indented{1}{plot(\spad{f},{a}..\spad{b}) plots the function

```

```

\\spad{f(x)} \\indented{1}{on the interval \\spad{[a,{b}]}.
```

\\blankline

```

\\spad{X} fp:=(t:DFLOAT):DFLOAT +-> sin(\\spad{t})
\\spad{X} plot(\\spad{fp},{\\spad{-1}.0..1.0)\\$PLOT"
```

So when we have an example line starting with ++X, it gets converted to the compiler to \\spad{X}. So each example line is delimited by \\spad{X}.

The compiler also removes the newlines so if there is a subsequent \\spad{X} in the docstring then it implies multiple example lines and we loop over them, splitting them up at the delimiter.

If there is only one then we clean it up and print it. [cleanupLine p??]
[sayNewLine p??]

— defun sayExample —

```

(defun sayExample (docstring)
  (let (line point)
    (when (setq point (search "spad{X}" docstring))
      (setq line (subseq docstring (+ point 8)))
      (do ((mark (search "spad{X}" line) (search "spad{X}" line)))
          ((null mark))
        (princ (cleanupLine (subseq line 0 mark)))
        (|sayNewLine|)
        (setq line (subseq line (+ mark 8))))
      (princ (cleanupLine line))
      (|sayNewLine|)
      (|sayNewLine|))))
```

—————

30.2.8 defun cleanupLine

This function expects example lines in internal format that has been partially processed to remove the prefix. Thus we get lines that look like:

```

fp:=(t:DFLOAT):DFLOAT +-> sin(\\spad{t})
plot(\\spad{fp},{\\spad{-1}.0..1.0)\\$PLOT
```

It removes all instances of {}, and \, and unwraps the spad{} call, leaving only the argument. We return lines that look like:

```

fp:=(t:DFLOAT):DFLOAT +-> sin(t)
plot(fp,-1.0..1.0)$PLOT
```

which is hopefully exactly what the user wrote.

The compiler inserts {} as a space so we remove it. We remove all of the \ characters. We remove all of the `spad{...}` delimiters which will occur around other `spad` variables. Technically we should search recursively for the matching delimiter rather than the next brace but the problem does not arise in practice.

— **defun cleanupLine 0** —

```
(defun cleanupLine (line)
  (do ((mark (search "{}" line) (search "{}" line)))
      ((null mark))
      (setq line
        (concatenate 'string (subseq line 0 mark) (subseq line (+ mark 2))))))
  (do ((mark (search "\\" line) (search "\\" line)))
      ((null mark))
      (setq line
        (concatenate 'string (subseq line 0 mark) (subseq line (+ mark 1))))))
  (do ((mark (search "spad{" line) (search "spad{" line)))
      ((null mark))
      (let (left point mid right)
        (setq left (subseq line 0 mark))
        (setq point (search "]" line :start2 mark))
        (setq mid (subseq line (+ mark 5) point))
        (setq right (subseq line (+ point 1)))
        (setq line (concatenate 'string left mid right))))))
  line)
```

Chapter 31

)edit help page Command

31.1 edit help page man page

— edit.help —

```
=====
A.9. )edit
=====
```

User Level Required: interpreter

Command Syntax:

```
- )edit [filename]
```

Command Description:

This command is used to edit files. It works in conjunction with the `)read` and `)compile` commands to remember the name of the file on which you are working. By specifying the name fully, you can edit any file you wish. Thus

```
)edit /u/julius/matrix.input
```

will place you in an editor looking at the file `/u/julius/matrix.input`. By default, the editor is `vi`, but if you have an `EDITOR` shell environment variable defined, that editor will be used. When AXIOM is running under the X Window System, it will try to open a separate `xterm` running your editor if it thinks one is necessary. For example, under the Korn shell, if you issue

```
export EDITOR=emacs
```

then the `emacs` editor will be used by `)edit`.

If you do not specify a file name, the last file you edited, read or compiled will be used. If there is no ‘‘last file’’ you will be placed in the editor editing an empty unnamed file.

It is possible to use the)system command to edit a file directly. For example,

```
)system emacs /etc/rc.tcpip

calls emacs to edit the file.
```

Also See:

- o)system
- o)compile
- o)read

1

31.2 Functions

31.2.1 defun edit

[editSpad2Cmd p542]

— defun edit —

```
(defun |edit| (1) (|editSpad2Cmd| 1))
```

31.2.2 defun editSpad2Cmd

[pathname p1044]
 [pathnameDirectory p1043]
 [pathnameType p1042]
 [\$FINDFILE p??]
 [pathnameName p1042]
 [editFile p543]
 [updateSourceFiles p544]
 [/editfile p513]

¹ “system” (?? p ??) “read” (43.1.1 p 640)

— defun editSpad2Cmd —

```
(defun |editSpad2Cmd| (l)
  (let (olddir filetypes ll rc)
    (declare (special /editfile))
    (setq l (cond ((null l) /editfile) (t (car l))))
    (setq l (|pathname| l))
    (setq olddir (|pathnameDirectory| l))
    (setq filetypes
      (cond
        ((|pathnameType| l) (list (|pathnameType| l)))
        ((eq |$UserLevel| '|interpreter|) '("input" "INPUT" "spad" "SPAD"))
        ((eq |$UserLevel| '|compiler|) '("input" "INPUT" "spad" "SPAD"))
        (t '("input" "INPUT" "spad" "SPAD" "boot" "BOOT"
              "lisp" "LISP" "meta" "META"))))
    (setq ll
      (cond
        ((string= olddir "")
         (|pathname| ($findfile (|pathnameName| l) filetypes)))
        (t l)))
    (setq l (|pathname| ll))
    (setq /editfile l)
    (setq rc (|editFile| l))
    (|updateSourceFiles| l)
    rc))
```

—————

31.2.3 defun Implement the)edit command

```
[strconc p??]
[namestring p1042]
[pathname p1044]
[obey p??]
```

— defun editFile —

```
(defun |editFile| (file)
  (cond
    ((member (intern "WIN32" (find-package 'keyword)) *features*)
     (obey (strconc "notepad " (|namestring| (|pathname| file)))))
    (t
     (obey
      (strconc "$AXIOM/lib/SPAEDIT " (|namestring| (|pathname| file)))))))
```

—————

31.2.4 defun updateSourceFiles

```
[pathname p1044]
[pathnameName p1042]
[pathnameType p1042]
[makeInputFilename p981]
[member p1050]
[pathnameTypeId p1043]
[insert p??]
[$sourceFiles p??]
```

— defun updateSourceFiles —

```
(defun |updateSourceFiles| (arg)
  (declare (special |$sourceFiles|))
  (setq arg (|pathname| arg))
  (setq arg (|pathname| (list (|pathnameName| arg) (|pathnameType| arg) "*")))
  (when (and (makeInputFilename arg)
             (|member| (|pathnameTypeId| arg) '(boot lisp meta)))
    (setq |$sourceFiles| (|insert| arg |$sourceFiles|)))
  arg)
```

Chapter 32

)fin help page Command

32.1 fin help page man page

— fin.help —

```
=====
A.10. )fin
=====
```

User Level Required: development

Command Syntax:

-)fin

Command Description:

This command is used by AXIOM developers to leave the AXIOM system and return to the underlying Lisp system. To return to AXIOM, issue the ‘‘(spad)’’ function call to Lisp.

Also See:

- o)pquit
- o)quit

1

¹ “pquit” (41.2.1 p 632) “quit” (42.2.1 p 636)

32.1.1 defun Exit from the interpreter to lisp

```
[spad-reader p??]
[EOF p??]
```

— defun fin 0 —

```
(defun |fin| ()
  (setq *eof* t)
  (throw 'spad_reader nil))
```

—————

32.2 Functions

This command is in the list of `$noParseCommands` 19.1.3 which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` 19.2.1

Chapter 33

)frame help page Command

33.1 frame help page man page

— frame.help —

```
=====
A.11. )frame
=====
```

User Level Required: interpreter

Command Syntax:

```
- )frame new frameName
- )frame drop [frameName]
- )frame next
- )frame last
- )frame names
- )frame import frameName [objectName1 [objectName2 ...] ]
- )set message frame on | off
- )set message prompt frame
```

Command Description:

A frame can be thought of as a logical session within the physical session that you get when you start the system. You can have as many frames as you want, within the limits of your computer's storage, paging space, and so on. Each frame has its own step number, environment and history. You can have a variable named a in one frame and it will have nothing to do with anything that might be called a in any other frame.

Some frames are created by the HyperDoc program and these can have pretty

strange names, since they are generated automatically. To find out the names of all frames, issue

```
)frame names
```

It will indicate the name of the current frame.

You create a new frame ‘‘quark’’ by issuing

```
)frame new quark
```

The history facility can be turned on by issuing either `)set history on` or `)history on`. If the history facility is on and you are saving history information in a file rather than in the AXIOM environment then a history file with filename `quark.ahx` will be created as you enter commands. If you wish to go back to what you were doing in the ‘‘initial’’ frame, use

```
)frame next
```

or

```
)frame last
```

to cycle through the ring of available frames to get back to ‘‘initial’’.

If you want to throw away a frame (say ‘‘quark’’), issue

```
)frame drop quark
```

If you omit the name, the current frame is dropped.

If you do use frames with the history facility on and writing to a file, you may want to delete some of the older history files. These are directories, so you may want to issue a command like `rm -r quark.ahx` to the operating system.

You can bring things from another frame by using `)frame import`. For example, to bring the `f` and `g` from the frame ‘‘quark’’ to the current frame, issue

```
)frame import quark f g
```

If you want everything from the frame ‘‘quark’’, issue

```
)frame import quark
```

You will be asked to verify that you really want everything.

There are two `)set` flags to make it easier to tell where you are.

```
)set message frame on | off
```


will print more messages about frames when it is set on. By default, it is off.

```
)set message prompt frame
```

will give a prompt that looks like

```
initial (1) ->
```

when you start up. In this case, the frame name and step make up the prompt.

Also See:

- o)history
- o)set

1

33.2 Variables Used

The frame mechanism uses several dollar variables.

33.2.1 Primary variables

Primary variables are those which exist solely to make the frame mechanism work.

The `$interpreterFrameName` contains a symbol which is the name of the current frame in use.

The `$interpreterFrameRing` contains a list of all of the existing frames. The first frame on the list is the “current” frame. When AXIOMsys is started directly there is only one frame named “initial”.

If the system is started under sman (using the axiom shell script, for example), there are two frames, “initial” and “frame0”. In this case, “frame0” is the current frame. This can cause subtle problems because functions defined in the axiom initialization file (`.axiom.input`) will be defined in frame “initial” but the current frame will be “frame0”. They will appear to be undefined. However, if the user does “)frame next” they can switch to the “initial” frame and see the functions correctly defined.

The `$frameMessages` variable controls when frame messages will be displayed. The variable is initially NIL. It can be set on (T) or off (NIL) using the system command:

```
)set message frame on | off
```

¹ “history” (35.4.7 p 580) “set” (46.36.1 p 805)

Setting frame messages on will output a line detailing the current frame after every output is complete.

33.2.2 Used variables

The frame collects and uses a few top level variables. These are: `$InteractiveFrame`, `$IOindex`, `$HiFiAccess`, `$HistList`, `$HistListLen`, `$HistListAct`, `$HistRecord`, `$internalHistoryTable`, and `$localExposureData`.

These variables can also be changed by the frame mechanism when the user requests changing to a different frame.

33.3 Data Structures

33.3.1 Frames and the Interpreter Frame Ring

Axiom has the notion of “frames”. A frame is a data structure which holds all the vital data from an Axiom session. There can be multiple frames and these live in a top-level variable called `$interpreterFrameRing`. This variable holds a circular list of frames. The parts of a frame and their initial, default values are:

<code>\$interpreterFrameName</code>	a string, named on creation
<code>\$InteractiveFrame</code>	(list (list nil))
<code>\$IOindex</code>	an integer, 1
<code>\$HiFiAccess</code>	<code>\$HiFiAccess</code> , see the variable description
<code>\$HistList</code>	<code>\$HistList</code> , see the variable description
<code>\$HistListLen</code>	<code>\$HistListLen</code> , see the variable description
<code>\$HistListAct</code>	<code>\$HistListAct</code> , see the variable description
<code>\$HistRecord</code>	<code>\$HistRecord</code> , see the variable description
<code>\$internalHistoryTable</code>	nil
<code>\$localExposureData</code>	a copy of <code>\$localExposureData</code>

33.4 Accessor Functions

These could be macros but we wish to export them to the API code in the algebra so we keep them as functions.

33.4.1 0th Frame Component – `frameName`

33.4.2 `defun frameName`

— `defun frameName 0` —

```
(defun frameName (frame)
  (car frame))
```

33.4.3 1st Frame Component – frameInteractive

— defun frameInteractive 0 —

```
(defun frameInteractive (frame)
  (nth 1 frame))
```

33.4.4 2nd Frame Component – frameIOIndex

— defun frameIOIndex 0 —

```
(defun frameIOIndex (frame)
  (nth 2 frame))
```

33.4.5 3rd Frame Component – frameHiFiAccess

— defun frameHiFiAccess 0 —

```
(defun frameHiFiAccess (frame)
  (nth 3 frame))
```

33.4.6 4th Frame Component – frameHistList

— defun frameHistList 0 —

```
(defun frameHistList (frame)
  (nth 4 frame))
```

33.4.7 5th Frame Component – frameHistListLen

— defun frameHistListLen 0 —

```
(defun frameHistListLen (frame)
  (nth 5 frame))
```

33.4.8 6th Frame Component – frameHistListAct

— defun frameHistListAct 0 —

```
(defun frameHistListAct (frame)
  (nth 6 frame))
```

33.4.9 7th Frame Component – frameHistRecord

— defun frameHistRecord 0 —

```
(defun frameHistRecord (frame)
  (nth 7 frame))
```

33.4.10 8th Frame Component – frameHistoryTable

— defun frameHistoryTable 0 —

```
(defun frameHistoryTable (frame)
  (nth 8 frame))
```

33.4.11 9th Frame Component – frameExposureData

— defun frameExposureData 0 —

```
(defun frameExposureData (frame)
  (nth 9 frame))
```

33.5 Functions

33.5.1 Initializing the Interpreter Frame Ring

Now that we know what a frame looks like we need a function to initialize the list of frames. This function sets the initial frame name to “initial” and creates a list of frames containing an empty frame. This list is the interpreter frame ring and is not actually circular but is managed as a circular list.

As a final step we update the world from this frame. This has the side-effect of resetting all the important global variables to their initial values.

```
[emptyInterpreterFrame p554]
[updateFromCurrentInterpreterFrame p556]
[$interpreterFrameName p??]
[$interpreterFrameRing p??]
```

— defun initializeInterpreterFrameRing —

```
(defun |initializeInterpreterFrameRing| ()
  "Initializing the Interpreter Frame Ring"
  (declare (special |$interpreterFrameName| |$interpreterFrameRing|))
  (setq |$interpreterFrameName| ' |initial|)
  (setq |$interpreterFrameRing|
    (list (|emptyInterpreterFrame| |$interpreterFrameName|)))
  (|updateFromCurrentInterpreterFrame|)
  nil)
```

33.5.2 Creating a List of all of the Frame Names

This function simply walks across the frame in the frame ring and returns a list of the name of each frame. [`$interpreterFrameRing p??`]

— `defun frameNames 0` —

```
(defun |frameNames| ()
  "Creating a List of all of the Frame Names"
  (declare (special |$interpreterFrameRing|))
  (mapcar #'frameName |$interpreterFrameRing|))
```

33.5.3 Get Named Frame Environment (aka Interactive)

If the frame is found we return the environment portion of the frame otherwise we construct an empty environment and return it. The initial values of an empty frame are created here. This function returns a single frame that will be placed in the frame ring. [`frameInteractive p??`]

— `defun frameEnvironment` —

```
(defun |frameEnvironment| (fname)
  "Get Named Frame Environment (aka Interactive)"
  (let ((frame (|findFrameInRing| fname)))
    (if frame
      (frameInteractive frame)
      (list (list nil)))))
```

33.5.4 Create a new, empty Interpreter Frame

```
[|HiFiAccess p730|
 |HistList p??|
 |HistListLen p??|
 |HistListAct p??|
 |HistRecord p??|
 |localExposureDataDefault p694|
```

— `defun emptyInterpreterFrame 0` —

```
(defun |emptyInterpreterFrame| (name)
```

```
"Create a new, empty Interpreter Frame"
(declare (special |$HiFiAccess| |$HistList| |$HistListLen| |$HistListAct|
  |$HistRecord| |$localExposureDataDefault|))
(list name                               ; frame name
  (list (list nil))                     ; environment
  1                                     ; $IOindex
  |$HiFiAccess|
  |$HistList|
  |$HistListLen|
  |$HistListAct|
  |$HistRecord|
  nil                                  ; $internalHistoryTable
  (copy-seq |$localExposureDataDefault|))) ; $localExposureData
```

33.5.5 Collecting up the Environment into a Frame

We can collect up all the current environment information into one frame element with this call. It creates a list of the current values of the global variables and returns this as a frame element.

```
[$interpreterFrameName p??]
[$InteractiveFrame p??]
[$IOindex p??]
[$HiFiAccess p730]
[$HistList p??]
[$HistListLen p??]
[$HistListAct p??]
[$HistRecord p??]
[$internalHistoryTable p??]
[$localExposureData p694]
```

— defun createCurrentInterpreterFrame 0 —

```
(defun |createCurrentInterpreterFrame| ()
  "Collecting up the Environment into a Frame"
  (declare (special |$interpreterFrameName| |$InteractiveFrame| |$IOindex|
    |$HiFiAccess| |$HistList| |$HistListLen| |$HistListAct| |$HistRecord|
    |$internalHistoryTable| |$localExposureData|))
  (list
    |$interpreterFrameName|
    |$InteractiveFrame|
    |$IOindex|
    |$HiFiAccess|
    |$HistList|
    |$HistListLen|
```

```

|$HistListAct|
|$HistRecord|
|$internalHistoryTable|
|$localExposureData|))

```

33.5.6 Update from the Current Frame

The frames are kept on a circular list. The first element on that list is known as “the current frame”. This will initialize all of the interesting interpreter data structures from that frame.

```

[sayMessage p??]
[$interpreterFrameRing p??]
[$interpreterFrameName p??]
[$InteractiveFrame p??]
[$IOindex p??]
[$HiFiAccess p730]
[$HistList p??]
[$HistListLen p??]
[$HistListAct p??]
[$HistRecord p??]
[$internalHistoryTable p??]
[$localExposureData p694]
[$frameMessages p738]

```

— defun updateFromCurrentInterpreterFrame —

```

(defun |updateFromCurrentInterpreterFrame| ()
  "Update from the Current Frame"
  (let (tmp1)
    (declare (special |$interpreterFrameRing| |$interpreterFrameName|
      |$InteractiveFrame| |$IOindex| |$HiFiAccess| |$HistList| |$HistListLen|
      |$HistListAct| |$HistRecord| |$internalHistoryTable| |$localExposureData|
      |$frameMessages|))
    (setq tmp1 (first |$interpreterFrameRing|))
    (setq |$interpreterFrameName| (nth 0 tmp1))
    (setq |$InteractiveFrame|      (nth 1 tmp1))
    (setq |$IOindex|               (nth 2 tmp1))
    (setq |$HiFiAccess|            (nth 3 tmp1))
    (setq |$HistList|              (nth 4 tmp1))
    (setq |$HistListLen|           (nth 5 tmp1))
    (setq |$HistListAct|           (nth 6 tmp1))
    (setq |$HistRecord|            (nth 7 tmp1))
    (setq |$internalHistoryTable|  (nth 8 tmp1))
    (setq |$localExposureData|     (nth 9 tmp1))
    (when |$frameMessages|

```



```
(|sayMessage|
  '( "    Current interpreter frame is called"
    ,#(|bright| |$interpreterFrameName|))))
```

33.5.7 Find a Frame in the Frame Ring by Name

Each frame contains its name as the 0th element. We simply walk all the frames and if we find one we return it. [boot-equal p??]

```
[frameName p550]
[$interpreterFrameRing p??]
```

— defun findFrameInRing 0 —

```
(defun |findFrameInRing| (name)
  "Find a Frame in the Frame Ring by Name"
  (let (result)
    (declare (special |$interpreterFrameRing|))
    (dolist (frame |$interpreterFrameRing|)
      (when (boot-equal (frameName frame) name)
        (setq result frame)))
    result))
```

33.5.8 Update the Current Interpreter Frame

This function collects the normal contents of the world into a frame object, places it first on the frame list, and then sets the current values of the world from the frame object.

```
[createCurrentInterpreterFrame p555]
[updateFromCurrentInterpreterFrame p556]
[$interpreterFrameRing p??]
```

— defun updateCurrentInterpreterFrame —

```
(defun |updateCurrentInterpreterFrame| ()
  "Update the Current Interpreter Frame"
  (declare (special |$interpreterFrameRing|))
  (rplaca |$interpreterFrameRing| (|createCurrentInterpreterFrame|))
  (|updateFromCurrentInterpreterFrame|))
```

33.5.9 Move to the next Interpreter Frame in Ring

This function updates the current frame to make sure all of the current information is recorded. If there are more frame elements in the list then this will destructively move the current frame to the end of the list, that is, assume the frame list reads (1 2 3) this function will destructively change it to (2 3 1). [updateFromCurrentInterpreterFrame p556]

[*\$interpreterFrameRing* p??]

— **defun nextInterpreterFrame** —

```
(defun |nextInterpreterFrame| ()
  "Move to the next Interpreter Frame in Ring"
  (declare (special |$interpreterFrameRing|))
  (when (cdr |$interpreterFrameRing|)
    (setq |$interpreterFrameRing|
      (nconc (cdr |$interpreterFrameRing|) (list (car |$interpreterFrameRing|))))
    (|updateFromCurrentInterpreterFrame|)))
```

33.5.10 Change to the Named Interpreter Frame

[updateCurrentInterpreterFrame p557]

[findFrameInRing p557]

[nremove p??]

[updateFromCurrentInterpreterFrame p556]

[*\$interpreterFrameRing* p??]

— **defun changeToNamedInterpreterFrame** —

```
(defun |changeToNamedInterpreterFrame| (name)
  "Change to the Named Interpreter Frame"
  (let (frame)
    (declare (special |$interpreterFrameRing|))
    (|updateCurrentInterpreterFrame|)
    (setq frame (|findFrameInRing| name))
    (when frame
      (setq |$interpreterFrameRing|
        (cons frame (nremove |$interpreterFrameRing| frame)))
      (|updateFromCurrentInterpreterFrame|))))
```

33.5.11 Move to the previous Interpreter Frame in Ring

```
[updateCurrentInterpreterFrame p557]
[updateFromCurrentInterpreterFrame p556]
[$interpreterFrameRing p??]
```

— **defun previousInterpreterFrame** —

```
(defun |previousInterpreterFrame| ()
  "Move to the previous Interpreter Frame in Ring"
  (let (tmp1 1 b)
    (declare (special |$interpreterFrameRing|))
    (|updateCurrentInterpreterFrame|)
    (when (cdr |$interpreterFrameRing|)
      (setq tmp1 (reverse |$interpreterFrameRing|))
      (setq 1 (car tmp1))
      (setq b (nreverse (cdr tmp1)))
      (setq |$interpreterFrameRing| (nconc (cons 1 nil) b))
      (|updateFromCurrentInterpreterFrame|))))
```

33.5.12 Add a New Interpreter Frame

```
[boot-equal p??]
[framename p??]
[throwKeyedMsg p??]
[updateCurrentInterpreterFrame p557]
[initHistList p579]
[emptyInterpreterFrame p554]
[updateFromCurrentInterpreterFrame p556]
[$erase p??]
[histFileName p578]
[$interpreterFrameRing p??]
```

— **defun addNewInterpreterFrame** —

```
(defun |addNewInterpreterFrame| (name)
  "Add a New Interpreter Frame"
  (declare (special |$interpreterFrameRing|))
  (if (null name)
    (|throwKeyedMsg| 's2iz0018 nil) ; you must provide a name for new frame
    (progn
      (|updateCurrentInterpreterFrame|)
      (dolist (f |$interpreterFrameRing|)
        (when (boot-equal name (frameName f)) ; existing frame with same name
```

```

      (|throwKeyedMsg| 's2iz0019 (list name)))
    (|initHistList|)
    (setq |$interpreterFrameRing|
      (cons (|emptyInterpreterFrame| name) |$interpreterFrameRing|))
    (|updateFromCurrentInterpreterFrame|)
    ($erase (|histFileName|))))

```

33.5.13 Close an Interpreter Frame

```

[filename p??]
[throwKeyedMsg p??]
[$erase p??]
[makeHistFileName p577]
[updateFromCurrentInterpreterFrame p556]
[$interpreterFrameRing p??]
[$interpreterFrameName p??]

```

— defun closeInterpreterFrame —

```

(defun |closeInterpreterFrame| (name)
  "Close an Interpreter Frame"
  (declare (special |$interpreterFrameRing| |$interpreterFrameName|))
  (let (ifr found)
    (if (null (cdr |$interpreterFrameRing|))
      (if (and name (not (equal name |$interpreterFrameName|)))
        (|throwKeyedMsg| 's2iz0020 ; 1 frame left. not the correct name.
          (cons |$interpreterFrameName| nil))
        (|throwKeyedMsg| 's2iz0021 nil)) ; only 1 frame left, not closed
      (progn
        (if (null name)
          (setq |$interpreterFrameRing| (cdr |$interpreterFrameRing|))
          (progn
            (setq found nil)
            (setq ifr nil)
            (dolist (f |$interpreterFrameRing|)
              (if (or found (not (equal name (frameName f))))
                (setq ifr (cons f ifr)))
              (setq found t)))
            (if (null found)
              (|throwKeyedMsg| 's2iz0022 (cons name nil))
              (progn
                ($erase (|makeHistFileName| name))
                (setq |$interpreterFrameRing| (nreverse ifr))))))
        (|updateFromCurrentInterpreterFrame|))))

```

33.5.14 Display the Frame Names

```
[bright p??]
[frameName p??]
[sayKeyedMsg p329]
[$interpreterFrameRing p??]
```

— defun displayFrameNames —

```
(defun |displayFrameNames| ()
  "Display the Frame Names"
  (declare (special |$interpreterFrameRing|))
  (let (t1)
    (setq t1
      (mapcar #'(lambda (f) '(|%1| "      " ,@(|bright| (frameName f))))
        |$interpreterFrameRing|))
    (|sayKeyedMsg| 's2iz0024 (list (apply #'append t1)))))
```

33.5.15 Import items from another frame

```
[member p1050]
[frameNames p554]
[throwKeyedMsg p??]
[boot-equal p??]
[frameName p??]
[frameEnvironment p554]
[upcase p??]
[queryUserKeyedMsg p??]
[string2id-n p??]
[importFromFrame p561]
[sayKeyedMsg p329]
[clearCmdParts p503]
[seq p??]
[exit p??]
[putHist p588]
[get p??]
[getalist p??]
[$interpreterFrameRing p??]
```

— defun importFromFrame —

```

(defun |importFromFrame| (args)
  "Import items from another frame"
  (prog (temp1 fname fenv x v props vars plist prop val m)
    (declare (special |$interpreterFrameRing|))
    (when (and args (atom args)) (setq args (cons args nil)))
    (if (null args)
      (|throwKeyedMsg| 'S2IZ0073 nil) ; missing frame name
      (progn
        (setq temp1 args)
        (setq fname (car temp1))
        (setq args (cdr temp1))
        (cond
          ((null (|member| fname (|frameNames|)))
            (|throwKeyedMsg| 'S2IZ0074 (cons fname nil))) ; not frame name
          ((boot-equal fname (frameName (car |$interpreterFrameRing|)))
            (|throwKeyedMsg| 'S2IZ0075 NIL)) ; cannot import from curr frame
          (t
            (setq fenv (|frameEnvironment| fname))
            (cond
              ((null args)
                (setq x
                  (upcase (|queryUserKeyedMsg| 'S2IZ0076 (cons fname nil))))
                  ; import everything?
                (cond
                  ((member (string2id-n x 1) '(y yes))
                    (setq vars nil)
                    (do ((tmp0 (caar fenv) (cdr tmp0)) (tmp1 nil))
                      ((or (atom tmp0)
                        (progn (setq tmp1 (car tmp0)) nil)
                        (progn
                          (progn
                            (setq v (car tmp1))
                            (setq props (cdr tmp1))
                            tmp1
                            nil)))
                      nil)
                    (cond
                      ((eq v '|--macros|)
                        (do ((tmp2 props (cdr tmp2))
                          (tmp3 nil))
                          ((or (atom tmp2)
                            (progn (setq tmp3 (car tmp2)) nil)
                            (progn
                              (progn (setq m (car tmp3)) tmp3)
                              nil))
                        nil)
                      (setq vars (cons m vars))))
                    (t (setq vars (cons v vars))))
                  (|importFromFrame| (cons fname vars)))
              (t

```

```

(|sayKeyedMsg| 'S2IZ0077 (cons fname nil))))))
(t
 (do ((tmp4 args (cdr tmp4)) (v nil))
      ((or (atom tmp4) (progn (setq v (car tmp4)) nil)) nil)
      (seq
       (exit
        (progn
         (setq plist (getalist (caar fenv) v))
         (cond
          (plist
           (|clearCmdParts| (cons '|propert| (cons v nil)))
           (do ((tmp5 plist (cdr tmp5)) (tmp6 nil))
                ((or (atom tmp5)
                     (progn (setq tmp6 (car tmp5)) nil)
                     (progn
                      (progn
                       (setq prop (car tmp6))
                       (setq val (cdr tmp6))
                       tmp6)
                      nil))
                nil)
           (seq
            (exit (|putHist| v prop val |$InteractiveFrame|))))))
          ((setq m (|get| '|--macros--| v fenv))
           (|putHist| '|--macros--| v m |$InteractiveFrame|))
          (t
           (|sayKeyedMsg| 'S2IZ0079 ; frame not found
                        (cons v (cons fname nil)))))))
      (|sayKeyedMsg| 'S2IZ0078 ; import complete
                    (cons fname nil)))))))))

```

33.5.16 The top level frame command

[frameSpad2Cmd p564]

— defun frame —

```

(defun |frame| (l)
  "The top level frame command"
  (|frameSpad2Cmd| l))

```

33.5.17 The top level frame command handler

```
[throwKeyedMsg p??]
[helpSpad2Cmd p570]
[selectOptionLC p477]
[qcdr p??]
[qcar p??]
[object2Identifier p??]
[frameSpad2Cmd drop (vol9)]
[closeInterpreterFrame p560]
[import p??]
[importFromFrame p561]
[last p??]
[previousInterpreterFrame p559]
[names p??]
[displayFrameNames p561]
[new p??]
[addNewInterpreterFrame p559]
[next p38]
[nextInterpreterFrame p558]
[$options p??]
```

— defun frameSpad2Cmd —

```
(defun |frameSpad2Cmd| (args)
  "The top level frame command handler"
  (let (frameArgs arg a)
    (declare (special |$options|))
    (setq frameArgs '(|drop| |import| |last| |names| |new| |next|))
    (cond
      (|$options|
        (|throwKeyedMsg| 'S2IZ0016 ; frame command does not take options
          (cons ")frame" nil)))
      ((null args) (|helpSpad2Cmd| (cons '|frame| nil)))
      (t
        (setq arg (|selectOptionLC| (car args) frameArgs '|optionError|))
        (setq args (cdr args))
        (when (and (consp args)
          (eq (qcdr args) nil)
          (progn (setq a (qcar args)) t))
          (setq args a))
        (when (atom args) (setq args (|object2Identifier| args)))
        (case arg
          (|drop|
            (if (and args (consp args))
              (|throwKeyedMsg| 'S2IZ0017 ; not a valid frame name
                (cons args nil))
              (|closeInterpreterFrame| args))))
```



```
(|import| (|importFromFrame| args))
(|last| (|previousInterpreterFrame|))
(|names| (|displayFrameNames|))
(|new|
  (if (and args (consp args))
    (|throwKeyedMsg| 'S2IZ0017 ; not a valid frame name
      (cons args nil))
    (|addNewInterpreterFrame| args)))
(|next| (|nextInterpreterFrame|))
(t nil))))))
```

33.6 Frame File Messages

— Frame File Messages —

S2IZ0016

The %1b system command takes arguments but no options.

S2IZ0017

%1b is not a valid frame name

S2IZ0018

You must provide a name for the new frame.

S2IZ0019

You cannot use the name %1b for a new frame because an existing frame already has that name.

S2IZ0020

There is only one frame active and therefore that cannot be closed.
Furthermore, the frame name you gave is not the name of the current frame.
The current frame is called %1b .

S2IZ0021

The current frame is the only active one. Issue %b)clear all %d to clear its contents.

S2IZ0022

There is no frame called %1b and so your command cannot be processed.

S2IZ0024

The names of the existing frames are: %1 %1
The current frame is the first one listed.

S2IZ0073

%b)frame import %d must be followed by the frame name. The names of objects in that frame can then optionally follow the frame name. For example,
%ceon %b)frame import calculus %d %ceoff
imports all objects in the %b calculus %d frame, and
%ceon %b)frame import calculus epsilon delta %d %ceoff

imports the objects named %b epsilon %d and %b delta %d from the frame %b calculus %d .

Please note that if the current frame contained any information about objects with these names, then that information would be cleared before the import took place.

S2IZ0074

You cannot import anything from the frame %1b because that is not the name of an existing frame.

S2IZ0075

You cannot import from the current frame (nor is there a need!).

S2IZ0076

User verification required:

do you really want to import everything from the frame %1b ?

If so, please enter %b y %d or %b yes %d :

S2IZ0077

On your request, AXIOM will not import everything from frame %1b.

S2IZ0078

Import from frame %1b is complete. Please issue %b)display all %d if you wish to see the contents of the current frame.

S2IZ0079

AXIOM cannot import %1b from frame %2b because it cannot be found.

Chapter 34

)help help page Command

34.1 help help page man page

— help.help —

```
=====
A.12. )help
=====
```

User Level Required: interpreter

Command Syntax:

-)help
-)help commandName
-)help syntax

Command Description:

This command displays help information about system commands. If you issue

```
)help
```

then this very text will be shown. You can also give the name or abbreviation of a system command to display information about it. For example,

```
)help clear
```

will display the description of the)clear system command.

The command

)help syntax

will give further information about the Axiom language syntax.

All this material is available in the AXIOM User Guide and in HyperDoc. In HyperDoc, choose the Commands item from the Reference menu.

```
=====
A.1.  Introduction
=====
```

System commands are used to perform AXIOM environment management. Among the commands are those that display what has been defined or computed, set up multiple logical AXIOM environments (frames), clear definitions, read files of expressions and commands, show what functions are available, and terminate AXIOM.

Some commands are restricted: the commands

```
)set userlevel interpreter
)set userlevel compiler
)set userlevel development
```

set the user-access level to the three possible choices. All commands are available at development level and the fewest are available at interpreter level. The default user-level is interpreter. In addition to the)set command (discussed in description of command)set) you can use the HyperDoc settings facility to change the user-level. Click on [Settings] here to immediately go to the settings facility.

Each command listing begins with one or more syntax pattern descriptions plus examples of related commands. The syntax descriptions are intended to be easy to read and do not necessarily represent the most compact way of specifying all possible arguments and options; the descriptions may occasionally be redundant.

All system commands begin with a right parenthesis which should be in the first available column of the input line (that is, immediately after the input prompt, if any). System commands may be issued directly to AXIOM or be included in .input files.

A system command argument is a word that directly follows the command name and is not followed or preceded by a right parenthesis. A system command option follows the system command and is directly preceded by a right parenthesis. Options may have arguments: they directly follow the option. This example may make it easier to remember what is an option and what is an argument:

```
)syscmd arg1 arg2 )opt1 opt1arg1 opt1arg2 )opt2 opt2arg1 ...
```

In the system command descriptions, optional arguments and options are enclosed in brackets ('[' and ']'). If an argument or option name is in italics, it is meant to be a variable and must have some actual value substituted for it when the system command call is made. For example, the syntax pattern description

```
)read fileName [quietly]
```

would imply that you must provide an actual file name for *fileName* but need not use the *)quietly* option. Thus

```
)read matrix.input
```

is a valid instance of the above pattern.

System command names and options may be abbreviated and may be in upper or lower case. The case of actual arguments may be significant, depending on the particular situation (such as in file names). System command names and options may be abbreviated to the minimum number of starting letters so that the name or option is unique. Thus

```
)s Integer
```

is not a valid abbreviation for the *)set* command, because both *)set* and *)show* begin with the letter 's'. Typically, two or three letters are sufficient for disambiguating names. In our descriptions of the commands, we have used no abbreviations for either command names or options.

In some syntax descriptions we use a vertical line '|' to indicate that you must specify one of the listed choices. For example, in

```
)set output fortran on | off
```

only on and off are acceptable words for following boot. We also sometimes use '...' to indicate that additional arguments or options of the listed form are allowed. Finally, in the syntax descriptions we may also list the syntax of related commands.

```
=====
Other help topics
=====
```

Available help topics are:

abbreviations	assignment	blocks	browse	boot	cd
clear	clef	close	collection	compile	describe
display	edit	fin	for	frame	help
history	if	iterate	leave	library	lisp
load	ltrace	parallel	pquit	quit	read
repeat	savesystem	set	show	spool	suchthat

```

synonym      system      syntax      trace      undo      what
while

```

Available algebra help topics are:

34.2 Functions

34.2.1 The top level help command

```
[helpSpad2Cmd p570]
```

— defun help —

```

(defun |help| (1)
  "The top level help command"
  (|helpSpad2Cmd| 1))

```

34.2.2 The top level help command handler

```

[newHelpSpad2Cmd p570]
[sayKeyedMsg p329]

```

— defun helpSpad2Cmd —

```

(defun |helpSpad2Cmd| (args)
  "The top level help command handler"
  (unless (|newHelpSpad2Cmd| args)
    (|sayKeyedMsg| 's2iz0025 (cons args nil))))

```

34.2.3 defun newHelpSpad2Cmd

```

[makeInputFilename p981]
[obey p??]
[concat p1049]
[namestring p1042]

```

```
[make-instream p979]
[say p??]
[poundsign p??]
[sayKeyedMsg p329]
[pname p1047]
[selectOptionLC p477]
[$syscommands p442]
[$useFullScreenHelp p729]
```

— defun newHelpSpad2Cmd —

```
(defun |newHelpSpad2Cmd| (args)
  (let (sarg arg narg helpfile filestream line)
    (declare (special $syscommands |$useFullScreenHelp|))
    (when (null args) (setq args (list '?)))
    (if (> (|#| args) 1)
      (|sayKeyedMsg| 's2iz0026 nil)
      (progn
        (setq sarg (pname (car args)))
        (cond
          ((string= sarg "?") (setq args (list '|help|)))
          ((string= sarg "%") (setq args (list '|history|)))
          ((string= sarg "%%") (setq args (list '|history|)))
          (t nil))
        (setq arg (|selectOptionLC| (car args) $syscommands nil))
        (cond ((null arg) (setq arg (car args))))
        (setq narg (pname arg))
        (cond
          ((null (setq helpfile (makeInputFilename (list narg "help"))))
           nil)
          (|$useFullScreenHelp|
           (obey (concat "$AXIOM/lib/SPAEDIT " (|namestring| helpfile))) t)
          (t
           (setq filestream (make-instream helpfile))
           (do ((line (|read-line| filestream nil) (|read-line| filestream nil)))
               ((null line) (shut filestream))
              (say line))))))))))
```

Chapter 35

)history help page Command

35.1 history help page man page

— history.help —

```
=====
A.13. )history
=====
```

User Level Required: interpreter

Command Syntax:

-)history)on
-)history)off
-)history)write historyInputFileName
-)history)show [n] [both]
-)history)save savedHistoryName
-)history)restore [savedHistoryName]
-)history)reset
-)history)change n
-)history)memory
-)history)file
- %
- %% (n)
-)set history on | off

Command Description:

The history facility within AXIOM allows you to restore your environment to that of another session and recall previous computational results. Additional commands allow you to review previous input lines and to create an .input

file of the lines typed to AXIOM.

AXIOM saves your input and output if the history facility is turned on (which is the default). This information is saved if either of

```
)set history on
)history )on
```

has been issued. Issuing either

```
)set history off
)history )off
```

will discontinue the recording of information.

Whether the facility is disabled or not, the value of % in AXIOM always refers to the result of the last computation. If you have not yet entered anything, % evaluates to an object of type Variable('%'). The function %% may be used to refer to other previous results if the history facility is enabled. In that case, %(n) is the output from step n if n > 0. If n < 0, the step is computed relative to the current step. Thus %(-1) is also the previous step, %(-2), is the step before that, and so on. If an invalid step number is given, AXIOM will signal an error.

The environment information can either be saved in a file or entirely in memory (the default). Each frame (description of command)frame) has its own history database. When it is kept in a file, some of it may also be kept in memory for efficiency. When the information is saved in a file, the name of the file is of the form FRAME.ahx where "FRAME" is the name of the current frame. The history file is placed in the current working directory (see description of command)cd). Note that these history database files are not text files (in fact, they are directories themselves), and so are not in human-readable format.

The options to the)history command are as follows:

```
)change n
    will set the number of steps that are saved in memory to n. This option
    only has effect when the history data is maintained in a file. If you
    have issued )history )memory (or not changed the default) there is no
    need to use )history )change.

)on
    will start the recording of information. If the workspace is not empty,
    you will be asked to confirm this request. If you do so, the workspace
    will be cleared and history data will begin being saved. You can also
    turn the facility on by issuing )set history on.

)off
    will stop the recording of information. The )history )show command will
```

not work after issuing this command. Note that this command may be issued to save time, as there is some performance penalty paid for saving the environment data. You can also turn the facility off by issuing `)set history off`.

`)file`

indicates that history data should be saved in an external file on disk.

`)memory`

indicates that all history data should be kept in memory rather than saved in a file. Note that if you are computing with very large objects it may not be practical to keep this data in memory.

`)reset`

will flush the internal list of the most recent workspace calculations so that the data structures may be garbage collected by the underlying Lisp system. Like `)history)change`, this option only has real effect when history data is being saved in a file.

`)restore [savedHistoryName]`

completely clears the environment and restores it to a saved session, if possible. The `)save` option below allows you to save a session to a file with a given name. If you had issued `)history)save jacobi` the command `)history)restore jacobi` would clear the current workspace and load the contents of the named saved session. If no saved session name is specified, the system looks for a file called `last.akh`.

`)save savedHistoryName`

is used to save a snapshot of the environment in a file. This file is placed in the current working directory (see description of command `)cd`). Use `)history)restore` to restore the environment to the state preserved in the file. This option also creates an input file containing all the lines of input since you created the workspace frame (for example, by starting your AXIOM session) or last did a `)clear all` or `)clear completely`.

`)show [n] [both]`

can show previous input lines and output results. `)show` will display up to twenty of the last input lines (fewer if you haven't typed in twenty lines). `)show n` will display up to `n` of the last input lines. `)show both` will display up to five of the last input lines and output results. `)show n both` will display up to `n` of the last input lines and output results.

`)write historyInputFile`

creates an `.input` file with the input lines typed since the start of the session/frame or the last `)clear all` or `)clear completely`. If `historyInputFileName` does not contain a period (`'.'`) in the filename, `.input` is appended to it. For example, `)history)write chaos` and `)history)write chaos.input` both write the input lines to a file called `chaos.input` in your current working directory. If you issued one or more

`)undo` commands, `)history` `)write` eliminates all input lines backtracked over as a result of `)undo`. You can edit this file and then use `)read` to have AXIOM process the contents.

Also See:

- o `)frame`
- o `)read`
- o `)set`
- o `)undo`

1

History recording is done in two different ways:

- all changes in variable bindings (i.e. previous values) are written to `$HistList`, which is a circular list
- all new bindings (including the binding to `%`) are written to a file called `histFileName()` one older session is accessible via the file `$oldHistFileName()`

35.2 Initialized history variables

The following global variables are used:

`$HistList`, `$HistListLen` and `$HistListAct` which is the actual number of “undoable” steps)

`$HistRecord` collects the input line, all variable bindings and the output of a step, before it is written to the file `histFileName()`.

`$HiFiAccess` is a flag, which is reset by `)history` `)off`

The result of step `n` can be accessed by `%n`, which is translated into a call of `fetchOutput(n)`. The `updateHist` is called after every interpreter step. The `putHist` function records all changes in the environment to `$HistList` and `$HistRecord`.

35.2.1 `defvar $oldHistoryFileName`

— `initvars` —

```
(defvar |$oldHistoryFileName| ' |last| "vm/370 filename name component")
```

¹ “frame” (33.5.16 p 563) “read” (43.1.1 p 640) “set” (46.36.1 p 805) “undo” (54.4.6 p 920)

35.2.2 defvar \$historyFileType

— initvars —

```
(defvar |$historyFileType| '|axh|      "vm/370 filename type component")
```

35.2.3 defvar \$historyDirectory

— initvars —

```
(defvar |$historyDirectory| 'A      "vm/370 filename disk component")
```

35.2.4 defvar \$useInternalHistoryTable

— initvars —

```
(defvar |$useInternalHistoryTable| t  "t means keep history in core")
```

35.3 Data Structures**35.4 Functions****35.4.1 defun makeHistFileName**

[makePathname p1044]

— defun makeHistFileName —

```
(defun |makeHistFileName| (fname)
  (|makePathname| fname |$historyFileType| |$historyDirectory|))
```

35.4.2 defun oldHistFileName

```
[makeHistFileName p577]
[$oldHistoryFileName p576]
```

— defun oldHistFileName —

```
(defun |oldHistFileName| ()
  (declare (special |$oldHistoryFileName|))
  (|makeHistFileName| |$oldHistoryFileName|))
```

—————

35.4.3 defun histFileName

```
[makeHistFileName p577]
[$interpreterFrameName p??]
```

— defun histFileName —

```
(defun |histFileName| ()
  (declare (special |$interpreterFrameName|))
  (|makeHistFileName| |$interpreterFrameName|))
```

—————

35.4.4 defun histInputFileName

```
[makePathname p1044]
[$interpreterFrameName p??]
[$historyDirectory p577]
```

— defun histInputFileName —

```
(defun |histInputFileName| (fn)
  (declare (special |$interpreterFrameName| |$historyDirectory|))
  (if (null fn)
    (|makePathname| |$interpreterFrameName| 'input |$historyDirectory|)
    (|makePathname| fn 'input |$historyDirectory|)))
```

—————

35.4.5 defun initHist

[initHistList p579]
 [oldHistFileName p578]
 [histFileName p578]
 [histFileErase p615]
 [makeInputFilename p981]
 [\$replace p??]
 [\$useInternalHistoryTable p577]
 [\$HiFiAccess p730]

— defun initHist —

```
(defun |initHist| ()
  (let (oldFile newFile)
    (declare (special |$useInternalHistoryTable| |$HiFiAccess|))
    (if |$useInternalHistoryTable|
      (initHistList)
      (progn
        (setq oldFile (|oldHistFileName|))
        (setq newFile (|histFileName|))
        (|histFileErase| oldFile)
        (when (makeInputFilename newFile) (replaceFile oldFile newFile))
        (setq |$HiFiAccess| t)
        (initHistList))))))
```

35.4.6 defun initHistList

[\$HistListLen p??]
 [\$HistList p??]
 [\$HistListAct p??]
 [\$HistRecord p??]

— defun initHistList —

```
(defun |initHistList| ()
  (let (li)
    (declare (special |$HistListLen| |$HistList| |$HistListAct| |$HistRecord|))
    (setq |$HistListLen| 20)
    (setq |$HistList| (list nil))
    (setq li |$HistList|)
    (do ((i 1 (1+ i)))
      ((> i |$HistListLen|) nil)
      (setq li (cons nil li))))
```

```
(rplacd |$HistList| li)
(setq |$HistListAct| 0)
(setq |$HistRecord| nil)))
```

35.4.7 The top level history command

```
[sayKeyedMsg p329]
[historySpad2Cmd p580]
[$options p??]
```

— defun history —

```
(defun |history| (l)
  "The top level history command"
  (declare (special |$options|))
  (if (or l (null |$options|))
      (|sayKeyedMsg| 's2ih0006 nil) ; syntax error
      (|historySpad2Cmd|)))
```

35.4.8 The top level history command handler

```
[selectOptionLC p477]
[member p1050]
[sayKeyedMsg p329]
[initHistList p579]
[upcase p??]
[queryUserKeyedMsg p??]
[string2id-n p??]
[histFileErase p615]
[histFileName p578]
[clearSpad2Cmd p498]
[disableHist p601]
[setHistoryCore p582]
[resetInCoreHist p586]
[saveHistory p593]
[showHistory p??]
[changeHistListLen p587]
[restoreHistory p595]
[writeInputLines p585]
[seq p??]
```



```
[exit p??]
[$options p??]
[$HiFiAccess p730]
[$IOindex p??]
```

— defun historySpad2Cmd —

```
(defun |historySpad2Cmd| ()
  "The top level history command handler"
  (let (histOptions opts opt optargs x)
    (declare (special |$options| |$HiFiAccess| |$IOindex|))
    (setq histOptions
      '(|on| |off| |yes| |no| |change| |reset| |restore| |write|
        |save| |show| |file| |memory|))
    (setq opts
      (prog (tmp1)
        (setq tmp1 nil)
        (return
          (do ((tmp2 |$options| (cdr tmp2)) (tmp3 nil))
              ((or (atom tmp2)
                    (progn
                      (setq tmp3 (car tmp2))
                      nil)
                    (progn
                      (progn
                        (setq opt (car tmp3))
                        (setq optargs (cdr tmp3))
                        tmp3)
                      nil)))
              (nreverse0 tmp1)))
          (setq tmp1
            (cons
              (cons
                (|selectOptionLC| opt histOptions '|optionError|)
                optargs)
              tmp1))))))
    (do ((tmp4 opts (cdr tmp4)) (tmp5 nil))
        ((or (atom tmp4)
              (progn
                (setq tmp5 (car tmp4))
                nil)
              (progn
                (progn
                  (setq opt (car tmp5))
                  (setq optargs (cdr tmp5))
                  tmp5)
                nil)))
        nil)
    (seq
```

```

(exit
  (cond
    ((|member| opt '(|on| |yes|))
      (cond
        (|$HiFiAccess|
          (|sayKeyedMsg| 'S2IH0007 nil)) ; history already on
        ((eq1 |$I0index| 1)
          (setq |$HiFiAccess| t)
          (|initHistList|)
          (|sayKeyedMsg| 'S2IH0008 nil)) ; history now on
        (t
          (setq x ; really want to turn history on?
            (upcase (|queryUserKeyedMsg| 'S2IH0009 nil)))
          (cond
            ((member (string2id-n x 1) '(Y YES))
              (|histFileErase| (|histFileName|))
              (setq |$HiFiAccess| t)
              (setq |$options| nil)
              (|clearSpad2Cmd| '(|all|))
              (|sayKeyedMsg| 'S2IH0008 nil) ; history now on
              (|initHistList|))
            (t
              (|sayKeyedMsg| 'S2IH0010 nil)))))) ; history still off
    ((|member| opt '(|off| |no|))
      (cond
        ((null |$HiFiAccess|)
          (|sayKeyedMsg| 'S2IH0011 nil)) ; history already off
        (t
          (setq |$HiFiAccess| nil)
          (|disableHist|)
          (|sayKeyedMsg| 'S2IH0012 nil)))) ; history now off
    ((eq opt '|file|) (|setHistoryCore| nil))
    ((eq opt '|memory|) (|setHistoryCore| t))
    ((eq opt '|reset|) (|resetInCoreHist|))
    ((eq opt '|save|) (|saveHistory| optargs))
    ((eq opt '|show|) (|showHistory| optargs))
    ((eq opt '|change|) (|changeHistListLen| (car optargs)))
    ((eq opt '|restore|) (|restoreHistory| optargs))
    ((eq opt '|write|) (|writeInputLines| optargs 1))))))
'|done|))

```

35.4.9 defun setHistoryCore

We case on the inCore argument value

If history is already on and is kept in the same location as requested (file or memory)

then complain.

If history is not in use then start using the file or memory as requested. This is done by simply setting the `$useInternalHistoryTable` to the requested value, where T means use memory and NIL means use a file. We tell the user.

If history should be in memory, that is `inCore` is not NIL, and the history file already contains information we read the information from the file, store it in memory, and erase the history file. We modify `$useInternalHistoryTable` to T to indicate that we're maintaining the history in memory and tell the user.

Otherwise history must be on and in memory. We erase any old history file and then write the in-memory history to a new file

```
[boot-equal p??]
[sayKeyedMsg p329]
[rkeyids p??]
[histFileName p578]
[readHiFi p599]
[disableHist p601]
[histFileErase p615]
[rdefiostream p??]
[spadrwrite p603]
[object2Identifier p??]
[rshut p??]
[$useInternalHistoryTable p577]
[$internalHistoryTable p??]
[$HiFiAccess p730]
[$IOindex p??]
```

— **defun setHistoryCore** —

```
(defun |setHistoryCore| (inCore)
  (let (l vec str n rec)
    (declare (special |$useInternalHistoryTable| |$internalHistoryTable|
                     |$HiFiAccess| |$IOindex|))
    (cond
      ((boot-equal inCore |$useInternalHistoryTable|)
       (if inCore
           (|sayKeyedMsg| 's2ih0030 nil) ; memory history already in use
           (|sayKeyedMsg| 's2ih0029 nil))) ; file history already in use
      ((null |$HiFiAccess|)
       (setq |$useInternalHistoryTable| inCore)
       (if inCore
           (|sayKeyedMsg| 's2ih0032 nil) ; use memory history
           (|sayKeyedMsg| 's2ih0031 nil))) ; use file history
      (inCore
       (setq |$internalHistoryTable| nil)
       (cond
```

```

(not (eql |$I0index| 0))
  (setq l (length (rkeyids (|histFileName|))))
  (do ((i 1 (1+ i)))
      ((> i l) nil)
      (setq vec (unwind-protect (|readHiFi| i) (|disableHist|)))
      (setq |$internalHistoryTable|
        (cons (cons i vec) |$internalHistoryTable|)))
    (|histFileErase| (|histFileName|)))
  (setq |$useInternalHistoryTable| t)
  (|sayKeyedMsg| 'S2IH0032 nil)) ; use memory history
(t
  (setq |$HiFiAccess| nil)
  (|histFileErase| (|histFileName|))
  (setq str
    (rdefiostream
      (cons
        '(mode . output)
        (cons
          (cons 'file (|histFileName|))
          nil))))
    (do ((tmp0 (reverse |$internalHistoryTable|) (cdr tmp0))
        (tmp1 nil))
        ((or (atom tmp0)
              (progn
                (setq tmp1 (car tmp0))
                nil)
              (progn
                (progn
                  (setq n (car tmp1))
                  (setq rec (cdr tmp1))
                  tmp1)
                nil))
              nil))
        (spadrwrite (|object2Identifier| n) rec str))
    (rshut str)
    (setq |$HiFiAccess| t)
    (setq |$internalHistoryTable| nil)
    (setq |$useInternalHistoryTable| nil)
    (|sayKeyedMsg| 's2ih0031 nil)))) ; use file history

```

35.4.10 defvar \$underbar

Also used in the output routines.

— **initvars** —

```
(defvar underbar "_")
```

35.4.11 defun writeInputLines

[sayKeyedMsg p329]
 [throwKeyedMsg p??]
 [size p1047]
 [spaddifference p??]
 [concat p1049]
 [substring p??]
 [readHiFi p599]
 [histInputFileName p578]
 [histFileErase p615]
 [defiostream p980]
 [namestring p1042]
 [shut p980]
 [underbar p584]
 [\$HiFiAccess p730]
 [\$IOindex p??]

— defun writeInputLines —

```
(defun |writeInputLines| (fn initial)
  (let (maxn breakChars vec1 k svec done n lineList file inp)
    (declare (special underbar |$HiFiAccess| |$IOindex|))
    (cond
      ((null |$HiFiAccess|) (|sayKeyedMsg| 's2ih0013 nil)) ; history is not on
      ((null fn) (|throwKeyedMsg| 's2ih0038 nil)) ; missing file name
      (t
       (setq maxn 72)
       (setq breakChars (cons ' | (cons '+ nil)))
       (do ((tmp0 (spaddifference |$IOindex| 1))
            (i initial (+ i 1)))
           ((> i tmp0) nil)
           (setq vec1 (car (|readHiFi| i)))
           (when (stringp vec1) (setq vec1 (cons vec1 nil)))
           (dolist (vec vec1)
             (setq n (size vec))
             (do ()
                 ((null (> n maxn)) nil)
                 (setq done nil)
                 (do ((j 1 (1+ j)))
                     ((or (> j maxn) (null (null done)))) nil)
                 (setq k (spaddifference (1+ maxn) j))
                 (when (member (elt vec k) breakChars))
```

```

      (setq svec (concat (substring vec 0 (1+ k)) underbar))
      (setq lineList (cons svec lineList))
      (setq done t)
      (setq vec (substring vec (1+ k) nil))
      (setq n (size vec))))
    (when done (setq n 0)))
  (setq lineList (cons vec lineList)))
(setq file (|histInputFileName| fn))
(|histFileErase| file)
(setq inp
  (defiostream
    (cons
      '(mode . output)
      (cons (cons 'file file) nil)) 255 0))
(dolist (x (|removeUndoLines| (nreverse lineList)))
  (write-line x inp))
(cond
  ((not (eq fn '|redo|))
    (|sayKeyedMsg| 's2ih0014 ; edit this file to see input lines
      (list (|namestring| file)))))
(shut inp)
nil))))

```

35.4.12 defun resetInCoreHist

```

[$HistListAct p??]
[$HistListLen p??]
[$HistList p??]

```

— defun resetInCoreHist —

```

(defun |resetInCoreHist| ()
  (declare (special |$HistListAct| |$HistListLen| |$HistList|))
  (setq |$HistListAct| 0)
  (do ((i 1 (1+ i)))
    ((> i |$HistListLen|) nil)
    (setq |$HistList| (cdr |$HistList|))
    (rplaca |$HistList| nil)))

```

35.4.13 defun changeHistListLen

```
[sayKeyedMsg p329]
[spaddifference p??]
[$HistListLen p??]
[$HistList p??]
[$HistListAct p??]
```

— defun changeHistListLen —

```
(defun |changeHistListLen| (n)
  (let (dif 1)
    (declare (special |$HistListLen| |$HistList| |$HistListAct|))
    (if (null (integerp n))
      (|sayKeyedMsg| 's2ih0015 (list n)) ; only positive integers
      (progn
        (setq dif (spaddifference n |$HistListLen|))
        (setq |$HistListLen| n)
        (setq l (cdr |$HistList|))
        (cond
          ((> dif 0)
            (do ((i 1 (1+ i)))
              ((> i dif) nil)
              (setq l (cons nil l))))
          ((minusp dif)
            (do ((tmp0 (spaddifference dif))
                (i 1 (1+ i)))
              ((> i tmp0) nil)
              (setq l (cdr l)))
            (cond
              ((> |$HistListAct| n) (setq |$HistListAct| n))
              (t nil))))
        (rplacd |$HistList| l)
        '|done|))))
```

—————→

35.4.14 defun updateHist

```
[startTimingProcess p??]
[updateInCoreHist p588]
[writeHiFi p600]
[disableHist p601]
[updateCurrentInterpreterFrame p557]
[stopTimingProcess p??]
[$IOindex p??]
[$HiFiAccess p730]
```

```
[$HistRecord p??]
[$mkTestInputStack p??]
[$currentLine p??]
```

— defun updateHist —

```
(defun |updateHist| ()
  (declare (special |$IOindex| |$HiFiAccess| |$HistRecord| |$mkTestInputStack|
    |$currentLine|))
  (when |$IOindex|
    (|startTimingProcess| ' |history|)
    (|updateInCoreHist|)
    (when |$HiFiAccess|
      (unwind-protect (|writeHiFi|) (|disableHist|))
      (setq |$HistRecord| nil))
    (incf |$IOindex|)
    (|updateCurrentInterpreterFrame|)
    (setq |$mkTestInputStack| nil)
    (setq |$currentLine| nil)
    (|stopTimingProcess| ' |history|)))
```

—————

35.4.15 defun updateInCoreHist

```
[$HistList p??]
[$HistListLen p??]
[$HistListAct p??]
```

— defun updateInCoreHist —

```
(defun |updateInCoreHist| ()
  (declare (special |$HistList| |$HistListLen| |$HistListAct|))
  (setq |$HistList| (cdr |$HistList|))
  (rplaca |$HistList| nil)
  (when (> |$HistListLen| |$HistListAct|)
    (setq |$HistListAct| (1+ |$HistListAct|))))
```

—————

35.4.16 defun putHist

```
[recordOldValue p590]
[get p??]
[recordNewValue p589]
```



```
[putIntSymTab p??]
[$HiFiAccess p730]
```

— defun putHist —

```
(defun |putHist| (x prop val e)
  (declare (special |$HiFiAccess|))
  (when (null (eq x '%)) (|recordOldValue| x prop (|get| x prop e)))
  (when |$HiFiAccess| (|recordNewValue| x prop val))
  (|putIntSymTab| x prop val e))
```

—————

35.4.17 defun recordNewValue

```
[startTimingProcess p??]
[recordNewValue0 p589]
[stopTimingProcess p??]
```

— defun recordNewValue —

```
(defun |recordNewValue| (x prop val)
  (|startTimingProcess| '|history|)
  (|recordNewValue0| x prop val)
  (|stopTimingProcess| '|history|))
```

—————

35.4.18 defun recordNewValue0

```
[assq p1052]
[$HistRecord p??]
```

— defun recordNewValue0 —

```
(defun |recordNewValue0| (x prop val)
  (let (p1 p2 p)
    (declare (special |$HistRecord|))
    (if (setq p1 (assq x |$HistRecord|))
      (if (setq p2 (assq prop (cdr p1)))
        (rplacd p2 val)
        (rplacd p1 (cons (cons prop val) (cdr p1))))
      (progn
        (setq p (cons x (list (cons prop val))))
```

```
(setq |$HistRecord| (cons p |$HistRecord|))))))
```

35.4.19 defun recordOldValue

```
[startTimingProcess p??]
[recordOldValue0 p590]
[stopTimingProcess p??]
[assq p1052]
```

— defun recordOldValue —

```
(defun |recordOldValue| (x prop val)
  (|startTimingProcess| ' |history|)
  (|recordOldValue0| x prop val)
  (|stopTimingProcess| ' |history|))
```

35.4.20 defun recordOldValue0

```
[$HistList p??]
```

— defun recordOldValue0 —

```
(defun |recordOldValue0| (x prop val)
  (let (p1 p)
    (declare (special |$HistList|))
    (when (setq p1 (assq x (car |$HistList|)))
      (when (null (assq prop (cdr p1)))
        (rplacd p1 (cons (cons prop val) (cdr p1)))))
    (setq p (cons x (list (cons prop val))))
    (rplaca |$HistList| (cons p (car |$HistList|)))))
```

35.4.21 defun undoInCore

```
[undoChanges p591]
[spaddifference p??]
[readHiFi p599]
```

```
[disableHist p601]
[assq p1052]
[sayKeyedMsg p329]
[putHist p588]
[updateHist p587]
[$HistList p??]
[$HistListLen p??]
[$IOindex p??]
[$HiFiAccess p730]
[$InteractiveFrame p??]
```

— defun undoInCore —

```
(defun |undoInCore| (n)
  (let (li vec p p1 val)
    (declare (special |$HistList| |$HistListLen| |$IOindex| |$HiFiAccess|
      |$InteractiveFrame|))
    (setq li |$HistList|)
    (do ((i n (+ i 1)))
      ((> i |$HistListLen|) nil)
      (setq li (cdr li)))
    (|undoChanges| li)
    (setq n (spaddifference (spaddifference |$IOindex| n) 1))
    (and
      (> n 0)
      (if |$HiFiAccess|
        (progn
          (setq vec (cdr (unwind-protect (|readHiFi| n) (|disableHist|))))
          (setq val
            (and
              (setq p (assq '% vec))
              (setq p1 (assq '|value| (cdr p)))
              (cdr p1))))
          (|sayKeyedMsg| 's2ih0019 (cons n nil)))) ; no history file
      (setq |$InteractiveFrame| (|putHist| '% '|value| val |$InteractiveFrame|))
      (|updateHist|)))
```

35.4.22 defun undoChanges

```
[boot-equal p??]
[undoChanges p591]
[putHist p588]
[$HistList p??]
[$InteractiveFrame p??]
```

— defun undoChanges —

```
(defun |undoChanges| (li)
  (let (x)
    (declare (special |$HistList| |$InteractiveFrame|))
    (when (null (boot-equal (cdr li) |$HistList|)) (|undoChanges| (cdr li)))
    (dolist (p1 (car li))
      (setq x (car p1))
      (dolist (p2 (cdr p1))
        (|putHist| x (car p2) (cdr p2) |$InteractiveFrame|))))))
```

—————

35.4.23 defun undoFromFile

```
[seq p??]
[exit p??]
[recordOldValue p590]
[recordNewValue p589]
[readHiFi p599]
[disableHist p601]
[putHist p588]
[assq p1052]
[updateHist p587]
[$InteractiveFrame p??]
[$HiFiAccess p730]
```

— defun undoFromFile —

```
(defun |undoFromFile| (n)
  (let (var1 prop vec x p p1 val)
    (declare (special |$InteractiveFrame| |$HiFiAccess|))
    (do ((tmp0 (caar |$InteractiveFrame|) (cdr tmp0)) (tmp1 nil))
      ((or (atom tmp0)
           (progn (setq tmp1 (car tmp0)) nil)
           (progn
              (progn
                (setq x (car tmp1))
                (setq var1 (cdr tmp1))
                tmp1)
              nil))
         nil)
      (seq
       (exit
        (do ((tmp2 var1 (cdr tmp2)) (p nil))
```

```

      ((or (atom tmp2) (progn (setq p (car tmp2)) nil)) nil)
    (seq
      (exit
        (progn
          (setq prop (car p))
          (setq val (cdr p))
          (when val
            (progn
              (when (null (eq x '%))
                (|recordOldValue| x prop val))
              (when (|$HiFiAccess|
                (|recordNewValue| x prop val))
              (rplacd p nil))))))))))
  (do ((i 1 (1+ i)))
    ((> i n) nil)
    (setq vec
      (unwind-protect (cdr (|readHiFi| i)) (|disableHist|)))
    (do ((tmp3 vec (cdr tmp3)) (p1 nil))
      ((or (atom tmp3) (progn (setq p1 (car tmp3)) nil)) nil)
      (setq x (car p1))
      (do ((tmp4 (cdr p1) (cdr tmp4)) (p2 nil))
        ((or (atom tmp4) (progn (setq p2 (car tmp4)) nil)) nil)
        (setq (|$InteractiveFrame|
          (|putHist| x (car p2) (CDR p2) (|$InteractiveFrame|))))
      (setq val
        (and
          (setq p (assq '% vec))
          (setq p1 (assq '|value| (cdr p)))
          (cdr p1)))
      (setq (|$InteractiveFrame| (|putHist| '% '|value| val (|$InteractiveFrame|))
        (|updateHist|)))

```

35.4.24 defun saveHistory

```

[sayKeyedMsg p329]
[makeInputFilename p981]
[histFileName p578]
[throwKeyedMsg p??]
[makeHistFileName p577]
[histInputFileName p578]
[writeInputLines p585]
[histFileErase p615]
[rdefiostream p??]
[spadrwrite0 p602]
[object2Identifier p??]

```

```
[rshut p??]
[namestring p1042]
[$seen p??]
[$HiFiAccess p730]
[$useInternalHistoryTable p577]
[$internalHistoryTable p??]
```

— defun saveHistory —

```
(defun |saveHistory| (fn)
  (let (|$seen| savefile inputfile saveStr n rec val)
    (declare (special |$seen| |$HiFiAccess| |$useInternalHistoryTable|
                      |$internalHistoryTable|))
    (setq |$seen| (make-hash-table :test #'eq))
    (cond
      ((null |$HiFiAccess|)
       (|sayKeyedMsg| 's2ih0016 nil)) ; the history file is not on
      ((and (null |$useInternalHistoryTable|)
            (null (makeInputFilename (|histFileName|))))
       (|sayKeyedMsg| 's2ih0022 nil)) ; no history saved yet
      (null fn)
       (|throwKeyedMsg| 's2ih0037 nil)) ; need to specify a history filename
    (t
     (setq savefile (|makeHistFileName| fn))
     (setq inputfile (|histInputFileName| fn))
     (|writeInputLines| fn 1)
     (|histFileErase| savefile)
     (when |$useInternalHistoryTable|
      (setq saveStr
        (rdefiostream
         (cons '(mode . output)
              (cons (cons 'file savefile) nil))))
      (do ((tmp0 (reverse |$internalHistoryTable|) (cdr tmp0))
          (tmp1 nil))
          ((or (atom tmp0)
               (progn (setq tmp1 (car tmp0)) nil)
               (progn
                (progn
                 (setq n (car tmp1))
                 (setq rec (cdr tmp1))
                 tmp1)
                nil))
           nil)
       (setq val (spadrwrite0 (|object2Identifier| n) rec saveStr))
       (when (eq val '|writifyFailed|)
        (|sayKeyedMsg| 's2ih0035 ; can't save the value of step
                      (list n inputfile))))
     (rshut saveStr))
    (|sayKeyedMsg| 's2ih0018 ; saved history file is
```

```
(cons (|namestring| savefile) nil))
nil))))
```

35.4.25 defun restoreHistory

```
[qcdr p??]
[qcar p??]
[identp p1048]
[throwKeyedMsg p??]
[makeHistFileName p577]
[putHist p588]
[makeInputFilename p981]
[sayKeyedMsg p329]
[namestring p1042]
[clearSpad2Cmd p498]
[histFileName p578]
[histFileErase p615]
[$fcopy p??]
[rkeyids p??]
[readHiFi p599]
[disableHist p601]
[updateInCoreHist p588]
[get p??]
[rempropI p??]
[clearCmdSortedCaches p499]
[$options p??]
[$internalHistoryTable p??]
[$HiFiAccess p730]
[$e p??]
[$useInternalHistoryTable p577]
[$InteractiveFrame p??]
[$oldHistoryFileName p576]
```

— defun restoreHistory —

```
(defun |restoreHistory| (fn)
  (let (|$options| fnq restfile curfile l oldInternal vec line x a)
    (declare (special |$options| |$internalHistoryTable| |$HiFiAccess| |$e|
      |$useInternalHistoryTable| |$InteractiveFrame| |$oldHistoryFileName|))
    (cond
      ((null fn) (setq fnq |$oldHistoryFileName|))
      ((and (consp fn)
        (eq (qcdr fn) nil)
```

```

(progn
  (setq fnq (qcar fn))
  t)
(identp fnq))
(setq fnq fnq))
(t (|throwKeyedMsg| 's2ih0023 (cons fnq nil)))) ; invalid filename
(setq restfile (|makeHistFileName| fnq))
(if (null (makeInputFilename restfile))
  (|sayKeyedMsg| 's2ih0024 ; file does not exist
    (cons (|namestring| restfile) nil))
  (progn
    (setq |$options| nil)
    (|clearSpad2Cmd| '(|all|))
    (setq curfile (|histFileName|))
    (|histFileErase| curfile)
    ($fcopy restfile curfile)
    (setq l (length (rkeyids curfile)))
    (setq |$HiFiAccess| t)
    (setq oldInternal |$useInternalHistoryTable|)
    (setq |$useInternalHistoryTable| nil)
    (when oldInternal (setq |$internalHistoryTable| nil))
    (do ((i 1 (1+ i)))
      ((> i l) nil)
      (setq vec (unwind-protect (|readHiFi| i) (|disableHist|)))
      (when oldInternal
        (setq |$internalHistoryTable|
          (cons (cons i vec) |$internalHistoryTable|)))
      (setq line (car vec))
      (dolist (p1 (cdr vec))
        (setq x (car p1))
        (do ((tmp1 (cdr p1) (cdr tmp1)) (p2 nil))
          ((or (atom tmp1) (progn (setq p2 (car tmp1)) nil)) nil)
          (setq |$InteractiveFrame|
            (|putHist| x
              (car p2) (cdr p2) |$InteractiveFrame|))))
        (|updateInCoreHist|))
      (setq |$e| |$InteractiveFrame|)
      (do ((tmp2 (caar |$InteractiveFrame|) (cdr tmp2)) (tmp3 nil))
        ((or (atom tmp2)
          (progn
            (setq tmp3 (car tmp2))
            nil)
          (progn
            (progn
              (setq a (car tmp3))
              tmp3)
            nil))
          nil)
        (when (|get| a '|localModemap| |$InteractiveFrame|)
          (|rempropI| a '|localModemap|))

```



```

      (|rempropI| a ' |localVars|)
      (|rempropI| a ' |mapBody|)))
  (setq |$IOindex| (1+ 1))
  (setq |$useInternalHistoryTable| oldInternal)
  (|sayKeyedMsg| 'S2IH0025 ; workspace restored
    (cons (|namestring| restfile) nil))
  (|clearCmdSortedCaches|)
  nil))))

```

35.4.26 defun setIOindex

[*\$IOindex* *p??*]

— defun setIOindex —

```

(defun |setIOindex| (n)
  (declare (special |$IOindex|))
  (setq |$IOindex| n))

```

35.4.27 defun showInput

[*tab* *p??*]
 [readHiFi *p599*]
 [disableHist *p601*]
 [sayMSG *p331*]

— defun showInput —

```

(defun |showInput| (mini maxi)
  (let (vec l)
    (do ((|ind| mini (+ |ind| 1)))
      ((> |ind| maxi) nil)
      (setq vec (unwind-protect (|readHiFi| |ind|) (|disableHist|)))
      (cond
        ((> 10 |ind|) (tab 2))
        ((> 100 |ind|) (tab 1))
        (t nil))
      (setq l (car vec))
      (if (stringp l)
        (|sayMSG| (list " [" |ind| "]" " (car vec)))
        (progn

```

```
(|sayMSG| (list " [" |ind| "]" "))
(do ((tmp0 1 (cdr tmp0)) (ln nil))
  ((or (atom tmp0) (progn (setq ln (car tmp0)) nil)) nil)
(|sayMSG| (list " " ln))))))
```

35.4.28 defun showInOut

```
[assq p1052]
[spadPrint p??]
[objValUnwrap p??]
[objMode p??]
[readHiFi p599]
[disableHist p601]
[sayMSG p331]
```

— defun showInOut —

```
(defun |showInOut| (mini maxi)
  (let (vec Alist triple)
    (do ((ind mini (+ ind 1))
        ((> ind maxi) nil)
      (setq vec (unwind-protect (|readHiFi| ind) (|disableHist|)))
      (|sayMSG| (cons (car vec) nil))
      (cond
        ((setq Alist (assq '% (cdr vec)))
         (setq triple (cdr (assq '|value| (cdr Alist))))
         (setq |$I0index| ind)
         (|spadPrint| (|objValUnwrap| triple) (|objMode| triple)))))))
```

35.4.29 defun fetchOutput

```
[boot-equal p??]
[spaddifference p??]
[getI p??]
[throwKeyedMsg p??]
[readHiFi p599]
[disableHist p601]
[assq p1052]
```

— defun fetchOutput —

```

(defun |fetchOutput| (n)
  (let (vec Alist val)
    (cond
      ((and (boot-equal n (spaddifference 1)) (setq val (|getI| '% '|value|)))
        val)
      (|$HiFiAccess|
        (setq n
          (cond
            ((minusp n) (+ |$IOindex| n))
            (t n)))
          (cond
            ((>= n |$IOindex|)
              (|throwKeyedMsg| 'S2IH0001 (cons n nil))) ; no step n yet
            (> 1 n)
              (|throwKeyedMsg| 's2ih0002 (cons n nil))) ; only nonzero steps
            (t
              (setq vec (unwind-protect (|readHiFi| n) (|disableHist|)))
              (cond
                ((setq Alist (assq '% (cdr vec)))
                  (cond
                    ((setq val (cdr (assq '|value| (cdr Alist))))
                      val)
                    (t
                      (|throwKeyedMsg| 's2ih0003 (cons n nil)))) ; no step value
                  (t (|throwKeyedMsg| 's2ih0003 (cons n nil)))))) ; no step value
              (t (|throwKeyedMsg| 's2ih0004 nil)))) ; history not on

```

35.4.30 Read the history file using index n

```

[assoc p??]
[keyedSystemError p??]
[qcdr p??]
[rdefiostream p??]
[histFileName p578]
[spadrread p603]
[object2Identifier p??]
[rshut p??]
[$useInternalHistoryTable p577]
[$internalHistoryTable p??]

```

— defun readHiFi —

```

(defun |readHiFi| (n)
  "Read the history file using index n"
  (let (pair HiFi vec)

```

```

(declare (special |$useInternalHistoryTable| |$internalHistoryTable|))
(if |$useInternalHistoryTable|
  (progn
    (setq pair (|assoc| n |$internalHistoryTable|))
    (if (atom pair)
      (|keyedSystemError| 's2ih0034 nil) ; missing element
      (setq vec (qcdr pair))))
  (progn
    (setq HiFi
      (rdefiostream
        (cons
          '(mode . input)
          (cons
            (cons 'file (|histFileName|)) nil))))
    (setq vec (spadrread (|object2Identifier| n) HiFi))
    (rshut HiFi)))
vec))

```

35.4.31 Write information of the current step to history file

```

[rdefiostream p??]
[histFileName p578]
[spadrwrite p603]
[object2Identifier p??]
[rshut p??]
[$useInternalHistoryTable p577]
[$internalHistoryTable p??]
[$IOindex p??]
[$HistRecord p??]
[$currentLine p??]

```

— defun writeHiFi —

```

(defun |writeHiFi| ()
  "Writes information of the current step to history file"
  (let (HiFi)
    (declare (special |$useInternalHistoryTable| |$internalHistoryTable|
      |$IOindex| |$HistRecord| |$currentLine|))
    (if |$useInternalHistoryTable|
      (setq |$internalHistoryTable|
        (cons
          (cons |$IOindex|
            (cons |$currentLine| |$HistRecord|))
          |$internalHistoryTable|))
      (progn

```

```
(setq HiFi
  (rdefiostream
    (cons
      '(mode . output)
      (cons (cons 'file (|histFileName|)) nil))))
(spadrwrite (|object2Identifier| |$IOindex|)
  (cons |$currentLine| |$HistRecord|) HiFi)
(rshut HiFi))))
```

35.4.32 Disable history if an error occurred

```
[histFileErase p615]
[histFileName p578]
[$HiFiAccess p730]
```

— defun disableHist —

```
(defun |disableHist| ()
  "Disable history if an error occurred"
  (declare (special |$HiFiAccess|))
  (cond
    ((null |$HiFiAccess|)
      (|histFileErase| (|histFileName|)))
    (t nil)))
```

35.4.33 defun writeHistModesAndValues

```
[get p??]
[putHist p588]
[$InteractiveFrame p??]
```

— defun writeHistModesAndValues —

```
(defun |writeHistModesAndValues| ()
  (let (a x)
    (declare (special |$InteractiveFrame|))
    (do ((tmp0 (caar |$InteractiveFrame|) (cdr tmp0)) (tmp1 nil))
      ((or (atom tmp0)
        (progn
          (setq tmp1 (car tmp0))
          nil))
```

```

      (progn
        (progn
          (setq a (car tmp1))
          tmp1)
        nil))
    nil)
  (cond
    ((setq x (|get| a '|value| |$InteractiveFrame|))
     (|putHist| a '|value| x |$InteractiveFrame|))
    ((setq x (|get| a '|mode| |$InteractiveFrame|))
     (|putHist| a '|mode| x |$InteractiveFrame|))))))

```

35.5 Lisplib output transformations

Lisplib output transformations

Some types of objects cannot be saved by LISP/VM in lislibs. These functions transform an object to a writable form and back.

35.5.1 defun spadrwrite0

```

[safeWritify p604]
[rwrite p602]

```

— defun spadrwrite0 —

```

(defun spadrwrite0 (vec item stream)
  (let (val)
    (setq val (|safeWritify| item))
    (if (eq val '|writifyFailed|)
        val
        (progn
          (|rwrite| vec val stream)
          item))))

```

35.5.2 defun Random write to a stream

```

[rwrite p602]
[pname p1047]
[identp p1048]

```

— defun rwrite —

```
(defun |rwrite| (key val stream)
  (when (identp key) (setq key (pname key)))
  (rwrite key val stream)))
```

—————

35.5.3 defun spadrwrite

[spadrwrite0 p602]
[throwKeyedMsg p??]

— defun spadrwrite —

```
(defun spadrwrite (vec item stream)
  (let (val)
    (setq val (spadrwrite0 vec item stream))
    (if (eq val '|writifyFailed|)
        (|throwKeyedMsg| 's2ih0036 nil) ; cannot save value to file
        item)))
```

—————

35.5.4 defun spadrread

[dewritify p613]
[rread p603]

— defun spadrread —

```
(defun spadrread (vec stream)
  (|dewritify| (|rread| vec stream nil)))
```

—————

35.5.5 defun Random read a key from a stream

RREAD takes erroval to return if key is missing [rread p603]
[identp p1048]
[pname p1047]

— defun rread —

```
(defun |rread| (key rstream errorval)
  (when (identp key) (setq key (pname key)))
  (rread key rstream errorval))
```

35.5.6 defun unwritable?

```
[vecp p??]
[placep p??]
```

— defun unwritable? —

```
(defun |unwritable?| (ob)
  (cond
    ((or (consp ob) (vecp ob)) nil)
    ((or (compiled-function-p ob) (hash-table-p ob)) t)
    ((or (placep ob) (readtablep ob)) t)
    ((floatp ob) t)
    (t nil)))
```

35.5.7 defun writifyComplain

Create a full isomorphic object which can be saved in a lisplib. Note that `dewritify(writify(x))` preserves `UEQUALity` of hashtables. `HASHTABLEs` go both ways. `READTABLEs` cannot presently be transformed back. [sayKeyedMsg p329]
 [\$writifyComplained p??]

— defun writifyComplain —

```
(defun |writifyComplain| (s)
  (declare (special |$writifyComplained|))
  (unless |$writifyComplained|
    (setq |$writifyComplained| t)
    (|sayKeyedMsg| 's2ih0027 (list s)))) ; cannot save value
```

35.5.8 defun safeWritify

```
[writifyTag p??]
[writify p608]
```


— defun safeWritify —

```
(defun |safeWritify| (ob)
  (catch '|writifyTag| (|writify| ob)))
```

—————

35.5.9 defun writify,writifyInner

```
[writifyTag p??]
[seq p??]
[exit p??]
[hget p1046]
[qcar p??]
[qcdr p??]
[spadClosure? p609]
[writify,writifyInner p605]
[hput p1046]
[qrplaca p??]
[qrplacd p??]
[vecp p??]
[isDomainOrPackage p873]
[mkEvalable p911]
[devaluate p??]
[qvmaxindex p??]
[qsetvelt p??]
[qvelt p??]
[constructor? p??]
[hkeys p1046]
[hash-table-class p??]
[placep p??]
[boot-equal p??]
[$seen p??]
[$NonNullStream p609]
[$NullStream p609]
```

— defun writify,writifyInner —

```
(defun |writify,writifyInner| (ob)
  (prog (e name tmp1 tmp2 tmp3 x qcar qcdr d n keys nob)
    (declare (special |$seen| |$NonNullStream| |$NullStream|))
    (return
      (seq
        (when (null ob) (exit nil))
```

```

(when (setq e (hget |$seen| ob)) (exit e))
(when (consp ob)
  (exit
    (seq
      (setq qcar (qcar ob))
      (setq qcdr (qcdr ob))
      (when (setq name (|spadClosure?| ob))
        (exit
          (seq
            (setq d (|writify,writifyInner| (qcdr ob)))
            (setq nob
              (cons 'writified!!
                (cons 'spadclosure
                  (cons d (cons name nil))))))
            (hput |$seen| ob nob)
            (hput |$seen| nob nob)
            (exit nob))))
        (when
          (and
            (and (consp ob)
              (eq (qcar ob) 'lambda-closure)
              (progn
                (setq tmp1 (qcdr ob))
                (and (consp tmp1)
                  (progn
                    (setq tmp2 (qcdr tmp1))
                    (and
                      (consp tmp2)
                      (progn
                        (setq tmp3 (qcdr tmp2))
                        (and (consp tmp3)
                          (progn
                            (setq x (qcar tmp3))
                            t)))))))) x)
              (exit
                (throw '|writifyTag| '|writifyFailed|)))
                (setq nob (cons qcar qcdr))
                (hput |$seen| ob nob)
                (hput |$seen| nob nob)
                (setq qcar (|writify,writifyInner| qcar))
                (setq qcdr (|writify,writifyInner| qcdr))
                (qrplaca nob qcar)
                (qrplacd nob qcdr)
                (exit nob))))
          (when (vecp ob)
            (exit
              (seq
                (when (|isDomainOrPackage| ob)
                  (setq d (|mkEvalable| (|devaluate| ob)))
                  (setq nob (list 'writified!! 'devaluated (|writify,writifyInner| d)))

```

```

      (hput |$seen| ob nob)
      (hput |$seen| nob nob)
      (exit nob))
    (setq n (qvmaxindex ob))
    (setq nob (make-array (1+ n)))
    (hput |$seen| ob nob)
    (hput |$seen| nob nob)
    (do ((i 0 (≠ i)))
        ((> i n) nil)
      (qsetvelt nob i (|writify,writifyInner| (qvvelt ob i))))
    (exit nob)))
(when (eq ob 'writified!!)
  (exit
    (cons 'writified!! (cons 'self nil))))
(when (|constructor?| ob)
  (exit ob))
(when (compiled-function-p ob)
  (exit
    (throw '|writifyTag| '|writifyFailed|)))
(when (hash-table-p ob)
  (setq nob (cons 'writified!! nil))
  (hput |$seen| ob nob)
  (hput |$seen| nob nob)
  (setq keys (hkeys ob))
  (qrplacd nob
    (cons
      'hashtable
      (cons
        (hashtable-class ob)
        (cons
          (|writify,writifyInner| keys)
          (cons
            (prog (tmp0)
              (setq tmp0 nil)
              (return
                (do ((tmp1 keys (cdr tmp1)) (k nil))
                    ((or (atom tmp1)
                        (progn
                          (setq k (car tmp1))
                          nil))
                  (nreverse0 tmp0))
              (setq tmp0
                (cons (|writify,writifyInner| (hget ob k)) tmp0))))
            nil))))))
    (exit nob))
(when (placep ob)
  (setq nob (cons 'writified!! (cons 'place nil)))
  (hput |$seen| ob nob)
  (hput |$seen| nob nob)
  (exit nob))

```

```

(when (readtablep ob)
  (exit
    (throw '|writifyTag| '|writifyFailed|)))
(when (stringp ob)
  (exit
    (seq
      (when (eq ob |$NullStream|)
        (exit
          (cons 'writified!! (cons 'nullstream nil))))
      (when (eq ob |$NonNullStream|)
        (exit
          (cons 'writified!! (cons 'nonnullstream nil))))
      (exit ob))))
(when (floatp ob)
  (exit
    (seq
      (when (boot-equal ob (read-from-string (princ-to-string ob)))
        (exit ob))
      (exit
        (cons 'writified!!
          (cons 'float
            (cons ob
              (multiple-value-list (integer-decode-float ob))))))))
  (exit ob))))

```

35.5.10 defun writify

```

[ScanOrPairVec p614]
[function p??]
[writify,writifyInner p605]
[$seen p??]
[$writifyComplained p??]

```

— defun writify —

```

(defun |writify| (ob)
  (let (|$seen| |$writifyComplained|)
    (declare (special |$seen| |$writifyComplained|))
    (if (null (|ScanOrPairVec| (|function| |unwritable?|) ob))
      ob
      (progn
        (setq |$seen| (make-hash-table :test #'eq))
        (setq |$writifyComplained| nil)
        (|writify,writifyInner| ob))))

```

35.5.11 defun spadClosure?

```
[qcar p??]
[bpname p??]
[qcdr p??]
[vecp p??]
```

— defun spadClosure? —

```
(defun |spadClosure?| (ob)
  (let (fun name vec)
    (setq fun (qcar ob))
    (if (null (setq name (bpname fun)))
        nil
        (progn
         (setq vec (qcdr ob))
         (if (null (vecp vec))
             nil
             name))))))
```

35.5.12 defvar \$NonnullStream

— initvars —

```
(defvar |$NonnullStream| "NonnullStream")
```

35.5.13 defvar \$NullStream

— initvars —

```
(defvar |$NullStream| "NullStream")
```

35.5.14 defun dewritify,dewritifyInner

```

[seq p??]
[exit p??]
[hget p1046]
[intp p??]
[gensymmer p??]
[error p??]
[poundsign p??]
[hput p1046]
[dewritify,dewritifyInner p610]
[concat p1049]
[vmread p??]
[make-instream p979]
[spaddifference p??]
[qcar p??]
[qcdr p??]
[qrplaca p??]
[qrplacd p??]
[vecp p??]
[qvmaxindex p??]
[qsetvelt p??]
[qvelt p??]
[$seen p??]
[$NullStream p609]
[$NonNullStream p609]

```

— defun dewritify,dewritifyInner —

```

(defun |dewritify,dewritifyInner| (ob)
  (prog (e type oname f vec name tmp1 signif expon sign fval qcar qcdr n nob)
    (declare (special |$seen| |$NullStream| |$NonNullStream|))
    (return
      (seq
        (when (null ob)
          (exit nil))
        (when (setq e (hget |$seen| ob))
          (exit e))
        (when (and (consp ob) (eq (car ob) 'writified!))
          (exit
            (seq
              (setq type (elt ob 1))
              (when (eq type 'self)
                (exit 'writified!))
              (when (eq type 'bpi)
                (exit
                  (seq

```

```

(setq oname (elt ob 2))
(setq f
  (seq
    (when (integerp oname) (exit (eval (gensymmer oname))))
    (exit (symbol-function oname))))
(when (null (compiled-function-p f))
  (exit (|error| "A required BPI does not exist.")))
(when (and (> (|#| ob) 3) (not (equal (sxhash f) (elt ob 3))))
  (exit (|error| "A required BPI has been redefined.")))
(hput |$seen| ob f)
(exit f)))
(when (eq type 'hashtable)
  (exit
    (seq
      (setq nob (make-hash-table :test #'equal))
      (hput |$seen| ob nob)
      (hput |$seen| nob nob)
      (do ((tmp0 (elt ob 3) (cdr tmp0))
          (k nil)
          (tmp1 (elt ob 4) (cdr tmp1))
          (e nil))
          ((or (atom tmp0)
              (progn
                (setq k (car tmp0))
                nil)
              (atom tmp1)
              (progn
                (setq e (car tmp1))
                nil)))
          nil)
      (seq
        (exit
          (hput nob (|dewritify,dewritifyInner| k)
            (|dewritify,dewritifyInner| e))))
        (exit nob))))
  (when (eq type 'devaluated)
    (exit
      (seq
        (setq nob (eval (|dewritify,dewritifyInner| (elt ob 2))))
        (hput |$seen| ob nob)
        (hput |$seen| nob nob)
        (exit nob))))
    (when (eq type 'spadclosure)
      (exit
        (seq
          (setq vec (|dewritify,dewritifyInner| (elt ob 2)))
          (setq name (ELT ob 3))
          (when (null (fboundp name))
            (exit
              (|error|

```

```

        (concat "undefined function: " (symbol-name name))))))
      (setq nob (cons (symbol-function name) vec))
      (hput |$seen| ob nob)
      (hput |$seen| nob nob)
      (exit nob))))
    (when (eq type 'place)
      (exit
        (seq
          (setq nob (vmread (make-instream nil)))
          (hput |$seen| ob nob)
          (hput |$seen| nob nob)
          (exit nob))))))
    (when (eq type 'readtable)
      (exit (|error| "Cannot de-writify a read table.")))
    (when (eq type 'nullstream)
      (exit |$NullStream|))
    (when (eq type 'nonnullstream)
      (exit |$NonnullStream|))
    (when (eq type 'float)
      (exit
        (seq
          (progn
            (setq tmp1 (cddr ob))
            (setq fval (car tmp1))
            (setq signif (cadr tmp1))
            (setq expon (caddr tmp1))
            (setq sign (caddr tmp1))
            tmp1)
          (setq fval (scale-float (float signif fval) expon))
          (when (minusp sign)
            (exit (spaddifference fval)))
          (exit fval))))))
      (exit (|error| "Unknown type to de-writify."))))))
    (when (consp ob)
      (exit
        (seq
          (setq qcar (qcar ob))
          (setq qcdr (qcdr ob))
          (setq nob (cons qcar qcdr))
          (hput |$seen| ob nob)
          (hput |$seen| nob nob)
          (qrplaca nob (|dewritify,dewritifyInner| qcar))
          (qrplacd nob (|dewritify,dewritifyInner| qcdr))
          (exit nob))))))
    (when (vecp ob)
      (exit
        (seq
          (setq n (qvmaxindex ob))
          (setq nob (make-array (1+ n)))
          (hput |$seen| ob nob)

```



```

(hput |$seen| nob nob)
(do ((i 0 (1+ i)))
    (> i n) nil)
(seq
 (exit
  (qsetvelt nob i
   (|dewritify,dewritifyInner| (qveld ob i))))))
(exit nob)))
(exit ob))))

```

35.5.15 defun dewritify

```

[ScanOrPairVec p614]
[function p??]
[dewritify,dewritifyInner p610]
[$seen p??]

```

— defun dewritify —

```

(defun |dewritify| (ob)
  (let (|$seen|)
    (declare (special |$seen|))
    (if (null (|ScanOrPairVec| #'(lambda (a) (eq a 'writified!!)) ob))
        ob
        (progn
         (setq |$seen| (make-hash-table :test #'eq))
         (|dewritify,dewritifyInner| ob)))))

```

35.5.16 defun ScanOrPairVec,ScanOrInner

```

[ScanOrPairVecAnswer p??]
[hget p1046]
[hput p1046]
[ScanOrPairVec,ScanOrInner p613]
[qcar p??]
[qcdr p??]
[vecp p??]
[$seen p??]

```

— defun ScanOrPairVec,ScanOrInner —

```
(defun |ScanOrPairVec,ScanOrInner| (f ob)
  (declare (special |$seen|))
  (when (hget |$seen| ob) nil)
  (when (consp ob)
    (hput |$seen| ob t)
    (|ScanOrPairVec,ScanOrInner| f (qcar ob))
    (|ScanOrPairVec,ScanOrInner| f (qcdr ob)))
  (when (vecp ob)
    (hput |$seen| ob t)
    (do ((tmp0 (spaddifference (|#| ob) 1)) (i 0 (1+ i)))
        ((> i tmp0) nil)
      (|ScanOrPairVec,ScanOrInner| f (elt ob i))))
  (when (funcall f ob) (throw '|ScanOrPairVecAnswer| t))
  nil)
```

35.5.17 defun ScanOrPairVec

```
[ScanOrPairVecAnswer p??]
[ScanOrPairVec,ScanOrInner p613]
[$seen p??]
```

— defun ScanOrPairVec —

```
(defun |ScanOrPairVec| (f ob)
  (let (|$seen|)
    (declare (special |$seen|))
    (setq |$seen| (make-hash-table :test #'eq))
    (catch '|ScanOrPairVecAnswer| (|ScanOrPairVec,ScanOrInner| f ob))))
```

35.5.18 defun gensymInt

```
[gensymp p??]
[error p??]
[pname p1047]
[charDigitVal p615]
```

— defun gensymInt —

```
(defun |gensymInt| (g)
  (let (p n)
    (if (null (gensymp g))
```

```
(|error| "Need a GENSYM")
(progn
  (setq p (pname g))
  (setq n 0)
  (do ((tmp0 (spaddifference (|#| p) 1)) (i 2 (1+ i)))
      ((> i tmp0) nil)
      (setq n (+ (* 10 n) (|charDigitVal| (elt p i)))))
  n)))
```

35.5.19 defun charDigitVal

```
[spaddifference p??]
[error p??]
```

— defun charDigitVal —

```
(defun |charDigitVal| (c)
  (let (digits n)
    (setq digits "0123456789")
    (setq n (spaddifference 1))
    (do ((tmp0 (spaddifference (|#| digits) 1)) (i 0 (1+ i)))
        ((or (> i tmp0) (null (minusp n))) nil)
        (if (char= c (elt digits i))
            (setq n i)
            nil))
    (if (minusp n)
        (|error| "Character is not a digit")
        n)))
```

35.5.20 defun histFileErase

— defun histFileErase —

```
(defun |histFileErase| (file)
  (when (probe-file file) (delete-file file)))
```

35.6 History File Messages

— History File Messages —

S2IH0001

You have not reached step %1b yet, and so its value cannot be supplied.

S2IH0002

Cannot supply value for step %1b because 1 is the first step.

S2IH0003

Step %1b has no value.

S2IH0004

The history facility is not on, so you cannot use %b %% %d .

S2IH0006

You have not used the correct syntax for the %b history %d command.

Issue %b)help history %d for more information.

S2IH0007

The history facility is already on.

S2IH0008

The history facility is now on.

S2IH0009

Turning on the history facility will clear the contents of the workspace.

Please enter %b y %d or %b yes %d if you really want to do this:

S2IH0010

The history facility is still off.

S2IH0011

The history facility is already off.

S2IH0012

The history facility is now off.

S2IH0013

The history facility is not on, so the .input file containing your user input cannot be created.

S2IH0014

Edit %b %1 %d to see the saved input lines.

S2IH0015

The argument %b n %d for %b)history)change n must be a nonnegative integer and your argument, %1b , is not one.

S2IH0016

The history facility is not on, so no information can be saved.

S2IH0018

The saved history file is %1b .

S2IH0019

There is no history file, so value of step %1b is undefined.

S2IH0022

No history information had been saved yet.

S2IH0023

%1b is not a valid filename for the history file.
S2IH0024
History information cannot be restored from %1b because the file does not exist.
S2IH0025
The workspace has been successfully restored from the history file %1b .
S2IH0026
The history facility command %1b cannot be performed because the history facility is not on.
S2IH0027
A value containing a %1b is being saved in a history file or a compiled input file INLIB. This type is not yet usable in other history operations. You might want to issue %b)history)off %d
S2IH0029
History information is already being maintained in an external file (and not in memory).
S2IH0030
History information is already being maintained in memory (and not in an external file).
S2IH0031
When the history facility is active, history information will be maintained in a file (and not in an internal table).
S2IH0032
When the history facility is active, history information will be maintained in memory (and not in an external file).
S2IH0034
Missing element in internal history table.
S2IH0035
Can't save the value of step number %1b. You can re-generate this value by running the input file %2b.
S2IH0036
The value specified cannot be saved to a file.
S2IH0037
You must specify a file name to the history save command
S2IH0038
You must specify a file name to the history write command

Chapter 36

)include help page Command

36.1 include help page man page

— include.help —

User Level Required: interpreter

Command Syntax:

```
)include filename
```

Command Description:

The `)include` command can be used in `.input` files to place the contents of another file inline with the current file. The path can be an absolute or relative pathname.

36.2 Functions

36.2.1 defun ncloopInclude1

[ncloopIncFileName p620]

[ncloopInclude p620]

— defun ncloopInclude1 —

```
(defun |ncloopInclude1| (name n)
  (let (a)
    (if (setq a (|ncloopIncFileName| name))
        (|ncloopInclude| a n)
        n)))
```

36.2.2 Returns the first non-blank substring of the given string

[incFileName p620]
[concat p1049]

— defun ncloopIncFileName —

```
(defun |ncloopIncFileName| (string)
  "Returns the first non-blank substring of the given string"
  (let (fn)
    (unless (setq fn (|incFileName| string))
      (write-line (concat string " not found"))))
  fn))
```

36.2.3 Open the include file and read it in

The ncloopInclude0 function is part of the parser and lives in int-top.boot. [ncloopInclude0 p73]

— defun ncloopInclude —

```
(defun |ncloopInclude| (name n)
  "Open the include file and read it in"
  (with-open-file (st name) (|ncloopInclude0| st name n)))
```

36.2.4 Return the include filename

Given a string we return the first token from the string which is the first non-blank substring. [incBiteOff p621]

— defun incFileName —


```
(defun |incFileName| (x)
  "Return the include filename"
  (car (|incBiteOff| x)))
```

36.2.5 Return the next token

Takes a sequence and returns the a list of the first token and the remaining string characters. If there are no remaining string characters the second string is of length 0. Effectively it "bites off" the first token in the string. If the string only 0 or more blanks it returns nil.

— **defun incBiteOff** —

```
(defun |incBiteOff| (x)
  "Return the next token"
  (let (blank nonblank)
    (setq x (string x))
    (when (setq nonblank (position #\space x :test-not #'char=))
      (setq blank (position #\space x :start nonblank))
      (if blank
        (list (subseq x nonblank blank) (subseq x blank))
        (list (subseq x nonblank) ""))))))
```

Chapter 37

)library help page Command

37.1 library help page man page

— library.help —

```
=====
A.14. )library
=====
```

User Level Required: interpreter

Command Syntax:

-)library libName1 [libName2 ...]
-)library)dir dirName
-)library)only objName1 [objlib2 ...]
-)library)noexpose

Command Description:

This command replaces the)load system command that was available in AXIOM releases before version 2.0. The)library command makes available to AXIOM the compiled objects in the libraries listed.

For example, if you)compile dopler.spad in your home directory, issue)library dopler to have AXIOM look at the library, determine the category and domain constructors present, update the internal database with various properties of the constructors, and arrange for the constructors to be automatically loaded when needed. If the)noexpose option has not been given, the constructors will be exposed (that is, available) in the current frame.

If you compiled a file you will have an NRLIB present, for example,

DOPLER.NRLIB, where DOPLER is a constructor abbreviation. The command `)library DOPLER` will then do the analysis and database updates as above.

To tell the system about all libraries in a directory, use `)library)dir dirName` where `dirName` is an explicit directory. You may specify `‘.’` as the directory, which means the current directory from which you started the system or the one you set via the `)cd` command. The directory name is required.

You may only want to tell the system about particular constructors within a library. In this case, use the `)only` option. The command `)library dopler)only Test1` will only cause the `Test1` constructor to be analyzed, autoloaded, etc..

Finally, each constructor in a library are usually automatically exposed when the `)library` command is used. Use the `)noexpose` option if you not want them exposed. At a later time you can use `)set expose add constructor` to expose any hidden constructors.

Note for AXIOM beta testers: At various times this command was called `)local` and `)with` before the name `)library` became the official name.

Also See:

- o `)cd`
- o `)compile`
- o `)frame`
- o `)set`

¹ “cd” (?? p ??) “frame” (33.5.16 p 563) “set” (46.36.1 p 805)

Chapter 38

)lisp help page Command

38.1 lisp help page man page

— lisp.help —

```
=====
A.15. )lisp
=====
```

User Level Required: development

Command Syntax:

-)lisp [lispExpression]

Command Description:

This command is used by AXIOM system developers to have single expressions evaluated by the Lisp system on which AXIOM is built. The `lispExpression` is read by the Lisp reader and evaluated. If this expression is not complete (unbalanced parentheses, say), the reader will wait until a complete expression is entered.

Since this command is only useful for evaluating single expressions, the `)fin` command may be used to drop out of AXIOM into Lisp.

Also See:

- o)system
- o)boot
- o)fin

¹

38.2 Functions

This command is in the list of `$noParseCommands` 19.1.3 which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` 19.2.1

¹ “system” (?? p ??) “boot” (5.1.8 p 25) “fin” (32.1.1 p 546)

Chapter 39

)load help page Command

39.1 load help page man page

— load.help —

```
=====
A.16. )load
=====
```

User Level Required: interpreter

Command Description:

This command is obsolete. Use)library instead.

—————

39.1.1 defun The)load command (obsolete)

We keep this command around in case anyone has the original Axiom book. [sayKeyedMsg p329]

— defun load —

```
(defun |load| (ignore)
  (declare (ignore ignore))
  (|sayKeyedMsg| 'S2IU0003 nil))
```

—————

Chapter 40

)ltrace help page Command

40.1 ltrace help page man page

— ltrace.help —

```
=====
A.17. )ltrace
=====
```

User Level Required: development

Command Syntax:

This command has the same arguments as options as the)trace command.

Command Description:

This command is used by AXIOM system developers to trace Lisp or BOOT functions. It is not supported for general use.

Also See:

- o)boot
- o)lisp
- o)trace

1

¹ "boot" (5.1.8 p 25) "lisp" (?? p ??) "trace" (53.1.7 p 845)

40.1.1 defun The top level)ltrace function

[trace p845]

— defun ltrace —

(defun |ltrace| (arg) (|ltrace| arg))

—————

40.2 Variables Used

40.3 Functions

Chapter 41

)pquit help page Command

41.1 pquit help page man page

— pquit.help —

```
=====
A.18. )pquit
=====
```

User Level Required: interpreter

Command Syntax:

-)pquit

Command Description:

This command is used to terminate AXIOM and return to the operating system. Other than by redoing all your computations or by using the)history)restore command to try to restore your working environment, you cannot return to AXIOM in the same state.

)pquit differs from the)quit in that it always asks for confirmation that you want to terminate AXIOM (the ‘p’ is for ‘protected’). When you enter the)pquit command, AXIOM responds

Please enter y or yes if you really want to leave the interactive
environment and return to the operating system:

If you respond with y or yes, you will see the message

You are now leaving the AXIOM interactive environment.

Issue the command `axiom` to the operating system to start a new session.

and AXIOM will terminate and return you to the operating system (or the environment from which you invoked the system). If you responded with something other than `y` or `yes`, then the message

You have chosen to remain in the AXIOM interactive environment.

will be displayed and, indeed, AXIOM would still be running.

Also See:

- o `)fin`
- o `)history`
- o `)close`
- o `)quit`
- o `)system`

1

41.2 Functions

41.2.1 The top level `pquit` command

[`pquitSpad2Cmd` p632]

— **defun `pquit`** —

```
(defun |pquit| ()
  "The top level pquit command"
  (|pquitSpad2Cmd|))
```

41.2.2 The top level `pquit` command handler

[`quitSpad2Cmd` p636]

[\$`quitCommandType` p797]

— **defun `pquitSpad2Cmd`** —

¹ “`fin`” (32.1.1 p 546) “`history`” (35.4.7 p 580) “`close`” (25.2.2 p 508) “`quit`” (42.2.1 p 636) “`system`” (?? p ??)

```
(defun |pquitSpad2Cmd| ()  
  "The top level pquit command handler"  
  (let ((|$quitCommandType| ' |protected|))  
    (declare (special |$quitCommandType|))  
    (|quitSpad2Cmd|)))
```

This command is in the list of `$noParseCommands` 19.1.3 which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` 19.2.1

Chapter 42

)quit help page Command

42.1 quit help page man page

— quit.help —

```
=====
A.19. )quit
=====
```

User Level Required: interpreter

Command Syntax:

-)quit
-)set quit protected | unprotected

Command Description:

This command is used to terminate AXIOM and return to the operating system. Other than by redoing all your computations or by using the)history)restore command to try to restore your working environment, you cannot return to AXIOM in the same state.

)quit differs from the)pquit in that it asks for confirmation only if the command

)set quit protected

has been issued. Otherwise,)quit will make AXIOM terminate and return you to the operating system (or the environment from which you invoked the system).

The default setting is)set quit protected so that)quit and)pquit behave in

the same way. If you do issue

```
)set quit unprotected
```

we suggest that you do not (somehow) assign)quit to be executed when you press, say, a function key.

Also See:

- o)fin
- o)history
- o)close
- o)pquit
- o)system

1

42.2 Functions

42.2.1 The top level quit command

[quitSpad2Cmd p636]

— defun quit —

```
(defun |quit| ()
  "The top level quit command"
  (|quitSpad2Cmd|))
```

42.2.2 The top level quit command handler

```
[upcase p??]
[queryUserKeyedMsg p??]
[string2id-n p??]
[leaveScratchpad p637]
[sayKeyedMsg p329]
[tersyscommand p450]
[$quitCommandType p797]
```

¹ “fin” (32.1.1 p 546) “history” (35.4.7 p 580) “close” (25.2.2 p 508) “pquit” (41.2.1 p 632) “system” (?? p ??)

— defun quitSpad2Cmd —

```
(defun |quitSpad2Cmd| ()
  "The top level quit command handler"
  (declare (special |$quitCommandType|))
  (if (eq |$quitCommandType| '|protected|)
      (let (x)
        (setq x (upcase (|queryUserKeyedMsg| 's2iz0031 nil)))
        (when (member (string2id-n x 1) '(y yes)) (|leaveScratchpad|))
        (|sayKeyedMsg| 's2iz0032 nil)
        (tersyscommand))
      (|leaveScratchpad|)))
```

—————

42.2.3 Leave the Axiom interpreter

— defun leaveScratchpad —

```
(defun |leaveScratchpad| ()
  "Leave the Axiom interpreter"
  (bye))
```

—————

This command is in the list of `$noParseCommands` 19.1.3 which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` 19.2.1

Chapter 43

)read help page Command

43.1 read help page man page

— read.help —

```
=====
A.20. )read
=====
```

User Level Required: interpreter

Command Syntax:

-)read [fileName]
-)read [fileName] []quiet] []ifthere]

Command Description:

This command is used to read .input files into AXIOM. The command

)read matrix.input

will read the contents of the file matrix.input into AXIOM. The ‘.input’ file extension is optional. See the AXIOM User Guide index for more information about .input files.

This command remembers the previous file you edited, read or compiled. If you do not specify a file name, the previous file will be read.

The)ifthere option checks to see whether the .input file exists. If it does not, the)read command does nothing. If you do not use this option and the file does not exist, you are asked to give the name of an existing .input

file.

The `)quiet` option suppresses output while the file is being read.

Also See:

- o `)compile`
- o `)edit`
- o `)history`

1

43.1.1 defun The `)read` command

[readSpad2Cmd p640]

— defun read —

```
(defun |read| (arg) (|readSpad2Cmd| arg))
```

43.1.2 defun Implement the `)read` command

```
[selectOptionLC p477]
[optionError p447]
[pathname p1044]
[pathnameTypeId p1043]
[makePathname p1044]
[pathnameName p1042]
[mergePathnames p1043]
[findfile p??]
[throwKeyedMsg p??]
[namestring p1042]
[upcase p??]
[member p1050]
[/read p642]
[$InteractiveMode p24]
[$findfile p??]
[$UserLevel p804]
[$options p??]
[/editfile p513]
```

¹ “edit” (31.2.1 p 542) “history” (35.4.7 p 580)

— defun readSpad2Cmd —

```
(defun |readSpad2Cmd| (arg)
  (prog (|$InteractiveMode| fullopt ifthere quiet ef devFTs fileTypes
        ll ft upft fs)
    (declare (special |$InteractiveMode| $findfile |$UserLevel| |$Options|
                      /editfile))
    (setq |$InteractiveMode| t)
    (dolist (opt |$Options|)
      (setq fullopt
        (|selectOptionLC| (caar opt) '(|quiet| |test| |ifthere|) '|optionError|))
      (cond
        ((eq fullopt '|ifthere|) (setq ifthere t))
        ((eq fullopt '|quiet|) (setq quiet t))))
    (setq ef (|pathname| /editfile))
    (when (eq (|pathnameTypeId| ef) 'spad)
      (setq ef (|makePathname| (|pathnameName| ef) "*" "*")))
    (if arg
      (setq arg (|mergePathnames| (|pathname| arg) ef))
      (setq arg ef))
    (setq devFTs '("input" "INPUT" "boot" "BOOT" "lisp" "LISP"))
    (setq fileTypes
      (cond
        ((eq |$UserLevel| '|interpreter|) '("input" "INPUT"))
        ((eq |$UserLevel| '|compiler|) '("input" "INPUT"))
        (t devFTs)))
    (setq ll ($findfile arg fileTypes))
    (unless ll
      (if ifthere
        (return nil)
        (|throwKeyedMsg| 'S2IL0003 (list (|namestring| arg)))))
    (setq ll (|pathname| ll))
    (setq ft (|pathnameType| ll))
    (setq upft (upcase ft))
    (cond
      ((null (|member| upft fileTypes))
        (setq fs (|namestring| arg))
        (if (|member| upft devFTs)
          (|throwKeyedMsg| 'S2IZ0033 (list fs))
          (|throwKeyedMsg| 'S2IZ0034 (list fs))))
      (t
        (setq /editfile ll)
        (when (string= upft "BOOT") (setq |$InteractiveMode| nil))
        (/read ll quiet)))))
```

—————

43.1.3 defun /read

```
[/read /rf (vol9)]
[/read /rq (vol9)]
[/editfile p513]
```

— defun /read —

```
(defun /read (l q)
  (declare (special /editfile))
  (setq /editfile l)
  (cond
    (q (/rq))
    (t (/rf)) )
  (flag |boot-NewKEY| 'key)
  (|terminateSystemCommand|)
  (|spadPrompt|))
```

Chapter 44

)regress help page Command

44.1 regress help page man page

— regress.help —

```
=====
A.18. )regress
=====
```

User Level Required: interpreter

Command Syntax:

-)regress fileName

Command Description:

The regress command will run the regress function that was compiled as part of the lisp image build process. This function expects an input filename, possibly containing a path prefix.

If the filename contains a period then we consider it a fully formed filename, otherwise we append ‘.output’, which is the default file extension.

```
)regress matrix
)regress matrix.output
)regress /path/to/file/matrix
)regress /path/to/file/matrix.output
```

will test the contents of the file matrix.output.

The idea behind regression testing is to check that the results we currently get match the results we used to get. In order to do that we create input files with a special comment format that contains the prior results. These are easy to create as all you need to do is run the Axiom function, capture the results, and turn them input specially formed comments using the `-- comment`.

A regression file caches the result of an Axiom function so we can automate the testing process. It is a file of many tests, each with their own output.

The regression file format uses the Axiom `-- comment` syntax to keep a copy of the expected output from an Axiom command. This expected output is compared character by character against the actual output.

The regression file is broken into numbered blocks, delimited by a `--S` for the beginning and a `--E` for the end. The total number of blocks is also given so missing or failed tests also raise an error.

There are 4 special kinds of `-- comments` in regression files:

<code>--S n of M</code>	this is test n of M tests in this file
<code>--E n</code>	this marks the end of test n
<code>--R any output</code>	this marks the actual expected output line
<code>--I any output</code>	this line is compared but ignored

A regression test file looks like:

```
)set break resume
)spool foo.output
)set message type off
)clear all

--S 1 of 3
2+3
--R
--R      this is the exact Axiom output
--R (1)  5
--E 1

--S 2 of 3
2+3
--R
--R      this should fail to match
--R (2)  7
--E 2

--S 3 of 3
2+3
--R
--R      this fails to match but we
--I (3)  7      use --I to ignore this line
--E 3
```


We can now run this file with

```
)read foo.input
```

Note that when this file is run it will create a spool file called "foo.output" because of the lines:

```
)spool foo.output
)spool
```

The "foo.output" file contains the console image of the result. It will look like:

```
Starts dribbling to foo.output (2012/2/28, 12:25:7).
)set message type off
)clear all

--S 1 of 3
2+3

      (1)  5
--R
--R      (1)  5
--E 1

--S 2 of 3
2+3

      (2)  5
--R
--R      (2)  7
--E 2

--S 3 of 3
2+3

      (3)  5
--R
--R      (3)  7
--E 3

)spool
```

This "foo.output" file can now be checked using the)regress command.

When we run the)regress foo.output we see;

```
testing foo
passed foo 1 of 3
```

```

MISMATCH
expected:" (2) 7"
got:" (2) 5"
FAILED foo 2 of 2
passed foo 3 of 3
regression result FAILED 1 of 3 stanzas file foo

```

Tests either pass or fail. A passing test generates the message:

```
passed foo 1 of 3
```

A failing test will give a reversed printout of the expected vs actual output as well as a FAILED message, as in:

```

MISMATCH
expected:" (2) 7"
got:" (2) 5"
FAILED foo 2 of 3

```

The last line of output is a summary:

```
regression result FAILED 1 of 3 stanzas file foo
```

— defun regress —

```

(defun |regress| (arg)
  (let (|$InteractiveMode| namestring dot1 outfile (extension "output"))
    (declare (special |$InteractiveMode|))
    (setq |$InteractiveMode| t)
    (setq namestring (symbol-name (car arg)))
    (setq dot1 (position #\. namestring))
    (unless dot1
      (setq outfile (concatenate 'string (subseq namestring 0) "." extension)))
    (if (probe-file outfile)
        (regress outfile)
        (format t (concatenate 'string outfile "% file not found")))))

```

Chapter 45

)savesystem help page Command

45.1 savesystem help page man page

— savesystem.help —

```
=====
A.8. )savesystem
=====
```

User Level Required: interpreter

Command Syntax:

```
- )savesystem filename
```

Command Description:

This command is used to save an AXIOM image to disk. This creates an executable file which, when started, has everything loaded into it that was there when the image was saved. Thus, after executing commands which cause the loading of some packages, the command:

```
)savesystem /tmp/savesys
```

will create an image that can be restarted with the UNIX command:

```
axiom -ws /tmp/savesys
```

This new system will not need to reload the packages and domains that were already loaded when the system was saved.

There is currently a restriction that only systems started with the command "AXIOMsys" may be saved.

45.1.1 defun The `)savesystem` command

[helpSpad2Cmd p570]

[spad-save p987]

— defun `savesystem` —

```
(defun |savesystem| (arg)
  (if (or (not (eq1 (|#| arg) 1)) (null (symbolp (car arg))))
      (|helpSpad2Cmd| '(|savesystem|))
      (spad-save (symbol-name (car arg)))))
```

Chapter 46

)set help page Command

46.1 set help page man page

— set.help —

```
=====
A.21. )set
=====
```

User Level Required: interpreter

Command Syntax:

-)set
-)set label1 [... labelN]
-)set label1 [... labelN] newValue

Command Description:

The)set command is used to view or set system variables that control what messages are displayed, the type of output desired, the status of the history facility, the way AXIOM user functions are cached, and so on. Since this collection is very large, we will not discuss them here. Rather, we will show how the facility is used. We urge you to explore the)set options to familiarize yourself with how you can modify your AXIOM working environment. There is a HyperDoc version of this same facility available from the main HyperDoc menu. Click [\[here\]](#) to go to it.

The)set command is command-driven with a menu display. It is tree-structured. To see all top-level nodes, issue)set by itself.

)set

Variables with values have them displayed near the right margin. Subtrees of selections have ‘‘...’’ displayed in the value field. For example, there are many kinds of messages, so issue `)set message` to see the choices.

```
)set message
```

The current setting for the variable that displays whether computation times are displayed is visible in the menu displayed by the last command. To see more information, issue

```
)set message time
```

This shows that time printing is on now. To turn it off, issue

```
)set message time off
```

As noted above, not all settings have so many qualifiers. For example, to change the `)quit` command to being unprotected (that is, you will not be prompted for verification), you need only issue

```
)set quit unprotected
```

Also See:

- o `)quit`

1

46.2 Overview

This section contains tree of information used to initialize the `)set` command in the interpreter. The current list is:

Variable	Description	Current Value

<code>compile</code>	Library compiler options	...
<code>breakmode</code>	execute break processing on error	break
<code>expose</code>	control interpreter constructor exposure	...
<code>functions</code>	some interpreter function options	...
<code>fortran</code>	view and set options for FORTRAN output	...
<code>kernel</code>	library functions built into the kernel for efficiency	...
<code>hyperdoc</code>	options in using HyperDoc	...

¹ “quit” (42.2.1 p 636)

help	view and set some help options	...
history	save workspace values in a history file	on
messages	show messages for various system features	...
naglink	options for NAGLink	...
output	view and set some output options	...
quit	protected or unprotected quit	unprotected
streams	set some options for working with streams	...
system	set some system development variables	...
userlevel	operation access level of system user	development

Variables with current values of ... have further sub-options.
 For example, issue `)set system` to see what the options are
 for system. For more information, issue `)help set .`

46.3 Variables Used

46.4 Functions

46.4.1 Initialize the set variables

The argument `settree` is initially the `$setOption` variable. The fourth element is a union-style switch symbol. The fifth element is usually a variable to set. The sixth element is a subtree to recurse for the `TREE` switch. The seventh element is usually the default value. For more detailed explanations see the list structure section 46.5. [sayMSG p331]

[literals p??]

[translateYesNo2TrueFalse p656]

[tree p??]

[initializeSetVariables p651]

— `defun initializeSetVariables` —

```
(defun |initializeSetVariables| (settree)
  "Initialize the set variables"
  (dolist (setdata settree)
    (case (fourth setdata)
      (function
        (if (functionp (fifth setdata))
            (funcall (fifth setdata) '|%initialize%|)
            (|sayMSG| (concatenate 'string "    Function not implemented. "
                                   (package-name *package*) ":" (string (fifth setdata))))))
        (integer (set (fifth setdata) (seventh setdata)))
        (string (set (fifth setdata) (seventh setdata)))
        (literals
         (set (fifth setdata) (|translateYesNo2TrueFalse| (seventh setdata))))
        (tree (|initializeSetVariables| (sixth setdata))))))
```

46.4.2 Reset the workspace variables

```
[copy p??]
[initializeSetVariables p651]
[/countlist p??]
[/editfile p513]
[/sourcefiles p??]
[/pretty p??]
[/spacelist p??]
[/timerlist p??]
[$sourceFiles p??]
[$existingFiles p??]
[$functionTable p500]
[$boot p25]
[$compileMapFlag p??]
[$echoLineStack p??]
[$operationNameList p??]
[$slamFlag p??]
[$CommandSynonymAlist p476]
[$InitialCommandSynonymAlist p474]
[$UserAbbreviationsAlist p??]
[$msgAlist p326]
[$msgDatabase p??]
[$msgDatabaseName p326]
[$dependeeClosureAlist p??]
[$IOindex p??]
[$coerceIntByMapCounter p??]
[$e p??]
[$env p??]
[$setOptions p??]
```

— defun resetWorkspaceVariables —

```
(defun |resetWorkspaceVariables| ()
  "Reset the workspace variables"
  (declare (special /countlist /editfile /sourcefiles |$sourceFiles| /pretty
    /spacelist /timerlist |$existingFiles| |$functionTable| $boot
    |$compileMapFlag| |$echoLineStack| |$operationNameList| |$slamFlag| | |
    |$CommandSynonymAlist| |$InitialCommandSynonymAlist|
    |$UserAbbreviationsAlist| |$msgAlist| |$msgDatabase| |$msgDatabaseName|
    |$dependeeClosureAlist| |$IOindex| |$coerceIntByMapCounter| |$e| |$env|
    |$setOptions|))
```



```

(setq /countlist nil)
(setq /editfile nil)
(setq /sourcefiles nil)
(setq |$sourceFiles| nil)
(setq /pretty nil)
(setq /spacelist nil)
(setq /timerlist nil)
(setq |$existingFiles| (make-hash-table :test #'equal))
(setq |$functionTable| nil)
(setq $boot nil)
(setq |$compileMapFlag| nil)
(setq |$echoLineStack| nil)
(setq |$operationNameList| nil)
(setq |$slamFlag| nil)
(setq |$CommandSynonymAlist| (copy |$InitialCommandSynonymAlist|))
(setq |$UserAbbreviationsAlist| nil)
(setq |$msgAlist| nil)
(setq |$msgDatabase| nil)
(setq |$msgDatabaseName| nil)
(setq |$dependeeClosureAlist| nil)
(setq |$I0index| 1)
(setq |$coerceIntByMapCounter| 0)
(setq |$e| (cons (cons nil nil) nil))
(setq |$env| (cons (cons nil nil) nil))
(|initializeSetVariables| |$setOptions|))

```

46.4.3 Display the set option information

```

[displaySetVariableSettings p655]
[centerAndHighlight p??]
[concat p1049]
[object2String p??]
[specialChar p978]
[sayBrightly p??]
[bright p??]
[sayMSG p331]
[boot-equal p??]
[sayMessage p??]
[eval p??]
[literals p??]
[translateTrueFalse2YesNo p657]
[$linelength p771]

```

— defun displaySetOptionInformation —

```

(defun |displaySetOptionInformation| (arg setdata)
  "Display the set option information"
  (let (current)
    (declare (special $linelength))
    (cond
      ((eq (fourth setdata) 'tree)
        (|displaySetVariableSettings| (sixth setdata) (first setdata)))
      (t
        (|centerAndHighlight|
          (concat "The " (|object2String| arg) " Option")
          $linelength (|specialChar| '|hbar|))
        (|sayBrightly|
          '(|%l| ,@( |bright| "Description:") ,(second setdata)))
        (case (fourth setdata)
          (function
            (terpri)
            (if (functionp (fifth setdata))
              (funcall (fifth setdata) '|%describe%|)
              (|sayMSG| " Function not implemented.")))
          (integer
            (|sayMessage|
              '(" The" ,@( |bright| arg) "option"
                " may be followed by an integer in the range"
                ,@( |bright| (elt (sixth setdata) 0)) "to"
                '|%l| ,@( |bright| (elt (sixth setdata) 1)) "inclusive."
                " The current setting is" ,@( |bright| (|eval| (fifth setdata))))))
          (string
            (|sayMessage|
              '(" The" ,@( |bright| arg) "option"
                " is followed by a string enclosed in double quote marks."
                '|%l| " The current setting is"
                ,@( |bright| (list '|'| (|eval| (fifth setdata)) '|'|))))))
          (literals
            (|sayMessage|
              '(" The" ,@( |bright| arg) "option"
                " may be followed by any one of the following:"))
            (setq current
              (|translateTrueFalse2YesNo| (|eval| (fifth setdata))))
            (dolist (name (sixth setdata))
              (if (boot-equal name current)
                (|sayBrightly| '(" ->" ,@( |bright| (|object2String| name))))
                (|sayBrightly| (list " " (|object2String| name))))
              (|sayMessage| " The current setting is indicated."))))))

```

46.4.4 Display the set variable settings

```
[concat p1049]
[object2String p??]
[centerAndHighlight p??]
[sayBrightly p??]
[say p??]
[fillerSpaces p20]
[specialChar p978]
[concat p1049]
[satisfiesUserLevel p449]
[spaddifference p??]
[poundsign p??]
[eval p??]
[bright p??]
[literals p??]
[translateTrueFalse2YesNo p657]
[tree p??]
[$linelength p771]
```

— **defun displaySetVariableSettings** —

```
(defun |displaySetVariableSettings| (settree label)
  "Display the set variable settings"
  (let (setoption opt subtree subname)
    (declare (special $linelength))
    (if (eq label '|')
      (setq label ")set")
      (setq label (concat " " (|object2String| label) " ")))
    (|centerAndHighlight|
     (concat "Current Values of" label " Variables") $linelength '| |)
    (terpri)
    (|sayBrightly|
     (list "Variable" "Description"
           "Current Value" ))
    (say (|fillerSpaces| $linelength (|specialChar| 'hbar|)))
    (setq subtree nil)
    (dolist (setdata settree)
      (when (|satisfiesUserLevel| (third setdata))
        (setq setoption (|object2String| (first setdata)))
        (setq setoption
         (concat setoption
          (|fillerSpaces| (spaddifference 13 (|#| setoption)) " ")
          (second setdata)))
        (setq setoption
         (concat setoption
          (|fillerSpaces| (spaddifference 55 (|#| setoption)) " ")))
        (case (fourth setdata)
```

```

(function
  (setq opt
    (if (functionp (fifth setdata))
        (funcall (fifth setdata) '(%display%)
          "unimplemented"))
    (cond
      ((consp opt)
        (setq opt
          (do ((t2 opt (cdr t2)) t1 (o nil))
              ((or (atom t2) (progn (setq o (car t2)) nil)) t1)
            (setq t1 (append t1 (cons o (cons " " nil)))))))
        (|sayBrightly| (|concat| setoption '(%b| opt '(%d|)))
          string
            (setq opt (|object2String| (|eval| (fifth setdata)))
              (|sayBrightly| '(',setoption ,@(|bright| opt))))
          integer
            (setq opt (|object2String| (|eval| (fifth setdata)))
              (|sayBrightly| '(',setoption ,@(|bright| opt))))
          literals
            (setq opt (|object2String|
              (|translateTrueFalse2YesNo| (|eval| (fifth setdata))))
              (|sayBrightly| '(',setoption ,@(|bright| opt))))
          TREE
            (|sayBrightly| '(',setoption ,@(|bright| "..."))
              (setq subtree t)
              (setq subname (|object2String| (first setdata))))))
    (terpri)
    (when subtree
      (|sayBrightly|
        ("Variables with current values of" ,@(|bright| "...")
          "have further sub-options. For example,")
      (|sayBrightly|
        ("issue" ,@(|bright| ")set ") ,subname
          " to see what the options are for" ,@(|bright| subname) "."
          |%l| "For more information, issue" ,@(|bright| ")help set") "."))))

```

46.4.5 Translate options values to t or nil

[member p1050]

— defun translateYesNo2TrueFalse —

```

(defun |translateYesNo2TrueFalse| (x)
  "Translate options values to t or nil"
  (cond
    ((|member| x '(|yes| |on|)) t)

```

```
((|member| x '(|no| |off|)) nil)
(t x))
```

46.4.6 Translate t or nil to option values

— defun translateTrueFalse2YesNo —

```
(defun |translateTrueFalse2YesNo| (x)
  "Translate t or nil to option values"
  (cond
    ((eq x t) '|on|)
    ((null x) '|off|)
    (t x)))
```

46.5 The list structure

The structure of each list item consists of 7 items. Consider this example:

```
(userlevel
  "operation access level of system user"
  interpreter
  LITERALS
  $UserLevel
  (interpreter compiler development)
  development)
```

The list looks like (the names in bold are accessor names that can be found in **property.lisp.pamphlet**[1]. Look for "setName".):

1 *Name* the keyword the user will see. In this example the user would say ")set output userlevel".

2 *Label* the message the user will see. In this example the user would see "operation access level of system user".

3 *Level* the level where the command will be accepted. There are three levels: interpreter, compiler, development. These commands are restricted to keep the user from causing damage.

4 Type a symbol, one of **FUNCTION**, **INTEGER**, **STRING**, **LITERALS**, **FILENAME** or **TREE**.

5 *Var*

FUNCTION is the function to call

INTEGER is the variable holding the current user setting.

STRING is the variable holding the current user setting.

LITERALS variable which holds the current user setting.

FILENAME is the variable that holds the current user setting.

TREE

6 *Leaf*

FUNCTION is the list of all possible values

INTEGER is the range of possible values

STRING is a list of all possible values

LITERALS is a list of all of the possible values

FILENAME is the function to check the filename

TREE

7 *Def* is the default value

FUNCTION is the default setting

INTEGER is the default setting

STRING is the default setting

LITERALS is the default setting

FILENAME is the default value

TREE

46.6 breakmode

----- The breakmode Option -----

Description: execute break processing on error

The breakmode option may be followed by any one of the following:

```
nobreak
-> break
query
resume
```

```
fastlinks
quit
```

The current setting is indicated.

46.6.1 defvar \$BreakMode

— initvars —

```
(defvar |$BreakMode| ' |nobreak| "execute break processing on error")
```

—————

— breakmode —

```
(|breakmode|
 "execute break processing on error"
 |interpreter|
 LITERALS
 |$BreakMode|
 (|nobreak| |break| |query| |resume| |fastlinks| |quit|)
 |nobreak|) ; needed to avoid possible startup looping
```

—————

46.7 debug

Current Values of debug Variables

Variable	Description	Current Value
lambdatype	Show type information for #1 syntax	off
dalymode	Interpret leading open paren as lisp	off

— debug —

```
(|debug|
 "debug options"
 |interpreter|
 TREE
 |novar|
```

```
(
\getchunk{debuglambdtype}
\getchunk{debugdalymode}
))
```

46.8 debug lambda type

----- The lambdtype Option -----

Description: Show type information for #1 syntax

46.8.1 defvar \$lambdtype

— initvars —

```
(defvar $lambdtype nil "show type information for #1 syntax")
```

— debuglambdtype —

```
(|lambdtype|
"show type information for #1 syntax"
|interpreter|
LITERALS
$lambdtype
(|on| |off|)
|off|)
```

46.9 debug dalymode

The `$dalymode` variable is used in a case statement in `intloopReadConsole`. This variable can be set to any non-nil value. When not nil the interpreter will send any line that begins with an “(” to be sent to the underlying lisp. This is useful for debugging Axiom. The normal value of this variable is NIL.

This variable was created as an alternative to prefixing every lisp command with `)lisp`. When doing a lot of debugging this is tedious and error prone. This variable was created to shortcut

that process. Clearly it breaks some semantics of the language accepted by the interpreter as parens are used for grouping expressions.

----- The dalymode Option -----

Description: Interpret leading open paren as lisp

46.9.1 defvar \$dalymode

— initvars —

```
(defvar $dalymode nil "Interpret leading open paren as lisp")
```

— debugdalymode —

```
(|dalymode|
  "Interpret leading open paren as lisp"
  |interpreter|
  LITERALS
  $dalymode
  (|on| |off|)
  |off|)
```

46.10 compile

Current Values of compiler Variables

Variable	Description	Current Value
output	library in which to place compiled code	
input	controls libraries from which to load compiled code	

— compile —

```
(|compiler|
  "Library compiler options")
```

```

|interpreter|
TREE
|novar|
(
\getchunk{compileoutput}
\getchunk{compileinput}
))

```

46.11 compile output

----- The output Option -----

Description: library in which to place compiled code

— compileoutput —

```

(|output|
"library in which to place compiled code"
|interpreter|
FUNCTION
|setOutputLibrary|
NIL
|htSetOutputLibrary|
)

```

46.12 Variables Used

46.13 Functions

46.13.1 The set output command handler

```

[poundsign p??]
[describeOutputLibraryArgs p663]
[filep p??]
[openOutputLibrary p664]
[$outputLibraryName p??]

```

— defun setOutputLibrary —

```
(defun |setOutputLibrary| (arg)
  "The set output command handler"
  (let (fn)
    (declare (special |$outputLibraryName|))
    (cond
      ((eq arg '|%initialize%|) (setq |$outputLibraryName| nil))
      ((eq arg '|%display%|) (or |$outputLibraryName| "user.lib"))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?)) (/= (|#| arg) 1))
        (|describeOutputLibraryArgs|))
    (t
     (when (probe-file (setq fn (princ-to-string (car arg))))
       (setq fn (truename fn)))
     (|openOutputLibrary| (setq |$outputLibraryName| fn))))))
```

46.13.2 Describe the set output library arguments

[sayBrightly p??]

— defun describeOutputLibraryArgs —

```
(defun |describeOutputLibraryArgs| ()
  "Describe the set output library arguments"
  (|sayBrightly| (list
    '|%b| "set compile output library"
    '|%d| "is used to tell the compiler where to place"
    '|%l| "compiled code generated by the library compiler. By default it goes"
    '|%l| "in a file called"
    '|%b| "user.lib"
    '|%d| "in the current directory.")))
```

46.13.3 defvar \$output-library

— initvars —

```
(defvar output-library nil)
```

46.13.4 Open the output library

The input-libraries and output-library are now truename based. [dropInputLibrary p667]

[output-library p663]

[input-libraries p666]

— defun openOutputLibrary —

```
(defun |openOutputLibrary| (lib)
  "Open the output library"
  (declare (special output-library input-libraries))
  (|dropInputLibrary| lib)
  (setq output-library (truename lib))
  (push output-library input-libraries))
```

—————

46.14 compile input

----- The input Option -----

Description: controls libraries from which to load compiled code

)set compile input add library is used to tell AXIOM to add library to the front of the path which determines where compiled code is loaded from.

)set compile input drop library is used to tell AXIOM to remove library from this path.

— compileinput —

```
(|input|
  "controls libraries from which to load compiled code"
  |interpreter|
  FUNCTION
  |setInputLibrary|
  NIL
  |htSetInputLibrary|)
```

—————

46.15 Variables Used

46.16 Functions

46.16.1 The set input library command handler

The input-libraries is now maintained as a list of truenames. [describeInputLibraryArgs p666]

```
[qcar p??]
[qcdr p??]
[selectOptionLC p477]
[addInputLibrary p666]
[dropInputLibrary p667]
[setInputLibrary p665]
[input-libraries p666]
```

— defun setInputLibrary —

```
(defun |setInputLibrary| (arg)
  "The set input library command handler"
  (declare (special input-libraries))
  (let (tmp1 filename act)
    (cond
      ((eq arg '|%initialize%|) t)
      ((eq arg '|%display%|) (mapcar #'namestring input-libraries))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
       (|describeInputLibraryArgs|))
      ((and (consp arg)
            (progn
              (setq act (qcar arg))
              (setq tmp1 (qcdr arg))
              (and (consp tmp1)
                    (eq (qcdr tmp1) nil)
                    (progn (setq filename (qcar tmp1)) t))))
       (setq act (|selectOptionLC| act '(|add| |drop|) nil)))
      (cond
        ((eq act '|add|)
         (|addInputLibrary| (truename (princ-to-string filename))))
        ((eq act '|drop|)
         (|dropInputLibrary| (truename (princ-to-string filename))))
        (t (|setInputLibrary| nil))))))
```

—————

46.16.2 Describe the set input library arguments

[sayBrightly p??]

— defun describeInputLibraryArgs —

```
(defun |describeInputLibraryArgs| ()
  "Describe the set input library arguments"
  (|sayBrightly| (list
    '|%b| "set compile input add library"
    '|%d| "is used to tell AXIOM to add"
    '|%b| "library"
    '|%d| "to"
    '|%l| "the front of the path used to find compile code."'
    '|%l|
    '|%b| "set compile input drop library"
    '|%d| "is used to tell AXIOM to remove"
    '|%b| "library"
    '|%d|
    '|%l| "from this path.")))
```

—————

46.16.3 Add the input library to the list

The input-libraries variable is now maintained as a list of truenames. [dropInputLibrary p667]

[input-libraries p666]

— defun addInputLibrary —

```
(defun |addInputLibrary| (lib)
  "Add the input library to the list"
  (declare (special input-libraries))
  (|dropInputLibrary| lib)
  (push (true-name lib) input-libraries))
```

—————

46.16.4 defvar \$input-libraries

— initvars —

```
(defvar input-libraries nil)
```

46.16.5 Drop an input library from the list

[input-libraries p666]

— defun dropInputLibrary —

```
(defun |dropInputLibrary| (lib)
  "Drop an input library from the list"
  (declare (special input-libraries))
  (setq input-libraries (delete (truename lib) input-libraries :test #'equal)))
```

46.17 expose

----- The expose Option -----

Description: control interpreter constructor exposure

The following groups are explicitly exposed in the current frame (called initial):

```
        basic
categories
        naglink
        anna
```

The following constructors are explicitly exposed in the current frame:

there are no explicitly exposed constructors

The following constructors are explicitly hidden in the current frame:

there are no explicitly hidden constructors

When)set expose is followed by no arguments, the information you now see is displayed. When followed by the initialize argument, the exposure group data in the file interp.exposed is read and is then available. The arguments add and drop are used to add or drop exposure groups or explicit constructors from the local frame exposure data. Issue

)set expose add or)set expose drop
for more information.

— expose —

```
(|expose|
  "control interpreter constructor exposure"
  |interpreter|
  FUNCTION
  |setExpose|
  NIL
  |htSetExpose|)
```

46.18 Variables Used

NOTE: If you add new algebra you must also update this list otherwise the new algebra won't be loaded by the interpreter when needed.

46.18.1 defvar \$globalExposureGroupAlist

— initvars —

```
(defvar |$globalExposureGroupAlist|
  '(
    ;;define the groups |basic| |naglink| |anna| |categories| |Hidden| |defaults|
    (|basic|
      (|AffineAlgebraicSetComputeWithGroebnerBasis| . AFALGGRO)
      (|AffineAlgebraicSetComputeWithResultant| . AFALGRES)
      (|AffinePlane| . AFFPL)
      (|AffinePlaneOverPseudoAlgebraicClosureOfFiniteField| . AFFPLPS)
      (|AffineSpace| . AFFSP)
      (|AlgebraicManipulations| . ALGMANIP)
      (|AlgebraicNumber| . AN)
      (|AlgFactor| . ALGFACT)
      (|AlgebraicMultFact| . ALGMFACT)
      (|AlgebraPackage| . ALGPKG)
      (|AlgebraGivenByStructuralConstants| . ALGSC)
      (|Any| . ANY)
      (|AnyFunctions1| . ANY1)
      (|ApplicationProgramInterface| . API)
      (|ArrayStack| . ASTACK)
      (|AssociatedJordanAlgebra| . JORDAN)
      (|AssociatedLieAlgebra| . LIE)
      (|AttachPredicates| . PMPRED)
      (|AxiomServer| . AXSERV)
      (|BalancedBinaryTree| . BBTREE)
```



```

(|BasicStochasticDifferential| . BSD)
(|BasicOperator| . BOP)
(|BasicOperatorFunctions1| . BOP1)
(|Bezier| . BEZIER)
(|BinaryExpansion| . BINARY)
(|BinaryFile| . BINFILE)
(|BinarySearchTree| . BSTREE)
(|BinaryTournament| . BTOURN)
(|BinaryTree| . BTREE)
(|Bits| . BITS)
(|BlasLevelOne| . BLAS1)
(|BlowUpPackage| . BLUPPACK)
(|BlowUpWithHamburgerNoether| . BLHN)
(|BlowUpWithQuadTrans| . BLQT)
(|Boolean| . BOOLEAN)
(|CardinalNumber| . CARD)
(|CartesianTensor| . CARTEN)
(|CartesianTensorFunctions2| . CARTEN2)
(|Character| . CHAR)
(|CharacterClass| . CCLASS)
(|CharacteristicPolynomialPackage| . CHARPOL)
(|CliffordAlgebra| . CLIF)
(|Color| . COLOR)
(|CommonDenominator| . CDEN)
(|Commutator| . COMM)
(|Complex| . COMPLEX)
(|ComplexDoubleFloatMatrix| . CDFMAT)
(|ComplexDoubleFloatVector| . CDFVEC)
(|ComplexFactorization| . COMPFAC)
(|ComplexFunctions2| . COMPLEX2)
(|ComplexRootPackage| . CMPLXRT)
(|ComplexTrigonometricManipulations| . CTRIGMNP)
(|ContinuedFraction| . CONTFRAC)
(|CoordinateSystems| . COORDSYS)
(|CRAPackage| . CRAPACK)
(|CycleIndicators| . CYCLES)
(|Database| . DBASE)
(|DataList| . DLIST)
(|DecimalExpansion| . DECIMAL)
(|DenavitHartenbergMatrix| . DHMATRIX)
(|Dequeue| . DEQUEUE)
(|DesingTree| . DSTREE)
(|DesingTreePackage| . DTP)
(|DiophantineSolutionPackage| . DIOSP)
(|DirichletRing| . DIRRING)
(|DirectProductFunctions2| . DIRPROD2)
(|DisplayPackage| . DISPLAY)
(|DistinctDegreeFactorize| . DDFACT)
(|Divisor| . DIV)
(|DoubleFloat| . DFLOAT)

```

```

(|DoubleFloatMatrix| . DFMAT)
(|DoubleFloatVector| . DFVEC)
(|DoubleFloatSpecialFunctions| . DFSFUN)
(|DrawComplex| . DRAWCX)
(|DrawNumericHack| . DRAWHACK)
(|DrawOption| . DROPT)
(|EigenPackage| . EP)
(|ElementaryFunctionDefiniteIntegration| . DEFINTEF)
(|ElementaryFunctionLODESolver| . LODEEF)
(|ElementaryFunctionODESolver| . ODEEF)
(|ElementaryFunctionSign| . SIGNEF)
(|ElementaryFunctionStructurePackage| . EFSTRUC)
(|Equation| . EQ)
(|EquationFunctions2| . EQ2)
(|ErrorFunctions| . ERROR)
(|EuclideanGroebnerBasisPackage| . GBEUCLID)
(|Exit| . EXIT)
(|Export3D| . EXP3D)
(|Expression| . EXPR)
(|ExpressionFunctions2| . EXPR2)
(|ExpressionSolve| . EXPRSOL)
(|ExpressionSpaceFunctions2| . ES2)
(|ExpressionSpaceODESolver| . EXPRODE)
(|ExpressionToOpenMath| . OMEXPR)
(|ExpressionToUnivariatePowerSeries| . EXPR2UPS)
(|Factored| . FR)
(|FactoredFunctions2| . FR2)
(|FactorisationOverPseudoAlgebraicClosureOfAlgExtOfRationalNumber| . FACTEXT)
(|FactorisationOverPseudoAlgebraicClosureOfRationalNumber| . FACTRN)
(|File| . FILE)
(|FileName| . FNAME)
(|FiniteAbelianMonoidRingFunctions2| . FAMR2)
(|FiniteDivisorFunctions2| . FDIV2)
(|FiniteFieldFactorizationWithSizeParseBySideEffect| . FFFACTSE)
(|FiniteField| . FF)
(|FiniteFieldCyclicGroup| . FFCG)
(|FiniteFieldPolynomialPackage2| . FFPOLY2)
(|FiniteFieldNormalBasis| . FFNB)
(|FiniteFieldHomomorphisms| . FFHOM)
(|FiniteFieldSquareFreeDecomposition| . FFSQFR)
(|FiniteLinearAggregateFunctions2| . FLAGG2)
(|FiniteLinearAggregateSort| . FLASORT)
(|FiniteSetAggregateFunctions2| . FSAGG2)
(|FlexibleArray| . FARRAY)
(|Float| . FLOAT)
(|FloatingRealPackage| . FLOATRP)
(|FloatingComplexPackage| . FLOATCP)
(|FourierSeries| . FSERIES)
(|Fraction| . FRAC)
(|FractionalIdealFunctions2| . FRIDEAL2)

```

```

(|FractionFreeFastGaussian| . FFFG)
(|FractionFreeFastGaussianFractions| . FFFGF)
(|FractionFunctions2| . FRAC2)
(|FreeNilpotentLie| . FNLA)
(|FullPartialFractionExpansion| . FPARFRAC)
(|FunctionFieldCategoryFunctions2| . FFCAT2)
(|FunctionSpaceAssertions| . PMASSFS)
(|FunctionSpaceAttachPredicates| . PMPREDFS)
(|FunctionSpaceComplexIntegration| . FSCINT)
(|FunctionSpaceFunctions2| . FS2)
(|FunctionSpaceIntegration| . FSINT)
(|FunctionSpacePrimitiveElement| . FSPRMELT)
(|FunctionSpaceSum| . SUMFS)
(|GaussianFactorizationPackage| . GAUSSFAC)
(|GeneralPackageForAlgebraicFunctionField| . GPAFF)
(|GeneralUnivariatePowerSeries| . GSERIES)
(|GenerateUnivariatePowerSeries| . GENUPS)
(|GnuDraw| . GDRAW)
(|GraphicsDefaults| . GRDEF)
(|GroebnerPackage| . GB)
(|GroebnerFactorizationPackage| . GBF)
(|Guess| . GUESS)
(|GuessAlgebraicNumber| . GUESSAN)
(|GuessFinite| . GUESSF)
(|GuessFiniteFunctions| . GUESSF1)
(|GuessInteger| . GUESSINT)
(|GuessOption| . GOPT)
(|GuessPolynomial| . GUESSP)
(|GuessUnivariatePolynomial| . GUESSUP)
(|HallBasis| . HB)
(|Heap| . HEAP)
(|HexadecimalExpansion| . HEXADEC)
(|HTMLFormat| . HTMLFORM)
(|IdealDecompositionPackage| . IDECOMP)
(|IndexCard| . ICARD)
(|InfClsPt| . ICP)
(|InfiniteProductCharacteristicZero| . INFPRODO)
(|InfiniteProductFiniteField| . INPRODFF)
(|InfiniteProductPrimeField| . INPRODPF)
(|InfiniteTuple| . ITUPLE)
(|InfiniteTupleFunctions2| . ITFUN2)
(|InfiniteTupleFunctions3| . ITFUN3)
(|InfinitelyClosePoint| . INFCLSPT)
(|InfinitelyClosePointOverPseudoAlgebraicClosureOfFiniteField| . INFCLSPS)
(|Infinity| . INFINITY)
(|Integer| . INT)
(|IntegerCombinatoricFunctions| . COMBINAT)
(|IntegerLinearDependence| . ZLINDEP)
(|IntegerNumberTheoryFunctions| . INTHEORY)
(|IntegerPrimesPackage| . PRIMES)

```

```

(|IntegerRetractions| . INTRET)
(|IntegerRoots| . IROOT)
(|IntegrationResultFunctions2| . IR2)
(|IntegrationResultRFToFunction| . IRRF2F)
(|IntegrationResultToFunction| . IR2F)
(|InterfaceGroebnerPackage| . INTERGB)
(|InterpolateFormsPackage| . INTFRSP)
(|IntersectionDivisorPackage| . INTDIVP)
(|Interval| . INTRVL)
(|InventorDataSink| . IVDATA)
(|InventorViewPort| . IVVIEW)
(|InventorRenderPackage| . IVREND)
(|InverseLaplaceTransform| . INV LAPLA)
(|IrrRepSymNatPackage| . IRSN)
(|KernelFunctions2| . KERNEL2)
(|KeyedAccessFile| . KAFILE)
(|LaplaceTransform| . LAPLACE)
(|LazardMorenoSolvingPackage| . LAZM3PK)
(|Library| . LIB)
(|LieSquareMatrix| . LSQM)
(|LinearOrdinaryDifferentialOperator| . LOD0)
(|LinearSystemMatrixPackage| . LSMP)
(|LinearSystemMatrixPackage1| . LSMP1)
(|LinearSystemFromPowerSeriesPackage| . LISYSER)
(|LinearSystemPolynomialPackage| . LSPP)
(|List| . LIST)
(|LinesOpPack| . LOP)
(|ListFunctions2| . LIST2)
(|ListFunctions3| . LIST3)
(|ListToMap| . LIST2MAP)
(|LocalParametrizationOfSimplePointPackage| . LPARSPT)
(|MakeFloatCompiledFunction| . MKFLCFN)
(|MakeFunction| . MKFUNC)
(|MakeRecord| . MKRECORD)
(|MappingPackage1| . MAPPKG1)
(|MappingPackage2| . MAPPKG2)
(|MappingPackage3| . MAPPKG3)
(|MappingPackage4| . MAPPKG4)
(|MathMLFormat| . MMLFORM)
(|Matrix| . MATRIX)
(|MatrixCategoryFunctions2| . MATCAT2)
(|MatrixCommonDenominator| . MCDEN)
(|MatrixLinearAlgebraFunctions| . MATLIN)
(|MergeThing| . MTHING)
(|ModularDistinctDegreeFactorizer| . MDDFACT)
(|ModuleOperator| . MODOP)
(|MonoidRingFunctions2| . MRF2)
(|MoreSystemCommands| . MSYSCMD)
(|MPolyCatFunctions2| . MPC2)
(|MPolyCatRationalFunctionFactorizer| . MPRFF)

```

```

(|Multiset| . MSET)
(|MultivariateFactorize| . MULTFACT)
(|MultivariatePolynomial| . MPOLY)
(|MultFiniteFactorize| . MFINFACT)
(|MyUnivariatePolynomial| . MYUP)
(|MyExpression| . MYEXPR)
(|NeitherSparseOrDensePowerSeries| . NSDPS)
(|NewtonPolygon| . NPOLYGON)
(|NoneFunctions1| . NONE1)
(|NonNegativeInteger| . NNI)
(|NottinghamGroup| . NOTTING)
(|NormalizationPackage| . NORMPK)
(|NormInMonogenicAlgebra| . NORMMA)
(|NumberTheoreticPolynomialFunctions| . NTPOLFN)
(|Numeric| . NUMERIC)
(|NumericalOrdinaryDifferentialEquations| . NUMODE)
(|NumericalQuadrature| . NUMQUAD)
(|NumericComplexEigenPackage| . NCEP)
(|NumericRealEigenPackage| . NREP)
(|NumericContinuedFraction| . NCNTFRAC)
(|Octonion| . OCT)
(|OctonionCategoryFunctions2| . OCTCT2)
(|OneDimensionalArray| . ARRAY1)
(|OneDimensionalArrayFunctions2| . ARRAY12)
(|OnePointCompletion| . ONECOMP)
(|OnePointCompletionFunctions2| . ONECOMP2)
(|OpenMathConnection| . OMCONN)
(|OpenMathDevice| . OMDEV)
(|OpenMathEncoding| . OMENC)
(|OpenMathError| . OMERR)
(|OpenMathErrorKind| . OMERRK)
(|OpenMathPackage| . OMPKG)
(|OpenMathServerPackage| . OMSERVER)
(|OperationsQuery| . OPQUERY)
(|OrderedCompletion| . ORDCOMP)
(|OrderedCompletionFunctions2| . ORDCOMP2)
(|OrdinaryDifferentialRing| . ODR)
(|OrdSetInts| . OSI)
(|OrthogonalPolynomialFunctions| . ORTHPOL)
(|OutputPackage| . OUT)
(|PackageForAlgebraicFunctionField| . PAFF)
(|PackageForAlgebraicFunctionFieldOverFiniteField| . PAFFFF)
(|PackageForPoly| . PFORP)
(|PadeApproximantPackage| . PADEPAC)
(|Palette| . PALETTE)
(|PartialFraction| . PFR)
(|PatternFunctions2| . PATTERN2)
(|ParametricPlaneCurve| . PARPCURV)
(|ParametricSpaceCurve| . PARSCURV)
(|ParametricSurface| . PARSURF)

```

```

(|ParametricPlaneCurveFunctions2| . PARPC2)
(|ParametricSpaceCurveFunctions2| . PARSC2)
(|ParametricSurfaceFunctions2| . PARSU2)
(|ParametrizationPackage| . PARAMP)
(|PartitionsAndPermutations| . PARTPERM)
(|PatternMatch| . PATMATCH)
(|PatternMatchAssertions| . PMASS)
(|PatternMatchResultFunctions2| . PATRES2)
(|PendantTree| . PENDTREE)
(|Permanent| . PERMAN)
(|PermutationGroupExamples| . PGE)
(|PermutationGroup| . PERMGRP)
(|Permutation| . PERM)
(|Pi| . HACKPI)
(|PiCoercions| . PICOERCE)
(|Places| . PLACES)
(|PlacesOverPseudoAlgebraicClosureOfFiniteField| . PLACESPS)
(|Plcs| . PLCS)
(|PointFunctions2| . PTFUNC2)
(|PolyGroebner| . PGROEB)
(|Polynomial| . POLY)
(|PolynomialAN2Expression| . PAN2EXPR)
(|PolynomialComposition| . PCOMP)
(|PolynomialDecomposition| . PDECOMP)
(|PolynomialFunctions2| . POLY2)
(|PolynomialIdeals| . IDEAL)
(|PolynomialPackageForCurve| . PLPKCRV)
(|PolynomialToUnivariatePolynomial| . POLY2UP)
(|PositiveInteger| . PI)
(|PowerSeriesLimitPackage| . LIMITPS)
(|PrimeField| . PF)
(|PrimitiveArrayFunctions2| . PRIMARR2)
(|PrintPackage| . PRINT)
(|ProjectiveAlgebraicSetPackage| . PRJALGPK)
(|ProjectivePlane| . PROJPL)
(|ProjectivePlaneOverPseudoAlgebraicClosureOfFiniteField| . PROJPLPS)
(|ProjectiveSpace| . PROJSP)
(|PseudoAlgebraicClosureOfAlgExtOfRationalNumber| . PACEXT)
(|QuadraticForm| . QFORM)
(|QuasiComponentPackage| . QCMPACK)
(|Quaternion| . QUAT)
(|QuaternionCategoryFunctions2| . QUATCT2)
(|QueryEquation| . QEQUAT)
(|Queue| . QUEUE)
(|QuotientFieldCategoryFunctions2| . QFCAT2)
(|RadicalEigenPackage| . REP)
(|RadicalSolvePackage| . SOLVERAD)
(|RadixExpansion| . RADIX)
(|RadixUtilities| . RADUTIL)
(|RandomNumberSource| . RANDSRC)

```

```

(|RationalFunction| . RF)
(|RationalFunctionDefiniteIntegration| . DEFINTRF)
(|RationalFunctionFactor| . RFFACT)
(|RationalFunctionFactorizer| . RFFACTOR)
(|RationalFunctionIntegration| . INTRF)
(|RationalFunctionLimitPackage| . LIMITRF)
(|RationalFunctionSign| . SIGNRF)
(|RationalFunctionSum| . SUMRF)
(|RationalRetractions| . RATRET)
(|RealClosure| . RECLOS)
(|RealPolynomialUtilitiesPackage| . POLUTIL)
(|RealZeroPackage| . REALO)
(|RealZeroPackageQ| . REALOQ)
(|RecurrenceOperator| . RECOP)
(|RectangularMatrixCategoryFunctions2| . RMCAT2)
(|RegularSetDecompositionPackage| . RSDCMPK)
(|RegularTriangularSet| . REGSET)
(|RegularTriangularSetGcdPackage| . RSETGCD)
(|RepresentationPackage1| . REP1)
(|RepresentationPackage2| . REP2)
(|ResolveLatticeCompletion| . RESLATC)
(|RewriteRule| . RULE)
(|RightOpenIntervalRootCharacterization| . ROIRC)
(|RomanNumeral| . ROMAN)
(|RootsFindingPackage| . RFP)
(|Ruleset| . RULESET)
(|ScriptFormulaFormat| . FORMULA)
(|ScriptFormulaFormat1| . FORMULA1)
(|Segment| . SEG)
(|SegmentBinding| . SEGBIND)
(|SegmentBindingFunctions2| . SEGBIND2)
(|SegmentFunctions2| . SEG2)
(|Set| . SET)
(|SimpleAlgebraicExtensionAlgFactor| . SAEFACT)
(|SimplifyAlgebraicNumberConvertPackage| . SIMPAN)
(|SingleInteger| . SINT)
(|SmithNormalForm| . SMITH)
(|SparseUnivariatePolynomialExpressions| . SUPEXPR)
(|SparseUnivariatePolynomialFunctions2| . SUP2)
(|SpecialOutputPackage| . SPECOUT)
(|SquareFreeRegularSetDecompositionPackage| . SRDCMPK)
(|SquareFreeRegularTriangularSet| . SREGSET)
(|SquareFreeRegularTriangularSetGcdPackage| . SFRGCD)
(|SquareFreeQuasiComponentPackage| . SFQCMPK)
(|Stack| . STACK)
(|Stream| . STREAM)
(|StreamFunctions1| . STREAM1)
(|StreamFunctions2| . STREAM2)
(|StreamFunctions3| . STREAM3)
(|StreamTensor| . STNSR)

```

```

(|StochasticDifferential| . SD)
(|String| . STRING)
(|SturmHabichtPackage| . SHP)
(|Symbol| . SYMBOL)
(|SymmetricGroupCombinatoricFunctions| . SGCF)
(|SystemSolvePackage| . SYSSOLP)
(|SAERationalFunctionAlgFactor| . SAERFFC)
(|Tableau| . TABLEAU)
(|TaylorSeries| . TS)
(|TaylorSolve| . UTSSOL)
(|TexFormat| . TEX)
(|TexFormat1| . TEX1)
(|TextFile| . TEXTFILE)
(|ThreeDimensionalViewport| . VIEW3D)
(|ThreeSpace| . SPACE3)
(|Timer| . TIMER)
(|TopLevelDrawFunctions| . DRAW)
(|TopLevelDrawFunctionsForAlgebraicCurves| . DRAWCURV)
(|TopLevelDrawFunctionsForCompiledFunctions| . DRAWCFUN)
(|TopLevelDrawFunctionsForPoints| . DRAWPT )
(|TopLevelThreeSpace| . TOPSP)
(|TranscendentalManipulations| . TRMANIP)
(|TransSolvePackage| . SOLVETRA)
(|Tree| . TREE)
(|TrigonometricManipulations| . TRIGMNIP)
(|UnivariateLaurentSeriesFunctions2| . ULS2)
(|UnivariateFormalPowerSeries| . UFPS)
(|UnivariateFormalPowerSeriesFunctions| . UFPS1)
(|UnivariatePolynomial| . UP)
(|UnivariatePolynomialCategoryFunctions2| . UPOLYC2)
(|UnivariatePolynomialCommonDenominator| . UPCDEN)
(|UnivariatePolynomialFunctions2| . UP2)
(|UnivariatePolynomialMultiplicationPackage| . UPMP)
(|UnivariateTaylorSeriesCZero| . UTSZ)
(|UnivariatePuisseuxSeriesFunctions2| . UPXS2)
(|UnivariateTaylorSeriesFunctions2| . UTS2)
(|UniversalSegment| . UNISEG)
(|UniversalSegmentFunctions2| . UNISEG2)
(|UserDefinedVariableOrdering| . UDVO)
(|U32Vector| . U32VEC)
(|Vector| . VECTOR)
(|VectorFunctions2| . VECTOR2)
(|ViewDefaultsPackage| . VIEWDEF)
(|Void| . VOID)
(|WuWenTsunTriangularSet| . WUTSET))
(|naglink|
  (|Asp1| . ASP1)
  (|Asp4| . ASP4)
  (|Asp6| . ASP6)
  (|Asp7| . ASP7)

```



```

(|Asp8| . ASP8)
(|Asp9| . ASP9)
(|Asp10| . ASP10)
(|Asp12| . ASP12)
(|Asp19| . ASP19)
(|Asp20| . ASP20)
(|Asp24| . ASP24)
(|Asp27| . ASP27)
(|Asp28| . ASP28)
(|Asp29| . ASP29)
(|Asp30| . ASP30)
(|Asp31| . ASP31)
(|Asp33| . ASP33)
(|Asp34| . ASP34)
(|Asp35| . ASP35)
(|Asp41| . ASP41)
(|Asp42| . ASP42)
(|Asp49| . ASP49)
(|Asp50| . ASP50)
(|Asp55| . ASP55)
(|Asp73| . ASP73)
(|Asp74| . ASP74)
(|Asp77| . ASP77)
(|Asp78| . ASP78)
(|Asp80| . ASP80)
(|FortranCode| . FC)
(|FortranCodePackage1| . FCPAK1)
(|FortranExpression| . FEXPR)
(|FortranMachineTypeCategory| . FMTC)
(|FortranMatrixCategory| . FMC)
(|FortranMatrixFunctionCategory| . FMFUN)
(|FortranOutputStackPackage| . FOP)
(|FortranPackage| . FORT)
(|FortranProgramCategory| . FORTCAT)
(|FortranProgram| . FORTRAN)
(|FortranFunctionCategory| . FORTFN)
(|FortranScalarType| . FST)
(|FortranType| . FT)
(|FortranTemplate| . FTEM)
(|FortranVectorFunctionCategory| . FVFUN)
(|FortranVectorCategory| . FVC)
(|MachineComplex| . MCMLX)
(|MachineFloat| . MFLOAT)
(|MachineInteger| . MINT)
(|MultiVariableCalculusFunctions| . MCALCFN)
(|NagDiscreteFourierTransformInterfacePackage| . NAGDIS)
(|NagEigenInterfacePackage| . NAGEIG)
(|NAGLinkSupportPackage| . NAGSP)
(|NagOptimisationInterfacePackage| . NAGOPT)
(|NagQuadratureInterfacePackage| . NAGQUA)

```

```

(|NagResultChecks| . NAGRES)
(|NagSpecialFunctionsInterfacePackage| . NAGSPE)
(|NagPolynomialRootsPackage| . NAGC02)
(|NagRootFindingPackage| . NAGC05)
(|NagSeriesSummationPackage| . NAGC06)
(|NagIntegrationPackage| . NAGD01)
(|NagOrdinaryDifferentialEquationsPackage| . NAGD02)
(|NagPartialDifferentialEquationsPackage| . NAGD03)
(|NagInterpolationPackage| . NAGE01)
(|NagFittingPackage| . NAGE02)
(|NagOptimisationPackage| . NAGE04)
(|NagMatrixOperationsPackage| . NAGF01)
(|NagEigenPackage| . NAGF02)
(|NagLinearEquationSolvingPackage| . NAGF04)
(|NagLapack| . NAGF07)
(|NagSpecialFunctionsPackage| . NAGS)
(|PackedHermitianSequence| . PACKED)
(|Result| . RESULT)
(|SimpleFortranProgram| . SFORT)
(|Switch| . SWITCH)
(|SymbolTable| . SYMTAB)
(|TemplateUtilities| . TEMUTL)
(|TheSymbolTable| . SYMS)
(|ThreeDimensionalMatrix| . M3D))
(|anna|
  (|AnnaNumericalIntegrationPackage| . INTPACK)
  (|AnnaNumericalOptimizationPackage| . OPTPACK)
  (|AnnaOrdinaryDifferentialEquationPackage| . ODEPACK)
  (|AnnaPartialDifferentialEquationPackage| . PDEPACK)
  (|AttributeButtons| . ATTRBUT)
  (|BasicFunctions| . BFUNCT)
  (|d01ajfAnnaType| . D01AJFA)
  (|d01akfAnnaType| . D01AKFA)
  (|d01alfAnnaType| . D01ALFA)
  (|d01amfAnnaType| . D01AMFA)
  (|d01anfAnnaType| . D01ANFA)
  (|d01apfAnnaType| . D01APFA)
  (|d01aqfAnnaType| . D01AQFA)
  (|d01asfAnnaType| . D01ASFA)
  (|d01fcfAnnaType| . D01FCFA)
  (|d01gbfAnnaType| . D01GBFA)
  (|d01AgentsPackage| . D01AGNT)
  (|d01TransformFunctionType| . D01TRNS)
  (|d01WeightsPackage| . D01WGTS)
  (|d02AgentsPackage| . D02AGNT)
  (|d02bbfAnnaType| . D02BBFA)
  (|d02bhfAnnaType| . D02BHFA)
  (|d02cjfAnnaType| . D02CJFA)
  (|d02ejfAnnaType| . D02EJFA)
  (|d03AgentsPackage| . D03AGNT)

```

```

(|d03eefAnnaType| . D03EEFA)
(|d03fafAnnaType| . D03FAFA)
(|e04AgentsPackage| . E04AGNT)
(|e04dgfAnnaType| . E04DGFA)
(|e04fdfAnnaType| . E04FDFA)
(|e04gcfAnnaType| . E04GCFA)
(|e04jafAnnaType| . E04JAFA)
(|e04mbfAnnaType| . E04MBFA)
(|e04nafAnnaType| . E04NAFA)
(|e04ucfAnnaType| . E04UCFA)
(|ExpertSystemContinuityPackage| . ESCONT)
(|ExpertSystemContinuityPackage1| . ESCONT1)
(|ExpertSystemToolsPackage| . ESTOOLS)
(|ExpertSystemToolsPackage1| . ESTOOLS1)
(|ExpertSystemToolsPackage2| . ESTOOLS2)
(|NumericalIntegrationCategory| . NUMINT)
(|NumericalIntegrationProblem| . NIPROB)
(|NumericalODEProblem| . ODEPROB)
(|NumericalOptimizationCategory| . OPTCAT)
(|NumericalOptimizationProblem| . OPTPROB)
(|NumericalPDEProblem| . PDEPROB)
(|ODEIntensityFunctionsTable| . ODEIFTBL)
(|IntegrationFunctionsTable| . INTFTBL)
(|OrdinaryDifferentialEquationsSolverCategory| . ODECAT)
(|PartialDifferentialEquationsSolverCategory| . PDECAT)
(|RoutinesTable| . ROUTINE))
(|categories|
(|AbelianGroup| . ABELGRP)
(|AbelianMonoid| . ABELMON)
(|AbelianMonoidRing| . AMR)
(|AbelianSemiGroup| . ABELSG)
(|AffineSpaceCategory| . AFSPCAT)
(|Aggregate| . AGG)
(|Algebra| . ALGEBRA)
(|AlgebraicallyClosedField| . ACF)
(|AlgebraicallyClosedFunctionSpace| . ACFS)
(|ArcHyperbolicFunctionCategory| . AHYP)
(|ArcTrigonometricFunctionCategory| . ATRIG)
(|AssociationListAggregate| . ALAGG)
(|AttributeRegistry| . ATTREG)
(|BagAggregate| . BGAGG)
(|BasicType| . BASTYPE)
(|BiModule| . BMODULE)
(|BinaryRecursiveAggregate| . BRAGG)
(|BinaryTreeCategory| . BTCAT)
(|BitAggregate| . BTAGG)
(|BlowUpMethodCategory| . BLMETCT)
(|CachableSet| . CACHSET)
(|CancellationAbelianMonoid| . CABMON)
(|CharacteristicNonZero| . CHARNZ)

```

```

(|CharacteristicZero| . CHARZ)
(|CoercibleTo| . KOERCE)
(|Collection| . CLAGG)
(|CombinatorialFunctionCategory| . CFCAT)
(|CombinatorialOpsCategory| . COMBOPC)
(|CommutativeRing| . COMRING)
(|ComplexCategory| . COMPCAT)
(|ConvertibleTo| . KONVERT)
(|DequeueAggregate| . DQAGG)
(|DesingTreeCategory| . DSTRCAT)
(|Dictionary| . DIAGG)
(|DictionaryOperations| . DIOPS)
(|DifferentialExtension| . DIFEXT)
(|DifferentialPolynomialCategory| . DPOLCAT)
(|DifferentialRing| . DIFRING)
(|DifferentialVariableCategory| . DVARCAT)
(|DirectProductCategory| . DIRPCAT)
(|DivisionRing| . DIVRING)
(|DivisorCategory| . DIVCAT)
(|DoublyLinkedAggregate| . DLAGG)
(|ElementaryFunctionCategory| . ELEMFUN)
(|Eltable| . ELTAB)
(|EltableAggregate| . ELTAGG)
(|EntireRing| . ENTIRER)
(|EuclideanDomain| . EUCDOM)
(|Evalable| . EVALAB)
(|ExpressionSpace| . ES)
(|ExtensibleLinearAggregate| . ELAGG)
(|ExtensionField| . XF)
(|Field| . FIELD)
(|FieldOfPrimeCharacteristic| . FPC)
(|Finite| . FINITE)
(|FileCategory| . FILECAT)
(|FileNameCategory| . FNCAT)
(|FiniteAbelianMonoidRing| . FAMR)
(|FiniteAlgebraicExtensionField| . FAXF)
(|FiniteDivisorCategory| . FDIVCAT)
(|FiniteFieldCategory| . FFIELDC)
(|FiniteLinearAggregate| . FLAGG)
(|FiniteRankNonAssociativeAlgebra| . FINAALG)
(|FiniteRankAlgebra| . FINRALG)
(|FiniteSetAggregate| . FSAGG)
(|FloatingPointSystem| . FPS)
(|FramedAlgebra| . FRAMALG)
(|FramedNonAssociativeAlgebra| . FRNAALG)
(|FramedNonAssociativeAlgebraFunctions2| . FRNAAF2)
(|FreeAbelianMonoidCategory| . FAMONC)
(|FreeLieAlgebra| . FLALG)
(|FreeModuleCat| . FMCAT)
(|FullyEvalableOver| . FEVALAB)

```

```

(|FullyLinearlyExplicitRingOver| . FLINEXP)
(|FullyPatternMatchable| . FPATMAB)
(|FullyRetractableTo| . FRETRCT)
(|FunctionFieldCategory| . FFCAT)
(|FunctionSpace| . FS)
(|GcdDomain| . GCDDOM)
(|GradedAlgebra| . GRALG)
(|GradedModule| . GRMOD)
(|Group| . GROUP)
(|HomogeneousAggregate| . HOAGG)
(|HyperbolicFunctionCategory| . HYPCAT)
(|IndexedAggregate| . IXAGG)
(|IndexedDirectProductCategory| . IDPC)
(|InfinitelyClosePointCategory| . INFCLCT)
(|InnerEvalable| . IEVALAB)
(|IntegerNumberSystem| . INS)
(|IntegralDomain| . INTDOM)
(|IntervalCategory| . INTCAT)
(|KeyedDictionary| . KDAGG)
(|LazyStreamAggregate| . LZSTAGG)
(|LeftAlgebra| . LALG)
(|LeftModule| . LMODULE)
(|LieAlgebra| . LIECAT)
(|LinearAggregate| . LNAGG)
(|LinearlyExplicitRingOver| . LINEXP)
(|LinearOrdinaryDifferentialOperatorCategory| . LODOCAT)
(|LiouvillianFunctionCategory| . LFCAT)
(|ListAggregate| . LSAGG)
(|LocalPowerSeriesCategory| . LOCPWC)
(|Logic| . LOGIC)
(|MatrixCategory| . MATCAT)
(|Module| . MODULE)
(|Monad| . MONAD)
(|MonadWithUnit| . MONADWU)
(|Monoid| . MONOID)
(|MonogenicAlgebra| . MONOGEN)
(|MonogenicLinearOperator| . MLO)
(|MultiDictionary| . MDAGG)
(|MultisetAggregate| . MSETAGG)
(|MultivariateTaylorSeriesCategory| . MTSCAT)
(|NonAssociativeAlgebra| . NAALG)
(|NonAssociativeRing| . NASRING)
(|NonAssociativeRng| . NARNG)
(|NormalizedTriangularSetCategory| . NTSCAT)
(|Object| . OBJECT)
(|OctonionCategory| . OC)
(|OneDimensionalArrayAggregate| . A1AGG)
(|OpenMath| . OM)
(|OrderedAbelianGroup| . OAGROUP)
(|OrderedAbelianMonoid| . OAMON)

```

```

(|OrderedAbelianMonoidSup| . OAMONS)
(|OrderedAbelianSemiGroup| . OASGP)
(|OrderedCancellationAbelianMonoid| . OCAMON)
(|OrderedFinite| . ORDFIN)
(|OrderedIntegralDomain| . OINTDOM)
(|OrderedMonoid| . ORDMON)
(|OrderedMultisetAggregate| . OMSAGG)
(|OrderedRing| . ORDRING)
(|OrderedSet| . ORDSET)
(|PAdicIntegerCategory| . PADICCT)
(|PartialDifferentialRing| . PDRING)
(|PartialTranscendentalFunctions| . PTRANFN)
(|Patternable| . PATAB)
(|PatternMatchable| . PATMAB)
(|PermutationCategory| . PERMCAT)
(|PlacesCategory| . PLACESC)
(|PlottablePlaneCurveCategory| . PPCURVE)
(|PlottableSpaceCurveCategory| . PSCURVE)
(|PointCategory| . PTCAT)
(|PolynomialCategory| . POLYCAT)
(|PolynomialFactorizationExplicit| . PFECAT)
(|PolynomialSetCategory| . PSETCAT)
(|PowerSeriesCategory| . PSCAT)
(|PrimitiveFunctionCategory| . PRIMCAT)
(|PrincipalIdealDomain| . PID)
(|PriorityQueueAggregate| . PRQAGG)
(|ProjectiveSpaceCategory| . PRSPCAT)
(|PseudoAlgebraicClosureOfAlgExtOfRationalNumberCategory| . PACEXTC)
(|PseudoAlgebraicClosureOfFiniteField| . PACOFF)
(|PseudoAlgebraicClosureOfFiniteFieldCategory| . PACFFC)
(|PseudoAlgebraicClosureOfPerfectFieldCategory| . PACPERC)
(|PseudoAlgebraicClosureOfRationalNumber| . PACRAT)
(|PseudoAlgebraicClosureOfRationalNumberCategory| . PACRATC)
(|QuaternionCategory| . QUATCAT)
(|QueueAggregate| . QUAGG)
(|QuotientFieldCategory| . QFCAT)
(|RadicalCategory| . RADCAT)
(|RealClosedField| . RCFIELD)
(|RealConstant| . REAL)
(|RealNumberSystem| . RNS)
(|RealRootCharacterizationCategory| . RRCC)
(|RectangularMatrixCategory| . RMATCAT)
(|RecursiveAggregate| . RCAGG)
(|RecursivePolynomialCategory| . RPOLCAT)
(|RegularChain| . RGCHAIN)
(|RegularTriangularSetCategory| . RSETCAT)
(|RetractableTo| . RETRACT)
(|RightModule| . RMODULE)
(|Ring| . RING)
(|Rng| . RNG)

```

```

(|SegmentCategory| . SEGCAT)
(|SegmentExpansionCategory| . SEGXCAT)
(|SemiGroup| . SGROUP)
(|SetAggregate| . SETAGG)
(|SetCategory| . SETCAT)
(|SetCategoryWithDegree| . SETCATD)
(|SExpressionCategory| . SEXCAT)
(|SpecialFunctionCategory| . SPFCAT)
(|SquareFreeNormalizedTriangularSetCategory| . SNTSCAT)
(|SquareFreeRegularTriangularSetCategory| . SFRTCAT)
(|SquareMatrixCategory| . SMATCAT)
(|StackAggregate| . SKAGG)
(|StepThrough| . STEP)
(|StreamAggregate| . STAGG)
(|StringAggregate| . SRAGG)
(|StringCategory| . STRICAT)
(|StructuralConstantsPackage| . SCPKG)
(|TableAggregate| . TBAGG)
(|ThreeSpaceCategory| . SPACEC)
(|TranscendentalFunctionCategory| . TRANFUN)
(|TriangularSetCategory| . TSETCAT)
(|TrigonometricFunctionCategory| . TRIGCAT)
(|TwoDimensionalArrayCategory| . ARR2CAT)
(|Type| . TYPE)
(|UnaryRecursiveAggregate| . URAGG)
(|UniqueFactorizationDomain| . UFD)
(|UnivariateLaurentSeriesCategory| . ULSCAT)
(|UnivariateLaurentSeriesConstructorCategory| . ULSCCAT)
(|UnivariatePolynomialCategory| . UPOLYC)
(|UnivariatePowerSeriesCategory| . UPSCAT)
(|UnivariatePuisseuxSeriesCategory| . UPXSCAT)
(|UnivariatePuisseuxSeriesConstructorCategory| . UPXSCCA)
(|UnivariateSkewPolynomialCategory| . OREPCAT)
(|UnivariateTaylorSeriesCategory| . UTSCAT)
(|VectorCategory| . VECTCAT)
(|VectorSpace| . VSPACE)
(|XAlgebra| . XALG)
(|XFreeAlgebra| . XFALG)
(|XPolynomialsCat| . XPOLYC)
(|ZeroDimensionalSolvePackage| . ZDSOLVE))
(|Hidden|
  (|AlgebraicFunction| . AF)
  (|AlgebraicFunctionField| . ALGFF)
  (|AlgebraicHermiteIntegration| . INTHERAL)
  (|AlgebraicIntegrate| . INTALG)
  (|AlgebraicIntegration| . INTAF)
  (|AnonymousFunction| . ANON)
  (|AntiSymm| . ANTISYM)
  (|ApplyRules| . APPRULE)
  (|ApplyUnivariateSkewPolynomial| . APPLYORE))

```

```

(|ArrayStack| . ASTACK)
(|AssociatedEquations| . ASSOCEQ)
(|AssociationList| . ALIST)
(|Automorphism| . AUTOMOR)
(|BalancedFactorisation| . BALFACT)
(|BalancedPAdicInteger| . BPADIC)
(|BalancedPAdicRational| . BPADICRT)
(|BezoutMatrix| . BEZOUT)
(|BoundIntegerRoots| . BOUNDZRO)
(|BrillhartTests| . BRILL)
(|ChangeOfVariable| . CHVAR)
(|CharacteristicPolynomialInMonogenicalAlgebra| . CPIMA)
(|ChineseRemainderToolsForIntegralBases| . IBACHIN)
(|CoerceVectorMatrixPackage| . CVMP)
(|CombinatorialFunction| . COMBF)
(|CommonOperators| . COMMONOP)
(|CommuteUnivariatePolynomialCategory| . COMMUPC)
(|ComplexIntegerSolveLinearPolynomialEquation| . CINTSLPE)
(|ComplexPattern| . COMPLPAT)
(|ComplexPatternMatch| . CPMATCH)
(|ComplexRootFindingPackage| . CRFP)
(|ConstantLODE| . ODECONST)
(|CyclicStreamTools| . CSTTOOLS)
(|CyclotomicPolynomialPackage| . CYCLOTOM)
(|DefiniteIntegrationTools| . DFINTTLS)
(|DegreeReductionPackage| . DEGRED)
(|DeRhamComplex| . DERHAM)
(|DifferentialSparseMultivariatePolynomial| . DSMP)
(|DirectProduct| . DIRPROD)
(|DirectProductMatrixModule| . DPMM)
(|DirectProductModule| . DPMO)
(|DiscreteLogarithmPackage| . DLP)
(|DistributedMultivariatePolynomial| . DMP)
(|DoubleResultantPackage| . DBLRESP)
(|DrawOptionFunctions0| . DROPT0)
(|DrawOptionFunctions1| . DROPT1)
(|ElementaryFunction| . EF)
(|ElementaryFunctionsUnivariateLaurentSeries| . EFULS)
(|ElementaryFunctionsUnivariatePuisseuxSeries| . EFUPXS)
(|ElementaryIntegration| . INTEF)
(|ElementaryRischDE| . RDEEF)
(|ElementaryRischDESystem| . RDEEFS)
(|EllipticFunctionsUnivariateTaylorSeries| . ELFUTS)
(|EqTable| . EQTBL)
(|EuclideanModularRing| . EMR)
(|EvaluateCycleIndicators| . EVALCYC)
(|ExponentialExpansion| . EXPEXPAN)
(|ExponentialOfUnivariatePuisseuxSeries| . EXPUPXS)
(|ExpressionSpaceFunctions1| . ES1)
(|ExpressionTubePlot| . EXPRTUBE)

```



```

(|ExtAlgBasis| . EAB)
(|FactoredFunctions| . FACTFUNC)
(|FactoredFunctionUtilities| . FRUTIL)
(|FactoringUtilities| . FACUTIL)
(|FGLMIfCanPackage| . FGLMICPK)
(|FindOrderFinite| . FORDER)
(|FiniteDivisor| . FDIV)
(|FiniteFieldCyclicGroupExtension| . FFCGX)
(|FiniteFieldCyclicGroupExtensionByPolynomial| . FFCGP)
(|FiniteFieldExtension| . FFX)
(|FiniteFieldExtensionByPolynomial| . FFP)
(|FiniteFieldFunctions| . FFF)
(|FiniteFieldNormalBasisExtension| . FFNBX)
(|FiniteFieldNormalBasisExtensionByPolynomial| . FFNBP)
(|FiniteFieldPolynomialPackage| . FFPOLY)
(|FiniteFieldSolveLinearPolynomialEquation| . FFSLPE)
(|FormalFraction| . FORMAL)
(|FourierComponent| . FCOMP)
(|FractionalIdeal| . FRIDEAL)
(|FramedModule| . FRMOD)
(|FreeAbelianGroup| . FAGROUP)
(|FreeAbelianMonoid| . FAMONOID)
(|FreeGroup| . FGROU)
(|FreeModule| . FM)
(|FreeModule1| . FM1)
(|FreeMonoid| . FMONOID)
(|FunctionalSpecialFunction| . FSPECF)
(|FunctionCalled| . FUNCTION)
(|FunctionFieldIntegralBasis| . FFINTBAS)
(|FunctionSpaceReduce| . FSRED)
(|FunctionSpaceToUnivariatePowerSeries| . FS2UPS)
(|FunctionSpaceToExponentialExpansion| . FS2EXXP)
(|FunctionSpaceUnivariatePolynomialFactor| . FSUPFACT)
(|GaloisGroupFactorizationUtilities| . GALFACTU)
(|GaloisGroupFactorizer| . GALFACT)
(|GaloisGroupPolynomialUtilities| . GALPOLYU)
(|GaloisGroupUtilities| . GALUTIL)
(|GeneralHenselPackage| . GHENSEL)
(|GeneralDistributedMultivariatePolynomial| . GDMP)
(|GeneralPolynomialGcdPackage| . GENPGCD)
(|GeneralSparseTable| . GSTBL)
(|GenericNonAssociativeAlgebra| . GCNAALG)
(|GenExEuclid| . GENEZ)
(|GeneralizedMultivariateFactorize| . GENMFACT)
(|GeneralModulePolynomial| . GMODPOL)
(|GeneralPolynomialSet| . GPOLSET)
(|GeneralTriangularSet| . GTSET)
(|GenUFactorize| . GENUFACT)
(|GenusZeroIntegration| . INTGO)
(|GosperSummationMethod| . GOSPER)

```

```

(|GraphImage| . GRIMAGE)
(|GrayCode| . GRAY)
(|GroebnerInternalPackage| . GBINTERN)
(|GroebnerSolve| . GROEBSOL)
(|GuessOptionFunctions0| . GOPT0)
(|HashTable| . HASHTBL)
(|Heap| . HEAP)
(|HeuGcd| . HEUGCD)
(|HomogeneousDistributedMultivariatePolynomial| . HDMP)
(|HyperellipticFiniteDivisor| . HELLDIV)
(|IncrementingMaps| . INCRMAPS)
(|IndexedBits| . IBITS)
(|IndexedDirectProductAbelianGroup| . IDPAG)
(|IndexedDirectProductAbelianMonoid| . IDPAM)
(|IndexedDirectProductObject| . IDPO)
(|IndexedDirectProductOrderedAbelianMonoid| . IDPOAM)
(|IndexedDirectProductOrderedAbelianMonoidSup| . IDPOAMS)
(|IndexedExponents| . INDE)
(|IndexedFlexibleArray| . IFARRAY)
(|IndexedList| . ILIST)
(|IndexedMatrix| . IMATRIX)
(|IndexedOneDimensionalArray| . IARRAY1)
(|IndexedString| . ISTRING)
(|IndexedTwoDimensionalArray| . IARRAY2)
(|IndexedVector| . IVECTOR)
(|InnerAlgFactor| . IALGFACT)
(|InnerAlgebraicNumber| . IAN)
(|InnerCommonDenominator| . ICDEN)
(|InnerFiniteField| . IFF)
(|InnerFreeAbelianMonoid| . IFAMON)
(|InnerIndexedTwoDimensionalArray| . IIARRAY2)
(|InnerMatrixLinearAlgebraFunctions| . IMATLIN)
(|InnerMatrixQuotientFieldFunctions| . IMATQF)
(|InnerModularGcd| . INMODGCD)
(|InnerMultFact| . INNMFACT)
(|InnerNormalBasisFieldFunctions| . INBFF)
(|InnerNumericEigenPackage| . INEP)
(|InnerNumericFloatSolvePackage| . INFSP)
(|InnerPAdicInteger| . IPADIC)
(|InnerPolySign| . INPSIGN)
(|InnerPolySum| . ISUMP)
(|InnerPrimeField| . IPF)
(|InnerSparseUnivariatePowerSeries| . ISUPS)
(|InnerTable| . INTABL)
(|InnerTaylorSeries| . ITAYLOR)
(|InnerTrigonometricManipulations| . ITRIGMNP)
(|InputForm| . INFORM)
(|InputFormFunctions1| . INFORM1)
(|IntegerBits| . INTBIT)
(|IntegerFactorizationPackage| . INTFACT)

```

```

(|IntegerMod| . ZMOD)
(|IntegerSolveLinearPolynomialEquation| . INTSLPE)
(|IntegralBasisPolynomialTools| . IBPTOOLS)
(|IntegralBasisTools| . IBATOOOL)
(|IntegrationResult| . IR)
(|IntegrationTools| . INTTOOLS)
(|InternalPrintPackage| . IPRNTPK)
(|InternalRationalUnivariateRepresentationPackage| . IRURPK)
(|IrredPolyOverFiniteField| . IRREDFFX)
(|Kernel| . KERNEL)
(|Kovacic| . KOVACIC)
(|LaurentPolynomial| . LAUPOL)
(|LeadingCoefDetermination| . LEADCDET)
(|LexTriangularPackage| . LEXTRIPK)
(|LieExponentials| . LEXP)
(|LiePolynomial| . LPOLY)
(|LinearDependence| . LINDEP)
(|LinearOrdinaryDifferentialOperatorFactorizer| . LODOF)
(|LinearOrdinaryDifferentialOperator1| . LOD01)
(|LinearOrdinaryDifferentialOperator2| . LOD02)
(|LinearOrdinaryDifferentialOperatorsOps| . LODOOPS)
(|LinearPolynomialEquationByFractions| . LPEFRAC)
(|LinGroebnerPackage| . LGROBP)
(|LiouvillianFunction| . LF)
(|ListMonoidOps| . LMOPS)
(|ListMultiDictionary| . LMDICT)
(|LocalAlgebra| . LA)
(|Localize| . LO)
(|LyndonWord| . LWORD)
(|Magma| . MAGMA)
(|MakeBinaryCompiledFunction| . MKBCFUNC)
(|MakeCachableSet| . MKCHSET)
(|MakeUnaryCompiledFunction| . MKUCFUNC)
(|MappingPackageInternalHacks1| . MAPHACK1)
(|MappingPackageInternalHacks2| . MAPHACK2)
(|MappingPackageInternalHacks3| . MAPHACK3)
(|MeshCreationRoutinesForThreeDimensions| . MESH)
(|ModMonic| . MODMON)
(|ModularField| . MODFIELD)
(|ModularHermitianRowReduction| . MHROWRED)
(|ModularRing| . MODRING)
(|ModuleMonomial| . MODMONOM)
(|MoebiusTransform| . MOEBIUS)
(|MonoidRing| . MRING)
(|MonomialExtensionTools| . MONOTOOL)
(|MPolyCatPolyFactorizer| . MPCPF)
(|MPolyCatFunctions3| . MPC3)
(|MRationalFactorize| . MRATFAC)
(|MultipleMap| . MMAP)
(|MultivariateLifting| . MLIFT)

```

```

(|MultivariateSquareFree| . MULTSQFR)
(|HomogeneousDirectProduct| . HDP)
(|NewSparseMultivariatePolynomial| . NSMP)
(|NewSparseUnivariatePolynomial| . NSUP)
(|NewSparseUnivariatePolynomialFunctions2| . NSUP2)
(|NonCommutativeOperatorDivision| . NCODIV)
(|NewtonInterpolation| . NEWTON)
(|None| . NONE)
(|NonLinearFirstOrderODESolver| . NODE1)
(|NonLinearSolvePackage| . NLINSOL)
(|NormRetractPackage| . NORMRETR)
(|NPCoef| . NPCOEF)
(|NumberFormats| . NUMFMT)
(|NumberFieldIntegralBasis| . NFINTBAS)
(|NumericTubePlot| . NUMTUBE)
(|ODEIntegration| . ODEINT)
(|ODETools| . ODETOOLS)
(|Operator| . OP)
(|OppositeMonogenicLinearOperator| . OML0)
(|OrderedDirectProduct| . ODP)
(|OrderedFreeMonoid| . OFMONOID)
(|OrderedVariableList| . OVAR)
(|OrderingFunctions| . ORDFUNS)
(|OrderlyDifferentialPolynomial| . ODPOL)
(|OrderlyDifferentialVariable| . ODVAR)
(|OrdinaryWeightedPolynomials| . OWP)
(|OutputForm| . OUTFORM)
(|PadeApproximants| . PADE)
(|PAdicInteger| . PADIC)
(|PAdicRational| . PADICRAT)
(|PAdicRationalConstructor| . PADICRC)
(|PAdicWildFunctionFieldIntegralBasis| . PWFFINTB)
(|ParadoxicalCombinatorsForStreams| . YSTREAM)
(|ParametricLinearEquations| . PLEQN)
(|PartialFractionPackage| . PFRPAC)
(|Partition| . PRITITION)
(|Pattern| . PATTERN)
(|PatternFunctions1| . PATTERN1)
(|PatternMatchFunctionSpace| . PMFS)
(|PatternMatchIntegerNumberSystem| . PMINS)
(|PatternMatchIntegration| . INTPM)
(|PatternMatchKernel| . PMKERNEL)
(|PatternMatchListAggregate| . PMLSAGG)
(|PatternMatchListResult| . PATLRES)
(|PatternMatchPolynomialCategory| . PMPLCAT)
(|PatternMatchPushDown| . PMDOWN)
(|PatternMatchQuotientFieldCategory| . PMQFCAT)
(|PatternMatchResult| . PATRES)
(|PatternMatchSymbol| . PMSYM)
(|PatternMatchTools| . PMTOOLS)

```

```

(|PlaneAlgebraicCurvePlot| . ACPLLOT)
(|Plot| . PLOT)
(|PlotFunctions1| . PLOT1)
(|PlotTools| . PLOTTOOL)
(|Plot3D| . PLOT3D)
(|PoincareBirkhoffWittLyndonBasis| . PBWLB)
(|Point| . POINT)
(|PointsOfFiniteOrder| . PFO)
(|PointsOfFiniteOrderRational| . PFOQ)
(|PointsOfFiniteOrderTools| . PFOTOOLS)
(|PointPackage| . PTPACK)
(|PolToPol| . POLTOPOL)
(|PolynomialCategoryLifting| . POLYLIFT)
(|PolynomialCategoryQuotientFunctions| . POLYCATQ)
(|PolynomialFactorizationByRecursion| . PFBR)
(|PolynomialFactorizationByRecursionUnivariate| . PFBRU)
(|PolynomialGcdPackage| . PGCD)
(|PolynomialInterpolation| . PINTERP)
(|PolynomialInterpolationAlgorithms| . PINTERPA)
(|PolynomialNumberTheoryFunctions| . PNTHEORY)
(|PolynomialRing| . PR)
(|PolynomialRoots| . POLYROOT)
(|PolynomialSetUtilitiesPackage| . PSETPK)
(|PolynomialSolveByFormulas| . SOLVEFOR)
(|PolynomialSquareFree| . PSQFR)
(|PrecomputedAssociatedEquations| . PREASSOC)
(|PrimitiveArray| . PRIMARR)
(|PrimitiveElement| . PRIMELT)
(|PrimitiveRatDE| . ODEPRIM)
(|PrimitiveRatRicDE| . ODEPRRIC)
(|Product| . PRODUCT)
(|PseudoRemainderSequence| . PRS)
(|PseudoLinearNormalForm| . PSEUDLIN)
(|PureAlgebraicIntegration| . INTPAF)
(|PureAlgebraicLODE| . ODEPAL)
(|PushVariables| . PUSHVAR)
(|QuasiAlgebraicSet| . QALGSET)
(|QuasiAlgebraicSet2| . QALGSET2)
(|RadicalFunctionField| . RADFF)
(|RandomDistributions| . RDIST)
(|RandomFloatDistributions| . RFDIST)
(|RandomIntegerDistributions| . RIDIST)
(|RationalFactorize| . RATFACT)
(|RationalIntegration| . INTRAT)
(|RationalInterpolation| . RINTERP)
(|RationalLODE| . ODERAT)
(|RationalRicDE| . ODERTRIC)
(|RationalUnivariateRepresentationPackage| . RURPK)
(|RealSolvePackage| . REALSOLV)
(|RectangularMatrix| . RMATRIX)

```

```

(|ReducedDivisor| . RDIV)
(|ReduceLODE| . ODERED)
(|ReductionOfOrder| . REDORDER)
(|Reference| . REF)
(|RepeatedDoubling| . REPDB)
(|RepeatedSquaring| . REPSQ)
(|ResidueRing| . RESRING)
(|RetractSolvePackage| . RETSOL)
(|RuleCalled| . RULECOLD)
(|SetOfMIntegersInOneToN| . SETMN)
(|SExpression| . SEX)
(|SExpressionOf| . SEXOF)
(|SequentialDifferentialPolynomial| . SDPOL)
(|SequentialDifferentialVariable| . SDVAR)
(|SimpleAlgebraicExtension| . SAE)
(|SingletonAsOrderedSet| . SAOS)
(|SortedCache| . SCACHE)
(|SortPackage| . SORTPAK)
(|SparseMultivariatePolynomial| . SMP)
(|SparseMultivariateTaylorSeries| . SMTS)
(|SparseTable| . STBL)
(|SparseUnivariatePolynomial| . SUP)
(|SparseUnivariateSkewPolynomial| . ORESUP)
(|SparseUnivariateLaurentSeries| . SULS)
(|SparseUnivariatePuisseuxSeries| . SUPXS)
(|SparseUnivariateTaylorSeries| . SUTS)
(|SplitHomogeneousDirectProduct| . SHDP)
(|SplittingNode| . SPLNODE)
(|SplittingTree| . SPLTREE)
(|SquareMatrix| . SQMATRIX)
(|Stack| . STACK)
(|StorageEfficientMatrixOperations| . MATSTOR)
(|StreamInfiniteProduct| . STINPROD)
(|StreamTaylorSeriesOperations| . STTAYLOR)
(|StreamTranscendentalFunctions| . STTF)
(|StreamTranscendentalFunctionsNonCommutative| . STTFNC)
(|StringTable| . STRTBL)
(|SubResultantPackage| . SUBRESP)
(|SubSpace| . SUBSPACE)
(|SubSpaceComponentProperty| . COMPPROP)
(|SuchThat| . SUCH)
(|SupFractionFactorizer| . SUPFRACF)
(|SymmetricFunctions| . SYMFUNC)
(|SymmetricPolynomial| . SYMPOLY)
(|SystemODESolver| . ODESYS)
(|Table| . TABLE)
(|TableauxBumpers| . TABLBUMP)
(|TabulatedComputationPackage| . TBCMPPK)
(|TangentExpansions| . TANEXP)
(|ToolsForSign| . TOOLSIGN)

```

```

(|TranscendentalHermiteIntegration| . INTHERTR)
(|TranscendentalIntegration| . INTTR)
(|TranscendentalRischDE| . RDETR)
(|TranscendentalRischDESystem| . RDETRS)
(|TransSolvePackageService| . SOLVESER)
(|TriangularMatrixOperations| . TRIMAT)
(|TubePlot| . TUBE)
(|TubePlotTools| . TUBETOOL)
(|Tuple| . TUPLE)
(|TwoDimensionalArray| . ARRAY2)
(|TwoDimensionalPlotClipping| . CLIP)
(|TwoDimensionalViewport| . VIEW2D)
(|TwoFactorize| . TWOFACT)
(|UnivariateFactorize| . UNIFACT)
(|UnivariateLaurentSeries| . ULS)
(|UnivariateLaurentSeriesConstructor| . ULSCONS)
(|UnivariatePolynomialDecompositionPackage| . UPDECOMP)
(|UnivariatePolynomialDivisionPackage| . UPDIVP)
(|UnivariatePolynomialSquareFree| . UPSQFREE)
(|UnivariatePuisseuxSeries| . UPXS)
(|UnivariatePuisseuxSeriesConstructor| . UPXSCONS)
(|UnivariatePuisseuxSeriesWithExponentialSingularity| . UPXSING)
(|UnivariateSkewPolynomial| . OREUP)
(|UnivariateSkewPolynomialCategoryOps| . OREPCTO)
(|UnivariateTaylorSeries| . UTS)
(|UnivariateTaylorSeriesODESolver| . UTSODE)
(|UserDefinedPartialOrdering| . UDPO)
(|UTSodetools| . UTSODETL)
(|Variable| . VARIABLE)
(|ViewportPackage| . VIEW)
(|WeierstrassPreparation| . WEIER)
(|WeightedPolynomials| . WP)
(|WildFunctionFieldIntegralBasis| . WFFINTBS)
(|XDistributedPolynomial| . XDPOLY)
(|XExponentialPackage| . XEXPPKG)
(|XPBWPolynomial| . XPBWPOLY)
(|XPolynomial| . XPOLY)
(|XPolynomialRing| . XPR)
(|XRecursivePolynomial| . XRPOLY))
(|defaults|
  (|AbelianGroup&| . ABELGRP-)
  (|AbelianMonoid&| . ABELMON-)
  (|AbelianMonoidRing&| . AMR-)
  (|AbelianSemiGroup&| . ABELSG-)
  (|Aggregate&| . AGG-)
  (|Algebra&| . ALGEBRA-)
  (|AlgebraicallyClosedField&| . ACF-)
  (|AlgebraicallyClosedFunctionSpace&| . ACFS-)
  (|ArcTrigonometricFunctionCategory&| . ATRIG-)
  (|BagAggregate&| . BGAGG-)

```

```

(|BasicType&| . BASTYPE-)
(|BinaryRecursiveAggregate&| . BRAGG-)
(|BinaryTreeCategory&| . BTCAT-)
(|BitAggregate&| . BTAGG-)
(|Collection&| . CLAGG-)
(|ComplexCategory&| . COMPCAT-)
(|Dictionary&| . DIAGG-)
(|DictionaryOperations&| . DIOPS-)
(|DifferentialExtension&| . DIFEXT-)
(|DifferentialPolynomialCategory&| . DPOLCAT-)
(|DifferentialRing&| . DIFRING-)
(|DifferentialVariableCategory&| . DVARCAT-)
(|DirectProductCategory&| . DIRPCAT-)
(|DivisionRing&| . DIVRING-)
(|ElementaryFunctionCategory&| . ELEMFUN-)
(|EltableAggregate&| . ELTAGG-)
(|EuclideanDomain&| . EUCDOM-)
(|Evalable&| . EVALAB-)
(|ExpressionSpace&| . ES-)
(|ExtensibleLinearAggregate&| . ELAGG-)
(|ExtensionField&| . XF-)
(|Field&| . FIELD-)
(|FieldOfPrimeCharacteristic&| . FPC-)
(|FiniteAbelianMonoidRing&| . FAMR-)
(|FiniteAlgebraicExtensionField&| . FAXF-)
(|FiniteDivisorCategory&| . FDIVCAT-)
(|FiniteFieldCategory&| . FFIELD-)
(|FiniteLinearAggregate&| . FLAGG-)
(|FiniteSetAggregate&| . FSAGG-)
(|FiniteRankAlgebra&| . FINRALG-)
(|FiniteRankNonAssociativeAlgebra&| . FINAALG-)
(|FloatingPointSystem&| . FPS-)
(|FramedAlgebra&| . FRAMALG-)
(|FramedNonAssociativeAlgebra&| . FRNAALG-)
(|FullyEvalableOver&| . FEVALAB-)
(|FullyLinearlyExplicitRingOver&| . FLINEXP-)
(|FullyRetractableTo&| . FRETRCT-)
(|FunctionFieldCategory&| . FFCAT-)
(|FunctionSpace&| . FS-)
(|GcdDomain&| . GCDDOM-)
(|GradedAlgebra&| . GRALG-)
(|GradedModule&| . GRMOD-)
(|Group&| . GROUP-)
(|HomogeneousAggregate&| . HOAGG-)
(|HyperbolicFunctionCategory&| . HYPCAT-)
(|IndexedAggregate&| . IXAGG-)
(|InnerEvalable&| . IEVALAB-)
(|IntegerNumberSystem&| . INS-)
(|IntegralDomain&| . INTDOM-)
(|KeyedDictionary&| . KDAGG-)

```



```

(|LazyStreamAggregate&| . LZSTAGG-)
(|LeftAlgebra&| . LALG-)
(|LieAlgebra&| . LIECAT-)
(|LinearAggregate&| . LNAGG-)
(|ListAggregate&| . LSAGG-)
(|Logic&| . LOGIC-)
(|LinearOrdinaryDifferentialOperatorCategory&| . LODOCAT-)
(|MatrixCategory&| . MATCAT-)
(|Module&| . MODULE-)
(|Monad&| . MONAD-)
(|MonadWithUnit&| . MONADWU-)
(|Monoid&| . MONOID-)
(|MonogenicAlgebra&| . MONOGEN-)
(|NonAssociativeAlgebra&| . NAALG-)
(|NonAssociativeRing&| . NASRING-)
(|NonAssociativeRng&| . NARNG-)
(|OctonionCategory&| . OC-)
(|OneDimensionalArrayAggregate&| . A1AGG-)
(|OrderedRing&| . ORDRING-)
(|OrderedSet&| . ORDSET-)
(|PartialDifferentialRing&| . PDRING-)
(|PolynomialCategory&| . POLYCAT-)
(|PolynomialFactorizationExplicit&| . PFECAT-)
(|PolynomialSetCategory&| . PSETCAT-)
(|PowerSeriesCategory&| . PSCAT-)
(|QuaternionCategory&| . QUATCAT-)
(|QuotientFieldCategory&| . QFCAT-)
(|RadicalCategory&| . RADCAT-)
(|RealClosedField&| . RCFIELD-)
(|RealNumberSystem&| . RNS-)
(|RealRootCharacterizationCategory&| . RRCC-)
(|RectangularMatrixCategory&| . RMATCAT-)
(|RecursiveAggregate&| . RCAGG-)
(|RecursivePolynomialCategory&| . RPOLCAT-)
(|RegularTriangularSetCategory&| . RSETCAT-)
(|RetractableTo&| . RETRACT-)
(|Ring&| . RING-)
(|SemiGroup&| . SGROUP-)
(|SetAggregate&| . SETAGG-)
(|SetCategory&| . SETCAT-)
(|SquareMatrixCategory&| . SMATCAT-)
(|StreamAggregate&| . STAGG-)
(|StringAggregate&| . SRAGG-)
(|TableAggregate&| . TBAGG-)
(|TranscendentalFunctionCategory&| . TRANFUN-)
(|TriangularSetCategory&| . TSETCAT-)
(|TrigonometricFunctionCategory&| . TRIGCAT-)
(|TwoDimensionalArrayCategory&| . ARR2CAT-)
(|UnaryRecursiveAggregate&| . URAGG-)
(|UniqueFactorizationDomain&| . UFD-)

```

```
(|UnivariateLaurentSeriesConstructorCategory&| . ULSCCAT-)
(|UnivariatePolynomialCategory&| . UPOLYC-)
(|UnivariatePowerSeriesCategory&| . UPSCAT-)
(|UnivariatePuisseuxSeriesConstructorCategory&| . UPXSCCA-)
(|UnivariateSkewPolynomialCategory&| . OREPCAT-)
(|UnivariateTaylorSeriesCategory&| . UTSCAT-)
(|VectorCategory&| . VECTCAT-)
(|VectorSpace&| . VSPACE-)))
```

46.18.2 defvar \$localExposureDataDefault

— initvars —

```
(defvar |$localExposureDataDefault|
  (vector
    ;;These groups will be exposed
    (list '|basic| '|categories| '|naglink| '|anna|)
    ;;These constructors will be explicitly exposed
    (list )
    ;;These constructors will be explicitly hidden
    (list )))
```

46.18.3 defvar \$localExposureData

— initvars —

```
(defvar |$localExposureData| (copy-seq |$localExposureDataDefault|))
```

46.19 Functions

46.19.1 The top level set expose command handler

```
[displayExposedGroups p702]
[sayMSG p331]
```

```
[displayExposedConstructors p702]
[displayHiddenConstructors p703]
[sayKeyedMsg p329]
[namestring p1042]
[pathname p1044]
[qcar p??]
[qcdr p??]
[selectOptionLC p477]
[setExposeAdd p695]
[setExposeDrop p699]
[setExpose p694]
```

— defun setExpose —

```
(defun |setExpose| (arg)
  "The top level set expose command handler"
  (let (fnargs fn)
    (cond
      ((eq arg '|%initialize%|))
      ((eq arg '|%display%|) "...")
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
       (|displayExposedGroups|)
       (|sayMSG| " ")
       (|displayExposedConstructors|)
       (|sayMSG| " ")
       (|displayHiddenConstructors|)
       (|sayMSG| " ")))
    ((and (consp arg)
          (progn (setq fn (qcar arg)) (setq fnargs (qcdr arg)) t)
          (setq fn (|selectOptionLC| fn '(|add| |drop|) nil))))
    (cond
      ((eq fn '|add|) (|setExposeAdd| fnargs))
      ((eq fn '|drop|) (|setExposeDrop| fnargs))
      (t nil)))
    (t (|setExpose| nil)))))
```

—————

46.19.2 The top level set expose add command handler

```
[centerAndHighlight p??]
[specialChar p978]
[displayExposedGroups p702]
[sayMSG p331]
[displayExposedConstructors p702]
[sayKeyedMsg p329]
```

```
[qcar p??]
[qcdr p??]
[selectOptionLC p477]
[setExposeAddGroup p696]
[setExposeAddConstr p698]
[setExposeAdd p695]
[$linelength p771]
```

— defun setExposeAdd —

```
(defun |setExposeAdd| (arg)
  "The top level set expose add command handler"
  (declare (special $linelength))
  (let (fnargs fn)
    (cond
      ((null arg)
        (|centerAndHighlight|
          '|The add Option| $linelength (|specialChar| '|hbar|))
        (|displayExposedGroups|)
        (|sayMSG| " ")
        (|displayExposedConstructors|)
        (|sayMSG| " ")
        (|sayKeyedMsg| 's2iz0049e nil))
      ((and (consp arg)
        (progn (setq fn (qcar arg)) (setq fnargs (qcdr arg)) t)
        (setq fn (|selectOptionLC| fn '(|group| |constructor|) nil)))
        (cond
          ((eq fn '|group|) (|setExposeAddGroup| fnargs))
          ((eq fn '|constructor|) (|setExposeAddConstr| fnargs))
          (t nil)))
      (t (|setExposeAdd| nil))))))
```

—————

46.19.3 Expose a group

Note that \$localExposureData is a vector of lists. It consists of [exposed groups,exposed constructors,hidden constructors] [object2String p??]

```
[qcar p??]
[setelt p??]
[displayExposedGroups p702]
[sayMSG p331]
[displayExposedConstructors p702]
[displayHiddenConstructors p703]
[clearClams p??]
[getalist p??]
```

```

[sayKeyedMsg p329]
[member p1050]
[msort p??]
[centerAndHighlight p??]
[specialChar p978]
[namestring p1042]
[pathname p1044]
[sayAsManyPerLineAsPossible p??]
[$globalExposureGroupAlist p668]
[$localExposureData p694]
[$interpreterFrameName p??]
[$linelength p771]

```

— defun setExposeAddGroup —

```

(defun |setExposeAddGroup| (arg)
  "Expose a group"
  (declare (special |$globalExposureGroupAlist| |$localExposureData|
                  |$interpreterFrameName| $linelength))
  (if (null arg)
      (progn
        (|centerAndHighlight|
         '|The group Option| $linelength (|specialChar| '|hbar|))
        (|displayExposedGroups|)
        (|sayMSG| " ")
        (|sayAsManyPerLineAsPossible|
         (mapcar #'(lambda (x) (|object2String| (first x)))
                  |$globalExposureGroupAlist|)))
      (dolist (x arg)
        (when (consp x) (setq x (qcar x)))
        (cond
         ((eq x '|all|)
          (setelt |$localExposureData| 0
                  (mapcar #'first |$globalExposureGroupAlist|))
          (setelt |$localExposureData| 1 nil)
          (setelt |$localExposureData| 2 nil)
          (|displayExposedGroups|)
          (|sayMSG| " ")
          (|displayExposedConstructors|)
          (|sayMSG| " ")
          (|displayHiddenConstructors|)
          (|clearClams|))
         ((null (getalist |$globalExposureGroupAlist| x))
          (|sayKeyedMsg| 's2iz0049h (cons x nil)))
         (|member| x (elt |$localExposureData| 0))
          (|sayKeyedMsg| 's2iz0049i (list x |$interpreterFrameName|)))
        (t
         (setelt |$localExposureData| 0
                  (msort (cons x (elt |$localExposureData| 0))))))

```

```
(|sayKeyedMsg| 's2iz0049r (list x |$interpreterFrameName|))
(|clearClams|))))))
```

46.19.4 The top level set expose add constructor handler

```
[unabbrev p??]
[qcar p??]
[getdatabase p1009]
[sayKeyedMsg p329]
[member p1050]
[setelt p??]
[delete p??]
[msort p??]
[clearClams p??]
[centerAndHighlight p??]
[specialChar p978]
[displayExposedConstructors p702]
[$linelength p771]
[$localExposureData p694]
[$interpreterFrameName p??]
```

— defun setExposeAddConstr —

```
(defun |setExposeAddConstr| (arg)
  "The top level set expose add constructor handler"
  (declare (special $linelength |$localExposureData| |$interpreterFrameName|))
  (if (null arg)
      (progn
        (|centerAndHighlight|
         '|The constructor Option| $linelength (|specialChar| 'hbar|))
        (|displayExposedConstructors|))
      (dolist (x arg)
        (setq x (|unabbrev| x))
        (when (consp x) (setq x (qcar x)))
        (cond
         ((null (getdatabase x 'constructorkind))
          (|sayKeyedMsg| 's2iz0049j (list x)))
         ((|member| x (elt |$localExposureData| 1))
          (|sayKeyedMsg| 's2iz0049k (list x |$interpreterFrameName| )))
         (t
          (when (|member| x (elt |$localExposureData| 2))
            (setelt |$localExposureData| 2
              (|delete| x (elt |$localExposureData| 2))))
            (setelt |$localExposureData| 1
```

```
(msort (cons x (elt |$localExposureData| 1))))
(|clearClams|)
(|sayKeyedMsg| 's2iz0049p (list x |$interpreterFrameName| ))))))))
```

46.19.5 The top level set expose drop handler

```
[centerAndHighlight p??]
[specialChar p978]
[displayHiddenConstructors p703]
[sayMSG p331]
[sayKeyedMsg p329]
[qcar p??]
[qcdr p??]
[selectOptionLC p477]
[setExposeDropGroup p700]
[setExposeDropConstr p701]
[setExposeDrop p699]
[$linelength p771]
```

— defun setExposeDrop —

```
(defun |setExposeDrop| (arg)
  "The top level set expose drop handler"
  (declare (special $linelength))
  (let (fnargs fn)
    (cond
      ((null arg)
        (|centerAndHighlight|
          '|The drop Option| $linelength (|specialChar| '|hbar|))
        (|displayHiddenConstructors|)
        (|sayMSG| " ")
        (|sayKeyedMsg| 's2iz0049f nil))
      ((and (consp arg)
        (progn (setq fn (qcar arg)) (setq fnargs (qcdr arg)) t)
        (setq fn (|selectOptionLC| fn '|group| |constructor|) nil)))
        (cond
          ((eq fn '|group|) (|setExposeDropGroup| fnargs))
          ((eq fn '|constructor|) (|setExposeDropConstr| fnargs))
          (t nil)))
      (t (|setExposeDrop| nil))))))
```

46.19.6 The top level set expose drop group handler

```
[qcar p??]
[setelt p??]
[displayExposedGroups p702]
[sayMSG p331]
[displayExposedConstructors p702]
[displayHiddenConstructors p703]
[clearClams p??]
[member p1050]
[delete p??]
[sayKeyedMsg p329]
[getalist p??]
[centerAndHighlight p??]
[specialChar p978]
[$linelength p771]
[$localExposureData p694]
[$interpreterFrameName p??]
[$globalExposureGroupAlist p668]
```

— defun setExposeDropGroup —

```
(defun |setExposeDropGroup| (arg)
  "The top level set expose drop group handler"
  (declare (special $linelength |$localExposureData| |$interpreterFrameName|
    |$globalExposureGroupAlist|))
  (if (null arg)
    (progn
      (|centerAndHighlight|
        '|The group Option| $linelength (|specialChar| '|hbar|))
      (|sayKeyedMsg| 's2iz0049l nil)
      (|sayMSG| " ")
      (|displayExposedGroups|))
    (dolist (x arg)
      (when (consp x) (setq x (qcar x)))
      (cond
        ((eq x '|all|)
         (setelt |$localExposureData| 0 nil)
         (setelt |$localExposureData| 1 nil)
         (setelt |$localExposureData| 2 nil)
         (|displayExposedGroups|)
         (|sayMSG| " ")
         (|displayExposedConstructors|)
         (|sayMSG| " ")
         (|displayHiddenConstructors|)
         (|clearClams|))
        ((|member| x (elt |$localExposureData| 0))
         (setelt |$localExposureData| 0
```



```

(|delete| x (elt |$localExposureData| 0)))
(|clearClams|)
(|sayKeyedMsg| 's2iz0049s (list x |$interpreterFrameName| )))
((getalist |$globalExposureGroupAlist| x)
(|sayKeyedMsg| 's2iz0049i (list x |$interpreterFrameName| )))
(t (|sayKeyedMsg| 's2iz0049h (list x ))))))))

```

46.19.7 The top level set expose drop constructor handler

```

[unabbrev p??]
[qcar p??]
[getdatabase p1009]
[sayKeyedMsg p329]
[member p1050]
[setelt p??]
[delete p??]
[msort p??]
[clearClams p??]
[centerAndHighlight p??]
[specialChar p978]
[sayMSG p331]
[displayExposedConstructors p702]
[displayHiddenConstructors p703]
[$linelength p771]
[$localExposureData p694]
[$interpreterFrameName p??]

```

— defun setExposeDropConstr —

```

(defun |setExposeDropConstr| (arg)
  "The top level set expose drop constructor handler"
  (declare (special $linelength |$localExposureData| |$interpreterFrameName|))
  (if (null arg)
    (progn
      (|centerAndHighlight|
        '|The constructor Option| $linelength (|specialChar| '|hbar|))
      (|sayKeyedMsg| 's2iz0049n nil)
      (|sayMSG| " ")
      (|displayExposedConstructors|)
      (|sayMSG| " ")
      (|displayHiddenConstructors|))
    (dolist (x arg)
      (setq x (|unabbrev| x))
      (when (consp x) (setq x (qcar x)))

```

```
(cond
  ((null (getdatabase x 'constructorkind))
    (|sayKeyedMsg| 's2iz0049j (list x)))
  ((|member| x (elt |$localExposureData| 2))
    (|sayKeyedMsg| 's2iz0049o (list x |$interpreterFrameName|)))
  (t
    (when (|member| x (elt |$localExposureData| 1))
      (setelt |$localExposureData| 1
        (|delete| x (elt |$localExposureData| 1))))
    (setelt |$localExposureData| 2
      (msort (cons x (elt |$localExposureData| 2))))
    (|clearClams|)
    (|sayKeyedMsg| 's2iz0049q (list x |$interpreterFrameName|))))))
```

46.19.8 Display exposed groups

```
[sayKeyedMsg p329]
[centerAndHighlight p??]
|$interpreterFrameName p??]
|$localExposureData p694]
```

— defun displayExposedGroups —

```
(defun |displayExposedGroups| ()
  "Display exposed groups"
  (declare (special |$interpreterFrameName| |$localExposureData|))
  (|sayKeyedMsg| 's2iz0049a (list |$interpreterFrameName|))
  (if (null (elt |$localExposureData| 0))
    (|centerAndHighlight| "there are no exposed groups")
    (dolist (c (elt |$localExposureData| 0))
      (|centerAndHighlight| c))))
```

46.19.9 Display exposed constructors

```
[sayKeyedMsg p329]
[centerAndHighlight p??]
|$localExposureData p694]
```

— defun displayExposedConstructors —

```
(defun |displayExposedConstructors| ()
```

```
"Display exposed constructors"
(declare (special |$localExposureData|))
(|sayKeyedMsg| 's2iz0049b nil)
(if (null (elt |$localExposureData| 1))
    (|centerAndHighlight| "there are no explicitly exposed constructors")
    (dolist (c (elt |$localExposureData| 1))
        (|centerAndHighlight| c))))
```

46.19.10 Display hidden constructors

```
[sayKeyedMsg p329]
[centerAndHighlight p??]
[$localExposureData p694]
```

— defun displayHiddenConstructors —

```
(defun |displayHiddenConstructors| ()
  "Display hidden constructors"
  (declare (special |$localExposureData|))
  (|sayKeyedMsg| 's2iz0049c nil)
  (if (null (elt |$localExposureData| 2))
      (|centerAndHighlight| "there are no explicitly hidden constructors")
      (dolist (c (elt |$localExposureData| 2))
          (|centerAndHighlight| c))))
```

46.20 functions

Current Values of functions Variables

Variable	Description	Current Value
cache	number of function results to cache	0
compile	compile, don't just define function bodies	off
recurrence	specially compile recurrence relations	on

— functions —

```
(|functions|
```

```

"some interpreter function options"
|interpreter|
TREE
|novar|
(
\getchunk{functionscache}
\getchunk{functionscompile}
\getchunk{functionsrecurrence}
))

```

46.21 functions cache

----- The cache Option -----

Description: number of function results to cache

)set functions cache is used to tell AXIOM how many values computed by interpreter functions should be saved. This can save quite a bit of time in recursive functions, though one must consider that the cached values will take up (perhaps valuable) room in the workspace.

The value given after cache must either be the word all or a positive integer. This may be followed by any number of function names whose cache sizes you wish to so set. If no functions are given, the default cache size is set.

Examples:)set fun cache all
)set fun cache 10 f g Legendre

In general, functions will cache no returned values.

— functionscache —

```

(|cache|
"number of function results to cache"
|interpreter|
FUNCTION
|setFunctionsCache|
NIL
|htSetCache|)

```

46.22 Variables Used

46.22.1 defvar \$cacheAlist

— initvars —

```
(defvar |$cacheAlist| nil)
```

—————

46.23 Functions

46.23.1 The top level set functions cache handler

```
\calls{setFunctionsCache}{object2String}
\calls{setFunctionsCache}{describeSetFunctionsCache}
\calls{setFunctionsCache}{sayAllCacheCounts}
\calls{setFunctionsCache}{sayMessage}
\calls{setFunctionsCache}{bright}
\calls{setFunctionsCache}{terminateSystemCommand}
\calls{setFunctionsCache}{countCache}
\usesdollar{setFunctionsCache}{options}
\usesdollar{setFunctionsCache}{cacheCount}
\usesdollar{setFunctionsCache}{cacheAlist}
\begin{chunk}{defun setFunctionsCache}
(defun |setFunctionsCache| (arg)
  "The top level set functions cache handler"
  (let (|$options| n)
    (declare (special |$options| |$cacheCount| |$cacheAlist|))
    (cond
      ((eq arg '|%initialize%|)
       (setq |$cacheCount| 0)
       (setq |$cacheAlist| nil))
      ((eq arg '|%display%|)
       (if (null |$cacheAlist|)
           (|object2String| |$cacheCount|)
           "..."))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
       (|describeSetFunctionsCache|)
       (terpri)
       (|sayAllCacheCounts|))
      (t
       (setq n (car arg))
       (cond
         ((and (not (eq n '|all|)) (or (null (integerp n)) (minusp n)))
```

```

(|sayMessage|
  ("Your value of" ,@(|bright| n) "is invalid because ..."))
(|describeSetFunctionsCache|)
(|terminateSystemCommand|))
(t
  (when (cdr arg) (list (cons '|vars| (cdr arg)))))
(|countCache| n))))))

\end{chunk}

\defunsec{countCache}{Display a particular cache count}
\calls{countCache}{qcdr}
\calls{countCache}{qcar}
\calls{countCache}{identp}
\calls{countCache}{sayKeyedMsg}
\calls{countCache}{insertAlist}
\calls{countCache}{intern1}
\calls{countCache}{sayCacheCount}
\calls{countCache}{optionError}
\usesdollar{countCache}{options}
\usesdollar{countCache}{cacheAlist}
\usesdollar{countCache}{cacheCount}
\begin{chunk}{\defun countCache}
(defun |countCache| (n)
  "Display a particular cache count"
  (let (tmp1 1 cachecountname)
    (declare (special |$options| |$cacheAlist| |$cacheCount|))
    (cond
      (|$options|
        (cond
          ((and (consp |$options|)
            (eq (qcdr |$options|) nil)
            (progn
              (setq tmp1 (qcar |$options|))
              (and (consp tmp1)
                (eq (qcar tmp1) '|vars|)
                (progn (setq 1 (qcdr tmp1)) t))))))
        (dolist (x 1)
          (if (null (identp x))
            (|sayKeyedMsg| 's2if0007 (list x))
            (progn
              (setq |$cacheAlist| (|insertAlist| x n |$cacheAlist|))
              (setq cachecountname (intern1 x ";COUNT"))
              (set cachecountname n)
              (|sayCacheCount| x n))))))
      (t (|optionError| (caar |$options|) nil))))
  (t
    (|sayCacheCount| nil (setq |$cacheCount| n))))))

\end{chunk}

```

```

\defun{insertAlist}{insertAlist}
\calls{insertAlist}{rplac}
\calls{insertAlist}{?order}
\begin{chunk}{\defun insertAlist}
(defun |insertAlist| (a b z)
  (labels (
    (fn (a b z)
      (cond
        ((null (cdr z)) (rplac (cdr z) (list (cons a b))))
        ((equal a (elt (elt z 1) 0)) (rplac (cdr (elt z 1)) b))
        ((?order (elt (elt z 1) 0) a) (rplac (cdr z) (cons (cons a b) (cdr z))))
        (t (fn a b (cdr z))))))
    (cond
      ((null z) (list (cons a b)))
      ((equal a (elt (elt z 0) 0)) (rplac (cdar z) b) z)
      ((?order (elt (elt z 0) 0) a) (cons (cons a b) z))
      (t (fn a b z) z))))
\end{chunk}

\defunsec{describeSetFunctionsCache}{Describe the set functions cache}
\calls{describeSetFunctionsCache}{sayBrightly}
\begin{chunk}{\defun describeSetFunctionsCache}
(defun |describeSetFunctionsCache| ()
  "Describe the set functions cache"
  (|sayBrightly| (list
    '|%b| "set functions cache"
    '|%d| "is used to tell AXIOM how many"
    '|%l| " values computed by interpreter functions should be saved. This"
    '|%l| " can save quite a bit of time in recursive functions, though one"
    '|%l| " must consider that the cached values will take up (perhaps"
    '|%l| " valuable) room in the workspace."
    '|%l|
    '|%l| " The value given after"
    '|%b| "cache"
    '|%d| "must either be the word"
    '|%b| "all"
    '|%d| "or a positive integer."
    '|%l| " This may be followed by any number of function names whose cache"
    '|%l| " sizes you wish to so set. If no functions are given, the default"
    '|%l| " cache size is set."
    '|%l|
    '|%l| " Examples:"
    '|%l| " )set fun cache all )set fun cache 10 f g Legendre"))))
\end{chunk}

\defunsec{sayAllCacheCounts}{Display all cache counts}
\calls{sayAllCacheCounts}{sayCacheCount}

```

```

\usesdollar{sayAllCacheCounts}{cacheCount}
\usesdollar{sayAllCacheCounts}{cacheAlist}
\begin{chunk}{defun sayAllCacheCounts}
(defun |sayAllCacheCounts| ()
  "Display all cache counts"
  (let (x n)
    (declare (special |$cacheCount| |$cacheAlist|))
    (|sayCacheCount| nil |$cacheCount|)
    (when |$cacheAlist|
      (do ((t0 |$cacheAlist| (cdr t0)) (t1 nil))
          ((or (atom t0)
               (progn (setq t1 (car t0)) nil)
               (progn
                  (progn (setq x (car t1)) (setq n (cdr t1)) t1)
                  nil)))
          nil)
      (when (not (equal n |$cacheCount|)) (|sayCacheCount| x n))))))

\end{chunk}

\defunsec{sayCacheCount}{Describe the cache counts}
\calls{sayCacheCount}{bright}
\calls{sayCacheCount}{linearFormatName}
\calls{sayCacheCount}{sayBrightly}
\begin{chunk}{defun sayCacheCount}
(defun |sayCacheCount| (fn n)
  "Describe the cache counts"
  (let (prefix phrase)
    (setq prefix
      (cond
        (fn (cons '|function| (|bright| (|linearFormatName| fn))))
        ((eq1 n 0) (list '|interpreter functions|))
        (t (list '|In general, interpreter functions|))))
    (cond
      ((eq1 n 0)
       (cond
         (fn
          (|sayBrightly|
           '(" Caching for " ,prefix "is turned off")))
         (t
          (|sayBrightly| " In general, functions will cache no returned values."
           ))))
      (t
       (setq phrase
         (cond
           ((eq n '|all|) '(',@(|bright| '|all|) |values.|))
           ((eq1 n 1) (list '| only the last value.|))
           (t '(| the last| ,@(|bright| n) |values.|))))
       (|sayBrightly|
        '(" " ,@prefix "will cache" ,@phrase))))))

```



```

\end{chunk}

\section{functions compile}
\begin{verbatim}
----- The compile Option -----

Description: compile, don't just define function bodies

The compile option may be followed by any one of the following:

-> on
    off

The current setting is indicated.
```

46.23.2 defvar \$compileDontDefineFunctions

```

      — initvars —

(defvar |$compileDontDefineFunctions| t
  "compile, don't just define function bodies")

      —————

      — functionscompile —

(|compile|
  "compile, don't just define function bodies"
  |interpreter|
  LITERALS
  |$compileDontDefineFunctions|
  (|on| |off|)
  |on|)

      —————
```

46.24 functions recurrence

```

----- The recurrence Option -----

Description: specially compile recurrence relations
```

The recurrence option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

46.24.1 defvar \$compileRecurrence

— initvars —

```
(defvar |$compileRecurrence| t "specially compile recurrence relations")
```

—————

— functionsrecurrence —

```
(|recurrence|
 "specially compile recurrence relations"
 |interpreter|
 LITERALS
 |$compileRecurrence|
 (|on| |off|)
 |on|)
```

—————

46.25 fortran

Current Values of fortran Variables

Variable	Description	Current Value
ints2floats	where sensible, coerce integers to reals	on
fortindent	the number of characters indented	6
fortlength	the number of characters on a line	72
typedecs	print type and dimension lines	on
defaulttype	default generic type for FORTRAN object	REAL
precision	precision of generated FORTRAN objects	double
intrinsic	whether to use INTRINSIC FORTRAN functions	off
explength	character limit for FORTRAN expressions	1320
segment	split long FORTRAN expressions	on

optlevel	FORTRAN optimisation level	0
startindex	starting index for FORTRAN arrays	1
calling	options for external FORTRAN calls	...

Variables with current values of ... have further sub-options.
 For example, issue)set calling to see what the options are for calling.

For more information, issue)help set .

— fortran —

```
(|fortran|
  "view and set options for FORTRAN output"
  |interpreter|
  TREE
  |novar|
  (
    \getchunk{fortranints2floats}
    \getchunk{fortranfortindent}
    \getchunk{fortranfortlength}
    \getchunk{fortrantypedecs}
    \getchunk{fortrandefaulttype}
    \getchunk{fortranprecision}
    \getchunk{fortranintrinsic}
    \getchunk{fortranexplength}
    \getchunk{fortransegment}
    \getchunk{fortranoptlevel}
    \getchunk{fortranstartindex}
    \getchunk{fortrancalling}
  ))
```

46.25.1 ints2floats

----- The ints2floats Option -----

Description: where sensible, coerce integers to reals

The ints2floats option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

46.25.2 defvar \$fortInts2Floats

— initvars —

```
(defvar |$fortInts2Floats| t "where sensible, coerce integers to reals")
```

— fortranints2floats —

```
(|ints2floats|
 "where sensible, coerce integers to reals"
 |interpreter|
 LITERALS
 |$fortInts2Floats|
 (|on| |off|)
 |on|)
```

46.25.3 fortindent

----- The fortindent Option -----

Description: the number of characters indented

The fortindent option may be followed by an integer in the range 0 to inclusive. The current setting is 6

46.25.4 defvar \$fortIndent

— initvars —

```
(defvar |$fortIndent| 6 "the number of characters indented")
```

— fortranfortindent —

```
(|fortindent|
 "the number of characters indented"
```

```
|interpreter|
INTEGER
|$fortIndent|
(0 NIL)
6)
```

46.25.5 fortlength

----- The fortlength Option -----

Description: the number of characters on a line

The fortlength option may be followed by an integer in the range 1 to inclusive. The current setting is 72

46.25.6 defvar \$fortLength

— initvars —

```
(defvar |$fortLength| 72 "the number of characters on a line")
```

— fortranfortlength —

```
(|fortlength|
 "the number of characters on a line"
|interpreter|
INTEGER
|$fortLength|
(1 NIL)
72)
```

46.25.7 typedecs

----- The typedecs Option -----

Description: print type and dimension lines

The `typedecs` option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

46.25.8 `defvar $printFortranDecs`

— `initvars` —

```
(defvar |$printFortranDecs| t "print type and dimension lines")
```

—————

— `fortrantypedecs` —

```
(|typedecs|
 "print type and dimension lines"
 |interpreter|
 LITERALS
 |$printFortranDecs|
 (|on| |off|)
 |on|)
```

—————

46.25.9 `defaulttype`

----- The `defaulttype` Option -----

Description: default generic type for FORTRAN object

The `defaulttype` option may be followed by any one of the following:

```
-> REAL
    INTEGER
    COMPLEX
    LOGICAL
    CHARACTER
```

The current setting is indicated.

46.25.10 defvar \$defaultFortranType

— initvars —

```
(defvar |$defaultFortranType| 'real "default generic type for FORTRAN object")
```

— fortrandefaulttype —

```
(|defaulttype|
 "default generic type for FORTRAN object"
 |interpreter|
 LITERALS
 |$defaultFortranType|
 (REAL INTEGER COMPLEX LOGICAL CHARACTER)
 REAL)
_____
```

46.25.11 precision

----- The precision Option -----

Description: precision of generated FORTRAN objects

The precision option may be followed by any one of the following:

```
single
-> double
```

The current setting is indicated.

46.25.12 defvar \$fortranPrecision

— initvars —

```
(defvar |$fortranPrecision| '|double| "precision of generated FORTRAN objects")
```

— fortranprecision —

```
(|precision|
"precision of generated FORTRAN objects"
|interpreter|
LITERALS
|$fortranPrecision|
(|single| |double|)
|double|)
```

46.25.13 intrinsic

----- The intrinsic Option -----

Description: whether to use INTRINSIC FORTRAN functions

The intrinsic option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

46.25.14 defvar \$useIntrinsicFunctions

— initvars —

```
(defvar |$useIntrinsicFunctions| nil
"whether to use INTRINSIC FORTRAN functions")
```

— fortranintrinsic —

```
(|intrinsic|
"whether to use INTRINSIC FORTRAN functions"
|interpreter|
LITERALS
|$useIntrinsicFunctions|
(|on| |off|)
|off|)
```


46.25.15 explength

----- The explength Option -----

Description: character limit for FORTRAN expressions

The explength option may be followed by an integer in the range 0 to inclusive. The current setting is 1320

46.25.16 defvar \$maximumFortranExpressionLength

— initvars —

```
(defvar |$maximumFortranExpressionLength| 1320
  "character limit for FORTRAN expressions")
```

— fortranexplength —

```
(|explength|
  "character limit for FORTRAN expressions"
  |interpreter|
  INTEGER
  |$maximumFortranExpressionLength|
  (0 NIL)
  1320)
```

46.25.17 segment

----- The segment Option -----

Description: split long FORTRAN expressions

The segment option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

46.25.18 defvar \$fortranSegment

— initvars —

```
(defvar |$fortranSegment| t "split long FORTRAN expressions")
```

—————

— fortransegment —

```
(|segment|
 "split long FORTRAN expressions"
 |interpreter|
 LITERALS
 |$fortranSegment|
 (|on| |off|)
 |on|)
```

—————

46.25.19 optlevel

----- The optlevel Option -----

Description: FORTRAN optimisation level

The optlevel option may be followed by an integer in the range 0 to 2 inclusive. The current setting is 0

46.25.20 defvar \$fortranOptimizationLevel

— initvars —

```
(defvar |$fortranOptimizationLevel| 0 "FORTRAN optimisation level")
```

—————

— fortranoptlevel —

```
(|optlevel|
  "FORTRAN optimisation level"
  |interpreter|
  INTEGER
  |$fortranOptimizationLevel|
  (0 2)
  0)
```

46.25.21 startindex

----- The startindex Option -----

Description: starting index for FORTRAN arrays

The startindex option may be followed by an integer in the range 0 to 1 inclusive. The current setting is 1

46.25.22 defvar \$fortranArrayStartingIndex

— initvars —

```
(defvar |$fortranArrayStartingIndex| 1 "starting index for FORTRAN arrays")
```

— fortranstartindex —

```
(|startindex|
  "starting index for FORTRAN arrays"
  |interpreter|
  INTEGER
  |$fortranArrayStartingIndex|
  (0 1)
  1)
```

46.25.23 calling

Current Values of calling Variables

Variable	Description	Current Value
tempfile	set location of temporary data files	/tmp/
directory	set location of generated FORTRAN files	./
linker	linker arguments (e.g. libraries to search)	-lxlf

— fortrancalling —

```
(|calling|
"options for external FORTRAN calls"
|interpreter|
TREE
|novar|
(
\getchunk{callingtempfile}
\getchunk{callingdirectory}
\getchunk{callinglinker}
)
)
```

—————→

tempfile

----- The tempfile Option -----

Description: set location of temporary data files

)set fortran calling tempfile is used to tell AXIOM where to place intermediate FORTRAN data files . This must be the name of a valid existing directory to which you have permission to write (including the final slash).

Syntax:

```
)set fortran calling tempfile DIRECTORYNAME
```

The current setting is /tmp/

46.25.24 defvar \$fortranTmpDir

— initvars —

```
(defvar |$fortranTmpDir| "/tmp/" "set location of temporary data files")
```

— callingtempfile —

```
(|tempfile|
  "set location of temporary data files"
  |interpreter|
  FUNCTION
  |setFortTmpDir|
  (("enter directory name for which you have write-permission"
    DIRECTORY
    |$fortranTmpDir|
    |chkDirectory|
    "/tmp/"))
  NIL)
```

46.25.25 The top level set fortran calling tempfile handler

```
[pname p1047]
[describeSetFortTmpDir p722]
[validateOutputDirectory p722]
[sayBrightly p??]
[bright p??]
[$fortranTmpDir p720]
```

— defun setFortTmpDir —

```
(defun |setFortTmpDir| (arg)
  "The top level set fortran calling tempfile handler"
  (let (mode)
    (declare (special |$fortranTmpDir|))
    (cond
      ((eq arg '|%initialize%|) (setq |$fortranTmpDir| "/tmp/"))
      ((eq arg '|%display%|)
        (if (stringp |$fortranTmpDir|)
          |$fortranTmpDir|
          (pname |$fortranTmpDir|)))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
        (|describeSetFortTmpDir|))
      ((null (setq mode (|validateOutputDirectory| arg)))
        (|sayBrightly|
          (" Sorry, but your argument(s)" ,@(|bright| arg)
            "is(are) not valid." |%l|))
        (|describeSetFortTmpDir|))
      (t (setq |$fortranTmpDir| mode))))))
```

46.25.26 Validate the output directory

— defun validateOutputDirectory —

```
(defun |validateOutputDirectory| (x)
  "Validate the output directory"
  (let ((dirname (car x)))
    (when (and (pathname-directory dirname) (null (probe-file dirname)))
      dirname)))
```

46.25.27 Describe the set fortran calling tempfile

```
[sayBrightly p??]
[$fortranTmpDir p720]
```

— defun describeSetFortTmpDir —

```
(defun |describeSetFortTmpDir| ()
  "Describe the set fortran calling tempfile"
  (declare (special |$fortranTmpDir|))
  (|sayBrightly| (list
    '|%b| ")set fortran calling tempfile"
    '|%d| " is used to tell AXIOM where"
    '|%l| " to place intermediate FORTRAN data files . This must be the "
    '|%l| " name of a valid existing directory to which you have permission "
    '|%l| " to write (including the final slash)."'
    '|%l|
    '|%l| " Syntax:"
    '|%l| " )set fortran calling tempfile DIRECTORYNAME"
    '|%l|
    '|%l| " The current setting is"
    '|%b| |$fortranTmpDir|
    '|%d|)))
```

directory

----- The directory Option -----

Description: set location of generated FORTRAN files

)set fortran calling directory is used to tell AXIOM where to place generated FORTRAN files. This must be the name of a valid existing directory to which you have permission to write (including the final slash).

Syntax:

)set fortran calling directory DIRECTORYNAME

The current setting is ./

46.25.28 defvar \$fortranDirectory

— initvars —

```
(defvar |$fortranDirectory| "./" "set location of generated FORTRAN files")
```

—————

— callingdirectory —

```
(|directory|
 "set location of generated FORTRAN files"
 |interpreter|
 FUNCTION
 |setFortDir|
 (("enter directory name for which you have write-permission"
  DIRECTORY
  |$fortranDirectory|
  |chkDirectory|
  "./")
 NIL)
```

—————

46.25.29 defun setFortDir

```
[pname p1047]
[describeSetFortDir p724]
[validateOutputDirectory p722]
[sayBrightly p??]
[bright p??]
```

[`$fortranDirectory` p723]

— **defun setFortDir** —

```
(defun |setFortDir| (arg)
  (declare (special |$fortranDirectory|))
  (let (mode)
    (COND
      ((eq arg '|%initialize%|) (setq |$fortranDirectory| "./*"))
      ((eq arg '|%display%|)
       (if (stringp |$fortranDirectory|
           |$fortranDirectory|
           (pname |$fortranDirectory|)))
        ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
         (|describeSetFortDir|))
        ((null (setq mode (|validateOutputDirectory| arg)))
         (|sayBrightly|
          '(" Sorry, but your argument(s)" ,@(|bright| arg)
            "is(are) not valid." |%l|))
         (|describeSetFortDir|))
        (t (setq |$fortranDirectory| mode))))))
```

—————

46.25.30 defun describeSetFortDir

[`sayBrightly` p??]

[`$fortranDirectory` p723]

— **defun describeSetFortDir** —

```
(defun |describeSetFortDir| ()
  (declare (special |$fortranDirectory|))
  (|sayBrightly| (list
    '|%b| ")set fortran calling directory"
    '|%d| " is used to tell AXIOM where"
    '|%l| " to place generated FORTRAN files. This must be the name "
    '|%l| " of a valid existing directory to which you have permission "
    '|%l| " to write (including the final slash)."
    '|%l|
    '|%l| " Syntax:"
    '|%l| " )set fortran calling directory DIRECTORYNAME"
    '|%l|
    '|%l| " The current setting is"
    '|%b| |$fortranDirectory|
    '|%d|)))
```

linker

----- The linker Option -----

Description: linker arguments (e.g. libraries to search)

)set fortran calling linkerargs is used to pass arguments to the linker when using mkFort to create functions which call Fortran code. For example, it might give a list of libraries to be searched, and their locations.

The string is passed verbatim, so must be the correct syntax for the particular linker being used.

Example:)set fortran calling linker "-lxlif"

The current setting is -lxlif

46.25.31 defvar \$fortranLibraries

— initvars —

```
(defvar |$fortranLibraries| "-lxlif"
  "linker arguments (e.g. libraries to search)")
```

— callinglinker —

```
(|linker|
  "linker arguments (e.g. libraries to search)"
  |interpreter|
  FUNCTION
  |setLinkerArgs|
  (("enter linker arguments "
    STRING
    |$fortranLibraries|
    |chkDirectory|
    "-lxlif"))
  NIL
)
```

46.25.32 defun setLinkerArgs

[object2String p??]
 [describeSetLinkerArgs p726]
 [\$fortranLibraries p725]

— defun setLinkerArgs —

```
(defun |setLinkerArgs| (arg)
  (declare (special |$fortranLibraries|))
  (cond
    ((eq arg '|%initialize%|) (setq |$fortranLibraries| "-lxlif"))
    ((eq arg '|%display%|) (object2String |$fortranLibraries|))
    ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
     (|describeSetLinkerArgs|))
    ((and (listp arg) (stringp (car arg)))
     (setq |$fortranLibraries| (car arg)))
    (t (|describeSetLinkerArgs|))))
```

46.25.33 defun describeSetLinkerArgs

[sayBrightly p??]
 [\$fortranLibraries p725]

— defun describeSetLinkerArgs —

```
(defun |describeSetLinkerArgs| ()
  (declare (special |$fortranLibraries|))
  (|sayBrightly| (list
    '|%b| " )set fortran calling linkerargs"
    '|%d| " is used to pass arguments to the linker"
    '|%l| " when using "
    '|%b| "mkFort"
    '|%d| " to create functions which call Fortran code."
    '|%l| " For example, it might give a list of libraries to be searched,"
    '|%l| " and their locations."
    '|%l| " The string is passed verbatim, so must be the correct syntax for"
    '|%l| " the particular linker being used."
    '|%l|
    '|%l| " Example: )set fortran calling linker \"-lxlif\""'
    '|%l|
    '|%l| " The current setting is"
    '|%b| |$fortranLibraries|
    '|%d|)))
```

46.26 hyperdoc

Current Values of hyperdoc Variables

Variable	Description	Current Value
fullscreen	use full screen for this facility	off
mathwidth	screen width for history output	120

— hyperdoc —

```
(|hyperdoc|
  "options in using HyperDoc"
  |interpreter|
  TREE
  |novar|
  (
    \getchunk{hyperdocfullscreen}
    \getchunk{hyperdocmathwidth}
  ))
```

46.26.1 fullscreen

----- The fullscreen Option -----

Description: use full screen for this facility

The fullscreen option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

46.26.2 defvar \$fullScreenSysVars

— initvars —

```
(defvar |$fullScreenSysVars| nil "use full screen for this facility")
```

— hyperdocfullscreen —

```
(|fullscreen|
 "use full screen for this facility"
 |interpreter|
 LITERALS
 |$fullScreenSysVars|
 (|on| |off|)
 |off|)
```

46.26.3 mathwidth

----- The mathwidth Option -----

Description: screen width for history output

The mathwidth option may be followed by an integer in the range 0 to inclusive. The current setting is 120

46.26.4 defvar \$historyDisplayWidth

— initvars —

```
(defvar |$historyDisplayWidth| 120 "screen width for history output")
```

— hyperdocmathwidth —

```
(|mathwidth|
 "screen width for history output"
 |interpreter|
 INTEGER
 |$historyDisplayWidth|
 (0 NIL)
 120)
```

46.27 help

Current Values of help Variables

Variable	Description	Current Value

fullscreen	use fullscreen facility, if possible	on

— help —

```
(|help|
  "view and set some help options"
  |interpreter|
  TREE
  |novar|
  (
    \getchunk{helpfullscreen}
  ))
```

46.27.1 fullscreen

----- The fullscreen Option -----

Description: use fullscreen facility, if possible

The fullscreen option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

46.27.2 defvar \$useFullScreenHelp

— initvars —

```
(defvar |$useFullScreenHelp| t "use fullscreen facility, if possible")
```

— helpfullscreen —

```
(|fullscreen|
 "use fullscreen facility, if possible"
 |interpreter|
 LITERALS
 |$useFullScreenHelp|
 (|on| |off|)
 |on|)
```

46.28 history

----- The history Option -----

Description: save workspace values in a history file

The history option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

46.28.1 defvar \$HiFiAccess

— initvars —

```
(defvar |$HiFiAccess| t "save workspace values in a history file")
```

— history —

```
(|history|
 "save workspace values in a history file"
 |interpreter|
 LITERALS)
```

```
|$HiFiAccess|
(|on| |off|)
|on|)
```

46.29 messages

Current Values of messages Variables

Variable	Description	Current Value
autoload	print file auto-load messages	off
bottomup	display bottom up modemap selection	off
coercion	display datatype coercion messages	off
dropmap	display old map defn when replaced	off
expose	warning for unexposed functions	off
file	print msgs also to SPADMSG LISTING	off
frame	display messages about frames	off
highlighting	use highlighting in system messages	off
instant	present instantiation summary	off
insteach	present instantiation info	off
interponly	say when function code is interpreted	on
number	display message number with message	off
prompt	set type of input prompt to display	step
selection	display function selection msgs	off
set	show)set setting after assignment	off
startup	display messages on start-up	off
summary	print statistics after computation	off
testing	print system testing header	off
time	print timings after computation	off
type	print type after computation	on
void	print Void value when it occurs	off
any	print the internal type of objects of domain Any	on
naglink	show NAGLink messages	on

— messages —

```
(|messages|
 "show messages for various system features"
 |interpreter|
 TREE
 |novar|
 (
 \getchunk{messagesany}
 \getchunk{messagesautoload}
```

```

\getchunk{messagesbottomup}
\getchunk{messagescoercion}
\getchunk{messagesdropmap}
\getchunk{messagesexpose}
\getchunk{messagesfile}
\getchunk{messagesframe}
\getchunk{messageshighlighting}
\getchunk{messagesinstant}
\getchunk{messagesinsteach}
\getchunk{messagesinterponly}
\getchunk{messagesnaglink}
\getchunk{messagesnumber}
\getchunk{messagesprompt}
\getchunk{messagesselecion}
\getchunk{messagesset}
\getchunk{messagesstartup}
\getchunk{messagessummary}
\getchunk{messagestesting}
\getchunk{messagestime}
\getchunk{messagestype}
\getchunk{messagesvoid}
))

```

46.29.1 any

----- The any Option -----

Description: print the internal type of objects of domain Any

The any option may be followed by any one of the following:

```

-> on
    off

```

The current setting is indicated.

46.29.2 defvar \$printAnyIfTrue

— initvars —

```

(defvar |$printAnyIfTrue| t
  "print the internal type of objects of domain Any")

```

— messagesany —

```
(|any|
 "print the internal type of objects of domain Any"
 |interpreter|
 LITERALS
 |$printAnyIfTrue|
 (|on| |off|)
 |on|)
```

46.29.3 autoload

----- The autoload Option -----

Description: print file auto-load messages

46.29.4 defvar \$printLoadMsgs

— initvars —

```
(defvar |$printLoadMsgs| nil "print file auto-load messages")
```

— messagesautoload —

```
(|autoload|
 "print file auto-load messages"
 |interpreter|
 LITERALS
 |$printLoadMsgs|
 (|on| |off|)
 |on|)
```

46.29.5 bottomup

----- The bottomup Option -----

Description: display bottom up modemap selection

The bottomup option may be followed by any one of the following:

on
-> off

The current setting is indicated.

46.29.6 defvar \$reportBottomUpFlag

— initvars —

```
(defvar |$reportBottomUpFlag| nil "display bottom up modemap selection")
```

—————

— messagesbottomup —

```
(|bottomup|
 "display bottom up modemap selection"
 |development|
 LITERALS
 |$reportBottomUpFlag|
 (|on| |off|)
 |off|)
```

—————

46.29.7 coercion

----- The coercion Option -----

Description: display datatype coercion messages

The coercion option may be followed by any one of the following:

```

    on
-> off

```

The current setting is indicated.

46.29.8 defvar \$reportCoerceIfTrue

— initvars —

```
(defvar |$reportCoerceIfTrue| nil "display datatype coercion messages")
```

—————

— messagescoercion —

```

(|coercion|
 "display datatype coercion messages"
 |development|
 LITERALS
 |$reportCoerceIfTrue|
 (|on| |off|)
 |off|)

```

—————

46.29.9 dropmap

----- The dropmap Option -----

Description: display old map defn when replaced

The dropmap option may be followed by any one of the following:

```

    on
-> off

```

The current setting is indicated.

46.29.10 defvar \$displayDroppedMap

```

— initvars —

(defvar |$displayDroppedMap| nil "display old map defn when replaced")

—————

— messagesdropmap —

(|dropmap|
 "display old map defn when replaced"
 |interpreter|
 LITERALS
 |$displayDroppedMap|
 (|on| |off|)
 |off|)

—————

```

46.29.11 expose

```

----- The expose Option -----

Description: warning for unexposed functions

The expose option may be followed by any one of the
following:

    on
-> off

The current setting is indicated.

```

46.29.12 defvar \$giveExposureWarning

```

— initvars —

(defvar |$giveExposureWarning| nil "warning for unexposed functions")

—————

```

— messagesexpose —

```
(|expose|
 "warning for unexposed functions"
 |interpreter|
 LITERALS
 |$giveExposureWarning|
 (|on| |off|)
 |off|)
```

46.29.13 file

----- The file Option -----

Description: print msgs also to SPADMSG LISTING

The file option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

46.29.14 defvar \$printMsgsToFile

— initvars —

```
(defvar |$printMsgsToFile| nil "print msgs also to SPADMSG LISTING")
```

— messagesfile —

```
(|file|
 "print msgs also to SPADMSG LISTING"
 |development|
 LITERALS
 |$printMsgsToFile|
 (|on| |off|)
```

```
|off|)
```

46.29.15 frame

----- The frame Option -----

Description: display messages about frames

The frame option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

46.29.16 defvar \$frameMessages

— initvars —

```
(defvar |$frameMessages| nil "display messages about frames")
```

— messagesframe —

```
(|frame|
 "display messages about frames"
 |interpreter|
 LITERALS
 |$frameMessages|
 (|on| |off|)
 |off|)
```

46.29.17 highlighting

----- The highlighting Option -----

Description: use highlighting in system messages

The highlighting option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

46.29.18 defvar \$highlightAllowed

— initvars —

```
(defvar |$highlightAllowed| nil "use highlighting in system messages")
```

— messageshighlighting —

```
(|highlighting|
 "use highlighting in system messages"
 |interpreter|
 LITERALS
 |$highlightAllowed|
 (|on| |off|)
 |off|)
```

46.29.19 instant

----- The instant Option -----

Description: present instantiation summary

The instant option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

46.29.20 defvar \$reportInstantiations

— initvars —

```
(defvar |$reportInstantiations| nil "present instantiation summary")
```

—————

— messagesinstant —

```
(|instant|
 "present instantiation summary"
 |development|
 LITERALS
 |$reportInstantiations|
 (|on| |off|)
 |off|)
```

—————

46.29.21 insteach

----- The insteach Option -----

Description: present instantiation info

The insteach option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

46.29.22 defvar \$reportEachInstantiation—

— initvars —

```
(defvar |$reportEachInstantiation| nil "present instantiation info")
```

—————

— messagesinsteach —

```
(|insteach|
  "present instantiation info"
  |development|
  LITERALS
  |$reportEachInstantiation|
  (|on| |off|)
  |off|)
```

—————

46.29.23 interponly

----- The interponly Option -----

Description: say when function code is interpreted

The interponly option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

46.29.24 defvar \$reportInterpOnly

— initvars —

```
(defvar |$reportInterpOnly| t "say when function code is interpreted")
```

—————

— messagesinterponly —

```
(|interponly|
  "say when function code is interpreted"
  |interpreter|
  LITERALS
  |$reportInterpOnly|
  (|on| |off|))
```

```
|on|)
```

46.29.25 naglink

----- The naglink Option -----

Description: show NAGLink messages

The naglink option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

46.29.26 defvar \$nagMessages

— initvars —

```
(defvar |$nagMessages| t "show NAGLink messages")
```

— messagesnaglink —

```
(|naglink|
 "show NAGLink messages"
 |interpreter|
 LITERALS
 |$nagMessages|
 (|on| |off|)
 |on|)
```

46.29.27 number

----- The number Option -----

Description: display message number with message

The number option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

46.29.28 defvar \$displayMsgNumber

— initvars —

```
(defvar |$displayMsgNumber| nil "display message number with message")
```

— messagesnumber —

```
(|number|
 "display message number with message"
 |interpreter|
 LITERALS
 |$displayMsgNumber|
 (|on| |off|)
 |off|)
```

46.29.29 prompt

----- The prompt Option -----

Description: set type of input prompt to display

The prompt option may be followed by any one of the following:

```
none
frame
plain
-> step
```

verbose

The current setting is indicated.

46.29.30 defvar \$inputPromptType

— initvars —

```
(defvar |$inputPromptType| '|step| "set type of input prompt to display")
```

—————

— messagesprompt —

```
(|prompt|
 "set type of input prompt to display"
 |interpreter|
 LITERALS
 |$inputPromptType|
 (|none| |frame| |plain| |step| |verbose|)
 |step|)
```

—————

46.29.31 selection

----- The selection Option -----

Description: display function selection msgs

The selection option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

TPDHERE: This is a duplicate of)set mes bot on because both use the \$reportBottomUpFlag flag

— messagesselection —

```
(|selection|
 "display function selection msgs"
 |interpreter|
 LITERALS
 |$reportBottomUpFlag|
 (|on| |off|)
 |off|)
```

46.29.32 set

----- The set Option -----

Description: show)set setting after assignment

The set option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

46.29.33 defvar \$displaySetValue

— initvars —

```
(defvar |$displaySetValue| nil "show )set setting after assignment")
```

— messageset —

```
(|set|
 "show )set setting after assignment"
 |interpreter|
 LITERALS
 |$displaySetValue|
 (|on| |off|)
 |off|)
```

46.29.34 startup

----- The startup Option -----

Description: display messages on start-up

The startup option may be followed by any one of the following:

on
-> off

The current setting is indicated.

46.29.35 defvar \$displayStartMsgs

— initvars —

```
(defvar |$displayStartMsgs| t "display messages on start-up")
```

—————

— messagesstartup —

```
(|startup|
 "display messages on start-up"
 |interpreter|
 LITERALS
 |$displayStartMsgs|
 (|on| |off|)
 |on|)
```

—————

46.29.36 summary

----- The summary Option -----

Description: print statistics after computation

The summary option may be followed by any one of the following:

```

    on
-> off

```

The current setting is indicated.

46.29.37 defvar \$printStatsSummaryIfTrue

— initvars —

```

(defvar |$printStatsSummaryIfTrue| nil
  "print statistics after computation")

```

—————

— messagessummary —

```

(|summary|
  "print statistics after computation"
  |interpreter|
  LITERALS
  |$printStatsSummaryIfTrue|
  (|on| |off|)
  |off|)

```

—————

46.29.38 testing

----- The testing Option -----

Description: print system testing header

The testing option may be followed by any one of the following:

```

    on
-> off

```

The current setting is indicated.

46.29.39 defvar \$testingSystem

— initvars —

```
(defvar |$testingSystem| nil "print system testing header")
```

—————

— messagestesting —

```
(|testing|
 "print system testing header"
 |development|
 LITERALS
 |$testingSystem|
 (|on| |off|)
 |off|)
```

—————

46.29.40 time

----- The time Option -----

Description: print timings after computation

The time option may be followed by any one of the following:

```
on
-> off
long
```

The current setting is indicated.

46.29.41 defvar \$printTimeIfTrue

— initvars —

```
(defvar |$printTimeIfTrue| nil "print timings after computation")
```

—————

— **messagetime** —

```
(|time|
 "print timings after computation"
 |interpreter|
 LITERALS
 |$printTimeIfTrue|
 (|on| |off| |long|)
 |off|)
```

46.29.42 type

----- The type Option -----

Description: print type after computation

The type option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

46.29.43 defvar \$printTypeIfTrue— **initvars** —

```
(defvar |$printTypeIfTrue| t "print type after computation")
```

— **messagetype** —

```
(|type|
 "print type after computation"
 |interpreter|
 LITERALS
 |$printTypeIfTrue|
 (|on| |off|)
 |on|)
```

46.29.44 void

----- The void Option -----

Description: print Void value when it occurs

The void option may be followed by any one of the following:

on
-> off

The current setting is indicated.

46.29.45 defvar \$printVoidIfTrue

— initvars —

```
(defvar |$printVoidIfTrue| nil "print Void value when it occurs")
```

— messagesvoid —

```
(|void|
 "print Void value when it occurs"
 |interpreter|
 LITERALS
 |$printVoidIfTrue|
 (|on| |off|)
 |off|)
```

46.30 naglink

Current Values of naglink Variables

Variable	Description	Current Value

host	internet address of host for NAGLink	localhost
persistence	number of (fortran) functions to remember	1
messages	show NAGLink messages	on
double	enforce DOUBLE PRECISION ASPs	on

— naglink —

```
(|naglink|
  "options for NAGLink"
  |interpreter|
  TREE
  |novar|
  (
    \getchunk{naglinkhost}
    \getchunk{naglinkpersistence}
    \getchunk{naglinkmessages}
    \getchunk{naglinkdouble}
  ))
```

—————

46.30.1 host

----- The host Option -----

Description: internet address of host for NAGLink

)set naglink host is used to tell AXIOM which host to contact for a NAGLink request. An Internet address should be supplied. The host specified must be running the NAGLink daemon.

The current setting is localhost

46.30.2 defvar \$nagHost

— initvars —

```
(defvar |$nagHost| "localhost" "internet address of host for NAGLink")
```

—————

— naglinkhost —

```
(|host|
  "internet address of host for NAGLink"
  |interpreter|
  FUNCTION
  |setNagHost|
  (("enter host name"
    DIRECTORY
    |$nagHost|
    |chkDirectory|
    "localhost"))
  NIL)
```

46.30.3 defun setNagHost

```
[object2String p??]
[describeSetNagHost p752]
[$nagHost p751]
```

— defun setNagHost —

```
(defun |setNagHost| (arg)
  (declare (special |$nagHost|))
  (cond
    ((eq arg '|%initialize%|) (setq |$nagHost| "localhost"))
    ((eq arg '|%display%|) (|object2String| |$nagHost|))
    ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
     (|describeSetNagHost|))
    (t (setq |$nagHost| (|object2String| arg))))))
```

46.30.4 defun describeSetNagHost

```
[sayBrightly p??]
[$nagHost p751]
```

— defun describeSetNagHost —

```
(defun |describeSetNagHost| ()
  (declare (special |$nagHost|))
  (|sayBrightly| (list
    '|%b| "')set naglink host"
    '|%d| "is used to tell AXIOM which host to contact for"
```

```
'|%l| " a NAGLink request. An Internet address should be supplied. The host"
'|%l| " specified must be running the NAGLink daemon."
'|%l|
'|%l| " The current setting is"
'|%b| |$nagHost|
'|%d|)))
```

46.30.5 persistence

----- The persistence Option -----

Description: number of (fortran) functions to remember

)set naglink persistence is used to tell the nagd daemon how many ASP source and object files to keep around in case you reuse them. This helps to avoid needless recompilations. The number specified should be a non-negative integer.

The current setting is 1

46.30.6 defvar \$fortPersistence

— initvars —

```
(defvar |$fortPersistence| 1 "number of (fortran) functions to remember")
```

— naglinkpersistence —

```
(|persistence|
 "number of (fortran) functions to remember"
 |interpreter|
 FUNCTION
 |setFortPers|
 ("Requested remote storage (for asps):"
 INTEGER
 |$fortPersistence|
 (0 NIL)
 10))
 NIL)
```

46.30.7 defun setFortPers

```
[describeFortPersistence p754]
[sayMessage p??]
[bright p??]
[terminateSystemCommand p450]
[$fortPersistence p753]
```

— defun setFortPers —

```
(defun |setFortPers| (arg)
  (let (n)
    (declare (special |$fortPersistence|))
    (cond
      ((eq arg '|%initialize%|) (setq |$fortPersistence| 1))
      ((eq arg '|%display%|) |$fortPersistence|)
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
       (|describeFortPersistence|))
      (t
       (setq n (car arg))
       (cond
         ((or (null (integerp n)) (minusp n))
          (|sayMessage|
           '("Your value of" ,@( |bright| n) "is invalid because ..."))
          (|describeFortPersistence|)
          (|terminateSystemCommand|))
         (t (setq |$fortPersistence| (car arg))))))))
```

46.30.8 defun describeFortPersistence

```
[sayBrightly p??]
[$fortPersistence p753]
```

— defun describeFortPersistence —

```
(defun |describeFortPersistence| ()
  (declare (special |$fortPersistence|))
  (|sayBrightly| (list
    '|%b| " )set naglink persistence"
    '|%d| "is used to tell the "
    '|%b| '|nagd|
    '|%d| '| daemon how many ASP|
```

```
'|%l|
" source and object files to keep around in case you reuse them. This helps"
'|%l| " to avoid needless recompilations. The number specified should be a "
'|%l| " non-negative integer."
'|%l|
'|%l| " The current setting is"
'|%b| |$fortPersistence|
'|%d|)))
```

46.30.9 messages

----- The messages Option -----

Description: show NAGLink messages

The messages option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

TPDHERE: this is the same as)set nag mes on

— **naglinkmessages** —

```
(|messages|
 "show NAGLink messages"
 |interpreter|
 LITERALS
 |$nagMessages|
 (|on| |off|)
 |on|)
```

46.30.10 double

----- The double Option -----

Description: enforce DOUBLE PRECISION ASPs

The double option may be followed by any one of the following:

```
-> on
    off
```

The current setting is indicated.

46.30.11 defvar \$nagEnforceDouble

— initvars —

```
(defvar |$nagEnforceDouble| t "enforce DOUBLE PRECISION ASPs")
```

— naglinkdouble —

```
(|double|
 "enforce DOUBLE PRECISION ASPs"
 |interpreter|
 LITERALS
 |$nagEnforceDouble|
 (|on| |off|)
 |on|)
```

46.31 output

The result of the)set output command is:

Variable	Description	Current Value
abbreviate	abbreviate type names	off
algebra	display output in algebraic form	On:CONSOLE
characters	choose special output character set	plain
fortran	create output in FORTRAN format	Off:CONSOLE
fraction	how fractions are formatted	vertical
html	create output in HTML style	Off:CONSOLE
length	line length of output displays	77
mathml	create output in MathML style	Off:CONSOLE
openmath	create output in OpenMath style	Off:CONSOLE

<code>script</code>	display output in SCRIPT formula format	Off:CONSOLE
<code>scripts</code>	show subscripts,... linearly	off
<code>showeditor</code>	view output of)show in editor	off
<code>tex</code>	create output in TeX style	Off:CONSOLE

Since the output option has a bunch of sub-options each suboption is defined within the output structure.

— **output** —

```
(|output|
  "view and set some output options"
  |interpreter|
  TREE
  |novar|
  (
    \getchunk{outputabbreviate}
    \getchunk{outputalgebra}
    \getchunk{outputcharacters}
    \getchunk{outputfortran}
    \getchunk{outputfraction}
    \getchunk{outputhtml}
    \getchunk{outputlength}
    \getchunk{outputmathml}
    \getchunk{outputopenmath}
    \getchunk{outputscript}
    \getchunk{outputscripts}
    \getchunk{outputshoweditor}
    \getchunk{outputtex}
  ))
```

—————

46.31.1 abbreviate

----- The abbreviate Option -----

Description: abbreviate type names

The abbreviate option may be followed by any one of the following:

on
-> off

The current setting is indicated.

46.31.2 defvar \$abbreviateTypes

— initvars —

```
(defvar |$abbreviateTypes| nil "abbreviate type names")
```

—————

— outputabbreviate —

```
(|abbreviate|
 "abbreviate type names"
 |interpreter|
 LITERALS
 |$abbreviateTypes|
 (|on| |off|)
 |off|)
```

—————

46.31.3 algebra

----- The algebra Option -----

Description: display output in algebraic form

)set output algebra is used to tell AXIOM to turn algebra-style output printing on and off, and where to place the output. By default, the destination for the output is the screen but printing is turned off.

Syntax:)set output algebra <arg>

where arg can be one of

on	turn algebra printing on (default state)
off	turn algebra printing off
console	send algebra output to screen (default state)
fp<.fe>	send algebra output to file with file prefix fp and file extension .fe. If not given, .fe defaults to .spout.

If you wish to send the output to a file, you may need to issue this command twice: once with on and once with the file name. For example, to send algebra output to the file polymer.spout, issue the two commands

```
)set output algebra on
)set output algebra polymer
```

The output is placed in the directory from which you invoked AXIOM or the one you set with the)cd system command.
The current setting is: On:CONSOLE

46.31.4 defvar \$algebraFormat

— initvars —

```
(defvar |$algebraFormat| t "display output in algebraic form")
```

—————

46.31.5 defvar \$algebraOutputFile

— initvars —

```
(defvar |$algebraOutputFile| "CONSOLE"
  "where algebra printing goes (enter {\em console} or a pathname)?")
```

—————

— outputalgebra —

```
(|algebra|
  "display output in algebraic form"
  |interpreter|
  FUNCTION
  |setOutputAlgebra|
  (("display output in algebraic form"
    LITERALS
    |$algebraFormat|
    (|off| |on|)
    |on|)
    (break $algebraFormat)
    ("where algebra printing goes (enter {\em console} or a pathname)?"
     FILENAME
     |$algebraOutputFile|
     |chkOutputFileName|
     "console"))
  NIL)
```

46.31.6 defvar \$algebraOutputStream

— initvars —

```
(defvar |$algebraOutputStream| *standard-output*)
```

46.31.7 defun setOutputAlgebra

```
[defiostream p980]
[concat p1049]
[describeSetOutputAlgebra p762]
[qcdr p??]
[qcar p??]
[member p1050]
[upcase p??]
[sayKeyedMsg p329]
[shut p980]
[pathnameType p1042]
[pathnameDirectory p1043]
[pathnameName p1042]
[$filep p??]
[make-outstream p979]
[object2String p??]
[$algebraOutputStream p760]
[$algebraOutputFile p759]
[$filep p??]
[$algebraFormat p759]
```

— defun setOutputAlgebra —

```
(defun |setOutputAlgebra| (arg)
  (let (label tmp1 tmp2 ptype fn ft fm filename teststream)
    (declare (special |$algebraOutputStream| |$algebraOutputFile| $filep
      |$algebraFormat|))
    (cond
      ((eq arg '|%initialize%|)
       (setq |$algebraOutputStream|
         (defiostream '((mode . output) (device . console)) 255 0))
       (setq |$algebraOutputFile| "CONSOLE")
       (setq |$algebraFormat| t))
```

```

((eq arg '|%display%|)
 (if |$algebraFormat|
  (setq label "On:")
  (setq label "Off:"))
 (concat label |$algebraOutputFile|))
((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
 (|describeSetOutputAlgebra|))
(t
 (cond
  ((and (consp arg)
        (eq (qcdr arg) nil)
        (progn (setq fn (qcar arg)) t)
        (|member| fn '(y n ye yes no o on of off console
                      |y| |n| |ye| |yes| |no| |o| |on| |of| |off| |console|))))
   '|ok|)
  (t (setq arg (list fn '|spout|)))))
(cond
 ((and (consp arg)
       (eq (qcdr arg) nil)
       (progn (setq fn (qcar arg)) t))
  (cond
   ((|member| (upcase fn) '(y n ye o of))
    (|sayKeyedMsg| 's2iv0002 '(|algebra| |algebra|)))
   ((|member| (upcase fn) '(no off)) (setq |$algebraFormat| nil))
   ((|member| (upcase fn) '(yes on)) (setq |$algebraFormat| t))
   ((eq (upcase fn) 'console)
    (shut |$algebraOutputStream|)
    (setq |$algebraOutputStream|
          (defiostream '((mode . output) (device . console)) 255 0))
    (setq |$algebraOutputFile| "CONSOLE")))))
((or
  (and (consp arg)
        (progn
         (setq fn (qcar arg))
         (setq tmp1 (qcdr arg))
         (and (consp tmp1)
              (eq (qcdr tmp1) nil)
              (progn (setq ft (qcar tmp1)) t))))
  (and (consp arg)
        (progn (setq fn (qcar arg))
                 (setq tmp1 (qcdr arg))
                 (and (consp tmp1)
                      (progn (setq ft (qcar tmp1))
                             (setq tmp2 (qcdr tmp1))
                             (and (consp tmp2)
                                  (eq (qcdr tmp2) nil)
                                  (progn
                                   (setq fm (qcar tmp2))
                                   t)))))))
  (when (setq ptype (|pathnameType| fn))

```

```

(setq fn (concat (|pathnameDirectory| fn) (|pathnameName| fn)))
(setq ft ptype)
(unless fm (setq fm 'a))
(setq filename ($filep fn ft fm))
(cond
  ((null filename)
   (|sayKeyedMsg| 's2iv0003 (list fn ft fm)))
  ((setq teststream (make-outstream filename 255 0))
   (shut |$algebraOutputStream|)
   (setq |$algebraOutputStream| teststream)
   (setq |$algebraOutputFile| (|object2String| filename))
   (|sayKeyedMsg| 's2iv0004 (list "Algebra" |$algebraOutputFile|)))
  (t (|sayKeyedMsg| 's2iv0003 (list fn ft fm)))))
(t
  (|sayKeyedMsg| 's2iv0005 nil)
  (|describeSetOutputAlgebra|))))))

```

46.31.8 defun describeSetOutputAlgebra

```

[|sayBrightly| p??]
[setOutputAlgebra p760]

```

— defun describeSetOutputAlgebra —

```

(defun |describeSetOutputAlgebra| ()
  (|sayBrightly| (list
    '|%b| "set output algebra"
    '|%d| "is used to tell AXIOM to turn algebra-style output"
    '|%l| "printing on and off, and where to place the output. By default, the"
    '|%l| "destination for the output is the screen but printing is turned off."
    '|%l|
    '|%l| "Syntax:  )set output algebra <arg>"
    '|%l| "   where arg can be one of"
    '|%l| "   on      turn algebra printing on (default state)"
    '|%l| "   off     turn algebra printing off"
    '|%l| "   console  send algebra output to screen (default state)"
    '|%l| "   fp<.fe>  send algebra output to file with file prefix fp"
    '|%l|
    "               and file extension .fe. If not given, .fe defaults to .spout."
    '|%l|
    '|%l|
    "If you wish to send the output to a file, you may need to issue this command"
    '|%l| "twice: once with"
    '|%b| "on"
    '|%d| "and once with the file name. For example, to send"

```

```
'|%l| "algebra output to the file"
'|%b| "polymer.spout,"
'|%d| "issue the two commands"
'|%l|
'|%l| " )set output algebra on"
'|%l| " )set output algebra polymer"
'|%l|
'|%l| "The output is placed in the directory from which you invoked AXIOM or"
'|%l| "the one you set with the )cd system command."
'|%l| "The current setting is: "
'|%b| (|setOutputAlgebra| '|%display%|)
'|%d|)))
```

46.31.9 characters

----- The characters Option -----

Description: choose special output character set

The characters option may be followed by any one of the following:

```
default
-> plain
```

The current setting is indicated. This option determines the special characters used for algebraic output. This is what the current choice of special characters looks like:

ulc is shown as +	urc is shown as +
llc is shown as +	lrc is shown as +
vbar is shown as	hbar is shown as -
quad is shown as ?	lbrk is shown as [
rbrk is shown as]	lbrc is shown as {
rbrc is shown as }	ttee is shown as +
btee is shown as +	rtee is shown as +
ltee is shown as +	ctee is shown as +
bslash is shown as \	

— outputcharacters —

```
(|characters|
"choose special output character set"
```

```
|interpreter|
FUNCTION
|setOutputCharacters|
NIL
|htSetOutputCharacters|)
```

46.31.10 defun setOutputCharacters

```
[sayMessage p??]
[bright p??]
[sayBrightly p??]
[concat p1049]
[pname p1047]
[specialChar p978]
[sayAsManyPerLineAsPossible p??]
[qcdr p??]
[qcar p??]
[downcase p??]
[setOutputCharacters p764]
[$specialCharacters p977]
[$plainRTspecialCharacters p976]
[$RTspecialCharacters p976]
[$specialCharacterAlist p977]
```

— defun setOutputCharacters —

```
(defun |setOutputCharacters| (arg)
  (let (current char s l fn)
    (declare (special |$specialCharacters| |$plainRTspecialCharacters|
                     |$RTspecialCharacters| |$specialCharacterAlist|))
    (if (eq arg '|%initialize%|)
        (setq |$specialCharacters| |$plainRTspecialCharacters|)
        (progn
          (setq current
                (cond
                 ((eq |$specialCharacters| |$RTspecialCharacters|) "default")
                 ((eq |$specialCharacters| |$plainRTspecialCharacters|) "plain")
                 (t "unknown"))))
          (cond
           ((eq arg '|%display%|) current)
           ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
            (|sayMessage|
             (" The" ,@(|bright| "characters")
              "option may be followed by any one of the following:"))
```



```

(dolist (name '("default" "plain"))
  (if (string= (string current) name)
    (|sayBrightly| '(" ->" ,@(|bright| name)))
    (|sayBrightly| (list " " name))))
(terpri)
(|sayBrightly|
" The current setting is indicated within the list. This option determines ")
(|sayBrightly|
" the special characters used for algebraic output. This is what the")
(|sayBrightly|
" current choice of special characters looks like:")
(do ((t1 |$specialCharacterAlist| (CDR t1)) (t2 nil))
  ((or (atom t1)
    (progn (setq t2 (car t1)) nil)
    (progn (progn (setq char (car t2)) t2) nil)) nil)
  (setq s
    (concat " " (pname char) " is shown as "
      (pname (|specialChar| char))))
  (setq l (cons s l)))
(|sayAsManyPerLineAsPossible| (reverse l)))
(and (consp arg)
  (eq (qcdr arg) NIL)
  (progn (setq fn (qcar arg)) t)
  (setq fn (downcase fn)))
(cond
  ((eq fn '|default|)
    (setq |$specialCharacters| |$RTspecialCharacters|))
  ((eq fn '|plain|)
    (setq |$specialCharacters| |$plainRTspecialCharacters|))
  (t (|setOutputCharacters| nil)))
(t (|setOutputCharacters| nil))))))

```

46.31.11 fortran

----- The fortran Option -----

Description: create output in FORTRAN format

)set output fortran is used to tell AXIOM to turn FORTRAN-style output printing on and off, and where to place the output. By default, the destination for the output is the screen but printing is turned off.

Also See:)set fortran

Syntax:)set output fortran <arg>

where `arg` can be one of

<code>on</code>	turn FORTRAN printing on
<code>off</code>	turn FORTRAN printing off (default state)
<code>console</code>	send FORTRAN output to screen (default state)
<code>fp<.fe></code>	send FORTRAN output to file with file prefix fp and file extension .fe. If not given, .fe defaults to .sfort.

If you wish to send the output to a file, you must issue this command twice: once with `on` and once with the file name. For example, to send FORTRAN output to the file `polymer.sfort`, issue the two commands

```
)set output fortran on
)set output fortran polymer
```

The output is placed in the directory from which you invoked AXIOM or the one you set with the `)cd` system command. The current setting is: `Off:CONSOLE`

46.31.12 `defvar $fortranFormat`

— initvars —

```
(defvar |$fortranFormat| nil "create output in FORTRAN format")
```

—————

46.31.13 `defvar $fortranOutputFile`

— initvars —

```
(defvar |$fortranOutputFile| "CONSOLE"
  "where FORTRAN output goes (enter {\em console} or a a pathname)")
```

—————

— outputfortran —

```
(|fortran|
  "create output in FORTRAN format"
  |interpreter|
  FUNCTION
```

```

|setOutputFortran|
(("create output in FORTRAN format"
  LITERALS
  |$fortranFormat|
  (|off| |on|)
  |off|)
(|break| |$fortranFormat|)
("where FORTRAN output goes (enter {\em console} or a a pathname)"
  FILENAME
  |$fortranOutputFile|
  |chkOutputFileName|
  "console"))
NIL)

```

46.31.14 defun setOutputFortran

```

[defiostream p980]
[concat p1049]
[describeSetOutputFortran p769]
[upcase p??]
[qcdr p??]
[qcar p??]
[member p1050]
[sayKeyedMsg p329]
[shut p980]
[pathnameType p1042]
[pathnameDirectory p1043]
[pathnameName p1042]
[$filep p??]
[makeStream p981]
[object2String p??]
[$fortranOutputStream p??]
[$fortranOutputFile p766]
[$filep p??]
[$fortranFormat p766]

```

— defun setOutputFortran —

```

(defun |setOutputFortran| (arg)
  (let (label APPEND quiet tmp1 tmp2 ptype fn ft fm filename teststream)
    (declare (special |$fortranOutputStream| |$fortranOutputFile| $filep
      |$fortranFormat|))
    (cond
      ((eq arg '|%initialize%|)

```

```

(setq |$fortranOutputStream|
  (defiostream '((mode . output) (device . console)) 255 0))
(setq |$fortranOutputFile| "CONSOLE")
(setq |$fortranFormat| nil))
((eq arg '|%display%|)
  (if |$fortranFormat|
    (setq label "On:")
    (setq label "Off:"))
  (concat label |$fortranOutputFile|))
((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
  (|describeSetOutputFortran|))
(t
  (DO ()
    ((null (and (listp arg)
      (|member| (upcase (car arg)) ' (append quiet))))
      nil)
    (cond
      ((eq (upcase (car arg)) 'append) (setq append t))
      ((eq (upcase (car arg)) 'quiet) (setq quiet t))
      (t nil))
    (setq arg (cdr arg)))
  (cond
    ((and (consp arg)
      (eq (qcdr arg) nil)
      (progn (setq fn (qcar arg)) t)
      (|member| fn '(Y N YE YES NO O ON OF OFF CONSOLE
        |y| |n| |ye| |yes| |no| |o| |on| |of| |off| |console|))))
      '|ok|)
    (t (setq arg (list fn '|sfort|))))
  (cond
    ((and (consp arg) (eq (qcdr arg) nil) (progn (setq fn (qcar arg)) t))
      (cond
        ((|member| (upcase fn) '(y n ye o of))
          (|sayKeyedMsg| 's2iv0002 '(fortran |fortran|)))
        ((|member| (upcase fn) '(no off)) (setq |$fortranFormat| nil))
        ((|member| (upcase fn) '(yes on)) (setq |$fortranFormat| t))
        ((eq (upcase fn) 'console)
          (shut |$fortranOutputStream|)
          (setq |$fortranOutputStream|
            (defiostream '((mode . output) (device . console)) 255 0))
          (setq |$fortranOutputFile| "CONSOLE"))))
      ((or
        (and (consp arg)
          (progn
            (setq fn (qcar arg))
            (setq tmp1 (qcdr arg))
            (and (consp tmp1)
              (eq (qcdr tmp1) nil)
              (progn (setq ft (qcar tmp1)) t))))
          (and (consp arg)

```

```

(progn
  (setq fn (qcar arg))
  (setq tmp1 (qcdr arg))
  (and (consp tmp1)
    (progn
      (setq ft (qcar tmp1))
      (setq tmp2 (qcdr tmp1))
      (and (consp tmp2)
        (eq (qcdr tmp2) nil)
        (progn (setq fm (qcar tmp2)) t))))))
(when (setq ptype (|pathnameType| fn))
  (setq fn (concat (|pathnameDirectory| fn) (|pathnameName| fn)))
  (setq ft ptype))
(unless fm (setq fm 'a))
(setq filename ($filep fn ft fm))
(cond
  ((null filename)
   (|sayKeyedMsg| 'S2IV0003 (list fn ft fm)))
  ((setq teststream (|makeStream| append filename 255 0))
   (SHUT |$fortranOutputStream|)
   (setq |$fortranOutputStream| teststream)
   (setq |$fortranOutputFile| (|object2String| filename))
   (unless quiet
    (|sayKeyedMsg| 'S2IV0004 (list 'fortran |$fortranOutputFile|))))
  ((null quiet)
   (|sayKeyedMsg| 'S2IV0003 (list fn ft fm)))
  (t nil)))
(t
 (unless quiet (|sayKeyedMsg| 'S2IV0005 nil))
 (|describeSetOutputFortran|))))

```

46.31.15 defun describeSetOutputFortran

```

[sayBrightly p??]
[setOutputFortran p767]

```

— defun describeSetOutputFortran —

```

(defun |describeSetOutputFortran| ()
  (|sayBrightly| (list
    '|%b| ")set output fortran"
    '|%d| "is used to tell AXIOM to turn FORTRAN-style output"
    '|%l| "printing on and off, and where to place the output. By default, the"
    '|%l| "destination for the output is the screen but printing is turned off."
    '|%l|

```

```
'|%l| "Also See: )set fortran"
'|%l|
'|%l| "Syntax: )set output fortran <arg>"
'|%l| "   where arg can be one of"
'|%l| "   on           turn FORTRAN printing on"
'|%l| "   off          turn FORTRAN printing off (default state)"
'|%l| "   console      send FORTRAN output to screen (default state)"
'|%l|
"   fp<.fe>      send FORTRAN output to file with file prefix fp and file"
'|%l| "               extension .fe. If not given, .fe defaults to .sfort."
'|%l|
'|%l| "If you wish to send the output to a file, you must issue this command"
'|%l| "twice: once with"
'|%b| "on"
'|%d| "and once with the file name. For example, to send"
'|%l| "FORTRAN output to the file"
'|%b| "polymer.sfort,"
'|%d| "issue the two commands"
'|%l|
'|%l| "   )set output fortran on"
'|%l| "   )set output fortran polymer"
'|%l|
'|%l| "The output is placed in the directory from which you invoked AXIOM or"
'|%l| "the one you set with the )cd system command."
'|%l| "The current setting is: "
'|%b| (|setOutputFortran| '|%display%|)
'|%d|)))
```

46.31.16 fraction

----- The fraction Option -----

Description: how fractions are formatted

The fraction option may be followed by any one of the following:

```
-> vertical
    horizontal
```

The current setting is indicated.

46.31.17 defvar \$fractionDisplayType

— initvars —

```
(defvar |$fractionDisplayType| ' |vertical| "how fractions are formatted")
```

— outputfraction —

```
(|fraction|
 "how fractions are formatted"
 |interpreter|
 LITERALS
 |$fractionDisplayType|
 (|vertical| |horizontal|)
 |vertical|)
```

46.31.18 length

----- The length Option -----

Description: line length of output displays

The length option may be followed by an integer in the range 10 to 245 inclusive. The current setting is 77

46.31.19 defvar \$margin

— initvars —

```
(defvar $margin 3)
```

46.31.20 defvar \$linelength

— initvars —

```
(defvar $linelength 77 "line length of output displays")
```

— outputlength —

```
(|length|
 "line length of output displays"
 |interpreter|
 INTEGER
 $LINELENGTH
 (10 245)
 77)
```

46.31.21 mathml

----- The mathml Option -----

Description: create output in MathML style

)set output mathml is used to tell AXIOM to turn MathML-style output printing on and off, and where to place the output. By default, the destination for the output is the screen but printing is turned off.

Syntax:)set output mathml <arg>
 where arg can be one of
 on turn MathML printing on
 off turn MathML printing off (default state)
 console send MathML output to screen (default state)
 fp<.fe> send MathML output to file with file prefix fp
 and file extension .fe. If not given,
 .fe defaults to .smml.

If you wish to send the output to a file, you must issue this command twice: once with on and once with the file name. For example, to send MathML output to the file polymer.smml, issue the two commands

```
      )set output mathml on
      )set output mathml polymer
```

The output is placed in the directory from which you invoked AXIOM or the one you set with the)cd system command.

The current setting is: Off:CONSOLE

46.31.22 defvar \$mathmlFormat

— initvars —

```
(defvar |$mathmlFormat| nil "create output in MathML format")
```

—————

46.31.23 defvar \$mathmlOutputFile

— initvars —

```
(defvar |$mathmlOutputFile| "CONSOLE"
  "where MathML output goes (enter {\em console} or a pathname)")
```

—————

— outputmathml —

```
(|mathml|
  "create output in MathML style"
  |interpreter|
  FUNCTION
  |setOutputMathml|
  (("create output in MathML format"
    LITERALS
    |$mathmlFormat|
    (|off| |on|)
    |off|)
  (|break| |$mathmlFormat|)
  ("where MathML output goes (enter {\em console} or a pathname)"
  FILENAME
  |$mathmlOutputFile|
  |chkOutputFileName|
  "console"))
NIL)
```

—————

46.31.24 defun setOutputMathml

```
[defiostream p980]
[concat p1049]
[describeSetOutputMathml p776]
[qcdr p??]
[qcar p??]
[member p1050]
[upcase p??]
[sayKeyedMsg p329]
[shut p980]
[pathnameType p1042]
[pathnameDirectory p1043]
[pathnameName p1042]
[$filep p??]
[make-outstream p979]
[object2String p??]
[$mathmlOutputStream p??]
[$mathmlOutputFile p773]
[$mathmlFormat p773]
[$filep p??]
```

— defun setOutputMathml —

```
(defun |setOutputMathml| (arg)
  (let (label tmp1 tmp2 ptype fn ft fm filename teststream)
    (declare (special |$mathmlOutputStream| |$mathmlOutputFile| |$mathmlFormat|
                      $filep))
    (cond
      ((eq arg '|%initialize%|)
       (setq |$mathmlOutputStream|
             (defiostream '((mode . output) (device . console)) 255 0))
       (setq |$mathmlOutputFile| "CONSOLE")
       (setq |$mathmlFormat| nil))
      ((eq arg '|%display%|)
       (if |$mathmlFormat|
         (setq label "On:")
         (setq label "Off:"))
       (concat label |$mathmlOutputFile|))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
       (|describeSetOutputMathml|))
      (t
       (cond
         ((and (consp arg)
              (eq (qcdr arg) nil)
              (progn (setq fn (qcar arg)) t)
              (|member| fn '(y n ye yes no o on of off console
                           |y| |n| |ye| |yes| |no| |o| |on| |of| |off| |console|))))
```

```

      '|ok|)
    (t (setq arg (list fn '|smml|))))
  (cond
    ((and (consp arg)
          (eq (qcdr arg) nil)
          (progn (setq fn (qcar arg)) t)))
    (cond
      ((|member| (upcase fn) '(y n ye o of))
       (|sayKeyedMsg| 's2iv0002 '(|MathML| |mathml|)))
      ((|member| (upcase fn) '(no off)) (setq |$mathmlFormat| nil))
      ((|member| (upcase fn) '(yes on)) (setq |$mathmlFormat| t))
      ((eq (upcase fn) 'console)
       (shut |$mathmlOutputStream|)
       (setq |$mathmlOutputStream|
             (defiostream '((mode . output) (device . console)) 255 0))
       (setq |$mathmlOutputFile| "CONSOLE"))))
    ((or
      (and (consp arg)
           (progn
            (setq fn (qcar arg))
            (setq tmp1 (qcdr arg))
            (and (consp tmp1)
                 (eq (qcdr tmp1) nil)
                 (progn (setq ft (qcar tmp1)) t))))
      (and (consp arg)
           (progn (setq fn (qcar arg))
                  (setq tmp1 (qcdr arg))
                  (and (consp tmp1)
                       (progn
                        (setq ft (qcar tmp1))
                        (setq tmp2 (qcdr tmp1))
                        (and (consp tmp2)
                             (eq (qcdr tmp2) nil)
                             (progn
                              (setq fm (qcar tmp2))
                              t))))))))
      (when (setq ptype (|pathnameType| fn))
        (setq fn
              (concat (|pathnameDirectory| fn) (|pathnameName| fn)))
        (setq ft ptype))
      (unless fm (setq fm 'a))
      (setq filename ($filep fn ft fm))
      (cond
        ((null filename) (|sayKeyedMsg| 's2iv0003 (list fn ft fm)))
        ((setq teststream (make-outstream filename 255 0))
         (shut |$mathmlOutputStream|)
         (setq |$mathmlOutputStream| teststream)
         (setq |$mathmlOutputFile| (|object2String| filename))
         (|sayKeyedMsg| 's2iv0004 (list "MathML" |$mathmlOutputFile|)))
        (t (|sayKeyedMsg| 's2iv0003 (list fn ft fm)))))

```

```
(t
  (|sayKeyedMsg| 's2iv0005 nil)
  (|describeSetOutputMathml|))))))
```

46.31.25 defun describeSetOutputMathml

```
[sayBrightly p??]
[setOutputMathml p774]
```

— defun describeSetOutputMathml —

```
(defun |describeSetOutputMathml| ()
  (|sayBrightly| (LIST
    '|%b| " )set output mathml"
    '|%d| "is used to tell AXIOM to turn MathML-style output"
    '|%l| "printing on and off, and where to place the output. By default, the"
    '|%l| "destination for the output is the screen but printing is turned off."
    '|%l|
    '|%l| "Syntax: )set output mathml <arg>"
    '|%l| " where arg can be one of"
    '|%l| " on turn MathML printing on"
    '|%l| " off turn MathML printing off (default state)"
    '|%l| " console send MathML output to screen (default state)"
    '|%l| " fp<.fe> send MathML output to file with file prefix fp and file"
    '|%l| " extension .fe. If not given, .fe defaults to .stex."
    '|%l|
    '|%l| "If you wish to send the output to a file, you must issue this command"
    '|%l| "twice: once with"
    '|%b| "on"
    '|%d| "and once with the file name. For example, to send"
    '|%l| "MathML output to the file"
    '|%b| "polymer.smml,"
    '|%d| "issue the two commands"
    '|%l|
    '|%l| " )set output mathml on"
    '|%l| " )set output mathml polymer"
    '|%l|
    '|%l| "The output is placed in the directory from which you invoked AXIOM or"
    '|%l| "the one you set with the )cd system command."
    '|%l| "The current setting is: "
    '|%b| (|setOutputMathml| '|%display%|)
    '|%d|)))
```

46.31.26 html

----- The html Option -----

Description: create output in html style

)set output html is used to tell AXIOM to turn html-style output printing on and off, and where to place the output. By default, the destination for the output is the screen but printing is turned off.

Syntax:)set output html <arg>

where arg can be one of

on	turn html printing on
off	turn html printing off (default state)
console	send html output to screen (default state)
fp<.fe>	send html output to file with file prefix fp and file extension .fe. If not given, .fe defaults to .html.

If you wish to send the output to a file, you must issue this command twice: once with on and once with the file name. For example, to send MathML output to the file polymer.html, issue the two commands

```
)set output html on
)set output html polymer
```

The output is placed in the directory from which you invoked Axiom or the one you set with the)cd system command.
The current setting is: Off:CONSOLE

46.31.27 defvar \$htmlFormat

— initvars —

```
(defvar |$htmlFormat| nil "create output in HTML format")
```

46.31.28 defvar \$htmlOutputFile

— initvars —

```
(defvar |$htmlOutputFile| "CONSOLE")
```

"where HTML output goes (enter {\em console} or a pathname)")

— outputhtml —

```
(|html|
  "create output in HTML style"
  |interpreter|
  FUNCTION
  |setOutputHtml|
  ("create output in HTML format"
    LITERALS
    |$htmlFormat|
    (|off| |on|)
    |off|)
  (|break| |$htmlFormat|)
  ("where HTML output goes (enter {\em console} or a pathname)"
    FILENAME
    |$htmlOutputFile|
    |chkOutputFileName|
    "console"))
NIL)
```

46.31.29 defun setOutputHtml

```
[defiostream p980]
[concat p1049]
[describeSetOutputHtml p780]
[qcdr p??]
[qcar p??]
[member p1050]
[upcase p??]
[sayKeyedMsg p329]
[shut p980]
[pathnameType p1042]
[pathnameDirectory p1043]
[pathnameName p1042]
[$filep p??]
[make-outstream p979]
[object2String p??]
[$htmlOutputStream p??]
[$htmlOutputFile p777]
```

```
[$htmlFormat p777]
[$filep p??]
```

— defun setOutputHtml —

```
(defun |setOutputHtml| (arg)
  (let (label tmp1 tmp2 ptype fn ft fm filename teststream)
    (declare (special |$htmlOutputStream| |$htmlOutputFile| |$htmlFormat|
                      $filep))
    (cond
      ((eq arg '|%initialize%|)
       (setq |$htmlOutputStream|
             (defiostream '((mode . output) (device . console)) 255 0))
       (setq |$htmlOutputFile| "CONSOLE")
       (setq |$htmlFormat| nil))
      ((eq arg '|%display%|)
       (if |$htmlFormat|
         (setq label "On:")
         (setq label "Off:"))
       (concat label |$htmlOutputFile|))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
       (|describeSetOutputHtml|))
      (t
       (cond
         ((and (consp arg)
              (eq (qcdr arg) nil)
              (progn (setq fn (qcar arg)) t)
              (|member| fn '(y n ye yes no o on of off console
                           |y| |n| |ye| |yes| |no| |o| |on| |of| |off| |console|)))
          '|ok|)
         (t (setq arg (list fn '|smml|))))
       (cond
         ((and (consp arg)
              (eq (qcdr arg) nil)
              (progn (setq fn (qcar arg)) t))
          (cond
            ((|member| (upcase fn) '(y n ye o of))
             (|sayKeyedMsg| 's2iv0002 '(|HTML| |html|)))
            ((|member| (upcase fn) '(no off)) (setq |$htmlFormat| nil))
            ((|member| (upcase fn) '(yes on)) (setq |$htmlFormat| t))
            ((eq (upcase fn) 'console)
             (shut |$htmlOutputStream|)
             (setq |$htmlOutputStream|
                   (defiostream '((mode . output) (device . console)) 255 0))
             (setq |$htmlOutputFile| "CONSOLE"))))
         ((or
          (and (consp arg)
               (progn
                (setq fn (qcar arg))
                (setq tmp1 (qcdr arg))
```

```

      (and (consp tmp1)
           (eq (qcdr tmp1) nil)
           (progn (setq ft (qcar tmp1)) t))))
    (and (consp arg)
         (progn (setq fn (qcar arg))
                 (setq tmp1 (qcdr arg))
                 (and (consp tmp1)
                      (progn
                       (setq ft (qcar tmp1))
                       (setq tmp2 (qcdr tmp1))
                       (and (consp tmp2)
                           (eq (qcdr tmp2) nil)
                           (progn
                            (setq fm (qcar tmp2))
                            t)))))))
    (when (setq ptype (|pathnameType| fn))
        (setq fn
              (concat (|pathnameDirectory| fn) (|pathnameName| fn)))
        (setq ft ptype))
    (unless fm (setq fm 'a))
    (setq filename ($filep fn ft fm))
    (cond
     ((null filename) (|sayKeyedMsg| 's2iv0003 (list fn ft fm)))
     ((setq teststream (make-outstream filename 255 0))
      (shut |$htmlOutputStream|)
      (setq |$htmlOutputStream| teststream)
      (setq |$htmlOutputFile| (|object2String| filename))
      (|sayKeyedMsg| 's2iv0004 (list "HTML" |$htmlOutputFile|)))
     (t (|sayKeyedMsg| 's2iv0003 (list fn ft fm))))
    (t
     (|sayKeyedMsg| 's2iv0005 nil)
     (|describeSetOutputHtml|))))))

```

46.31.30 defun describeSetOutputHtml

```

[sayBrightly p??]
[setOutputHtml p778]

```

— defun describeSetOutputHtml —

```

(defun |describeSetOutputHtml| ()
  (|sayBrightly| (LIST
    '|%b| "set output html"
    '|%d| "is used to tell AXIOM to turn HTML-style output"
    '|%l| "printing on and off, and where to place the output. By default, the"

```



```
'|%l| "destination for the output is the screen but printing is turned off."
'|%l|
'|%l| "Syntax:  )set output html <arg>"
'|%l| "    where arg can be one of"
'|%l| "    on          turn HTML printing on"
'|%l| "    off         turn HTML printing off (default state)"
'|%l| "    console      send HTML output to screen (default state)"
'|%l| "    fp<.fe>       send HTML output to file with file prefix fp and file"
'|%l| "                  extension .fe. If not given, .fe defaults to .stex."
'|%l|
'|%l| "If you wish to send the output to a file, you must issue this command"
'|%l| "twice: once with"
'|%b| "on"
'|%d| "and once with the file name. For example, to send"
'|%l| "HTML output to the file"
'|%b| "polymer.smml,"
'|%d| "issue the two commands"
'|%l|
'|%l| " )set output html on"
'|%l| " )set output html polymer"
'|%l|
'|%l| "The output is placed in the directory from which you invoked AXIOM or"
'|%l| "the one you set with the )cd system command."
'|%l| "The current setting is: "
'|%b| (|setOutputHtml| '|%display%|)
'|%d|)))
```

46.31.31 openmath

----- The openmath Option -----

Description: create output in OpenMath style

)set output tex is used to tell AXIOM to turn OpenMath output printing on and off, and where to place the output. By default, the destination for the output is the screen but printing is turned off.

```
Syntax:  )set output tex <arg>
         where arg can be one of
         on          turn OpenMath printing on
         off         turn OpenMath printing off (default state)
         console      send OpenMath output to screen (default state)
         fp<.fe>       send OpenMath output to file with file prefix fp
                       and file extension .fe. If not given,
                       .fe defaults to .sopen.
```

If you wish to send the output to a file, you must issue this command twice: once with on and once with the file name. For example, to send OpenMath output to the file polymer.sopen, issue the two commands

```
)set output openmath on
)set output openmath polymer
```

The output is placed in the directory from which you invoked AXIOM or the one you set with the)cd system command. The current setting is: Off:CONSOLE

46.31.32 defvar \$openMathFormat

— initvars —

```
(defvar |$openMathFormat| nil "create output in OpenMath format")
```

—————

46.31.33 defvar \$openMathOutputFile

— initvars —

```
(defvar |$openMathOutputFile| "CONSOLE"
  "where TeX output goes (enter {\em console} or a pathname)")
```

—————

— outputopenmath —

```
(|openmath|
  "create output in OpenMath style"
  |interpreter|
  FUNCTION
  |setOutputOpenMath|
  ("create output in OpenMath format"
   LITERALS
   |$openMathFormat|
   (|off| |on|)
   |off|)
  (|break| |$openMathFormat|)
```

```

    ("where TeX output goes (enter {\em console} or a pathname)"
     FILENAME
     |$openMathOutputFile|
     |chkOutputFileName|
     "console"))
  NIL)

```

46.31.34 defun setOutputOpenMath

```

[defiostream p980]
[concat p1049]
[describeSetOutputOpenMath p785]
[qcdr p??]
[qcar p??]
[member p1050]
[upcase p??]
[sayKeyedMsg p329]
[shut p980]
[pathnameType p1042]
[pathnameDirectory p1043]
[pathnameName p1042]
[$filep p??]
[make-outstream p979]
[object2String p??]
[$openMathOutputStream p??]
[$openMathFormat p782]
[$filep p??]
[$openMathOutputFile p782]

```

— defun setOutputOpenMath —

```

(defun |setOutputOpenMath| (arg)
  (let (label tmp1 tmp2 ptype fn ft fm filename teststream)
    (declare (special |$openMathOutputStream| |$openMathFormat| $filep
                      |$openMathOutputFile|))
    (cond
      ((eq arg '|%initialize%|)
       (setq |$openMathOutputStream|
              (defiostream '((mode . output) (device . console)) 255 0))
       (setq |$openMathOutputFile| "CONSOLE")
       (setq |$openMathFormat| NIL))
      ((eq arg '|%display%|)
       (if |$openMathFormat|
           (setq label "On:"))

```

```

(setq label "Off:"))
(concat label |$openMathOutputFile|))
((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
(|describeSetOutputOpenMath|))
(t
(cond
((and (consp arg)
(eq (qcdr arg) nil)
(progn (setq fn (qcar arg)) t)
(|member| fn '(y n ye yes no o on of off console
|y| |n| |ye| |yes| |no| |o| |on| |of| |off| |console|)))
'|ok|)
(t (setq arg (list fn '|som|))))
(cond
((and (consp arg)
(eq (qcdr arg) nil)
(progn (setq fn (qcar arg)) t))
(cond
((|member| (upcase fn) '(y n ye o of))
(|sayKeyedMsg| 's2iv0002 '(|OpenMath| |openmath|)))
((|member| (upcase fn) '(no off)) (setq |$openMathFormat| nil))
((|member| (upcase fn) '(yes on)) (setq |$openMathFormat| t))
((eq (upcase fn) 'console)
(shut |$openMathOutputStream|)
(setq |$openMathOutputStream|
(defiostream '((mode . output) (device . console)) 255 0))
(setq |$openMathOutputFile| "CONSOLE"))))
((or
(and (consp arg)
(progn (setq fn (qcar arg))
(setq tmp1 (qcdr arg))
(and (consp tmp1)
(eq (qcdr tmp1) nil)
(progn (setq ft (qcar tmp1)) t))))
(and (consp arg)
(progn
(setq fn (qcar arg))
(setq tmp1 (qcdr arg))
(and (consp tmp1)
(progn (setq ft (qcar tmp1))
(setq tmp2 (qcdr tmp1))
(and (consp tmp2)
(eq (qcdr tmp2) nil)
(progn (setq fm (qcar tmp2)) t))))))
(when (setq ptype (|pathnameType| fn))
(setq fn (concat (|pathnameDirectory| fn) (|pathnameName| fn)))
(setq ft ptype))
(unless fm (setq fm 'a))
(setq filename ($filep fn ft fm))
(cond

```

```

((null filename)
 (|sayKeyedMsg| 's2iv0003 (list fn ft fm)))
((setq teststream (make-outstream filename 255 0))
 (shut |$openMathOutputStream|)
 (setq |$openMathOutputStream| teststream)
 (setq |$openMathOutputFile| (|object2String| filename))
 (|sayKeyedMsg| 's2iv0004 (list "OpenMath" |$openMathOutputFile|)))
(t
 (|sayKeyedMsg| 's2iv0003 (list fn ft fm))))))
(t
 (|sayKeyedMsg| 's2iv0005 nil)
 (|describeSetOutputOpenMath|))))))

```

46.31.35 defun describeSetOutputOpenMath

```

[|sayBrightly| p??]
[setOutputOpenMath p783]

```

— defun describeSetOutputOpenMath —

```

(defun |describeSetOutputOpenMath| ()
  (|sayBrightly| (list
    '|%b| ")set output openmath"
    '|%d| "is used to tell AXIOM to turn OpenMath output"
    '|%l| "printing on and off, and where to place the output. By default, the"
    '|%l| "destination for the output is the screen but printing is turned off."
    '|%l|
    '|%l| "Syntax:    )set output openmath <arg>"
    '|%l| "    where arg can be one of"
    '|%l| "    on      turn OpenMath printing on"
    '|%l| "    off      turn OpenMath printing off (default state)"
    '|%l| "    console   send OpenMath output to screen (default state)"
    '|%l|
    "    fp<.fe>    send OpenMath output to file with file prefix fp and file"
    '|%l| "                extension .fe. If not given, .fe defaults to .som."
    '|%l|
    '|%l| "If you wish to send the output to a file, you must issue this command"
    '|%l| "twice: once with"
    '|%b| "on"
    '|%d| "and once with the file name. For example, to send"
    '|%l| "OpenMath output to the file"
    '|%b| "polymer.som,"
    '|%d| "issue the two commands"
    '|%l|
    '|%l| "    )set output openmath on"
  ))

```

```
'|%l| " )set output openmath polymer"
'|%l|
'|%l| "The output is placed in the directory from which you invoked AXIOM or"
'|%l| "the one you set with the )cd system command."
'|%l| "The current setting is: "
'|%b| (|setOutputOpenMath| '|%display%|)
'|%d|)))
```

46.31.36 script

----- The script Option -----

Description: display output in SCRIPT formula format

)set output script is used to tell AXIOM to turn IBM Script formula-style output printing on and off, and where to place the output. By default, the destination for the output is the screen but printing is turned off.

Syntax:)set output script <arg>
 where arg can be one of
 on turn IBM Script formula printing on
 off turn IBM Script formula printing off
 (default state)
 console send IBM Script formula output to screen
 (default state)
 fp<.fe> send IBM Script formula output to file with file
 prefix fp and file extension .fe. If not given,
 .fe defaults to .sform.

If you wish to send the output to a file, you must issue this command twice: once with on and once with the file name. For example, to send IBM Script formula output to the file polymer.sform, issue the two commands

```
)set output script on
)set output script polymer
```

The output is placed in the directory from which you invoked AXIOM or the one you set with the)cd system command. The current setting is: Off:CONSOLE

46.31.37 defvar \$formulaFormat

— initvars —

```
(defvar |$formulaFormat| nil "display output in SCRIPT format")
```

—————

46.31.38 defvar \$formulaOutputFile

— initvars —

```
(defvar |$formulaOutputFile| "CONSOLE"
  "where script output goes (enter {\em console} or a a pathname)")
```

—————

— outputscript —

```
(|script|
  "display output in SCRIPT formula format"
  |interpreter|
  FUNCTION
  |setOutputFormula|
  ("display output in SCRIPT format"
   LITERALS
   |$formulaFormat|
   (|off| |on|)
   |off|)
  (|break| |$formulaFormat|)
  ("where script output goes (enter {\em console} or a a pathname)"
   FILENAME
   |$formulaOutputFile|
   |chkOutputFileName|
   "console"))
NIL)
```

—————

46.31.39 defun setOutputFormula

```
[defiostream p980]
[concat p1049]
```

```
[describeSetOutputFormula p790]
[qcdr p??]
[qcar p??]
[member p1050]
[upcase p??]
[sayKeyedMsg p329]
[shut p980]
[pathnameType p1042]
[pathnameDirectory p1043]
[pathnameName p1042]
[$filep p??]
[make-outstream p979]
[object2String p??]
[$formulaOutputStream p??]
[$formulaOutputFile p787]
[$filep p??]
[$formulaFormat p787]
```

— defun setOutputFormula —

```
(defun |setOutputFormula| (arg)
  (let (label tmp1 tmp2 ptype fn ft fm filename teststream)
    (declare (special |$formulaOutputStream| |$formulaOutputFile| $filep
      |$formulaFormat|))
    (cond
      ((eq arg '|%initialize%|)
        (setq |$formulaOutputStream|
          (defiostream '((mode . output) (device . console)) 255 0))
        (setq |$formulaOutputFile| "CONSOLE")
        (setq |$formulaFormat| nil))
      ((eq arg '|%display%|)
        (if |$formulaFormat|
          (setq label "On:")
          (setq label "Off:"))
        (concat label |$formulaOutputFile|))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
        (|describeSetOutputFormula|))
      (t
        (cond
          ((and (consp arg)
            (eq (qcdr arg) nil)
            (progn (setq fn (qcar arg)) t)
            (|member| fn '(y n ye yes no o on of off console
              |y| |n| |ye| |yes| |no| |o| |on| |of| |off| |console|))))
            '|ok|)
          (t (setq arg (list fn '|sform|))))
        (cond
          ((and (consp arg)
```



```

      (eq (qcdr arg) nil)
      (progn (setq fn (qcar arg)) t))
(cond
  ((|member| (upcase fn) '(y n ye o of))
   (|sayKeyedMsg| 's2iv0002 '(|script| |script|)))
  ((|member| (upcase fn) '(no off)) (setq |$formulaFormat| nil))
  ((|member| (upcase fn) '(yes on)) (setq |$formulaFormat| t))
  ((eq (upcase fn) 'console)
   (SHUT |$formulaOutputStream|)
   (setq |$formulaOutputStream|
        (defiostream '((mode . output) (device . console)) 255 0))
   (setq |$formulaOutputFile| "CONSOLE"))))
(or
  (and (consp arg)
       (progn (setq fn (qcar arg))
              (setq tmp1 (qcdr arg))
              (and (consp tmp1)
                   (eq (qcdr tmp1) nil)
                   (progn (setq ft (qcar tmp1)) t))))
  (and (consp arg)
       (progn (setq fn (qcar arg))
              (setq tmp1 (qcdr arg))
              (and (consp tmp1)
                   (progn (setq ft (qcar tmp1))
                          (setq tmp2 (qcdr tmp1))
                          (and (consp tmp2)
                               (eq (qcdr tmp2) nil)
                               (progn
                                (setq fm (qcar tmp2)) t)))))))
  (if (setq ptype (|pathnameType| fn))
      (setq fn (concat (|pathnameDirectory| fn) (|pathnameName| fn)))
      (setq ft ptype))
  (unless fm (setq fm 'a))
  (setq filename ($filep fn ft fm))
  (cond
    ((null filename) (|sayKeyedMsg| 's2iv0003 (list fn ft fm)))
    ((setq teststream (make-outstream filename 255 0))
     (shut |$formulaOutputStream|)
     (setq |$formulaOutputStream| teststream)
     (setq |$formulaOutputFile| (|object2String| filename))
     (|sayKeyedMsg| 's2iv0004
                    (list "IBM Script formula" |$formulaOutputFile| )))
    (t
     (|sayKeyedMsg| 's2iv0003 (list fn ft fm)))))
(t
  (|sayKeyedMsg| 's2iv0005 nil)
  (|describeSetOutputFormula|))))))

```

46.31.40 defun describeSetOutputFormula

```
[sayBrightly p??]
[setOutputFormula p787]
```

— defun describeSetOutputFormula —

```
(defun |describeSetOutputFormula| ()
  (|sayBrightly| (list
    '|%b| " )set output script"
    '|%d| "is used to tell AXIOM to turn IBM Script formula-style"
    '|%l|
    "output printing on and off, and where to place the output. By default, the"
    '|%l| "destination for the output is the screen but printing is turned off."
    '|%l|
    '|%l| "Syntax: )set output script <arg>"
    '|%l| " where arg can be one of"
    '|%l| " on turn IBM Script formula printing on"
    '|%l| " off turn IBM Script formula printing off (default state)"
    '|%l| " console send IBM Script formula output to screen (default state)"
    '|%l|
    " fp<.fe> send IBM Script formula output to file with file prefix fp"
    '|%l|
    " and file extension .fe. If not given, .fe defaults to .sform."
    '|%l|
    '|%l| "If you wish to send the output to a file, you must issue this command"
    '|%l| "twice: once with"
    '|%b| "on"
    '|%d| "and once with the file name. For example, to send"
    '|%l| "IBM Script formula output to the file"
    '|%b| "polymer.sform,"
    '|%d| "issue the two commands"
    '|%l|
    '|%l| " )set output script on"
    '|%l| " )set output script polymer"
    '|%l|
    '|%l| "The output is placed in the directory from which you invoked AXIOM or"
    '|%l| "the one you set with the )cd system command."
    '|%l| "The current setting is: "
    '|%b| (|setOutputFormula| '|%display%|)
    '|%d|)))
```

46.31.41 scripts

----- The scripts Option -----

Description: show subscripts,... linearly

The scripts option may be followed by any one of the following:

```
yes
no
```

The current setting is indicated.

46.31.42 defvar \$linearFormatScripts

— initvars —

```
(defvar |$linearFormatScripts| nil "show subscripts,... linearly")
```

— outputscripts —

```
(|scripts|
 "show subscripts,... linearly"
 |interpreter|
 LITERALS
 |$linearFormatScripts|
 (|on| |off|)
 |off|)
```

46.31.43 showeditor

----- The showeditor Option -----

Description: view output of)show in editor

The showeditor option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

46.31.44 defvar \$useEditorForShowOutput

— initvars —

```
(defvar |$useEditorForShowOutput| nil "view output of )show in editor")
```

— outputshoweditor —

```
(|showeditor|
 "view output of )show in editor"
 |interpreter|
 LITERALS
 |$useEditorForShowOutput|
 (|on| |off|)
 |off|)
```

46.31.45 tex

----- The tex Option -----

Description: create output in TeX style

)set output tex is used to tell AXIOM to turn TeX-style output printing on and off, and where to place the output. By default, the destination for the output is the screen but printing is turned off.

Syntax:)set output tex <arg>

where arg can be one of

on	turn TeX printing on
off	turn TeX printing off (default state)
console	send TeX output to screen (default state)
fp<.fe>	send TeX output to file with file prefix fp and file extension .fe. If not given, .fe defaults to .stex.

If you wish to send the output to a file, you must issue this command twice: once with on and once with the file name. For example, to send TeX output to the file polymer.stex, issue the two commands

```
)set output tex on
)set output tex polymer
```

The output is placed in the directory from which you invoked AXIOM or the one you set with the `)cd` system command.
The current setting is: Off:CONSOLE

46.31.46 defvar \$texFormat

— initvars —

```
(defvar |$texFormat| nil "create output in TeX format")
```

—————

46.31.47 defvar \$texOutputFile

— initvars —

```
(defvar |$texOutputFile| "CONSOLE"
  "where TeX output goes (enter {\em console} or a pathname)")
```

—————

— outputtex —

```
(|tex|
  "create output in TeX style"
  |interpreter|
  FUNCTION
  |setOutputTex|
  (("create output in TeX format"
    LITERALS
    |$texFormat|
    (|off| |on|)
    |off|)
  (|break| |$texFormat|)
  ("where TeX output goes (enter {\em console} or a pathname)"
  FILENAME
  |$texOutputFile|
  |chkOutputFileName|
  "console"))
NIL)
```

46.31.48 defun setOutputTex

[defiostream p980]
 [concat p1049]
 [describeSetOutputTex p796]
 [qcdr p??]
 [qcar p??]
 [member p1050]
 [upcase p??]
 [sayKeyedMsg p329]
 [shut p980]
 [pathnameType p1042]
 [pathnameDirectory p1043]
 [pathnameName p1042]
 [\$filep p??]
 [make-outstream p979]
 [object2String p??]
 [\$texOutputStream p??]
 [\$texOutputFile p793]
 [\$texFormat p793]
 [\$filep p??]

— defun setOutputTex —

```
(defun |setOutputTex| (arg)
  (let (label tmp1 tmp2 ptype fn ft fm filename teststream)
    (declare (special |$texOutputStream| |$texOutputFile| |$texFormat| $filep))
    (cond
      ((eq arg '|%initialize%|)
       (setq |$texOutputStream|
             (defiostream '((mode . output) (device . console)) 255 0))
       (setq |$texOutputFile| "CONSOLE")
       (setq |$texFormat| nil))
      ((eq arg '|%display%|)
       (if |$texFormat|
          (setq label "On:")
          (setq label "Off:"))
       (concat label |$texOutputFile|))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
       (|describeSetOutputTex|))
      (t
       (cond
         ((and (consp arg)
                (eq (qcdr arg) nil)
                (progn (setq fn (qcar arg)) t))
```

```

(|member| fn '(y n ye yes no o on of off console
  |y| |n| |ye| |yes| |no| |o| |on| |of| |off| |console|)))
' |ok|)
(t (setq arg (list fn '|stex| nil))))
(cond
  ((and (consp arg)
        (eq (qcdr arg) nil)
        (progn (setq fn (qcar arg)) t))
   (cond
    ((|member| (upcase fn) '(y n ye o of))
     (|sayKeyedMsg| 's2iv0002 '(|TeX| |tex|)))
    ((|member| (upcase fn) '(no off)) (setq |$texFormat| nil))
    ((|member| (upcase fn) '(yes on)) (setq |$texFormat| t))
    ((eq (upcase fn) 'console)
     (shut |$texOutputStream|)
     (setq |$texOutputStream|
           (defiostream '((mode . output) (device . console)) 255 0))
     (setq |$texOutputFile| "CONSOLE"))))
   ((or
    (and (consp arg)
         (progn (setq fn (qcar arg))
                 (setq tmp1 (qcdr arg))
                 (and (consp tmp1)
                      (eq (qcdr tmp1) nil)
                      (progn (setq ft (qcar tmp1)) t))))
    (and (consp arg)
         (progn (setq fn (qcar arg))
                 (setq tmp1 (qcdr arg))
                 (and (consp tmp1)
                      (progn (setq ft (qcar tmp1))
                              (setq tmp2 (qcdr tmp1))
                              (and (consp tmp2)
                                   (eq (qcdr tmp2) nil)
                                   (progn (setq fm (qcar tmp2)) t)))))))
    (when (setq ptype (|pathnameType| fn))
      (setq fn (concat (|pathnameDirectory| fn) (|pathnameName| fn)))
      (setq ft ptype))
    (unless fm (setq fm 'A))
    (setq filename ($filep fn ft fm))
    (cond
     ((null filename) (|sayKeyedMsg| 's2iv0003 (list fn ft fm)))
     ((setq teststream (make-outstream filename 255 0))
      (shut |$texOutputStream|)
      (setq |$texOutputStream| teststream)
      (setq |$texOutputFile| (|object2String| filename))
      (|sayKeyedMsg| 's2iv0004 (list "TeX" |$texOutputFile|)))
     (t (|sayKeyedMsg| 'S2IV0003 (list fn ft fm)))))
   (t
    (|sayKeyedMsg| 's2iv0005 nil)
    (|describeSetOutputTex|))))))

```

46.31.49 defun describeSetOutputTex

[sayBrightly p??]
 [setOutputTex p794]

— defun describeSetOutputTex —

```
(defun |describeSetOutputTex| ()
  (|sayBrightly| (list
    '|%b| " )set output tex"
    '|%d| "is used to tell AXIOM to turn TeX-style output"
    '|%l| "printing on and off, and where to place the output. By default, the"
    '|%l| "destination for the output is the screen but printing is turned off."
    '|%l|
    '|%l| "Syntax: )set output tex <arg>"
    '|%l| " where arg can be one of"
    '|%l| " on turn TeX printing on"
    '|%l| " off turn TeX printing off (default state)"
    '|%l| " console send TeX output to screen (default state)"
    '|%l| " fp<.fe> send TeX output to file with file prefix fp and file"
    '|%l| " extension .fe. If not given, .fe defaults to .stex."
    '|%l|
    '|%l| "If you wish to send the output to a file, you must issue this command"
    '|%l| "twice: once with"
    '|%b| "on"
    '|%d| "and once with the file name. For example, to send"
    '|%l| "TeX output to the file"
    '|%b| "polymer.stex,"
    '|%d| "issue the two commands"
    '|%l|
    '|%l| " )set output tex on"
    '|%l| " )set output tex polymer"
    '|%l|
    '|%l| "The output is placed in the directory from which you invoked AXIOM or"
    '|%l| "the one you set with the )cd system command."
    '|%l| "The current setting is: "
    '|%b| (|setOutputTex| '|%display%|)
    '|%d|)))
```

46.32 quit

----- The quit Option -----

Description: protected or unprotected quit

The quit option may be followed by any one of the following:

```
protected
-> unprotected
```

The current setting is indicated.

46.32.1 defvar \$quitCommandType

— initvars —

```
(defvar |$quitCommandType| '|protected| "protected or unprotected quit")
```

— quit —

```
(|quit|
 "protected or unprotected quit"
 |interpreter|
 LITERALS
 |$quitCommandType|
 (|protected| |unprotected|)
 |protected|)
```

46.33 streams

Current Values of streams Variables

Variable	Description	Current Value
calculate	specify number of elements to calculate	10
showall	display all stream elements computed	off

— streams —

```
(|streams|
  "set some options for working with streams"
  |interpreter|
  TREE
  |novar|
  (
    \getchunk{streamscalculat}
    \getchunk{streamsshowall}
  ))
```

—

46.33.1 calculate

----- The calculate Option -----

Description: specify number of elements to calculate

)set streams calculate is used to tell AXIOM how many elements of a stream to calculate when a computation uses the stream. The value given after calculate must either be the word all or a positive integer.

The current setting is 10 .

46.33.2 defvar \$streamCount

— initvars —

```
(defvar |$streamCount| 10
  "number of initial stream elements you want calculated")
```

—

— streamscalculat —

```
(|calculat|
  "specify number of elements to calculate"
  |interpreter|
  FUNCTION
  |setStreamsCalculate|
```

```

(("number of initial stream elements you want calculated"
  INTEGER
  |$streamCount|
  (0 NIL)
  10))
NIL)

```

46.33.3 defun setStreamsCalculate

```

[object2String p??]
[describeSetStreamsCalculate p799]
[sayMessage p??]
[bright p??]
[terminateSystemCommand p450]
[$streamCount p798]

```

— defun setStreamsCalculate —

```

(defun |setStreamsCalculate| (arg)
  (let (n)
    (declare (special |$streamCount|))
    (cond
      ((eq arg '|%initialize%|) (setq |$streamCount| 10))
      ((eq arg '|%display%|) (|object2String| |$streamCount|))
      ((or (null arg) (eq arg '|%describe%|) (eq (car arg) '?))
       (|describeSetStreamsCalculate|))
      (t
       (setq n (car arg))
       (cond
         ((and (not (eq n '|all|)) (or (null (integerp n)) (minusp n)))
          (|sayMessage|
           '("Your value of" ,@(|bright| n) "is invalid because ..."))
          (|describeSetStreamsCalculate|)
          (|terminateSystemCommand|))
         (t (setq |$streamCount| n)))))))

```

46.33.4 defun describeSetStreamsCalculate

```

[sayKeyedMsg p329]
[$streamCount p798]

```

— defun describeSetStreamsCalculate —

```
(defun |describeSetStreamsCalculate| ()
  (declare (special |$streamCount|))
  (|sayKeyedMsg| 's2iv0001 (list |$streamCount|)))
```

—————

46.33.5 showall

----- The showall Option -----

Description: display all stream elements computed

The showall option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

46.33.6 defvar \$streamsShowAll

— initvars —

```
(defvar |$streamsShowAll| nil "display all stream elements computed")
```

—————

— streamsshowall —

```
(|showall|
 "display all stream elements computed"
 |interpreter|
 LITERALS
 |$streamsShowAll|
 (|on| |off|)
 |off|)
```

—————

46.34 system

Current Values of system Variables

Variable	Description	Current Value

functioncode	show gen. LISP for functions when compiled	off
optimization	show optimized LISP code	off
prettyprint	prettyprint BOOT func's as they compile	off

— system —

```
(|system|
 "set some system development variables"
 |development|
 TREE
 |novar|
 (
 \getchunk{systemfunctioncode}
 \getchunk{systemoptimization}
 \getchunk{systemprettyprint}
 ))
```

—————

46.34.1 functioncode

----- The functioncode Option -----

Description: show gen. LISP for functions when compiled

The functioncode option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

46.34.2 defvar \$reportCompilation

— initvars —

```
(defvar |$reportCompilation| nil "show gen. LISP for functions when compiled")
```

— systemfunctioncode —

```
(|functioncode|
 "show gen. LISP for functions when compiled"
 |development|
 LITERALS
 |$reportCompilation|
 (|on| |off|)
 |off|)
```

46.34.3 optimization

----- The optimization Option -----

Description: show optimized LISP code

The optimization option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

46.34.4 defvar \$reportOptimization

— initvars —

```
(defvar |$reportOptimization| nil "show optimized LISP code")
```

— systemoptimization —

```
(|optimization|
```

```
"show optimized LISP code"
|development|
LITERALS
|$reportOptimization|
(|on| |off|)
|off|)
```

46.34.5 prettyprint

----- The prettyprint Option -----

Description: prettyprint BOOT func's as they compile

The prettyprint option may be followed by any one of the following:

```
on
-> off
```

The current setting is indicated.

46.34.6 defvar \$prettyprint

— initvars —

```
(defvar $prettyprint t "prettyprint BOOT func's as they compile")
```

— systemprettyprint —

```
(|prettyprint|
"prettyprint BOOT func's as they compile"
|development|
LITERALS
$prettyprint
(|on| |off|)
|on|)
```

46.35 userlevel

----- The userlevel Option -----

Description: operation access level of system user

The userlevel option may be followed by any one of the following:

```

    interpreter
    compiler
-> development

```

The current setting is indicated.

46.35.1 defvar \$UserLevel

— initvars —

```
(defvar |$UserLevel| '|development| "operation access level of system user")
```

— userlevel —

```

(|userlevel|
 "operation access level of system user"
 |interpreter|
 LITERALS
 |$UserLevel|
 (|interpreter| |compiler| |development|)
 |development|)

```

— initvars —

```

(defvar |$setOptions| '(
 \getchunk{breakmode}
 \getchunk{compile}
 \getchunk{debug}
 \getchunk{expose}
 \getchunk{functions}

```



```

\getchunk{fortran}
\getchunk{kernel}
\getchunk{hyperdoc}
\getchunk{help}
\getchunk{history}
\getchunk{messages}
\getchunk{naglink}
\getchunk{output}
\getchunk{quit}
\getchunk{streams}
\getchunk{system}
\getchunk{userlevel}
))

```

46.35.2 defvar \$setOptionNames

— initvars —

```
(defvar |$setOptionNames| (mapcar #'car |$setOptions|))
```

— postvars —

```
(eval-when (eval load)
  (|initializeSetVariables| |$setOptions|))
```

46.36 Set code

46.36.1 defun set

```

[set1 p806]
[$setOptions p??]

```

— defun set —

```
(defun |set| (l)
```

```
(declare (special |$setOptions|))
(|set1| 1 |$setOptions|))
```

46.36.2 defun set1

This function will be called with the top level arguments to)set. For instance, given the command

```
)set break break
```

this function gets

```
(set1 (|break| |break|) ....)
```

and given the command

```
)set mes auto off
```

this function gets

```
(set1 (|mes| |auto| |off|) ....)
```

which, because “message” is a TREE, generates the recursive call:

```
(set1 (|auto| |off|) <the message subtree>)
```

The “autoload” subtree is a FUNCTION (printLoadMessages), which gets called with %describe% [displaySetVariableSettings p655]

```
[seq p??]
[exit p??]
[selectOption p477]
[downcase p??]
[lassoc p??]
[satisfiesUserLevel p449]
[sayKeyedMsg p329]
[poundsign p??]
[displaySetOptionInformation p653]
[kdr p??]
[sayMSG p331]
[sayMessage p??]
[bright p??]
[object2String p??]
[translateYesNo2TrueFalse p656]
```

```
[use-fast-links p??]
[literals p??]
[tree p??]
[set1 p806]
[$setOptionNames p805]
[$UserLevel p804]
[$displaySetValue p745]
```

— defun set1 —

```
(defun |set1| (l settree)
  (let (|$setOptionNames| arg setdata st setfunarg num upperlimit arg2)
    (declare (special |$setOptionNames| |$UserLevel| |$displaySetValue|))
    (cond
      ((null l) (|displaySetVariableSettings| settree '||))
      (t
       (setq |$setOptionNames|
              (do ((t1 settree (cdr t1)) t0 (x nil))
                  ((or (atom t1) (progn (setq x (car t1)) nil)) (nreverse0 t0))
              (seq
               (exit
                (setq t0 (cons (elt x 0) t0))))))
       (setq arg
              (|selectOption| (downcase (car l)) |$setOptionNames| '|optionError|))
       (setq setdata (cons arg (lassoc arg settree)))
       (cond
          ((null (|satisfiesUserLevel| (third setdata)))
           (|sayKeyedMsg| 's2iz0007 (list |$UserLevel| "set option" nil)))
          ((eql 1 (|#| l)) (|displaySetOptionInformation| arg setdata))
          (t
           (setq st (fourth setdata))
           (case (fourth setdata)
             (function
              (setq setfunarg
                     (if (eq (elt l 1) 'default)
                         '|%initialize%|
                         (kdr l)))
              (if (functionp (fifth setdata))
                  (funcall (fifth setdata) setfunarg)
                  (|sayMSG| (concatenate 'string "    Function not implemented. "
                                           (string (fifth setdata)))))
              (when |$displaySetValue|
                (|displaySetOptionInformation| arg setdata))
              NIL)
             (string
              (setq arg2 (elt l 1))
              (cond
                ((eq arg2 'default) (set (fifth setdata) (seventh setdata)))
                (arg2 (set (fifth setdata) arg2)))
```

```

(t nil))
(when (or |$displaySetValue| (null arg2))
  (|displaySetOptionInformation| arg setdata))
NIL)
(integer
(setq arg2
(progn
  (setq num (elt 1 1))
  (cond
    ((and (integerp num)
      (>= num (elt (sixth setdata) 0))
      (or (null (setq upperlimit (elt (sixth setdata) 1)))
        (<= num upperlimit)))
      num)
    (t
      (|selectOption|
        (elt 1 1)
        (cons '|default| (sixth setdata)) nil))))))
(cond
  ((eq arg2 'default) (set (fifth setdata) (seventh setdata)))
  (arg2 (set (fifth setdata) arg2))
  (t nil))
(cond
  ((or |$displaySetValue| (null arg2))
    (|displaySetOptionInformation| arg setdata)))
(cond
  ((null arg2)
    (|sayMessage|
      (" Your value" ,@(|bright| (|object2String| (elt 1 1)))
        "is not among the valid choices.")))
  (t nil)))
(literals
(cond
  ((setq arg2
    (|selectOption| (elt 1 1)
      (cons '|default| (sixth setdata)) nil))
    (cond
      ((eq arg2 'default)
        (set (fifth setdata)
          (|translateYesNo2TrueFalse| (seventh setdata))))
      (t
        (cond ((eq arg2 '|nobreak|)
          #+:GCL (si::use-fast-links t)))
          (cond
            ((eq arg2 '|fastlinks|)
              #+:GCL (si::use-fast-links nil)
              (setq arg2 '|break|)))
            (set (fifth setdata) (|translateYesNo2TrueFalse| arg2))))))
  (when (or |$displaySetValue| (null arg2))
    (|displaySetOptionInformation| arg setdata))

```

```

(cond
  ((null arg2)
   (|sayMessage|
    (cons " Your value"
          (append (|bright| (|object2String| (elt 1 1)))
                  (cons "is not among the valid choices." nil))))))
  (t nil)))
(tree (|set1| (kdr 1) (sixth setdata)) nil)
(t
 (|sayMessage|
  ("Cannot handle set tree node type" ,@( |bright| st) |yet|))
 nil))))))

```

Chapter 47

)show help page Command

47.1 show help page man page

— show.help —

```
=====
A.22. )show
=====
```

User Level Required: interpreter

Command Syntax:

-)show nameOrAbbrev
-)show nameOrAbbrev)operations
-)show nameOrAbbrev)attributes

Command Description:

This command displays information about AXIOM domain, package and category constructors. If no options are given, the)operations option is assumed. For example,

```
)show POLY
)show POLY )operations
)show Polynomial
)show Polynomial )operations
```

each display basic information about the Polynomial domain constructor and then provide a listing of operations. Since Polynomial requires a Ring (for example, Integer) as argument, the above commands all refer to a unspecified ring R. In the list of operations, \$ means Polynomial(R).

The basic information displayed includes the signature of the constructor (the name and arguments), the constructor abbreviation, the exposure status of the constructor, and the name of the library source file for the constructor.

If operation information about a specific domain is wanted, the full or abbreviated domain name may be used. For example,

```
)show POLY INT
)show POLY INT )operations
)show Polynomial Integer
)show Polynomial Integer )operations
```

are among the combinations that will display the operations exported by the domain Polynomial(Integer) (as opposed to the general domain constructor Polynomial). Attributes may be listed by using the)attributes option.

Also See:

- o)display
- o)set
- o)what

1

47.1.1 defun The)show command

[showSpad2Cmd p812]

— defun show —

```
(defun |show| (arg) (|showSpad2Cmd| arg))
```

47.1.2 defun The internal)show command

```
[member p1050]
[helpSpad2Cmd p570]
[sayKeyedMsg p329]
[qcar p??]
[reportOperations p813]
[$showOptions p??]
```

¹ “display” (30.2.1 p 533) “set” (46.36.1 p 805) “what” (55.1.2 p 937)


```
[Se p??]
[Env p??]
[$InteractiveFrame p??]
[$options p??]
```

— defun showSpad2Cmd —

```
(defun |showSpad2Cmd| (arg)
  (let (|$showOptions| |$e| |$env| constr)
    (declare (special |$showOptions| |$e| |$env| |$InteractiveFrame| |$options|))
    (if (equal arg (list nil))
      (|helpSpad2Cmd| '(|show|))
      (progn
        (setq |$showOptions| '(|attributes| |operations|))
        (unless |$options| (setq |$options| '(|operations|)))
        (setq |$e| |$InteractiveFrame|)
        (setq |$env| |$InteractiveFrame|)
        (cond
          ((and (consp arg) (eq (qcdr arg) nil) (progn (setq constr (qcar arg)) t))
            (cond
              ((|member| constr '(|Union| |Record| |Mapping|))
                (cond
                  ((eq constr '|Record|)
                    (|sayKeyedMsg| 'S2IZ0044R
                      (list constr ")show Record(a: Integer, b: String)" )))
                  ((eq constr '|Mapping|) (|sayKeyedMsg| 'S2IZ0044M nil))
                  (t
                    (|sayKeyedMsg| 'S2IZ0045T
                      (list constr ")show Union(a: Integer, b: String)" )))
                    (|sayKeyedMsg| 'S2IZ0045U
                      (list constr ")show Union(Integer, String)" ))))
              ((and (consp constr) (eq (qcar constr) '|Mapping|)
                (|sayKeyedMsg| 'S2IZ0044M nil))
                (t (|reportOperations| constr constr))))
              (t (|reportOperations| arg arg))))))
```

—————

47.1.3 defun reportOperations

```
[sayBrightly p??]
[bright p??]
[sayKeyedMsg p329]
[qcar p??]
[isNameOfType p??]
[isDomainValuedVariable p957]
[reportOpsFromUnitDirectly0 p819]
```

```

[opOf p??]
[unabbrev p??]
[reportOpsFromLisplib0 p815]
[evaluateType p914]
[mkAtree p??]
[removeZeroOneDestructively p??]
[isType p??]
[$env p??]
[$eval p??]
[$genValue p53]
[$quadSymbol p??]
[$doNotAddEmptyModeIfTrue p??]

```

— defun reportOperations —

```

(defun |reportOperations| (oldArg u)
  (let (|$env| |$eval| |$genValue| |$doNotAddEmptyModeIfTrue|
        tmp1 v unitForm tree unitFormp)
    (declare (special |$env| |$eval| |$genValue| |$quadSymbol|
                      |$doNotAddEmptyModeIfTrue|))
    (setq |$env| (list (list nil)))
    (setq |$eval| t)
    (setq |$genValue| t)
    (when u
      (setq |$doNotAddEmptyModeIfTrue| t)
      (cond
        ((equal u |$quadSymbol|)
         (|sayBrightly|
          (cons " mode denotes" (append (|bright| "any") (list '|type|)))))
        ((eq u '|%)
         (|sayKeyedMsg| 'S2IZ0063 nil)
         (|sayKeyedMsg| 'S2IZ0064 nil))
        ((and (null (and (consp u) (eq (qcar u) '|Record|)))
              (null (and (consp u) (eq (qcar u) '|Union|)))
              (null (|isNameOfType| u))
              (null (and (consp u)
                        (eq (qcar u) '|typeOf|)
                        (progn
                          (setq tmp1 (qcdr u))
                          (and (consp tmp1) (eq (qcdr tmp1) nil))))))
         (when (atom oldArg) (setq oldArg (list oldArg)))
         (|sayKeyedMsg| 'S2IZ0063 nil)
         (dolist (op oldArg)
           (|sayKeyedMsg| 'S2IZ0062 (list (|opOf| op)))))
        ((setq v (|isDomainValuedVariable| u)) (|reportOpsFromUnitDirectly0| v))
        (t
         (if (atom u)
              (setq unitForm (|opOf| (|unabbrev| u)))
              (setq unitForm (|unabbrev| u))))

```

```
(if (atom unitForm)
  (|reportOpsFromLisplib0| unitForm u)
  (progn
    (setq unitFormp (|evaluateType| unitForm))
    (setq tree (|mkAtree| (|removeZeroOneDestructively| unitForm)))
    (if (setq unitFormp (|isType| tree))
      (|reportOpsFromUnitDirectly0| unitFormp)
      (|sayKeyedMsg| 'S2IZ0041 (list unitForm))))))
```

47.1.4 defun reportOpsFromLisplib0

```
[reportOpsFromLisplib1 p815]
[reportOpsFromLisplib p816]
[$useEditorForShowOutput p792]
```

— defun reportOpsFromLisplib0 —

```
(defun |reportOpsFromLisplib0| (unitForm u)
  (declare (special |$useEditorForShowOutput|))
  (if |$useEditorForShowOutput|
    (|reportOpsFromLisplib1| unitForm u)
    (|reportOpsFromLisplib| unitForm u)))
```

47.1.5 defun reportOpsFromLisplib1

```
[pathname p1044]
[erase p??]
[defiostream p980]
[sayShowWarning p824]
[reportOpsFromLisplib p816]
[shut p980]
[editFile p543]
[$sayBrightlyStream p??]
[$erase p??]
```

— defun reportOpsFromLisplib1 —

```
(defun |reportOpsFromLisplib1| (unitForm u)
  (let (|$sayBrightlyStream| showFile)
    (declare (special |$sayBrightlyStream| $erase)))
```

```
(setq showFile (|pathname| (list 'show 'listing 'a)))
($erase showFile)
(setq |$sayBrightlyStream|
  (defiostream '((file ,showFile) (mode . output)) 255 0))
(|sayShowWarning|)
(|reportOpsFromLisplib| unitForm u)
(shut |$sayBrightlyStream|)
(|editFile| showFile)))
```

47.1.6 defun reportOpsFromLisplib

```
[constructor? p??]
[sayKeyedMsg p329]
[getConstructorSignature p??]
[kdr p??]
[getdatabase p1009]
[eqsubstlist p??]
[nreverse0 p??]
[sayBrightly p??]
[concat p1049]
[bright p??]
[form2StringWithWhere p??]
[isExposedConstructor p818]
[strconc p??]
[namestring p1042]
[selectOptionLC p477]
[dc1 p??]
[centerAndHighlight p??]
[specialChar p978]
[remdup p??]
[msort p??]
[form2String p??]
[say2PerLine p??]
[formatAttribute p??]
[displayOperationsFromLisplib p818]
[$linelength p771]
[$showOptions p??]
[$options p??]
[$FormalMapVariableList p??]
```

— defun reportOpsFromLisplib —

```
(defun |reportOpsFromLisplib| (op u)
```

```

(let (fn s typ nArgs argList functorForm argml tmp1 functorFormWithDecl
      verb sourceFile opt attList)
  (declare (special $linelength |$showOptions| |$options|
                  |$FormalMapVariableList|))
  (if (null (setq fn (|constructor?| op)))
      (|sayKeyedMsg| 'S2IZ0054 (list u))
      (progn
        (setq argml (when (setq s (|getConstructorSignature| op)) (kdr s)))
        (setq typ (getdatabase op 'constructorkind))
        (setq nArgs (|#| argml))
        (setq argList (kdr (getdatabase op 'constructorform)))
        (setq functorForm (cons op argList))
        (setq argml (eqsubstlist argList |$FormalMapVariableList| argml))
        (mapcar #'(lambda (a m) (push (list '[:| a m) tmp1)) argList argml)
        (setq functorFormWithDecl (cons op (nreverse0 tmp1)))
        (|sayBrightly|
         (|concat| (|bright| (|form2StringWithWhere| functorFormWithDecl))
                   " is a" (|bright| typ) "constructor"))
        (|sayBrightly|
         (cons " Abbreviation for"
              (append (|bright| op) (cons "is" (|bright| fn))))))
      (if (|isExposedConstructor| op)
          (setq verb "is")
          (setq verb "is not"))
      (|sayBrightly|
       (cons " This constructor"
            (append (|bright| verb) (list "exposed in this frame."))))
      (setq sourceFile (getdatabase op 'sourcefile))
      (|sayBrightly|
       (cons " Issue"
            (append (|bright| (strconc ")edit " (|namestring| sourceFile))
                    (cons "to see algebra source code for"
                          (append (|bright| fn) (list '|%l|))))))
      (dolist (item |$options|)
        (setq opt (|selectOptionLC| (car item) |$showOptions| '|optionError|))
        (cond
         ((eq opt '|layout|) (|dc1| fn))
         ((eq opt '|views|)
          (|sayBrightly|
           (cons "To get" (append (|bright| "views")
                                   (list "you must give parameters of constructor")))))
         ((eq opt '|attributes|)
          (|centerAndHighlight| "Attributes" $linelength (|specialChar| '|hbar|))
          (|sayBrightly| ""))
         (setq attList
          (remdup
           (msort
            (mapcar #'(lambda (x) (caar x))
                     (reverse (getdatabase op 'attributes))))))
          (if (null attList)

```

```
(|sayBrightly|
  (|concat| '|%b| (|form2String| functorForm)
            '|%d| '|has no attributes.| '|%l|))
  (|say2PerLine| (mapcar #'|formatAttribute| attList))))
((eq opt '|operations|)
  (|displayOperationsFromLisplib| functorForm))))))
```

47.1.7 defun isExposedConstructor

```
[getalist p??]
[$localExposureData p694]
[$globalExposureGroupAlist p668]
```

— defun isExposedConstructor —

```
(defun |isExposedConstructor| (name)
  (let (x found)
    (declare (special |$globalExposureGroupAlist| |$localExposureData|))
    (cond
      ((member name '(|Union| |Record| |Mapping|)) t)
      ((member name (elt |$localExposureData| 2)) nil)
      ((member name (elt |$localExposureData| 1)) t)
      (t
       (loop for g in (elt |$localExposureData| 0)
              when (not found)
              do
                (setq x (getalist |$globalExposureGroupAlist| g))
                (when (and x (getalist x name)) (setq found t)))
       found))))
```

47.1.8 defun displayOperationsFromLisplib

```
[getdatabase p1009]
[centerAndHighlight p??]
[specialChar p978]
[reportOpsFromUnitDirectly p819]
[remdup p??]
[msort p??]
[eqsubstlist p??]
[formatOperationAlistEntry p??]
```

```
[say2PerLine p??]
[$FormalMapVariableList p??]
[$linelength p771]
```

— defun displayOperationsFromLisplib —

```
(defun |displayOperationsFromLisplib| (form)
  (let (name argl kind opList opl ops)
    (declare (special |$FormalMapVariableList| $linelength))
    (setq name (car form))
    (setq argl (cdr form))
    (setq kind (getdatabase name 'constructorkind))
    (|centerAndHighlight| "Operations" $linelength (|specialChar| '|hbar|))
    (setq opList (getdatabase name 'operationalist))
    (if (null opList)
        (|reportOpsFromUnitDirectly| form)
        (progn
          (setq opl
            (remdup (msort (eqsubstlist argl |$FormalMapVariableList| opList)))))
          (setq ops nil)
          (dolist (x opl)
            (setq ops (append ops (|formatOperationAlistEntry| x))))
          (|say2PerLine| ops)))))
```

47.1.9 defun reportOpsFromUnitDirectly0

```
[reportOpsFromUnitDirectly1 p823]
[reportOpsFromUnitDirectly p819]
[$useEditorForShowOutput p792]
```

— defun reportOpsFromUnitDirectly0 —

```
(defun |reportOpsFromUnitDirectly0| (D)
  (declare (special |$useEditorForShowOutput|))
  (if |$useEditorForShowOutput|
      (|reportOpsFromUnitDirectly1| D)
      (|reportOpsFromUnitDirectly| D)))
```

47.1.10 defun reportOpsFromUnitDirectly

```
[member p1050]
[qcar p??]
```

```

[evalDomain p911]
[getdatabase p1009]
[sayBrightly p??]
[concat p1049]
[formatOpType p??]
[isExposedConstructor p818]
[bright p??]
[sayBrightly p??]
[strconc p??]
[namestring p1042]
[selectOptionLC p477]
[centerAndHighlight p??]
[specialChar p978]
[remdup p??]
[msort p??]
[formatAttribute p??]
[centerAndHighlight p??]
[getl p??]
[systemErrorHere p??]
[nreverse0 p??]
[getOplistForConstructorForm p822]
[say2PerLine p??]
[formatOperation p??]
[$commentedOps p??]
[$CategoryFrame p??]
[$linelength p771]
[$options p??]
[$showOptions p??]

```

— defun reportOpsFromUnitDirectly —

```

(defun |reportOpsFromUnitDirectly| (unitForm)
  (let (|$commentedOps| isRecordOrUnion unit top kind abb sourceFile verb opt
        attList constructorFunction tmp1 funlist a sigList tmp2)
    (declare (special |$commentedOps| |$CategoryFrame| $linelength |$options|
                      |$showOptions|))
    (setq isRecordOrUnion
      (and (consp unitForm)
        (progn (setq a (qcar unitForm)) t)
        (|member| a '(|Record| |Union|))))
    (setq unit (|evalDomain| unitForm))
    (setq top (car unitForm))
    (setq kind (getdatabase top 'constructorkind))
    (|sayBrightly|
      (|concat| '|%b| (|formatOpType| unitForm) '|%d|
        "is a" '|%b| kind '|%d| "constructor."))
    (unless isRecordOrUnion

```



```

(setq abb (getdatabase top 'abbreviation))
(setq sourceFile (getdatabase top 'sourcefile))
(|sayBrightly|
  (cons " Abbreviation for"
    (append (|bright| top) (cons "is" (|bright| abb)))))
(if (|isExposedConstructor| top)
  (setq verb "is")
  (setq verb "is not"))
(|sayBrightly|
  (cons " This constructor"
    (append (|bright| verb) (list "exposed in this frame." ))))
(|sayBrightly|
  (cons " Issue"
    (append (|bright| (strconc ")edit " (|namestring| sourceFile))
      (cons "to see algebra source code for"
        (append (|bright| abb) (list '|%l|)))))))
(dolist (item |$options|)
  (setq opt (|selectOptionLC| (car item) |$showOptions| '|optionError|))
  (cond
    ((eq opt '|attributes|)
      (|centerAndHighlight| "Attributes" $linelength (|specialChar| '|hbar|))
      (if isRecordOrUnion
        (|sayBrightly| " Records and Unions have no attributes.")
        (progn
          (|sayBrightly| "")
          (setq attList
            (remdup
              (msort
                (mapcar #'(lambda (unit2) (car unit2)) (reverse (elt unit 2))))))
          (|say2PerLine|
            (mapcar #'|formatAttribute| attList))
          nil)))
      ((eq opt '|operations|)
        (setq |$commentedOps| 0)
        ; --new form is (<op> <signature> <slotNumber> <condition> <kind>)
        (|centerAndHighlight| "Operations" $linelength (|specialChar| '|hbar|))
        (|sayBrightly| "")
        (cond
          (isRecordOrUnion
            (setq constructorFunction (getl top '|makeFunctionList|))
            (unless constructorFunction
              (|systemErrorHere| "reportOpsFromUnitDirectly"))
            (setq tmp1
              (funcall constructorFunction '$ unitForm |$CategoryFrame|))
            (setq funlist (car tmp1))
            (setq sigList
              (remdup
                (msort
                  (dolist (fun funlist (nreverse0 tmp2))
                    (push '(((, (caar fun) ,(cadar fun)) t ,(caddar fun) 0 1)))

```

```

        tmp2))))))
      (t
       (setq sigList
        (remdup (msort (|getOplistForConstructorForm| unitForm))))))
      (|say2PerLine|
       (mapcar #'(lambda (x) (|formatOperation| x unit)) sigList))
      (unless (= |$commentedOps| 0)
       (|sayBrightly|
        (list "Functions that are not yet implemented are preceded by"
              (|bright| "--"))))
      (|sayBrightly| "")))
    (nil))

```

47.1.11 defun getOplistForConstructorForm

The new form is an op-Alist which has entries

```
(<op> . signature-Alist)
```

where signature-Alist has entries

```
(<signature> . item)
```

where item has form (|slotNumber_{*i*} |condition_{*i*} |kind_{*i*})

```
(<slotNumber> <condition> <kind>)
```

where |kind_{*i*} = ELT — CONST — Subsumed — (XLAM..) ..

```
<kind> = ELT | CONST | Subsumed | (XLAM..) ..
```

— defun getOplistForConstructorForm —

```

(defun |getOplistForConstructorForm| (form)
  (let (argl pairlis opAlist op signatureAlist result)
    (declare (special |$FormalMapVariableList|))
    (setq op (car form))
    (setq argl (cdr form))
    (setq pairlis
     (loop for fv in |$FormalMapVariableList|
           for arg in argl
           collect (cons fv arg)))
    (setq opAlist (|getOperationAlistFromLisplib| op))

```

```
(loop for item in opAlist do
  (setq op (car item))
  (setq signatureAlist (cdr item))
  (setq result
    (append result
      (|getOplistWithUniqueSignatures| op pairlis signatureAlist))))
result))
```

47.1.12 defun getOplistWithUniqueSignatures

— defun getOplistWithUniqueSignatures —

```
(defun |getOplistWithUniqueSignatures| (op pairlis signatureAlist)
  (let (sig slotNumber pred kind alist)
    (loop for item in signatureAlist
      when (not (eq (fourth item) '|Subsumed|))
      do
        (setq sig (first item))
        (setq slotNumber (second item))
        (setq pred (third item))
        (setq kind (fourth item))
        (setq alist
          (|insertAlist|
            (sublis pairlis (list op sig))
            (sublis pairlis (list pred (list kind nil slotNumber)))
            alist)))
    alist))
```

47.1.13 defun reportOpsFromUnitDirectly1

```
[pathname p1044]
[erase p??]
[defiostream p980]
[sayShowWarning p824]
[reportOpsFromUnitDirectly p819]
[shut p980]
[editFile p543]
[$sayBrightlyStream p??]
[$erase p??]
```

— defun reportOpsFromUnitDirectly1 —

```
(defun |reportOpsFromUnitDirectly1| (D)
  (let (|$sayBrightlyStream| showFile)
    (declare (special |$sayBrightlyStream| $erase))
    (setq showFile (|pathname| (list 'show 'listing 'a)))
    ($erase showFile)
    (setq |$sayBrightlyStream|
      (defiostream '((file ,showFile) (mode . output)) 255 0))
    (|sayShowWarning|)
    (|reportOpsFromUnitDirectly| D)
    (shut |$sayBrightlyStream|)
    (|editFile| showFile)))
```

47.1.14 defun sayShowWarning

[sayBrightly p??]

— defun sayShowWarning —

```
(defun |sayShowWarning| ()
  (|sayBrightly|
    "Warning: this is a temporary file and will be deleted the next")
  (|sayBrightly|
    "      time you use )show. Rename it and FILE if you wish to")
  (|sayBrightly| "      save the contents.")
  (|sayBrightly| ""))
```

Chapter 48

)spool help page Command

48.1 spool help page man page

— spool.help —

```
=====
A.23. )spool
=====
```

User Level Required: interpreter

Command Syntax:

-)spool [fileName]
-)spool

Command Description:

This command is used to save (spool) all AXIOM input and output into a file, called a spool file. You can only have one spool file active at a time. To start spool, issue this command with a filename. For example,

```
)spool integrate.out
```

To stop spooling, issue)spool with no filename.

If the filename is qualified with a directory, then the output will be placed in that directory. If no directory information is given, the spool file will be placed in the current directory. The current directory is the directory from which you started AXIOM or is the directory you specified using the)cd command.

Also See:

- o)cd

1

¹ “cd” (?? p ??)

Chapter 49

)summary help page Command

49.1 summary help page man page

— summary.help —

```
)credits      : list the people who have contributed to Axiom

)help <command> gives more information
)quit        : exit AXIOM

)abbreviation : query, set and remove abbreviations for constructors
)cd           : set working directory
)clear        : remove declarations, definitions or values
)close        : throw away an interpreter client and workspace
)compile      : invoke constructor compiler
)copyright    : show copyright and trademark information
)describe     : show database information for a category, domain, or package
)display      : display Library operations and objects in your workspace
)edit         : edit a file
)frame        : manage interpreter workspaces
)history      : manage aspects of interactive session
)library      : introduce new constructors
)lisp         : evaluate a LISP expression
)read         : execute AXIOM commands from a file
)savesystem   : save LISP image to a file
)set          : view and set system variables
)show         : show constructor information
)spool        : log input and output to a file
)synonym      : define an abbreviation for system commands
)system       : issue shell commands
)trace        : trace execution of functions
)undo         : restore workspace to earlier state
```

)what : search for various things by name

49.1.1 defun summary

[obey p??]
 [concat p1049]
 [getenvirom p31]

— defun summary —

```
(defun |summary| (l)
  (declare (ignore l))
  (obey (concat "cat " (getenvirom "AXIOM") "/doc/spadhelp/summary.help")))
```

Chapter 50

)synonym help page Command

50.1 synonym help page man page

— synonym.help —

```
=====
A.24. )synonym
=====
```

User Level Required: interpreter

Command Syntax:

-)synonym
-)synonym synonym fullCommand
-)what synonyms

Command Description:

This command is used to create short synonyms for system command expressions. For example, the following synonyms might simplify commands you often use.

```
)synonym save      history )save
)synonym restore   history )restore
)synonym mail      system mail
)synonym ls        system ls
)synonym fortran   set output fortran
```

Once defined, synonyms can be used in place of the longer command expressions. Thus

```
)fortran on
```

is the same as the longer

```
)set fortran output on
```

To list all defined synonyms, issue either of

```
)synonyms
)what synonyms
```

To list, say, all synonyms that contain the substring ‘‘ap’’, issue

```
)what synonyms ap
```

Also See:

- o `)set`
- o `)what`

1

50.1.1 `defun` The `)synonym` command

[`synonymSpad2Cmd` p830]

— `defun synonym` —

```
(defun |synonym| (&rest ignore)
  (declare (ignore ignore))
  (|synonymSpad2Cmd|))
```

50.1.2 `defun` The `)synonym` command implementation

```
[getSystemCommandLine p831]
[printSynonyms p472]
[processSynonymLine p833]
[putalist p??]
[terminateSystemCommand p450]
[$CommandSynonymAlist p476]
```

— `defun synonymSpad2Cmd` —

¹ “set” (46.36.1 p 805) “what” (55.1.2 p 937)

```
(defun |synonymSpad2Cmd| ()
  (let (line pair)
    (declare (special |$CommandSynonymAlist|))
    (setq line (|getSystemCommandLine|))
    (if (string= line "")
      (|printSynonyms| nil)
      (progn
        (setq pair (|processSynonymLine| line))
        (if |$CommandSynonymAlist|
          (putalist |$CommandSynonymAlist| (car pair) (cdr pair))
          (setq |$CommandSynonymAlist| (cons pair nil))))))
    (|terminateSystemCommand|)))
```

50.1.3 defun Return a sublist of applicable synonyms

The argument is a list of synonyms, and this returns a sublist of applicable synonyms at the current user level. [string2id-n p??]

[selectOptionLC p477]

[commandsForUserLevel p446]

[\$systemCommands p441]

[\$UserLevel p804]

— defun synonymsForUserLevel —

```
(defun |synonymsForUserLevel| (arg)
  (let (cmd nl)
    (declare (special |$systemCommands| |$UserLevel|))
    (if (eq |$UserLevel| '|development|)
      arg
      (dolist (syn (reverse arg))
        (setq cmd (string2id-n (cdr syn) 1))
        (when (|selectOptionLC| cmd (|commandsForUserLevel| |$systemCommands|) nil)
          (push syn nl))))
    nl))
```

50.1.4 defun Get the system command from the input line

[strpos p1047]

[substring p??]

[\$currentLine p??]

— defun `getSystemCommandLine` —

```
(defun |getSystemCommandLine| ()
  (let (p line)
    (declare (special |$currentLine|))
    (setq p (strpos ")" |$currentLine| 0 nil))
    (if p
      (setq line (substring |$currentLine| p nil))
      (setq line |$currentLine|))
    (string-left-trim '#\space) line)))
```

—————

50.1.5 defun Remove system keyword

```
[dropLeadingBlanks p??]
[maxindex p??]
```

— defun `processSynonymLine,removeKeyFromLine` —

```
(defun |processSynonymLine,removeKeyFromLine| (line)
  (prog (mx)
    (return
      (seq
        (setq line (|dropLeadingBlanks| line))
        (setq mx (maxindex line))
        (exit
          (do ((i 0 (1+ i)))
              ((> i mx) nil)
            (seq
              (exit
                (if (char= (elt line i) #\space)
                  (exit
                    (return
                     (do ((j (1+ i) (1+ j)))
                         ((> j mx) nil)
                       (seq
                        (exit
                          (if (char\= (elt line j) #\space)
                            (exit
                              (return
                               (substring line j nil))))))))))))))))))
```

—————

50.1.6 defun processSynonymLine

[processSynonymLine,removeKeyFromLine p832]

— **defun processSynonymLine** —

```
(defun |processSynonymLine| (line)
  (cons
    (string2id-n line 1)
    (|processSynonymLine,removeKeyFromLine| line)))
```

—————

This command is in the list of `$noParseCommands` 19.1.3 which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` 19.2.1

Chapter 51

)system help page Command

51.1 system help page man page

— system.help —

```
=====
A.25. )system
=====
```

User Level Required: interpreter

Command Syntax:

-)system cmdExpression

Command Description:

This command may be used to issue commands to the operating system while remaining in AXIOM. The cmdExpression is passed to the operating system for execution.

To get an operating system shell, issue, for example,)system sh. When you enter the key combination, Ctrl-D (pressing and holding the Ctrl key and then pressing the D key) the shell will terminate and you will return to AXIOM. We do not recommend this way of creating a shell because Lisp may field some interrupts instead of the shell. If possible, use a shell running in another window.

If you execute programs that misbehave you may not be able to return to AXIOM. If this happens, you may have no other choice than to restart AXIOM and restore the environment via)history)restore, if possible.

Also See:

- o)boot
- o)fin
- o)lisp
- o)pquit
- o)quit

1

This command is in the list of `$noParseCommands` 19.1.3 which means that its arguments are passed verbatim. This will eventually result in a call to the function `handleNoParseCommands` 19.2.1

¹ “boot” (5.1.8 p 25) “fin” (32.1.1 p 546) “lisp” (?? p ??) “pquit” (41.2.1 p 632) “quit” (42.2.1 p 636)

Chapter 52

)tangle help page Command

52.1 tangle help page man page

— tangle.help —

```
=====
A.19. )tangle
=====
```

User Level Required: interpreter

Command Syntax:

-)tangle [fileName]

Command Description:

This command is used to tangle pamphlet files.

)tangle matrix.input.pamphlet

will tangle the contents of the file matrix.input.pamphlet into matrix.input. The ‘.input.pamphlet’ is optional.

—

— defun tangle —

```
(defun |tangle| (arg)
  (let (|$InteractiveMode| namestring dot1 dot2 outfile
```

```

      (chunkname "*" (extension "input"))
(declare (special |$InteractiveMode| |$Options|))
(setq |$InteractiveMode| t)
(setq namestring (symbol-name (car arg)))
(setq dot1 (position #\. namestring))
(if dot1
  (setq outfile
    (concatenate 'string (subseq namestring 0 dot1) "." extension))
  (setq outfile
    (concatenate 'string (subseq namestring 0) "." extension)))
(setq dot2 (position #\. namestring :from-end t))
(cond
  ((and (numberp dot1) (numberp dot2) (< dot1 dot2)))
  ((and (numberp dot1) (numberp dot2) (= dot1 dot2))
   (setq namestring (concatenate 'string namestring ".pamphlet")))
  (t
   (setq namestring (concatenate 'string namestring ".input.pamphlet"))))
(if (probe-file namestring)
  (progn
    (tangle namestring chunkname outfile)
    (format t (concatenate 'string outfile " created from " namestring "%"))))
  (format t (concatenate 'string namestring " file not found~%")))))

```

Chapter 53

)trace help page Command

53.1 trace help page man page

— trace.help —

```
=====
A.26. )trace
=====
```

User Level Required: interpreter

Command Syntax:

-)trace
-)trace)off

-)trace function [options]
-)trace constructor [options]
-)trace domainOrPackage [options]

where options can be one or more of

-)after S-expression
-)before S-expression
-)break after
-)break before
-)cond S-expression
-)count
-)count n
-)depth n
-)local op1 [... opN]
-)nonquietly

```

- )nt
- )off
- )only listOfDataToDisplay
- )ops
- )ops op1 [... opN ]
- )restore
- )stats
- )stats reset
- )timer
- )varbreak
- )varbreak var1 [... varN ]
- )vars
- )vars var1 [... varN ]
- )within executingFunction

```

Command Description:

This command is used to trace the execution of functions that make up the AXIOM system, functions defined by users, and functions from the system library. Almost all options are available for each type of function but exceptions will be noted below.

To list all functions, constructors, domains and packages that are traced, simply issue

```
)trace
```

To untrace everything that is traced, issue

```
)trace )off
```

When a function is traced, the default system action is to display the arguments to the function and the return value when the function is exited. Note that if a function is left via an action such as a THROW, no return value will be displayed. Also, optimization of tail recursion may decrease the number of times a function is actually invoked and so may cause less trace information to be displayed. Other information can be displayed or collected when a function is traced and this is controlled by the various options. Most options will be of interest only to AXIOM system developers. If a domain or package is traced, the default action is to trace all functions exported.

Individual interpreter, lisp or boot functions can be traced by listing their names after)trace. Any options that are present must follow the functions to be traced.

```
)trace f
```

traces the function f. To untrace f, issue

```
)trace f )off
```

Note that if a function name contains a special character, it will be necessary to escape the character with an underscore

```
)trace _/D_,1
```

To trace all domains or packages that are or will be created from a particular constructor, give the constructor name or abbreviation after)trace.

```
)trace MATRIX
```

```
)trace List Integer
```

The first command traces all domains currently instantiated with Matrix. If additional domains are instantiated with this constructor (for example, if you have used Matrix(Integer) and Matrix(Float)), they will be automatically traced. The second command traces List(Integer). It is possible to trace individual functions in a domain or package. See the)ops option below.

The following are the general options for the)trace command.

```
)break after
```

causes a Lisp break loop to be entered after exiting the traced function.

```
)break before
```

causes a Lisp break loop to be entered before entering the traced function.

```
)break
```

is the same as)break before.

```
)count
```

causes the system to keep a count of the number of times the traced function is entered. The total can be displayed with)trace)stats and cleared with)trace)stats reset.

```
)count n
```

causes information about the traced function to be displayed for the first n executions. After the nth execution, the function is untraced.

```
)depth n
```

causes trace information to be shown for only n levels of recursion of the traced function. The command

```
)trace fib )depth 10
```

will cause the display of only 10 levels of trace information for the recursive execution of a user function fib.

)math
causes the function arguments and return value to be displayed in the AXIOM monospace two-dimensional math format.

)nonquietly
causes the display of additional messages when a function is traced.

)nt
This suppresses all normal trace information. This option is useful if the **)count** or **)timer** options are used and you are interested in the statistics but not the function calling information.

)off
causes untracing of all or specific functions. Without an argument, all functions, constructors, domains and packages are untraced. Otherwise, the given functions and other objects are untraced. To immediately retrace the untraced functions, issue **)trace** **)restore**.

)only listOfDataToDisplay
causes only specific trace information to be shown. The items are listed by using the following abbreviations:

a	display all arguments
v	display return value
1	display first argument
2	display second argument
15	display the 15th argument, and so on

)restore
causes the last untraced functions to be retraced. If additional options are present, they are added to those previously in effect.

)stats
causes the display of statistics collected by the use of the **)count** and **)timer** options.

)stats reset
resets to 0 the statistics collected by the use of the **)count** and **)timer** options.

)timer
causes the system to keep a count of execution times for the traced function. The total can be displayed with **)trace** **)stats** and cleared with **)trace** **)stats reset**.

)varbreak var1 [... varN]
causes a Lisp break loop to be entered after the assignment to any of the listed variables in the traced function.

)vars

causes the display of the value of any variable after it is assigned in the traced function. Note that library code must have been compiled (see description of command `)compile`) using the `)vartrace` option in order to support this option.

`)vars var1 [... varN]`

causes the display of the value of any of the specified variables after they are assigned in the traced function. Note that library code must have been compiled (see description of command `)compile`) using the `)vartrace` option in order to support this option.

`)within executingFunction`

causes the display of trace information only if the traced function is called when the given `executingFunction` is running.

The following are the options for tracing constructors, domains and packages.

`)local [op1 [... opN]]`

causes local functions of the constructor to be traced. Note that to untrace an individual local function, you must use the fully qualified internal name, using the escape character `_` before the semicolon.

`)trace FRAC)local`

`)trace FRAC_;cancelGcd)off`

`)ops op1 [... opN]`

By default, all operations from a domain or package are traced when the domain or package is traced. This option allows you to specify that only particular operations should be traced. The command

`)trace Integer)ops min max _+ _-`

traces four operations from the domain `Integer`. Since `+` and `-` are special characters, it is necessary to escape them with an underscore.

Also See:

- o `)boot`
- o `)lisp`
- o `)ltrace`

53.1.1 The trace global variables

This decides when to give trace and untrace messages.

¹ “boot” (5.1.8 p 25) “lisp” (?? p ??) “ltrace” (40.1.1 p 630)

53.1.2 defvar \$traceNoisely

— initvars —

```
(defvar |$traceNoisely| nil)
```

—————

53.1.3 defvar \$reportSpadTrace

This reports the traced functions

— initvars —

```
(defvar |$reportSpadTrace| nil)
```

—————

53.1.4 defvar \$optionAlist

— initvars —

```
(defvar |$optionAlist| nil)
```

—————

53.1.5 defvar \$tracedMapSignatures

— initvars —

```
(defvar |$tracedMapSignatures| nil)
```

—————

53.1.6 defvar \$traceOptionList

— initvars —


```
(defvar |$traceOptionList|
  '(|after| |before| |break| |cond| |count| |depth| |local| |mathprint|
    |nonquietly| |nt| |of| |only| |ops| |restore| |timer| |varbreak|
    |vars| |within|))
```

53.1.7 defun trace

[traceSpad2Cmd p845]

— defun trace —

```
(defun |trace| (l)
  (|traceSpad2Cmd| l))
```

53.1.8 defun traceSpad2Cmd

```
[qcar p??]
[qcdr p??]
[getMapSubNames p867]
[trace1 p846]
[augmentTraceNames p870]
[traceReply p897]
[$mapSubNameAlist p??]
```

— defun traceSpad2Cmd —

```
(defun |traceSpad2Cmd| (l)
  (let (tmp1 l1)
    (declare (special |$mapSubNameAlist|))
    (cond
      ((and (consp l)
        (eq (qcar l) '|Tuple|)
        (progn
          (setq tmp1 (qcdr l))
          (and (consp tmp1)
            (eq (qcdr tmp1) nil)
            (progn
              (setq l1 (qcar tmp1))
              t))))
        (setq l l1)))
    (setq |$mapSubNameAlist| (|getMapSubNames| l))
```

```
(|trace1| (|augmentTraceNames| 1))
(|traceReply|)))
```

53.1.9 defun trace1

```
[hasOption p449]
[throwKeyedMsg p??]
[unabbrev p??]
[isFunctor p??]
[getTraceOption p852]
[untraceDomainLocalOps p878]
[qslessp p1061]
[poundsign p??]
[untrace p860]
[centerAndHighlight p??]
[ptimers p857]
[say p??]
[pcounters p858]
[selectOptionLC p477]
[resetSpacers p856]
[resetTimers p856]
[resetCounters p856]
[qcar p??]
[qcdr p??]
[vecp p??]
[sayKeyedMsg p329]
[devaluate p??]
[lassoc p??]
[trace1 p846]
[delete p??]
[?t p900]
[seq p??]
[exit p??]
[transTraceItem p861]
[addassoc p??]
[getTraceOptions p850]
[/trace,0 p??]
[saveMapSig p851]
[$traceNoisely p844]
[$options p??]
[$lastUntraced p??]
[$optionAlist p844]
```

— defun trace1 —

```
(defun |trace1| (arg)
  (prog (|$traceNoisely| constructor ops lops temp1 opt a
        oldl newoptions domain tracelist optionlist domainlist
        oplist y varlist argument)
    (declare (special |$traceNoisely| |$options| |$lastUntraced|
                      |$optionAlist|))
    (return
     (seq
      (progn
       (setq |$traceNoisely| nil)
       (cond
        ((|hasOption| |$options| '|nonquietly|)
         (setq |$traceNoisely| t)))
        (cond
         ((|hasOption| |$options| '|off|)
          (cond
           ((or (setq ops (|hasOption| |$options| '|ops|))
                (setq lops (|hasOption| |$options| '|local|)))
            (cond
             ((null arg) (|throwKeyedMsg| 's2it0019 nil))
             (t
              (setq constructor
                     (|unabbrev|
                      (cond
                       ((atom arg) arg)
                       ((null (cdr arg))
                        (cond
                         ((atom (car arg)) (car arg))
                         (t (car (car arg))))))
                     (t nil))))))
           ((null (|isFunction| constructor))
            (|throwKeyedMsg| 's2it0020 nil))
            (t
             (cond (ops (setq ops (|getTraceOption| ops)) nil))
             (cond
              (lops
               (setq lops (cdr (|getTraceOption| lops)))
               (|untraceDomainLocalOps|)
               (t nil))))))
             ((and (qslessp 1 (|#| |$options|))
                  (null (|hasOption| |$options| '|nonquietly|)))
              (|throwKeyedMsg| 's2it0021 nil))
              (t (|untrace| arg))))
            ((|hasOption| |$options| '|stats|)
             (cond
              ((qslessp 1 (|#| |$options|))
```

```

(|throwKeyedMsg| 's2it0001 (cons ")trace ... )stats" nil)))
(t
  (setq temp1 (car |$options|))
  (setq opt (cdr temp1))
  (cond
    ((null opt)
      (|centerAndHighlight| "Traced function execution times" 78 '-)
      (|ptimers|)
      (say " ")
      (|centerAndHighlight| "Traced function execution counts" 78 '-)
      (|pcounters|))
    (t
      (|selectOptionLC| (car opt) '(|reset|) '|optionError|)
      (|resetSpacers|)
      (|resetTimers|)
      (|resetCounters|)
      (|throwKeyedMsg| 's2it0002 nil))))))
((setq a (|hasOption| |$options| '|restore|))
  (unless (setq oldl |$lastUntraced|)
    (setq newoptions (|delete| a |$options|))
    (if (null arg)
      (|trace1| oldl)
      (progn
        (dolist (x arg)
          (if (and (consp x)
                    (progn
                      (setq domain (qcar x))
                      (setq oplist (qcdr x))
                      t)
                  (vecp domain)))
            (|sayKeyedMsg| 's2it0003 (cons (|devalue| domain) nil))
            (progn
              (setq |$options| (append newoptions (lassoc x |$optionAlist|)))
              (|trace1| (list x))))))))))
((null arg) nil)
((and (consp arg) (eq (qcdr arg) nil) (eq (qcar arg) '?)) (|?t|))
(t
  (setq tracelist
    (or
      (prog (t1)
        (setq t1 nil)
        (return
          (do ((t2 arg (cdr t2)) (x nil))
            ((or (atom t2)
                  (progn (setq x (car t2)) nil))
              (nreverse0 t1))
          (seq
            (exit
              (setq t1 (cons (|transTraceItem| x) t1)))))))
      (return nil)))

```

```

(do ((t3 tracelist (cdr t3)) (x nil))
  ((or (atom t3) (progn (setq x (car t3)) nil)) nil)
  (seq
   (exit
    (setq |$optionAlist| (addassoc x |$options| |$optionAlist|))))))
(setq optionlist (|getTraceOptions| |$options|))
(setq argument
  (cond
   ((setq domainlist (lassoc '|of| optionlist))
    (cond
     ((lassoc '|ops| optionlist)
      (|throwKeyedMsg| 's2it0004 nil))
     (t
      (setq oplist
        (cond
         (tracelist (list (cons '|ops| tracelist)))
         (t nil)))
      (setq varlist
        (cond
         ((setq y (lassoc '|vars| optionlist))
          (list (cons '|vars| y)))
         (t nil)))
      (append domainlist (append oplist varlist))))))
  (optionlist (append tracelist optionlist))
  (t tracelist)))
(|/TRACE,0|
 (prog (t4)
  (setq t4 nil)
  (return
   (do ((t5 argument (cdr t5)) (|funName| nil))
     ((or (atom t5)
      (progn (setq |funName| (car t5)) nil))
      (nreverse0 t4))
     (seq
      (exit
       (setq t4 (cons |funName| t4))))))))
(|saveMapSig|
 (prog (t6)
  (setq t6 nil)
  (return
   (do ((t7 argument (cdr t7)) (|funName| nil))
     ((or (atom t7)
      (progn (setq |funName| (car t7)) nil))
      (nreverse0 t6))
     (seq
      (exit
       (setq t6 (cons |funName| t6))))))))))

```

53.1.10 defun getTraceOptions

```
[throwKeyedMsg p??]
[throwListOfKeyedMsgs p??]
[poundsign p??]
[seq p??]
[exit p??]
[getTraceOption p852]
[$traceErrorStack p??]
```

— defun getTraceOptions —

```
(defun |getTraceOptions| (|options|)
  (prog (|$traceErrorStack| optionlist temp1 key |parms|)
    (declare (special |$traceErrorStack|))
    (return
      (seq
        (progn
          (setq |$traceErrorStack| nil)
          (setq optionlist
            (prog (t0)
              (setq t0 nil)
              (return
                (do ((t1 |options| (cdr t1)) (x nil))
                  ((or (atom t1) (progn (setq x (car t1)) nil)) (nreverse0 t0))
                (seq
                  (exit
                    (setq t0 (cons (|getTraceOption| x) t0))))))))))
          (cond
            (|$traceErrorStack|
              (cond
                ((null (cdr |$traceErrorStack|))
                  (setq temp1 (car |$traceErrorStack|))
                  (setq key (car temp1))
                  (setq |parms| (cadr temp1))
                  (|throwKeyedMsg| key (cons "" |parms|)))
                (t
                  (|throwListOfKeyedMsgs| 's2it0017
                    (cons (|#| |$traceErrorStack|) nil)
                    (nreverse |$traceErrorStack|))))
              (t optionlist))))))
```

53.1.11 defun saveMapSig

```
[rassoc p??]
[addassoc p??]
[getMapSig p851]
[$tracedMapSignatures p844]
[$mapSubNameAlist p??]
```

— defun saveMapSig —

```
(defun |saveMapSig| (funnames)
  (let (map)
    (declare (special |$tracedMapSignatures| |$mapSubNameAlist|))
    (dolist (name funnames)
      (when (setq map (|rassoc| name |$mapSubNameAlist|))
        (setq |$tracedMapSignatures|
              (addassoc name (|getMapSig| map name) |$tracedMapSignatures|))))))
```

—————

53.1.12 defun getMapSig

```
[get p??]
[boot-equal p??]
[$InteractiveFrame p??]
```

— defun getMapSig —

```
(defun |getMapSig| (mapname subname)
  (let (lmms sig)
    (declare (special |$InteractiveFrame|))
    (when (setq lmms (|get| mapname '|localModemap| |$InteractiveFrame|))
      (do ((t0 lmms (cdr t0)) (|mm| nil) (t1 nil sig))
          ((or (atom t0) (progn (setq |mm| (car t0)) nil) t1) nil)
        (when (boot-equal (cadr |mm|) subname) (setq sig (cdar |mm|))))
      sig)))
```

—————

53.1.13 defun getTraceOption,hn

```
[seq p??]
[exit p??]
[isDomainOrPackage p873]
```

```
[stackTraceOptionError p859]
[domainToGenvar p859]
```

— defun getTraceOption,hn —

```
(defun |getTraceOption,hn| (x)
  (prog (g)
    (return
      (seq
        (if (and (atom x) (null (upper-case-p (elt (princ-to-string x) 0))))
          (exit
            (seq
              (if (|isDomainOrPackage| (eval x)) (exit x))
              (exit
                (|stackTraceOptionError|
                  (cons 's2it0013 (cons (cons x nil) nil)))))))
          (if (setq g (|domainToGenvar| x)) (exit g))
          (exit
            (|stackTraceOptionError| (cons 's2it0013 (cons (cons x nil) nil)))))))
```

—————

53.1.14 defun getTraceOption

```
[seq p??]
[exit p??]
[selectOptionLC p477]
[identp p1048]
[stackTraceOptionError p859]
[concat p1049]
[object2String p??]
[transOnlyOption p858]
[qcdr p??]
[qcar p??]
[getTraceOption,hn p851]
[isListOfIdentifiersOrStrings p867]
[isListOfIdentifiers p866]
[throwKeyedMsg p??]
[$traceOptionList p844]
```

— defun getTraceOption —

```
(defun |getTraceOption| (arg)
  (prog (l |opts| key a |n|)
    (declare (special |$traceOptionList|))
    (return
```



```

(seq
  (progn
    (setq key (car arg))
    (setq l (cdr arg))
    (setq key
      (|selectOptionLC| key |$traceOptionList| '|traceOptionError|))
    (setq arg (cons key l))
    (cond
      ((member key '(|nonquietly| |timer| |nt|)) arg)
      ((eq key '|break|)
        (cond
          ((null l) (cons '|break| (cons '|before| nil)))
          (t
            (setq |opts|
              (prog (t0)
                (setq t0 nil)
                (return
                  (do ((t1 l (cdr t1)) (y nil))
                    ((or (atom t1)
                        (progn (setq y (car t1)) nil))
                     (nreverse0 t0))
                  (seq
                    (exit
                     (setq t0
                       (cons
                        (|selectOptionLC| y '(|before| |after|) nil) t0))))))))
            (cond
              ((prog (t2)
                (setq t2 t)
                (return
                  (do ((t3 nil (null t2)) (t4 |opts| (cdr t4)) (y nil))
                    ((or t3 (atom t4) (progn (setq y (car t4)) nil)) t2)
                  (seq
                    (exit
                     (setq t2 (and t2 (identp y))))))))
                (cons '|break| |opts|))
              (t
                (|stackTraceOptionError| (cons 's2it0008 (cons nil nil))))))
          ((eq key '|restore|)
            (cond
              ((null l) arg)
              (t
                (|stackTraceOptionError|
                  (cons 's2it0009
                    (cons (cons (concat "") (|object2String| key)) nil) nil))))))
          ((eq key '|only|) (cons '|only| (|transOnlyOption| l)))
          ((eq key '|within|)
            (cond
              ((and (consp l)
                (eq (qcdr l) nil)

```

```

        (progn (setq a (qcar 1)) t)
        (identp a))
    arg)
  (t
    (|stackTraceOptionError|
      (cons 's2it0010 (cons (cons ")within" nil) nil))))))
  ((member key '(|cond| |before| |after|))
    (setq key
      (cond
        ((eq key '(|cond|) '|when|)
          (t key)))
      (cond
        ((and (consp 1)
              (eq (qcdr 1) nil)
              (progn (setq a (qcar 1)) t))
          (cons key 1))
        (t
          (|stackTraceOptionError|
            (cons 's2it0011
              (cons
                (cons (concat ")")
                  (|object2String| key)) nil) nil))))))
  ((eq key '|depth|)
    (cond
      ((and (consp 1)
            (eq (qcdr 1) nil)
            (progn (setq |n| (qcar 1)) t)
            (integerp |n|))
        arg)
      (t
        (|stackTraceOptionError|
          (cons 's2it0012 (cons (cons ")depth" nil) nil))))))
  ((eq key '|count|)
    (cond
      ((or (null 1)
            (and (consp 1)
                  (eq (qcdr 1) nil)
                  (progn (setq |n| (qcar 1)) t)
                  (integerp |n|)))
        arg)
      (t
        (|stackTraceOptionError|
          (cons 's2it0012 (cons (cons ")count" nil) nil))))))
  ((eq key '|of|)
    (cons '|of|
      (prog (t5)
        (setq t5 nil)
        (return
          (do ((t6 1 (cdr t6)) (y nil))
              ((or (atom t6) (progn (setq y (car t6)) nil)) (nreverse0 t5))

```

```

      (seq
        (exit
          (setq t5 (cons (|getTraceOption,hn| y) t5)))))))))
((member key '(|local| ops |vars|))
 (cond
  ((or (null 1)
        (and (consp 1) (eq (qcdr 1) nil) (eq (qcar 1) '|all|)))
   (cons key '|all|))
  ((|isListOfIdentifiersOrStrings| 1) arg)
  (t
   (|stackTraceOptionError|
    (cons 's2it0015
      (cons
        (cons (concat ") " (|object2String| key)) nil) nil))))))
((eq key '|varbreak|)
 (cond
  ((or (null 1)
        (and (consp 1) (eq (qcdr 1) nil) (eq (qcar 1) '|all|)))
   (cons '|varbreak| '|all|))
  ((|isListOfIdentifiers| 1) arg)
  (t
   (|stackTraceOptionError|
    (cons 's2it0016
      (cons
        (cons (concat ") " (|object2String| key)) nil) nil))))))
((eq key '|mathprint|)
 (cond
  ((null 1) arg)
  (t
   (|stackTraceOptionError|
    (cons 's2it0009
      (cons
        (cons (concat ") " (|object2String| key)) nil) nil))))))
(key (|throwKeyedMsg| 's2it0005 (cons key nil)))))))))

```

53.1.15 defun traceOptionError

[stackTraceOptionError p859]

[commandAmbiguityError p450]

— defun traceOptionError —

```

(defun |traceOptionError| (opt keys)
  (if (null keys)
      (|stackTraceOptionError| (cons 's2it0007 (cons (cons opt nil) nil)))

```

```
(|commandAmbiguityError| '|trace option| opt keys)))
```

53.1.16 defun resetTimers

```
[concat p1049]
[/timerlist p??]
```

— defun resetTimers —

```
(defun |resetTimers| ()
  (declare (special /timerlist))
  (dolist (timer /timerlist)
    (set (intern (concat timer ",TIMER")) 0)))
```

53.1.17 defun resetSpacers

```
[concat p1049]
[/spacelist p??]
```

— defun resetSpacers —

```
(defun |resetSpacers| ()
  (declare (special /spacelist))
  (dolist (spacer /spacelist)
    (set (intern (concat spacer ",SPACE")) 0)))
```

53.1.18 defun resetCounters

```
[concat p1049]
[/countlist p??]
```

— defun resetCounters —

```
(defun |resetCounters| ()
  (declare (special /countlist))
  (dolist (k /countlist)
    (set (intern (concat k ",COUNT")) 0)))
```

53.1.19 defun ptimers

```
[sayBrightly p??]
[bright p??]
[quotient p??]
[concat p1049]
[float p??]
[/timerlist p??]
```

— defun ptimers —

```
(defun |ptimers| ()
  (declare (special /timerlist |$timerTicksPerSecond|))
  (if (null /timerlist)
    (|sayBrightly| " no functions are timed")
    (dolist (timer /timerlist)
      (|sayBrightly|
        '(" " ,@( |bright| timer) |:| " "
          ,(quotient (eval (intern (concat timer " ,TIMER")))
                     (|float| |$timerTicksPerSecond|)) " sec."))))))
```

53.1.20 defun pspacers

```
[sayBrightly p??]
[bright p??]
[concat p1049]
[/spacelist p??]
```

— defun pspacers —

```
(defun |pspacers| ()
  (declare (special /spacelist))
  (if (null /spacelist)
    (|sayBrightly| " no functions have space monitored")
    (dolist (spacer /spacelist)
      (|sayBrightly|
        '(" " ,@( |bright| spacer) |:|
          ,(eval (intern (concat spacer " ,SPACE"))) " bytes")))))
```

53.1.21 defun pcounters

```
[sayBrightly p??]
[bright p??]
[concat p1049]
[/countlist p??]
```

— defun pcounters —

```
(defun |pcounters| ()
  (declare (special /countlist))
  (if (null /countlist)
      (|sayBrightly| " no functions are being counted")
      (dolist (k /countlist)
        (|sayBrightly|
         '(" " ,@( |bright| k) |:|| " " ,(eval (intern (concat k ",COUNT"))))
         " times")))))
```

—————

53.1.22 defun transOnlyOption

```
[transOnlyOption p858]
[upcase p??]
[stackTraceOptionError p859]
[qcar p??]
[qcdr p??]
```

— defun transOnlyOption —

```
(defun |transOnlyOption| (arg)
  (let (y n)
    (when (and (consp arg) (progn (setq n (qcar arg)) (setq y (qcdr arg)) t))
      (cond
        ((integerp n) (cons n (|transOnlyOption| y)))
        ((member (setq n (upcase n)) '(v a c)) (cons n (|transOnlyOption| y)))
        (t
         (|stackTraceOptionError| (cons 's2it0006 (list (list n))))
         (|transOnlyOption| y)))))
```

—————

53.1.23 defun stackTraceOptionError

[*\$traceErrorStack* *p??*]

— **defun stackTraceOptionError** —

```
(defun |stackTraceOptionError| (x)
  (declare (special |$traceErrorStack|))
  (push x |$traceErrorStack|)
  nil)
```

—————

53.1.24 defun removeOption

— **defun removeOption** —

```
(defun |removeOption| (op options)
  (let (opt t0)
    (do ((t1 options (cdr t1)) (optentry nil))
        ((or (atom t1)
              (progn (setq optentry (car t1)) nil)
                    (progn (progn (setq opt (car optentry)) optentry) nil))
         (nreverse0 t0))
      (when (not (equal opt op)) (setq t0 (cons optentry t0))))))
```

—————

53.1.25 defun domainToGenvar

[*unabbrevAndLoad* *p??*]
 [*getdatabase* *p1009*]
 [*opOf* *p??*]
 [*genDomainTraceName* *p860*]
 [*evalDomain* *p911*]
 [*\$doNotAddEmptyModeIfTrue* *p??*]

— **defun domainToGenvar** —

```
(defun |domainToGenvar| (arg)
  (let (|$doNotAddEmptyModeIfTrue| y g)
    (declare (special |$doNotAddEmptyModeIfTrue|))
    (setq |$doNotAddEmptyModeIfTrue| t)
```

```
(when
  (and (setq y (|unabbrevAndLoad| arg))
        (eq (getdatabase (|opOf| y) 'constructorkind) '|domain|))
  (setq g (|genDomainTraceName| y))
  (set g (|evalDomain| y))
  g)))
```

53.1.26 defun genDomainTraceName

```
[lassoc p??]
[genvar p??]
[$domainTraceNameAssoc p??]
```

— defun genDomainTraceName —

```
(defun |genDomainTraceName| (y)
  (let (u g)
    (declare (special |$domainTraceNameAssoc|))
    (if (setq u (lassoc y |$domainTraceNameAssoc|))
        u
        (progn
          (setq g (genvar))
          (setq |$domainTraceNameAssoc| (cons (cons y g) |$domainTraceNameAssoc|))
          g))))
```

53.1.27 defun untrace

```
[copy p??]
[transTraceItem p861]
[/untrace,0 p??]
[lassocSub p869]
[removeTracedMapSigs p862]
[$lastUntraced p??]
[$mapSubNameAlist p??]
[/tracenames p??]
```

— defun untrace —

```
(defun |untrace| (arg)
  (let (untracelist)
```



```
(declare (special |$lastUntraced| /tracenames |$mapSubNameAlist|))
(if arg
  (setq |$lastUntraced| arg)
  (setq |$lastUntraced| (copy /tracenames)))
(setq untracelist
  (do ((t1 arg (cdr t1)) (x nil) (t0 nil))
    ((or (atom t1) (progn (setq x (car t1)) nil))
     (nreverse0 t0))
    (push (|transTraceItem| x) t0)))
(|/UNTRACE,0|
  (do ((t3 untracelist (cdr t3)) (|funName| nil) (t2 nil))
    ((or (atom t3) (progn (setq |funName| (car t3)) nil))
     (nreverse0 t2))
    (push (|lassocSub| |funName| |$mapSubNameAlist|) t2)))
  (|removeTracedMapSigs| untracelist)))
```

53.1.28 defun transTraceItem

```
[get p??]
[member p1050]
[objMode p??]
[objVal p??]
[domainToGenvar p859]
[unabbrev p??]
[constructor? p??]
[vecp p??]
[transTraceItem p861]
[devaluate p??]
[throwKeyedMsg p??]
[$doNotAddEmptyModeIfTrue p??]
```

— defun transTraceItem —

```
(defun |transTraceItem| (x)
  (prog (|$doNotAddEmptyModeIfTrue| |value| y)
    (declare (special |$doNotAddEmptyModeIfTrue|))
    (return
      (progn
        (setq |$doNotAddEmptyModeIfTrue| t)
        (cond
          ((atom x)
            (cond
              ((and (setq |value| (|get| x '|value| |$InteractiveFrame|))
                (|member| (|objMode| |value|)
                  '(|Mode|) (|Domain|) (|SubDomain| (|Domain|))))))
```

```

(setq x (|objVal| |value|))
(cond
  ((setq y (|domainToGenvar| x)) y)
  (t x)))
(upper-case-p (elt (princ-to-string x) 0))
(setq y (|unabbrev| x))
(cond
  ((|constructor?| y) y)
  ((and (consp y) (|constructor?| (car y))) (car y))
  ((setq y (|domainToGenvar| x)) y)
  (t x)))
(t x)))
((vecp (car x)) (|transTraceItem| (|devaluate| (car x))))
((setq y (|domainToGenvar| x)) y)
(t (|throwKeyedMsg| 's2it0018 (cons x nil))))))

```

53.1.29 defun removeTracedMapSigs

[*\$tracedMapSignatures* p844]

— defun removeTracedMapSigs —

```

(defun |removeTracedMapSigs| (untraceList)
  (declare (special |$tracedMapSignatures|))
  (dolist (name untraceList)
    (remprop name |$tracedMapSignatures|)))

```

53.1.30 defun coerceTraceArgs2E

[*spadsysnamep* p??]
 [*pname* p1047]
 [*coerceSpadArgs2E* p863]
 [*objValUnwrap* p??]
 [*coerceInteractive* p??]
 [*objNewWrap* p??]
 [*\$OutputForm* p??]
 [*\$mathTraceList* p??]
 [*\$tracedMapSignatures* p844]

— defun coerceTraceArgs2E —

```

(defun |coerceTraceArgs2E| (tracename subname args)
  (declare (ignore tracename))
  (let (name)
    (declare (special |$OutputForm| |$mathTraceList| |$tracedMapSignatures|))
    (cond
      ((member (setq name subname) |$mathTraceList|)
        (if (spadsysnamep (pname name))
          (|coerceSpadArgs2E| (reverse (cdr (reverse args))))
          (do ((t1 '(|arg1| |arg2| |arg3| |arg4| |arg5| |arg6| |arg7| |arg8|
                    |arg9| |arg10| |arg11| |arg12| |arg13| |arg14| |arg15|
                    |arg16| |arg17| |arg18| |arg19|) (cdr t1))
              (name nil)
              (t2 args (cdr t2))
              (arg nil)
              (t3 (cdr (lassoc subname |$tracedMapSignatures|)) (cdr t3))
              (type nil)
              (t0 nil))
            ((or (atom t1)
                 (progn (setq name (car t1)) nil)
                 (atom t2)
                 (progn (setq arg (car t2)) nil)
                 (atom t3)
                 (progn (setq type (car t3)) nil))
              (nreverse0 t0))
          (setq t0
            (cons
              (list '= name
                (|objValUnwrap|
                  (|coerceInteractive|
                    (|objNewWrap| arg type) |$OutputForm|))) t0))))
        ((spadsysnamep (pname name)) (reverse (cdr (reverse args))))
        (t args))))

```

53.1.31 defun coerceSpadArgs2E

```

[seq p??]
[exit p??]
[objValUnwrap p??]
[coerceInteractive p??]
[objNewWrap p??]
[$streamCount p798]
[$OutputForm p??]
[$tracedSpadModemap p??]

```

— defun coerceSpadArgs2E —

```

(defun |coerceSpadArgs2E| (args)
  (let ((|$streamCount| 0))
    (declare (special |$streamCount| |$OutputForm| |$tracedSpadModemap|))
    (do ((t1 '(|arg1| |arg2| |arg3| |arg4| |arg5| |arg6| |arg7| |arg8|
                |arg9| |arg10| |arg11| |arg12| |arg13| |arg14| |arg15|
                |arg16| |arg17| |arg18| |arg19|) (cdr t1))
        (name nil)
        (t2 args (cdr t2))
        (arg nil)
        (t3 (cdr |$tracedSpadModemap|) (cdr t3))
        (type nil)
        (t0 nil))
      ((or (atom t1)
          (progn (setq name (car t1)) nil)
          (atom t2)
          (progn (setq arg (car t2)) nil)
          (atom t3)
          (progn (setq type (car t3)) nil))
        (nreverse0 t0))
      (seq
       (exit
        (setq t0
         (cons
          (cons '=
              (cons name
                    (cons (|objValUnwrap|
                          (|coerceInteractive|
                           (|objNewWrap| arg type)
                           |$OutputForm|)) nil)))
          t0))))))

```

53.1.32 defun subTypes

```

[lassoc p??]
[seq p??]
[exit p??]
[subTypes p864]

```

— defun subTypes —

```

(defun |subTypes| (|mm| |sublist|)
  (prog (s)
    (return
     (seq
      (cond

```

```

((atom |mm|)
 (cond ((setq s (lassoc |mm| |sublist|)) s) (t |mm|)))
(t
 (prog (t0)
  (setq t0 nil)
  (return
   (do ((t1 |mm| (cdr t1)) (|m| nil))
    ((or (atom t1) (progn (setq |m| (car t1)) nil)) (nreverse0 t0))
    (seq
     (exit
      (setq t0 (cons (|subTypes| |m| |sublist|) t0))))))))))

```

53.1.33 defun coerceTraceFunValue2E

```

[spadsysnamep p??]
[pname p1047]
[coerceSpadFunValue2E p866]
[lassoc p??]
[objValUnwrap p??]
[coerceInteractive p??]
[objNewWrap p??]
[$tracedMapSignatures p844]
[$OutputForm p??]
[$mathTraceList p??]

```

— defun coerceTraceFunValue2E —

```

(defun |coerceTraceFunValue2E| (tracename subname |value|)
  (let (name u)
    (declare (special |$tracedMapSignatures| |$OutputForm| |$mathTraceList|))
    (if (member (setq name subname) |$mathTraceList|)
        (cond
         ((spadsysnamep (pname tracename)) (|coerceSpadFunValue2E| |value|))
         ((setq u (lassoc subname |$tracedMapSignatures|))
          (|objValUnwrap|
           (|coerceInteractive| (|objNewWrap| |value| (car u)) |$OutputForm|)))
         (t |value|)))
    |value|)))

```

53.1.34 defun coerceSpadFunValue2E

```
[objValUnwrap p??]
[coerceInteractive p??]
[objNewWrap p??]
[$streamCount p798]
[$tracedSpadModemap p??]
[$OutputForm p??]
```

— defun coerceSpadFunValue2E —

```
(defun |coerceSpadFunValue2E| (|value|)
  (let (|$streamCount|)
    (declare (special |$streamCount| |$tracedSpadModemap| |$OutputForm|))
    (setq |$streamCount| 0)
    (|objValUnwrap|
     (|coerceInteractive|
      (|objNewWrap| |value| (car |$tracedSpadModemap|))
      |$OutputForm|))))
```

—————

53.1.35 defun isListOfIdentifiers

```
[seq p??]
[exit p??]
[identp p1048]
```

— defun isListOfIdentifiers —

```
(defun |isListOfIdentifiers| (arg)
  (prog ()
    (return
     (seq
      (prog (t0)
        (setq t0 t)
        (return
         (do ((t1 nil (null t0)) (t2 arg (cdr t2)) (x nil))
              ((or t1 (atom t2) (progn (setq x (car t2)) nil)) t0)
          (seq
           (exit
            (setq t0 (and t0 (identp x))))))))))))
```

—————

53.1.36 defun isListOfIdentifiersOrStrings

[seq p??]
 [exit p??]
 [identp p1048]

— defun isListOfIdentifiersOrStrings —

```
(defun |isListOfIdentifiersOrStrings| (arg)
  (prog ()
    (return
      (seq
        (prog (t0)
          (setq t0 t)
          (return
            (do ((t1 nil (null t0)) (t2 arg (cdr t2)) (x nil))
              ((or t1 (atom t2) (progn (setq x (car t2)) nil)) t0)
            (seq
              (exit
                (setq t0 (and t0 (or (identp x) (stringp x))))))))))))))
```

—————

53.1.37 defun getMapSubNames

[get p??]
 [union p??]
 [getPreviousMapSubNames p868]
 [unionq p??]
 [\$lastUntraced p??]
 [\$InteractiveFrame p??]
 [/tracenames p??]

— defun getMapSubNames —

```
(defun |getMapSubNames| (arg)
  (let (lmm subs)
    (declare (special /tracenames |$lastUntraced| |$InteractiveFrame|))
    (setq subs nil)
    (dolist (mapname arg)
      (when (setq lmm (|get| mapname '|localModemap| |$InteractiveFrame|))
        (setq subs
          (append
            (do ((t2 lmm (cdr t2)) (t1 nil) (lmm nil))
              ((or (atom t2)
                (progn (setq lmm (CAR t2)) nil)) (nreverse0 t1))
```

```

      (setq t1 (cons (cons mapname (cadr |mm|)) t1)))
    subs))))
  (|union| subs
   (|getPreviousMapSubNames| (unionq /tracenames |$lastUntraced|))))))

```

53.1.38 defun getPreviousMapSubNames

```

[get p??]
[exit p??]
[seq p??]

```

— defun getPreviousMapSubNames —

```

(defun |getPreviousMapSubNames| (|traceNames|)
  (prog (lmm subs)
    (return
      (seq
        (progn
          (setq subs nil)
          (seq
            (do ((t0 (assocleft (caar |$InteractiveFrame|)) (cdr t0))
                (mapname nil))
              ((or (atom t0) (progn (setq mapname (car t0)) nil)) nil)
            (seq
              (exit
                (cond
                  ((setq lmm
                     (|get| mapname '|localModemap| |$InteractiveFrame|))
                  (exit
                    (cond
                      ((member (cadar lmm) |traceNames|)
                       (exit
                        (do ((t1 lmm (cdr t1)) (|lmm| nil))
                          ((or (atom t1) (progn (setq |lmm| (car t1)) nil)) nil)
                        (seq
                          (exit
                            (setq subs
                              (cons (cons mapname (cadr |mm|)) subs))))))))))))
                    (exit subs))))))

```

53.1.39 defun lassocSub

[lassq p??]

— defun lassocSub —

```
(defun |lassocSub| (x subs)
  (let (y)
    (if (setq y (lassq x subs))
        y
        x)))
```

53.1.40 defun rassocSub

[rassoc p??]

— defun rassocSub —

```
(defun |rassocSub| (x subs)
  (let (y)
    (if (setq y (|rassoc| x subs))
        y
        x)))
```

53.1.41 defun isUncompiledMap

[get p??]

[\$InteractiveFrame p??]

— defun isUncompiledMap —

```
(defun |isUncompiledMap| (x)
  (let (y)
    (declare (special |$InteractiveFrame|))
    (when (setq y (|get| x 'value |$InteractiveFrame|))
      (and
        (eq (caar y) 'map)
        (null (|get| x 'localModemap |$InteractiveFrame|))))))
```

53.1.42 defun isInterpOnlyMap

```
[get p??]
[$InteractiveFrame p??]
```

— defun isInterpOnlyMap —

```
(defun |isInterpOnlyMap| (map)
  (let (x)
    (declare (special |$InteractiveFrame|))
    (when (setq x (|get| map '|localModemap| |$InteractiveFrame|))
      (eq (caaar x) '|interpOnly|))))
```

53.1.43 defun augmentTraceNames

```
[get p??]
[$InteractiveFrame p??]
```

— defun augmentTraceNames —

```
(defun |augmentTraceNames| (arg)
  (let (mml res)
    (declare (special |$InteractiveFrame|))
    (dolist (tracename arg)
      (if (setq mml (|get| tracename '|localModemap| |$InteractiveFrame|))
        (setq res
          (append
            (prog (t1)
              (setq t1 nil)
              (return
                (do ((t2 mml (cdr t2)) (|mml| nil))
                  ((or (atom t2)
                      (progn (setq |mml| (CAR t2)) nil))
                   (nreverse0 t1))
                (setq t1 (cons (cadr |mml|) t1))))))
          res))
        (setq res (cons tracename res))))
  res))
```

53.1.44 defun isSubForRedundantMapName

```
[rassocSub p869]
[member p1050]
[assocleft p??]
[$mapSubNameAlist p??]
```

— **defun isSubForRedundantMapName** —

```
(defun |isSubForRedundantMapName| (subname)
  (let (mapname tail)
    (declare (special |$mapSubNameAlist|))
    (when (setq mapname (|rassocSub| subname |$mapSubNameAlist|))
      (when (setq tail (|member| (cons mapname subname) |$mapSubNameAlist|))
        (member mapname (cdr (assocleft tail)))))))
```

—————

53.1.45 defun untraceMapSubNames

```
[assocright p??]
[/untrace,2 p??]
[setdifference p??]
[getPreviousMapSubNames p868]
[$mapSubNameAlist p??]
[$lastUntraced p??]
```

— **defun untraceMapSubNames** —

```
(defun |untraceMapSubNames| (|traceNames|)
  (let (|$mapSubNameAlist| subs)
    (declare (special |$mapSubNameAlist| |$lastUntraced|))
    (if
      (null (setq |$mapSubNameAlist| (|getPreviousMapSubNames| |traceNames|)))
      nil
      (dolist (name (setq subs (assocright |$mapSubNameAlist|)))
        (when (member name /tracenames)
          (|/UNTRACE,2| name nil)
          (setq |$lastUntraced| (setdifference |$lastUntraced| subs)))))))
```

—————

53.1.46 defun funfind,LAM

```
[qcar p??]
[SEQ p??]
[isFunctor p??]
[exit p??]
```

— defun funfind,LAM —

```
(defun |funfind,LAM| (functor opname)
  (prog (ops tmp1)
    (return
      (seq
        (progn
          (setq ops (|isFunctor| functor))
          (prog (t0)
            (setq t0 nil)
            (return
              (do ((t1 ops (cdr t1)) (u nil))
                ((or (atom t1) (progn (setq u (car t1)) nil)) (nreverse0 t0))
              (seq
                (exit
                  (cond
                    ((and (consp u)
                      (progn
                        (setq tmp1 (qcar u))
                        (and (consp tmp1) (equal (qcar tmp1) opname))))
                    (setq t0 (cons u t0))))))))))))))
```

—————

53.1.47 defmacro funfind

— defmacro funfind —

```
(defmacro |funfind| (&whole t0 &rest notused &aux t1)
  (declare (ignore notused))
  (dsetq t1 t0)
  (cons '|funfind,LAM| (wrap (cdr t1) '(quote quote))))
```

—————

53.1.48 defun isDomainOrPackage

[refvecp p??]
 [poundsign p??]
 [isFunctor p??]
 [opOf p??]

— defun isDomainOrPackage —

```
(defun |isDomainOrPackage| (dom)
  (and
    (refvecp dom)
    (> (|#| dom) 0)
    (|isFunctor| (|opOf| (elt dom 0)))))
```

—————

53.1.49 defun isTraceGensym

[gensymp p??]

— defun isTraceGensym —

```
(defun |isTraceGensym| (x)
  (gensymp x))
```

—————

53.1.50 defun spadTrace,g

— defun spadTrace,g —

```
(defun |spadTrace,g| (x)
  (if (stringp x) (intern x) x))
```

—————

53.1.51 defun spadTrace,isTraceable

[seq p??]
 [exit p??]

```
[gensymp p??]
[reportSpadTrace p890]
[bpiname p??]
```

— **defun spadTrace,isTraceable** —

```
(defun |spadTrace,isTraceable| (x |domain|)
  (prog (n |functionSlot|)
    (return
      (seq
        (progn
          (setq n (caddr x))
          x
          (seq
            (if (atom (elt |domain| n)) (exit nil))
            (setq |functionSlot| (car (elt |domain| n)))
            (if (gensymp |functionSlot|)
              (exit (seq (|reportSpadTrace| '|Already Traced| x) (exit nil))))
            (if (null (bpiname |functionSlot|))
              (exit
                (seq
                  (|reportSpadTrace| '|No function for| x)
                  (exit nil))))
              (exit t)))))))
```

—————→

53.1.52 defun spadTrace

```
[refvecp p??]
[aldorTrace p??]
[isDomainOrPackage p873]
[userError p??]
[seq p??]
[exit p??]
[spadTrace,g p873]
[getOption p890]
[removeOption p859]
[opOf p??]
[assoc p??]
[kdr p??]
[flattenOperationAlist p881]
[getOperationAlistFromLisplib p??]
[spadTrace,isTraceable p873]
[as-insert p??]
[bpiname p??]
```

```

[spadTraceAlias p889]
[subTypes p864]
[constructSubst p434]
[bptrace p??]
[rplac p??]
[printDashedLine p??]
[reportSpadTrace p890]
[setletprintflag p??]
[spadReply p893]
[$tracedModemap p??]
[$fromSpadTrace p??]
[$letAssoc p??]
[$reportSpadTrace p890]
[$traceNoisely p844]
[/tracenames p??]

```

— defun `spadTrace` —

```

(defun |spadTrace| (domain options)
  (let (|$tracedModemap| listofoperations listofvariables
        listofbreakvars anyiftrue domainid currententry
        currentalist opstructurelist sig kind triple fn op
        mm n alias tracename sigslotnumberalist)
    (declare (special |$tracedModemap| /tracenames |$fromSpadTrace| |$letAssoc|
                      |$reportSpadTrace| |$traceNoisely|))
    (setq |$fromSpadTrace| t)
    (setq |$tracedModemap| nil)
    (cond
      ((and (consp domain)
            (refvecp (car domain))
            (eql (elt (car domain) 0) 0))
       (|aldorTrace| domain options))
      ((null (|isDomainOrPackage| domain))
       (|userError| "bad argument to trace"))
      (t
       (setq listofoperations
              (prog (t0)
                    (setq t0 nil)
                    (return
                     (do ((t1 (|getOption| 'ops options) (cdr t1)) (x nil))
                         ((or (atom t1) (progn (setq x (car t1)) nil)) (nreverse0 t0))
                     (seq
                      (exit
                       (setq t0 (cons (|spadTrace,g| x) t0))))))))))
      (cond
        ((setq listofvariables (|getOption| 'vars options))
         (setq options (|removeOption| 'vars options))))
      (cond

```

```

((setq listofbreakvars (|getOption| 'varbreak options))
 (setq options (|removeOption| 'varbreak options)))
(setq anyiftrue (null listofoperations))
(setq domainid (|opOf| (elt domain 0)))
(setq currententry (|assoc| domain /tracenames))
(setq currentalist (kdr currententry))
(setq opstructurelist
 (|flattenOperationAlist| (|getOperationAlistFromLisplib| domainid)))
(setq sigslotnumberalist
 (prog (t2)
 (setq t2 nil)
 (return
 (do ((t3 opstructurelist (cdr t3)) (t4 nil))
 ((or (atom t3)
      (progn (setq t4 (CAR t3)) nil)
      (progn
        (progn
          (setq op (car t4))
          (setq sig (cadr t4))
          (setq n (caddr t4))
          (setq kind (car (cddddr t4))) t4)
        nil))
      (nreverse0 t2))
 (seq
  (exit
   (cond
    ((and (eq kind 'elt)
          (or anyiftrue (member op listofoperations))
          (integerp n)
          (|spadTrace, isTraceable|
           (setq triple
            (cons op (cons sig (cons n nil)))))) domain))
    (setq t2 (cons triple t2))))))))))
(cond
 (listofvariables
  (do ((t5 sigslotnumberalist (cdr t5)) (t6 nil))
    ((or (atom t5)
         (progn (setq t6 (car t5)) nil)
         (progn (progn (setq n (caddr t6)) t6) nil))
     nil)
   (seq
    (exit
     (progn
      (setq fn (car (elt domain n)))
      (setq |$letAssoc|
        (as-insert (bpiname fn) listofvariables |$letAssoc|))))))
 (cond
  (listofbreakvars
   (do ((t7 sigslotnumberalist (cdr t7)) (t8 nil))
     ((or (atom t7)

```



```
(progn (setq t8 (car t7)) nil)
      (progn (progn (setq n (caddr t8)) t8) nil))
nil)
(seq
(exit
(progn
(setq fn (car (elt domain n)))
(setq |$letAssoc|
(as-insert (bpiname fn)
(cons (cons 'break listofbreakvars) nil) |$letAssoc|))))))
(do ((t9 sigslotnumberalist (cdr t9)) (lpair| nil))
((or (atom t9)
(progn (setq lpair| (car t9)) nil)
(progn
(progn
(setq op (car lpair|))
(setq mm (cadr lpair|))
(setq n (caddr lpair|))
lpair|)
nil))
nil)
nil)
(seq
(exit
(progn
(setq alias (|spadTraceAlias| domainid op n))
(setq |$tracedModemap|
(|subTypes| mm (|constructSubst| (elt domain 0))))
(setq tracename
(bpitrace (car (elt domain n)) alias options))
(nconc lpair|
(cons listofvariables
(cons (car (elt domain n))
(cons tracename (cons alias nil)))))
(rplac (car (elt domain n)) tracename))))
(setq sigslotnumberalist
(prog (t10)
(setq t10 nil)
(return
(do ((t11 sigslotnumberalist (cdr t11)) (x nil))
((or (atom t11) (progn (setq x (car t11)) nil)) (nreverse0 t10))
(seq
(exit
(cond ((cdddr x) (setq t10 (cons x t10))))))))))
(cond
(|$reportSpadTrace|
(cond (|$traceNoisely| (|printDashedLine|))
(do ((t12 (|orderBySlotNumber| sigslotnumberalist) (cdr t12))
(x nil))
((or (atom t12)
(progn (setq x (car t12)) nil))
```

```

        nil)
      (seq (exit (|reportSpadTrace| 'tracing x))))))
    (cond (|$letAssoc| (setletprintflag t)))
  (cond
    (currententry
      (rplac (cdr currententry)
        (append sigslotnumberalist currentalist)))
    (t
      (setq /tracenames
        (cons (cons domain sigslotnumberalist) /tracenames))
        (|spadReply|))))))

```

53.1.53 defun traceDomainLocalOps

[sayMSG p331]

— defun traceDomainLocalOps —

```

(defun |traceDomainLocalOps| ()
  (|sayMSG| '(" The )local option has been withdrawn"))
  (|sayMSG| '(" Use )ltr to trace local functions.")))

```

53.1.54 defun untraceDomainLocalOps

[sayMSG p331]

— defun untraceDomainLocalOps —

```

(defun |untraceDomainLocalOps| ()
  (|sayMSG| '(" The )local option has been withdrawn"))
  (|sayMSG| '(" Use )ltr to trace local functions.")))

```

53.1.55 defun traceDomainConstructor

[getOption p890]

[seq p??]

[exit p??]

```

[spadTrace p874]
[concat p1049]
[embed p??]
[mkq p??]
[loadFunctor p1040]
[traceDomainLocalOps p878]
[$ConstructorCache p??]

```

— defun traceDomainConstructor —

```

(defun |traceDomainConstructor| (domainConstructor options)
  (prog (listOfLocalOps argl domain innerDomainConstructor)
    (declare (special |$ConstructorCache|))
    (return
      (seq
        (progn
          (|loadFunctor| domainConstructor)
          (setq listOfLocalOps (|getOption| 'local options))
          (when listOfLocalOps (|traceDomainLocalOps|))
          (cond
            ((and listOfLocalOps (null (|getOption| 'ops options))) nil)
            (t
              (do ((t2 (hget |$ConstructorCache| domainConstructor) (cdr t2))
                  (t3 nil))
                ((or (atom t2)
                     (progn (setq t3 (car t2)) nil)
                     (progn
                       (progn
                         (setq argl (car t3))
                         (setq domain (cddr t3)) t3)
                       nil))
                  nil)
              (seq
                (exit
                  (|spadTrace| domain options))))
            (setq /tracenames (cons domainConstructor /tracenames))
            (setq innerDomainConstructor
              (intern (concat domainConstructor ";")))
            (cond
              ((fboundp innerDomainConstructor)
               (setq domainConstructor innerDomainConstructor)))
            (embed domainConstructor
              (cons 'lambda
                (cons
                  (cons '&rest
                    (cons 'args nil))
                  (cons
                    (cons 'prog
                      (cons

```

```

(cons 'domain nil)
(cons
  (cons 'setq
    (cons 'domain
      (cons
        (cons 'apply (cons domainConstructor
          (cons 'args nil))) nil)))
    (cons
      (cons '|spadTrace|
        (cons 'domain
          (cons (mkq options) nil)))
        (cons (cons 'return (cons 'domain nil)) nil))))
    nil)))))))))

```

53.1.56 defun untraceDomainConstructor,keepTraced?

```

[seq p??]
[qcar p??]
[isDomainOrPackage p873]
[boot-equal p??]
[kar p??]
[devaluate p??]
[exit p??]
[/untrace,0 p??]

```

— defun untraceDomainConstructor,keepTraced? —

```

(defun |untraceDomainConstructor,keepTraced?| (df domainConstructor)
  (prog (dc)
    (return
      (seq
        (if (and
          (and
            (and (consp df) (progn (setq dc (qcar df)) t))
            (|isDomainOrPackage| dc))
            (boot-equal (kar (|devaluate| dc)) domainConstructor))
          (exit (seq (|/UNTRACE,0| (cons dc nil)) (exit nil))))
          (exit t))))))

```

53.1.57 defun untraceDomainConstructor

```
[untraceDomainConstructor,keepTraced? p880]
[unembed p??]
[seq p??]
[exit p??]
[concat p1049]
[delete p??]
[/tracenames p??]
```

— defun untraceDomainConstructor —

```
(defun |untraceDomainConstructor| (domainConstructor)
  (prog (innerDomainConstructor)
    (declare (special /tracenames))
    (return
      (seq
        (progn
          (setq /tracenames
            (prog (t0)
              (setq t0 nil)
              (return
                (do ((t1 /tracenames (cdr t1)) (df nil))
                  ((or (atom t1) (progn (setq df (car t1)) nil)) (nreverse0 t0))
                (seq
                  (exit
                    (cond ((|untraceDomainConstructor,keepTraced?|
                          df domainConstructor)
                      (setq t0 (cons df t0))))))))))
          (setq innerDomainConstructor
            (intern (concat domainConstructor ";")))
          (cond
            ((fboundp innerDomainConstructor) (unembed innerDomainConstructor))
            (t (unembed domainConstructor)))
          (setq /tracenames (|delete| domainConstructor /tracenames))))))
```

—————

53.1.58 defun flattenOperationAlist

```
[seq p??]
[exit p??]
```

— defun flattenOperationAlist —

```
(defun |flattenOperationAlist| (|opAlist|)
  (prog (op |mmList| |res|)
```

```

(return
  (seq
    (progn
      (setq |res| nil)
      (do ((t0 |opAlist| (cdr t0)) (t1 nil))
        ((or (atom t0)
              (progn (setq t1 (car t0)) nil)
              (progn
                (progn (setq op (car t1)) (setq |mmList| (cdr t1)) t1)
                nil))
          nil)
        (seq
          (exit
            (setq |res|
              (append |res|
                (prog (t2)
                  (setq t2 nil)
                  (return
                    (do ((t3 |mmList| (cdr t3)) (mm nil))
                      ((or (atom t3)
                            (progn (setq mm (car t3)) nil)) (nreverse0 t2))
                    (seq
                     (exit
                       (setq t2 (cons (cons op mm) t2))))))))))))
            |res|))))))

```

53.1.59 defun mapLetPrint

[getAliasIfTracedMapParameter p887]
 [getBpiNameIfTracedMap p888]
 [letPrint p883]

— defun mapLetPrint —

```

(defun |mapLetPrint| (x val currentFunction)
  (setq x (|getAliasIfTracedMapParameter| x currentFunction))
  (setq currentFunction (|getBpiNameIfTracedMap| currentFunction))
  (|letPrint| x val currentFunction))

```

53.1.60 defun letPrint

```
[lassoc p??]
[isgenvar p884]
[isSharpVarWithNum p884]
[gensymp p??]
[sayBrightlyNT p??]
[bright p??]
[shortenForPrinting p889]
[hasPair p889]
[pname p1047]
[break p904]
[$letAssoc p??]
```

— defun letPrint —

```
(defun |letPrint| (x |val| |currentFunction|)
  (prog (y)
    (declare (special |$letAssoc|))
    (return
      (progn
        (cond ((and |$letAssoc|
                     (or
                      (setq y (lassoc |currentFunction| |$letAssoc|))
                      (setq y (lassoc '|all| |$letAssoc|))))
              (cond
                ((and (or (eq y '|all|)
                          (member x y))
                     (null
                      (or (isgenvar x) (|isSharpVarWithNum| x) (gensymp x))))
                  (|sayBrightlyNT| (append (|bright| x) (cons '|:| nil)))
                  (prin1 (|shortenForPrinting| |val|))
                  (terpri)))
                (cond
                  ((and (setq y (|hasPair| 'break y))
                       (or (eq y '|all|)
                           (and (member x y)
                                (null (member (elt (pname x) 0) '($ |#|)))
                                (null (gensymp x))))
                     (|break|
                      (append
                       (|bright| |currentFunction|)
                       (cons "breaks after"
                           (append
                            (|bright| x)
                            (cons " := " (cons (|shortenForPrinting| |val|) nil)))))))
                    (t nil))))
          |val|))))
```

53.1.61 defun Identifier beginning with a sharpsign-number?

This tests if x is an identifier beginning with # followed by a number. [isSharpVar p884]

```
[pname p1047]
[qcsize p??]
[digitp p1047]
[dig2fix p??]
```

— defun isSharpVarWithNum —

```
(defun |isSharpVarWithNum| (x)
  (let (p n d ok c)
    (cond
      ((null (|isSharpVar| x)) nil)
      ((> 2 (setq n (qcsize (setq p (pname x))))) nil)
      (t
       (setq ok t)
       (setq c 0)
       (do ((t1 (1- n)) (i 1 (1+ i)))
           ((or (> i t1) (null ok)) nil)
          (setq d (elt p i))
          (when (setq ok (digitp d))
            (setq c (+ (* 10 c) (dig2fix d))))))
       (when ok c)))))
```

53.1.62 defun Identifier beginning with a sharpsign?

This tests if x is an identifier beginning with # [identp p1048]

— defun isSharpVar —

```
(defun |isSharpVar| (x)
  (and (identp x) (char= (schar (symbol-name x) 0) #\#)))
```

53.1.63 defun isgenvar

```
[size p1047]
[digitp p1047]
```


[identp p1048]

— defun isgenvar —

```
(defun isgenvar (x)
  (and (identp x)
    (let ((y (symbol-name x)))
      (and (char= #\$ (elt y 0)) (> (size y) 1) (digitp (elt y 1))))))
```

—————

53.1.64 defun letPrint2

[letPrint2 p885]
 [lassoc p??]
 [isgenvar p884]
 [isSharpVarWithNum p884]
 [gensymp p??]
 [mathprint p??]
 [print p??]
 [hasPair p889]
 [pname p1047]
 [break p904]
 [bright p??]
 [\$BreakMode p659]
 [\$letAssoc p??]

— defun letPrint2 —

```
(defun |letPrint2| (x |printform| |currentFunction|)
  (prog (|$BreakMode| |flag| y)
    (declare (special |$BreakMode| |$letAssoc|))
    (return
      (progn
        (setq |$BreakMode| nil)
        (cond
          ((and |$letAssoc|
            (or (setq y (lassoc |currentFunction| |$letAssoc|))
              (setq y (lassoc '|all| |$letAssoc|))))
            (cond
              ((and
                (or (eq y '|all|) (member x y))
                (null (or (isgenvar x) (isSharpVarWithNum x) (gensymp x))))
                (setq |$BreakMode| '|letPrint2|)
                (setq |flag| nil)
                (catch '|letPrint2|
```

```

(|mathprint| (cons '= (cons x (cons |printform| nil)))) |flag|)
(cond
  ((eq |flag| '|letPrint2|) (|print| |printform|))
  (t nil))))
(cond
  ((and
    (setq y (|hasPair| 'break y))
    (or (eq y '|all|)
        (and
          (member x y)
          (null (member (elt (pname x) 0) '($ |#|)))
          (null (gensymp x)))))
    (|break|
      (append
        (|bright| |currentFunction|)
        (cons "breaks after"
              (append (|bright| x) (cons '|:=| (cons |printform| nil)))))))
    (t nil))))
x)))

```

53.1.65 defun letPrint3

This is the version for use when we have our hands on a function to convert the data into type "Expression" [letPrint2 p885]

```

[lassoc p??]
[isgenvar p884]
[isSharpVarWithNum p884]
[gensymp p??]
[mathprint p??]
[spadcall p??]
[print p??]
[hasPair p889]
[pname p1047]
[break p904]
[bright p??]
[$BreakMode p659]
[$letAssoc p??]

```

— defun letPrint3 —

```

(defun |letPrint3| (x |xval| |printfn| |currentFunction|)
  (prog (|$BreakMode| |flag| y)
    (declare (special |$BreakMode| |$letAssoc|))
    (return

```

```

(progn
  (setq |$BreakMode| nil)
  (cond
    ((and |$letAssoc|
      (or (setq y (lassoc |currentFunction| |$letAssoc|))
        (setq y (lassoc '|all| |$letAssoc|))))
      (cond
        ((and
          (or (eq y '|all|) (member x y))
          (null (or (isgenvar x) (|isSharpVarWithNum| x) (gensymp x))))
          (setq |$BreakMode| '|letPrint2|)
          (setq |flag| nil)
          (catch '|letPrint2|
            (|mathprint|
              (cons '= (cons x (cons (spadcall |xval| |printfn|) nil))))
              |flag|)
          (cond
            ((eq |flag| '|letPrint2|) (|print| |xval|))
            (t nil))))
        (cond
          ((and
            (setq y (|hasPair| 'break y))
            (or
              (eq y '|all|)
              (and
                (member x y)
                (null (member (elt (pname x) 0) '($ |#|)))
                (null (gensymp x))))
            (|break|
              (append
                (|bright| |currentFunction|)
                (cons "breaks after"
                  (append (|bright| x) (cons " := " (cons |xval| nil)))))))
            (t nil))))
      x))))

```

53.1.66 defun getAliasIfTracedMapParameter

```

[isSharpVarWithNum p884]
[get p??]
[exit p??]
[spaddifference p??]
[string2pint-n p??]
[substring p??]
[pname p1047]

```

```
[seq p??]
[$InteractiveFrame p??]
```

— defun getAliasIfTracedMapParameter —

```
(defun |getAliasIfTracedMapParameter| (x |currentFunction|)
  (prog (|aliasList|)
    (declare (special |$InteractiveFrame|))
    (return
      (seq
        (cond
          ((|isSharpVarWithNum| x)
            (cond
              ((setq |aliasList|
                (|get| |currentFunction| 'alias |$InteractiveFrame|))
                (exit
                  (elt |aliasList|
                    (spaddifference
                      (string2pint-n (substring (pname x) 1 nil) 1) 1))))))
            (t x))))))
```

—————

53.1.67 defun getBpiNameIfTracedMap

```
[get p??]
[exit p??]
[seq p??]
[$InteractiveFrame p??]
[/tracenames p??]
```

— defun getBpiNameIfTracedMap —

```
(defun |getBpiNameIfTracedMap| (name)
  (prog (lmm bpiName)
    (declare (special |$InteractiveFrame| /tracenames))
    (return
      (seq
        (cond
          ((setq lmm (|get| name '|localModemap| |$InteractiveFrame|))
            (cond
              ((member (setq bpiName (cadar lmm)) /tracenames)
                (exit bpiName))))
          (t name))))))
```

—————

53.1.68 defun hasPair

[qcar p??]
 [qcdr p??]
 [hasPair p889]

— defun hasPair —

```
(defun |hasPair| (key arg)
  (prog (tmp1 a)
    (return
      (cond
        ((atom arg) nil)
        ((and (consp arg)
              (progn
                (setq tmp1 (qcar arg))
                (and (consp tmp1)
                     (equal (qcar tmp1) key)
                     (progn (setq a (qcdr tmp1)) t))))
          a)
        (t (|hasPair| key (cdr arg)))))))
```

—————

53.1.69 defun shortenForPrinting

[isDomainOrPackage p873]
 [devaluate p??]

— defun shortenForPrinting —

```
(defun |shortenForPrinting| (|val|)
  (if (|isDomainOrPackage| |val|)
      (|devaluate| |val|)
      |val|))
```

—————

53.1.70 defun spadTraceAlias

[internl p??]

— defun spadTraceAlias —

```
(defun |spadTraceAlias| (domainid op n)
```

[assoc p??]

[\$traceNoisely p844]

```
(defun |reportSpadTrace| (|header| t0)
  (prog (op sig n |t| |msg| |namePart| y |tracePart|)
    (declare (special |$traceNoisely|))
    (return
      (progn
        (setq op (car t0))
        (setq sig (cadr t0))
        (setq n (caddr t0))
        (setq |t| (cddddr t0))
        (cond
          ((null |$traceNoisely|) nil)
          (t
            (setq |msg|
              (cons |header|
                (cons '|%b|
                  (cons op
                    (cons '|:|
                      (cons '|%d|
                        (cons (CDR sig)
                          (cons '| -> |
                            (cons (car sig)
```

```

      (cons '| in slot |
        (cons n nil)))))))))
(setq |namePart| nil)
(setq |tracePart|
  (cond
    ((and (consp |t|) (progn (setq y (qcar |t|)) t) (null (null y)))
      (cond
        ((eq y '|all|)
          (cons '|%b| (cons '|all| (cons '|%d| (cons '|vars| nil)))))
        (t (cons '| vars: | (cons y nil)))))
      (t nil)))
(|sayBrightly| (append |msg| (append |namePart| |tracePart|)))))))))

```

53.1.73 defun orderBySlotNumber

```

[seq p??]
[assocright p??]
[orderList p??]
[exit p??]

```

— defun orderBySlotNumber —

```

(defun |orderBySlotNumber| (arg)
  (prog (n)
    (return
      (seq
        (assocright
          (|orderList|
            (prog (t0)
              (setq t0 nil)
              (return
                (do ((t1 arg (cdr t1)) (x nil))
                  ((or (atom t1)
                      (progn (setq x (car t1)) nil)
                      (progn (progn (setq n (caddr x)) x) nil))
                  (nreverse0 t0)))
              (seq
                (exit
                  (setq t0 (cons (cons n x) t0)))))))))))))

```

53.1.74 defun /tracereply

```
[qcar p??]
[isDomainOrPackage p873]
[devaluate p??]
[seq p??]
[exit p??]
[/tracenames p??]
```

— defun /tracereply —

```
(defun /tracereply ()
  (prog (|d| domainlist |functionList|)
    (declare (special /tracenames))
    (return
      (seq
        (cond
          ((null /tracenames) " Nothing is traced.")
          (t
            (do ((t0 /tracenames (cdr t0)) (x nil))
              ((or (atom t0) (progn (setq x (car t0)) nil)) nil)
            (seq
              (exit
                (cond
                  ((and (consp x)
                     (progn (setq |d| (qcar x)) t)
                     (|isDomainOrPackage| |d|))
                   (setq domainlist (cons (|devaluate| |d|) domainlist)))
                (t
                  (setq |functionList| (cons x |functionList|)))))))
            (append |functionList|
              (append domainlist (cons '|traced| nil))))))))))
```

—————

53.1.75 defun spadReply,printName

```
[seq p??]
[qcar p??]
[isDomainOrPackage p873]
[exit p??]
[devaluate p??]
```

— defun spadReply,printName —

```
(defun |spadReply,printName| (x)
```



```
(prog (|d|)
  (return
    (seq
      (if (and (and (consp x) (progn (setq |d| (qcar x)) t))
          (|isDomainOrPackage| |d|))
          (exit (|devaluate| |d|)))
        (exit x))))))
```

53.1.76 defun spadReply

```
[seq p??]
[exit p??]
[spadReply,printName p892]
[/tracenames p??]
```

— defun spadReply —

```
(defun |spadReply| ()
  (prog ()
    (declare (special /tracenames))
    (return
      (seq
        (prog (t0)
          (setq t0 nil)
          (return
            (do ((t1 /tracenames (cdr t1)) (x nil))
              ((or (atom t1) (progn (setq x (car t1)) nil)) (nreverse0 t0))
            (seq
              (exit
                (setq t0 (cons (|spadReply,printName| x) t0)))))))))))
```

53.1.77 defun spadUntrace

```
[isDomainOrPackage p873]
[userError p??]
[getOption p890]
[devaluate p??]
[assoc p??]
[sayMSG p331]
[bright p??]
```

```

[prefix2String p??]
[bpiname p??]
[remover p895]
[setletprintflag p??]
[bpiuntrace p??]
[rplac p??]
[seq p??]
[exit p??]
[delasc p??]
[spadReply p893]
[$letAssoc p??]
[/tracenames p??]

```

— defun `spadUntrace` —

```

(defun |spadUntrace| (domain options)
  (prog (anyiftrue listofoperations domainid |pair| sigslotnumberalist
        op sig n |lv| |bpiPointer| tracename alias |assocPair|
        |newSigSlotNumberAlist|)
    (declare (special |$letAssoc| /tracenames))
    (return
     (seq
      (cond
       ((null (|isDomainOrPackage| domain))
        (|userError| "bad argument to untrace")))
      (t
       (setq anyiftrue (null options))
       (setq listofoperations (|getOption| 'ops:| options))
       (setq domainid (|devaluate| domain))
       (cond
        ((null (setq |pair| (|assoc| domain /tracenames)))
         (|sayMSG|
          (cons " No functions in"
                (append
                 (|bright| (|prefix2String| domainid))
                 (cons "are now traced." nil))))))
        (t
         (setq sigslotnumberalist (cdr |pair|))
         (do ((t0 sigslotnumberalist (cdr t0)) (|pair| nil))
             ((or (atom t0)
                  (progn (setq |pair| (car t0)) nil)
                  (progn
                     (progn
                      (setq op (car |pair|))
                      (setq sig (cadr |pair|))
                      (setq n (caddr |pair|))
                      (setq |lv| (caddr |pair|))
                      (setq |bpiPointer| (car (cddddr |pair|)))
                      (setq tracename (cadr (cddddr |pair|)))

```

```

        (setq alias (caddr (cddddr |pair|)))
        |pair|)
      nil))
    nil)
  (seq
    (exit
      (cond
        ((or anyiftrue (member op listofoperations))
          (progn
            (bpiuntrace tracename alias)
            (rplac (car (elt domain n)) |bpiPointer|)
            (rplac (caddr |pair|) nil)
            (cond
              ((setq |assocPair|
                (|assoc| (bpiname |bpiPointer|) |$letAssoc|))
                (setq |$letAssoc| (remover |$letAssoc| |assocPair|))
                (cond
                  ((null |$letAssoc|) (setletprintflag nil))
                  (t nil)))
              (t nil))))))
          (t nil))))))
    (setq |newSigSlotNumberAlist|
      (prog (t1)
        (setq t1 nil)
        (return
          (do ((t2 sigslotnumberalist (cdr t2)) (x nil))
            ((or (atom t2) (progn (setq x (car t2)) nil)) (nreverse0 t1))
            (seq
              (exit
                (cond ((caddr x) (setq t1 (cons x t1))))))))))
      (cond
        (|newSigSlotNumberAlist|
          (rplac (cdr |pair|) |newSigSlotNumberAlist|))
        (t
          (setq /tracenames (delasc domain /tracenames))
          (|spadReply|))))))

```

53.1.78 defun remover

[remover p895]

— defun remover —

```

(defun remover (lst item)
  (cond
    ((null (consp lst)) (cond ((equal lst item) nil) (t lst)))
    ((equal (car lst) item) (cdr lst))

```

```
(t
  (rplnode lst (remover (car lst) item) (remover (cdr lst) item))
  (rplaca lst (remover (car lst) item))
  (rplacd lst (remover (cdr lst) item))
  lst)))
```

53.1.79 defun prTraceNames,fn

```
[seq p??]
[qcar p??]
[qcdr p??]
[isDomainOrPackage p873]
[exit p??]
[devaluate p??]
```

— defun prTraceNames,fn —

```
(defun |prTraceNames,fn| (x)
  (prog (|d| |t|)
    (return
      (seq
        (if (and (and (consp x)
                     (progn (setq |d| (qcar x)) (setq |t| (qcdr x)) t))
            (|isDomainOrPackage| |d|))
          (exit (cons (|devaluate| |d|) |t|)))
        (exit x))))))
```

53.1.80 defun prTraceNames

```
[seq p??]
[exit p??]
[prTraceNames,fn p896]
[/tracenames p??]
```

— defun prTraceNames —

```
(defun |prTraceNames| ()
  (declare (special /tracenames))
  (seq
    (progn
```

```
(do ((t0 /tracenames (cdr t0)) (x nil))
    ((or (atom t0) (progn (setq x (car t0)) nil)) nil)
  (seq
   (exit
    (print (|prTraceNames,fn| x)))))) nil)))
```

53.1.81 defvar \$constructors

— initvars —

```
(defvar |$constructors| nil)
```

53.1.82 defun traceReply

```
[sayMessage p??]
[sayBrightly p??]
[qcar p??]
[isDomainOrPackage p873]
[addTraceItem p900]
[isFunctor p??]
[isgenvar p884]
[userError p??]
[seq p??]
[exit p??]
[isSubForRedundantMapName p871]
[rassocSub p869]
[poundsign p??]
[sayMSG p331]
[sayBrightlyLength p??]
[flowSegmentedMsg p??]
[concat p1049]
[prefix2String p??]
[abbreviate p??]
[$domains p??]
[$packages p??]
[$constructors p897]
[$linelength p771]
[/tracenames p??]
```

— defun traceReply —

```
(defun |traceReply| ()
  (prog (|$domains| |$packages| |$constructors| |d| |functionList|
        |displayList|)
    (declare (special |$domains| |$packages| |$constructors| /tracenames
                      $linelength))
    (return
     (seq
      (progn
       (setq |$domains| nil)
       (setq |$packages| nil)
       (setq |$constructors| nil)
       (cond
        ((null /tracenames) (|sayMessage| "   Nothing is traced now."))
        (t
         (|sayBrightly| " ")
         (do ((t0 /tracenames (cdr t0)) (x nil))
             ((or (atom t0) (progn (setq x (car t0)) nil)) nil)
          (seq
           (exit
            (cond
             ((and (consp x)
                  (progn (setq |d| (qcar x)) t) (|isDomainOrPackage| |d|))
              (|addTraceItem| |d|))
             ((atom x)
              (cond
               ((|isFunctor| x) (|addTraceItem| x))
               ((|isgenvar| x) (|addTraceItem| (EVAL x)))
               (t (setq |functionList| (cons x |functionList|))))
              (t (|userError| "bad argument to trace"))))))
           (setq |functionList|
                (prog (t1)
                  (setq t1 nil)
                  (return
                   (do ((t2 |functionList| (cdr t2)) (x nil))
                       ((or (atom t2) (progn (setq x (car t2)) nil)) t1)
                    (seq
                     (exit
                      (cond
                       ((null (|isSubForRedundantMapName| x))
                        (setq t1
                          (append t1
                            (cons (|rassocSub| x |$mapSubNameAlist|)
                              (cons " " nil))))))))))))
                (cond
                 (|functionList|
                  (cond
                   ((eq 2 (|#| |functionList|))
```

```

      (|sayMSG| (cons '| Function traced: | |functionList|)))
    (<= (+ 22 (|sayBrightlyLength| |functionList|)) $linelength)
    (|sayMSG| (cons '| Functions traced: | |functionList|)))
  (t
    (|sayBrightly| " Functions traced:")
    (|sayBrightly|
      (|flowSegmentedMsg| |functionList| $linelength 6))))))
(cond
  (|$domains|
    (setq |displayList|
      (|concat|
        (|prefix2String| (CAR |$domains|))
        (prog (t3)
          (setq t3 nil)
          (return
            (do ((t4 (cdr |$domains|) (cdr t4)) (x nil))
              ((or (atom t4) (progn (setq x (car t4)) nil)) t3)
              (seq
                (exit
                  (setq t3
                    (append t3 (|concat| ", " " " (|prefix2String| x)))))))))))
    (cond
      ((atom |displayList|)
        (setq |displayList| (cons |displayList| nil)))
      (|sayBrightly| " Domains traced: ")
      (|sayBrightly| (|flowSegmentedMsg| |displayList| $linelength 6)))
    (cond
      (|$packages|
        (setq |displayList|
          (|concat|
            (|prefix2String| (CAR |$packages|))
            (prog (t5)
              (setq t5 nil)
              (return
                (do ((t6 (cdr |$packages|) (cdr t6)) (x nil))
                  ((or (atom t6) (progn (setq x (car t6)) nil)) t5)
                  (seq
                    (exit
                      (setq t5
                        (append t5 (|concat| ', | (|prefix2String| x)))))))))))
        (cond ((atom |displayList|)
          (setq |displayList| (cons |displayList| nil)))
          (|sayBrightly| " Packages traced: ")
          (|sayBrightly| (|flowSegmentedMsg| |displayList| $linelength 6)))
        (cond
          (|$constructors|
            (setq |displayList|
              (|concat|
                (|abbreviate| (CAR |$constructors|))
                (prog (t7)

```

```

(setq t7 nil)
(return
  (do ((t8 (cdr |$constructors|) (cdr t8)) (x nil))
      ((or (atom t8) (progn (setq x (car t8)) nil)) t7)
    (seq
      (exit
        (setq t7
          (append t7 (|concat| ' |, | (|abbreviate| x))))))))))
(cond ((atom |displayList|)
      (setq |displayList| (cons |displayList| nil))))
(|sayBrightly| "    Parameterized constructors traced:")
(|sayBrightly| (|flowSegmentedMsg| |displayList| $linelength 6)))
(t nil)))))))))

```

53.1.83 defun addTraceItem

```

[constructor? p??]
[isDomain p??]
[devaluate p??]
[isDomainOrPackage p873]
[$constructors p897]
[$domains p??]
[$packages p??]

```

— defun addTraceItem —

```

(defun |addTraceItem| (|d|)
  (declare (special |$constructors| |$domains| |$packages|))
  (cond
    ((|constructor?| |d|)
     (setq |$constructors| (cons |d| |$constructors|)))
    ((|isDomain| |d|)
     (setq |$domains| (cons (|devaluate| |d|) |$domains|)))
    ((|isDomainOrPackage| |d|)
     (setq |$packages| (cons (|devaluate| |d|) |$packages|)))))

```

53.1.84 defun ?t

```

[isgenvar p884]
[get p??]
[sayMSG p331]

```



```
[bright p??]
[rassocSub p869]
[qcar p??]
[qcdr p??]
[isDomainOrPackage p873]
[isDomain p??]
[reportSpadTrace p890]
[take p??]
[sayBrightly p??]
[devaluate p??]
[$mapSubNameAlist p??]
[$InteractiveFrame p??]
[/tracenames p??]
```

— defun ?t —

```
(defun |?t| ()
  (let (llm d suffix 1)
    (declare (special /tracenames |$InteractiveFrame| |$mapSubNameAlist|))
    (if (null /tracenames)
      (|sayMSG| (|bright| "nothing is traced"))
      (progn
        (dolist (x /tracenames)
          (cond
            ((and (atom x) (null (isgenvar x)))
              (progn
                (cond
                  ((setq llm (|get| x '|localModemap| |$InteractiveFrame|))
                    (setq x (list (cadar llm))))
                  (|sayMSG|
                    '("Function" ,@( |bright| (|rassocSub| x |$mapSubNameAlist|)
                      "traced"))))))
            (dolist (x /tracenames)
              (cond
                ((and (consp x)
                      (progn (setq d (qcar x)) (setq l (qcdr x)) t)
                      (|isDomainOrPackage| d))
                  (progn
                    (setq suffix (cond ((|isDomain| d) "domain") (t "package")))
                    (|sayBrightly|
                     '(" Functions traced in " ,suffix |%b| ,(|devaluate| d) |%d| ":"))
                    (dolist (x (|orderBySlotNumber| l))
                      (|reportSpadTrace| '| | (TAKE 4 x)))
                    (terpri))))))))))
```

53.1.85 defun tracelet

```
[gensymp p??]
[stupidIsSpadFunction p904]
[bpname p??]
[lassoc p??]
[union p??]
[setletprintflag p??]
[isgenvar p884]
[compileBoot p905]
[delete p??]
[$traceletflag p??]
[$QuickLet p??]
[$letAssoc p??]
[$traceletFunctions p??]
```

— defun tracelet —

```
(defun |tracelet| (fn |vars|)
  (prog ($traceletflag |$QuickLet| 1)
    (declare (special $traceletflag |$QuickLet| |$letAssoc|
                      |$traceletFunctions|))

    (return
     (progn
      (cond
       ((and (gensymp fn) (|stupidIsSpadFunction| (eval fn)))
        (setq fn (eval fn))
        (cond
         ((compiled-function-p fn) (setq fn (bpname fn)))
         (t nil))))
       (cond
        ((eq fn '|Undef|) nil)
        (t
         (setq |vars|
          (cond
           ((eq |vars| '|all|) '|all|)
           ((setq 1 (lassoc fn |$letAssoc|)) (|union| |vars| 1))
           (t |vars|)))
         (setq |$letAssoc| (cons (cons fn |vars|) |$letAssoc|))
         (cond (|$letAssoc| (setletprintflag t)))
         (setq $traceletflag t)
         (setq |$QuickLet| nil)
         (cond
          ((and (null (member fn |$traceletFunctions|))
                (null (isgenvar fn))
                (compiled-function-p (symbol-function fn))
                (null (|stupidIsSpadFunction| fn))
                (null (gensymp fn))))
```

```
(progn
  (setq |$traceletFunctions| (cons fn |$traceletFunctions|))
  (|compileBoot| fn)
  (setq |$traceletFunctions|
    (|delete| fn |$traceletFunctions|)))))))))
```

53.1.86 defun breaklet

```
[gensymp p??]
[stupidIsSpadFunction p904]
[bpiname p??]
[lassoc p??]
[assoc p??]
[union p??]
[setletprintflag p??]
[compileBoot p905]
[delete p??]
[$QuickLet p??]
[$letAssoc p??]
[$traceletFunctions p??]
```

— defun breaklet —

```
(defun |breaklet| (fn |vars|)
  (prog (|$QuickLet| |fnEntry| |pair|)
    (declare (special |$QuickLet| |$letAssoc| |$traceletFunctions|))
    (return
      (progn
        (cond
          ((and (gensymp fn) (|stupidIsSpadFunction| (eval fn)))
            (setq fn (eval fn))
            (cond
              ((compiled-function-p fn) (setq fn (bpiname fn)))
              (t nil))))
          (cond
            ((eq fn '|Undef|) nil)
            (t
              (setq |fnEntry| (lassoc fn |$letAssoc|))
              (setq |vars|
                (cond
                  ((setq |pair| (|assoc| 'break |fnEntry|))
                    (|union| |vars| (cdr |pair|)))
                  (t |vars|)))
              (setq |$letAssoc|
                (cond
```

```

((null |fnEntry|)
  (cons (cons fn (list (cons 'break |vars|))) |$letAssoc|))
  (|pair| (rplacd |pair| |vars|) |$letAssoc|)))
(cond (|$letAssoc| (setletprintflag t)))
(setq |$QuickLet| nil)
(cond
  ((and (null (member fn |$traceletFunctions|))
        (null (|stupidIsSpadFunction| fn))
        (null (gensymp fn))))
    (progn
      (setq |$traceletFunctions| (cons fn |$traceletFunctions|))
      (|compileBoot| fn)
      (setq |$traceletFunctions|
        (|delete| fn |$traceletFunctions|)))))))))

```

53.1.87 defun stupidIsSpadFunction

```

[strpos p1047]
[pname p1047]

```

— defun stupidIsSpadFunction —

```

(defun |stupidIsSpadFunction| (fn)
  (strpos ";" (pname fn) 0 nil))

```

53.1.88 defun break

```

[MONITOR,EVALTRAN p??]
[enable-backtrace p??]
[sayBrightly p??]
[interrupt p??]
[/breakcondition p??]

```

— defun break —

```

(defun |break| (msg)
  (prog (condition)
    (declare (special /breakcondition))
    (return
      (progn
        (setq condition (|MONITOR,EVALTRAN| /breakcondition nil))

```

```
(when (eval condition)
  (|sayBrightly| msg)
  (interrupt))))))
```

53.1.89 defun compileBoot

[/D,1 p??]

— defun compileBoot —

```
(defun |compileBoot| (fn)
  (/D,1| (list fn) '(/comp) nil nil))
```

Chapter 54

)undo help page Command

54.1 undo help page man page

— undo.help —

```
=====
A.27. )undo
=====
```

User Level Required: interpreter

Command Syntax:

-)undo
-)undo integer
-)undo integer [option]
-)undo)redo

where option is one of

-)after
-)before

Command Description:

This command is used to restore the state of the user environment to an earlier point in the interactive session. The argument of an)undo is an integer which must designate some step number in the interactive session.

```
)undo n
)undo n )after
```

These commands return the state of the interactive environment to that immediately after step *n*. If *n* is a positive number, then *n* refers to step number *n*. If *n* is a negative number, it refers to the *n*th previous command (that is, undoes the effects of the last *-n* commands).

A `)clear` all resets the `)undo` facility. Otherwise, an `)undo` undoes the effect of `)clear` with options `properties`, `value`, and `mode`, and that of a previous `undo`. If any such system commands are given between steps *n* and *n* + 1 (*n* > 0), their effect is undone for `)undo m` for any $0 < m \leq n$.

The command `)undo` is equivalent to `)undo -1` (it undoes the effect of the previous user expression). The command `)undo 0` undoes any of the above system commands issued since the last user expression.

`)undo n)before`

This command returns the state of the interactive environment to that immediately before step *n*. Any `)undo` or `)clear` system commands given before step *n* will not be undone.

`)undo)redo`

This command reads the file `redo.input`, created by the last `)undo` command. This file consists of all user input lines, excluding those backtracked over due to a previous `)undo`.

The command `)history)write` will eliminate the “undone” command lines of your program.

Also See:

o `)history`

1

54.2 Evaluation

Some Antique Comments About the Interpreter

EVAL BOOT contains the top level interface to the Scratchhpad-II interpreter. The Entry point into the interpreter from the parser is `processInteractive`.

The type analysis algorithm is contained in the file `BOTMUP BOOT`, and `MODSEL boot`, the map handling routines are in `MAP BOOT` and `NEWMAP BOOT`, and the interactive coerce routines are in `COERCE BOOT` and `COERCEFN BOOT`.

¹ “history” (35.4.7 p 580)

Conventions: All spad values in the interpreter are passed around in triples. These are lists of three items:

[value,mode,environment]

The value may be wrapped (this is a pair whose CAR is the atom WRAPPED and whose CDR is the value), which indicates that it is a real value, or unwrapped in which case it needs to be EVALed to produce the proper value. The mode is the type of value, and should always be completely specified (not contain \$EmptyMode). The environment is always empty, and is included for historical reasons.

Modemaps: Modemaps are descriptions of compiled Spad function which the interpreter uses to perform type analysis. They consist of patterns of types for the arguments, and conditions the types must satisfy for the function to apply. For each function name there is a list of modemaps in file modemap DATABASE for each distinct function with that name. The following is the list of the modemaps for “*” (multiplication. The first modemap (the one with the labels) is for module mltiplication which is multiplication of an element of a module by a member of its scalar domain.

This is the signature pattern for the modemap, it is of the form:

```

(DomainOfComputation TargetType <ArgumentType ...>)
|
|                                     This is the predicate that needs to be
|                                     satisfied for the modemap to apply
|                                     |
V                                     |
/-----/                           |
( ( (*1 *1 *2 *1)                   V
  /-----/
  ( (AND (ofCategory *1 (Module *2)) (ofCategory *2 (SimpleRing))) )
    . CATDEF) <-- This is the file where the function was defined
  ( (*1 *1 *2 *1)
    ( (AND (isDomain *2 (Integer)) (ofCategory *1 (AbelianGroup))) )
      . CATDEF)
  ( (*1 *1 *2 *1)
    ( (AND
      (isDomain *2 (NonNegativeInteger))
      (ofCategory *1 (AbelianMonoid))) )
      . CATDEF)
  ((*1 *1 *1 *1) ((ofCategory *1 (SemiGroup)) ) . CATDEF)
  )

```

Environments: Environments associate properties with atoms.

Some common properties are:

- **modeSet:** During interpretation we build a modeSet property for each node in the expression. This is (in theory) a list of all the types possible for the node. In the current implementation these modeSets always contain a single type.

- **value:** Value properties are always triples. This is where the values of variables are stored. We also build value properties for internal nodes during the bottom up phase.
- **mode:** This is the declared type of an identifier.

There are several different environments used in the interpreter:

- **\$InteractiveFrame:** this is the environment where the user values are stored. Any side effects of evaluation of a top-level expression are stored in this environment. It is always used as the starting environment for interpretation.
- **\$e:** This is the name used for **\$InteractiveFrame** while interpreting.
- **\$env:** This is local environment used by the interpreter. Only temporary information (such as types of local variables) is stored in **\$env**. It is thrown away after evaluation of each expression.

Frequently used global variables:

- **\$genValue:** if true then evaluate generated code, otherwise leave code unevaluated. If **\$genValue** is false then we are compiling.
- **\$op:** name of the top level operator (unused except in map printing)
- **\$mapList:** list of maps being type analyzed, used in recursive map type analysis.
- **\$compilingMap:** true when compiling a map, used to detect where to THROW when interpret-only is invoked
- **\$compilingLoop:** true when compiling a loop body, used to control nesting level of interp-only loop CATCH points
- **\$interpOnly:** true when in interpret only mode, used to call alternate forms of COLLECT and REPEAT.
- **\$inCOLLECT:** true when compiling a COLLECT, used only for hacked stream compiler.
- **\$StreamFrame:** used in printing streams, it is the environment where local stream variables are stored
- **\$declaredMode:** Weak type propagation for symbols, set in upCOERCE and upLET. This variable is used to determine the alternate polynomial types of Symbols.
- **\$localVars:** list of local variables in a map body
- **\$MapArgumentTypeList:** hack for stream compilation

54.2.1 defun evalDomain

```
[sayMSG p331]
[concat p1049]
[prefix2String p??]
[startTimingProcess p??]
[eval p??]
[mkEvalable p911]
[stopTimingProcess p??]
[$evalDomain p911]
```

— defun evalDomain —

```
(defun |evalDomain| (form)
  (let (result)
    (declare (special |$evalDomain|))
    (when |$evalDomain|
      (|sayMSG|
        (|concat| "   instantiating" ' |%b| (|prefix2String| form) ' |%d|)))
      (|startTimingProcess| ' |instantiation|)
      (setq result (|eval| (|mkEvalable| form)))
      (|stopTimingProcess| ' |instantiation|)
      result))
```

—————

54.2.2 defun mkEvalable

```
[qcar p??]
[qcdr p??]
[mkEvalable p911]
[devaluate p??]
[mkEvalableRecord p913]
[mkEvalableUnion p913]
[mkEvalableMapping p913]
[loadIfNecessary p??]
[getdatabase p1009]
[mkq p??]
[constructor? p??]
[fbpip p??]
[bpiname p??]
[$Integer p??]
[$EmptyMode p??]
```

— defun mkEvalable —

```

(defun |mkEvalable| (form)
  (let (op argl kind cosig)
    (declare (special |$Integer| |$EmptyMode|))
    (cond
      ((consp form)
        (setq op (qcar form))
        (setq argl (qcdr form))
        (cond
          ((eq op 'quote) form)
          ((eq op 'wrapped) (|mkEvalable| (|devaluate| argl)))
          ((eq op '|Record|) (|mkEvalableRecord| form))
          ((eq op '|Union|) (|mkEvalableUnion| form))
          ((eq op '|Mapping|) (|mkEvalableMapping| form))
          ((eq op '|Enumeration|) form)
        )
        (t
          (|loadIfNecessary| op)
          (setq kind (getdatabase op 'constructorkind))
          (cond
            ((setq cosig (getdatabase op 'cosig))
              (cons op
                (loop for x in argl for typeFlag in (rest cosig)
                  collect
                    (cond
                      (typeFlag
                        (cond
                          ((eq kind '|category|) (mkq x))
                          ((vecp x) (mkq x))
                          (t
                            (|loadIfNecessary| x)
                            (|mkEvalable| x))))
                        ((and (consp x) (eq (qcar x) 'quote)) x)
                        ((and (consp x) (eq (qcar x) '|#|) (consp (qcdr x))
                          (eq (qcdr (qcdr x)) nil))
                          (list 'size (mkq (qcar (qcdr x)))))
                        (t (mkq x))))))
              (t
                (cons op
                  (loop for x in argl
                    collect (|mkEvalable| x))))))
            (t
              (equal form |$EmptyMode|) |$Integer|
              ((and (identp form) (|constructor?| form)) (list form))
              ((fbpip form) (bpiname form))
              (t form))))
    )
  )

```

54.2.3 defun mkEvalableUnion

[mkEvalable p911]

— defun mkEvalableUnion —

```
(defun |mkEvalableUnion| (form)
  (cond
    ((|isTaggedUnion| form)
     (cons
      (car form)
      (loop for item in (rest form)
            collect (list '|:| (second item) (|mkEvalable| (third item))))))
    (t
     (cons (car form)
           (loop for d in (rest form)
                 collect (|mkEvalable| d))))))
```

54.2.4 defun mkEvalableRecord

[mkEvalable p911]

— defun mkEvalableRecord —

```
(defun |mkEvalableRecord| (form)
  (cons
   (car form)
   (loop for item in (rest form)
         collect (list (quote '|:|) (second item) (|mkEvalable| (third item))))))
```

54.2.5 defun mkEvalableMapping

[mkEvalable p911]

— defun mkEvalableMapping —

```
(defun |mkEvalableMapping| (form)
  (cons
   (car form)
   (loop for d in (rest form)
         collect (|mkEvalable| d))))
```

54.2.6 defun evaluateType

Takes a parsed, unabbreviated type and evaluates it, replacing type valued variables with their values, and calling bottomUp on non-type valued arguemnts to the constructor and finally checking to see whether the type satisfies the conditions of its modemap [isDomain-ValuedVariable p957]

```
[qcar p??]
[qcdr p??]
[mkAtree p??]
[bottomUp p??]
[objVal p??]
[getValue p??]
[evaluateSignature p918]
[member p1050]
[evaluateType p914]
[constructor? p??]
[throwEvalTypeMsg p917]
[$EmptyMode p??]
[$expandSegments p??]
```

— defun evaluateType —

```
(defun |evaluateType| (form)
  (let (|$expandSegments| domain formp op argl)
    (declare (special |$expandSegments| |$EmptyMode|))
    (cond
      ((setq domain (|isDomainValuedVariable| form)) domain)
      ((equal form |$EmptyMode|) form)
      ((eq form '?) |$EmptyMode|)
      ((stringp form) form)
      ((eq form '$) form)
      (t
       (setq |$expandSegments| nil)
       (cond
         ((and (consp form) (eq (qcar form) '|typeOf|) (consp (qcdr form))
          (eq (qcdr (qcdr form)) nil))
          (setq formp (|mkAtree| form))
          (|bottomUp| formp)
          (|objVal| (|getValue| formp)))
         ((consp form)
          (setq op (qcar form))
          (setq argl (qcdr form))
          (cond
            ((eq op 'category)
             (cond
```

```

((consp arg1)
 (cons op
  (cons (qcar arg1)
   (loop for s in (qcdr arg1)
    collect (|evaluateSignature| s))))))
(t form)))
((|member| op '(|Join| |Mapping|))
 (cons op
  (loop for arg in arg1
   collect (|evaluateType| arg))))
((eq op '|Union|)
 (cond
  ((and arg1 (consp (car arg1)) (consp (qcdr (car arg1)))
   (consp (qcdr (qcdr (car arg1))))
   (eq (qcdr (qcdr (qcdr (car arg1)))) nil)
   (|member| (qcar (car arg1)) '(:| |Declare|)))
   (cons op
    (loop for item in arg1
     collect
      (list '|:| (second item) (|evaluateType| (third item))))))
  (t
   (cons op
    (loop for arg in arg1
     collect (|evaluateType| arg))))))
((eq op '|Record|)
 (cons op
  (loop for item in arg1
   collect
    (list '|:| (second item) (|evaluateType| (third item))))))
((eq op '|Enumeration|) form)
(t (|evaluateType1| form)))
((|constructor?| form)
 (if (atom form)
  (|evaluateType| (list form))
  (|throwEvalTypeMsg| 'S2IE0003 (list form form))))
(t (|throwEvalTypeMsg| 'S2IE0004 (list form))))))

```

54.2.7 defun Eval args passed to a constructor

Evaluates the arguments passed to a constructor [constructor? p??]

[getConstructorSignature p??]

[throwEvalTypeMsg p917]

[replaceSharps p956]

[categoryForm? p??]

[evaluateType p914]

```

[evalCategory p957]
[getdatabase p1009]
[mkAtree p??]
[putTarget p??]
[bottumUp p??]
[qcar p??]
[qcdr p??]
[getAndEvalConstructorArgument p956]
[coerceOrRetract p??]
[objValUnwrap p??]
[throwKeyedMsgCannotCoerceWithValue p??]
[makeOrdinal p918]
[$quadSymbol p??]
[$EmptyMode p??]

```

— defun evaluateType1 —

```

(defun |evaluateType1| (form)
  (let (op arg1 sig ml xp tree tmp1 m1 z1 zt zv v typeList (argnum 0))
    (declare (special |$quadSymbol| |$EmptyMode|))
    (setq op (car form))
    (setq arg1 (cdr form))
    (cond
      ((|constructor?| op)
       (cond
         ((null (setq sig (|getConstructorSignature| form)))
          (|throwEvalTypeMsg| 'S2IE0005 (list form)))
         (t
          (setq ml (cdr sig))
          (setq ml (|replaceSharps| ml form))
          (cond
            ((not (eql (|#| arg1) (|#| ml)))
             (|throwEvalTypeMsg| 'S2IE0003 (list form form)))
            (t
             (loop for x in arg1 for m in ml
                   do
                     (setq typeList
                           (cons
                            (cond
                              ((|categoryForm?| m)
                               (setq m (|evaluateType| (subst x '$ m)))
                               (if (|evalCategory| (setq xp (|evaluateType| x)) m)
                                   xp
                                   (|throwEvalTypeMsg| 'S2IE0004 (list form))))
                              (t
                               (setq m (|evaluateType| m)))
                              (cond
                                ((and (eq (getdatabase (|opOf| m) 'constructorkind) '|domain|)

```



```

      (setq tree (|mkAtree| x))
      (|putTarget| tree m)
      (progn
        (setq tmp1 (|bottomUp| tree))
        (and (consp tmp1)
              (eq (qcdr tmp1) nil))))
      (setq m1 (qcar tmp1))
      (setq z1 (|getAndEvalConstructorArgument| tree))
      (setq zt (car z1))
      (setq zv (cdr z1))
      (if (setq v (|coerceOrRetract| z1 m))
          (|objValUnwrap| v)
          (|throwKeyedMsgCannotCoerceWithValue| zv zt m)))
      (t
       (when (equal x |$EmptyMode|) (setq x |$quadSymbol|))
       (|throwEvalTypeMsg| 'S2IE0006
        (list (|makeOrdinal| (incf argnum)) m form))))))
      typeList)))
      (cons op (nreverse typeList))))))
      (t (|throwEvalTypeMsg| 'S2IE0007 (list op))))))

```

54.2.8 defvar \$noEvalTypeMsg

— initvars —

```
(defvar |$noEvalTypeMsg| nil)
```

54.2.9 defun throwEvalTypeMsg

```

[spadThrow p??]
[throwKeyedMsg p??]
|$noEvalTypeMsg p917]

```

— defun throwEvalTypeMsg —

```

(defun |throwEvalTypeMsg| (msg args)
  (declare (special |$noEvalTypeMsg|))
  (if |$noEvalTypeMsg|
      (|spadThrow|)
      (|throwKeyedMsg| msg args)))

```

54.2.10 defun makeOrdinal

— defun makeOrdinal —

```
(defun |makeOrdinal| (i)
  (elt '(|first| |second| |third| |fourth| |fifth| |sixth| |seventh|
        |eighth| |ninth| |tenth|)
    (1- i)))
```

54.2.11 defun evaluateSignature

Calls evaluateType on a signature [evaluateType p914]

— defun evaluateSignature —

```
(defun |evaluateSignature| (sig)
  (cond
    ((and (consp sig) (eq (qcar sig) 'signature) (consp (qcdr sig))
      (consp (qcdr (qcdr sig))) (eq (qcdr (qcdr (qcdr sig))) nil))
      (cons 'signature (cons (qcar (qcdr sig))
        (list
          (loop for z in (qcar (qcdr (qcdr sig)))
            collect (if (eq z '$) z (|evaluateType| z)))))))
    (t sig)))
```

54.3 Data Structures

`$frameRecord = [delta1, delta2, ...]` where `delta(i)` contains changes in the “backwards” direction. Each `delta(i)` has the form `((var . proplist)...)` where `proplist` denotes an ordinary proplist. For example, an entry of the form `((x (value) (mode (Integer))))...` indicates that to undo 1 step, `x`’s value is cleared and its mode should be set to `(Integer)`.

A `delta(i)` of the form `(systemCommand . delta)` is a special delta indicating changes due to system commands executed between the last command and the current command. By recording these deltas separately, it is possible to undo to either BEFORE or AFTER the command. These special `delta(i)`s are given ONLY when a system command is given which alters the environment.

Note: `recordFrame('system)` is called before a command is executed, and `recordFrame('normal)` is called after (see `processInteractive1`). If no changes are found for former, no special entry is given.

The `$previousBindings` is a copy of the CAAR `$InteractiveFrame`. This is used to compute the `delta(i)s` stored in `$frameRecord`.

54.4 Functions

54.4.1 Initial Undo Variables

```
$undoFlag := true      --Default setting for undo is "on"
$frameRecord := nil    --Initial setting for frame record
$previousBindings := nil
```

54.4.2 defvar \$undoFlag

— initvars —

```
(defvar |$undoFlag| t "t means we record undo information")
```

—————

54.4.3 defvar \$frameRecord

— initvars —

```
(defvar |$frameRecord| nil "a list of value changes")
```

—————

54.4.4 defvar \$previousBindings

— initvars —

```
(defvar |$previousBindings| nil "a copy of Interactive Frame info for undo")
```

—————

54.4.5 defvar \$reportUndo

— initvars —

```
(defvar |$reportUndo| nil "t means we report the steps undo takes")
```

—————

54.4.6 defun undo

```
[stringPrefix? p??]  
[pname p1047]  
[read p640]  
[userError p??]  
[qcdr p??]  
[qcar p??]  
[spaddifference p??]  
[identp p1048]  
[undoSteps p928]  
[undoCount p927]  
[$options p??]  
[$InteractiveFrame p??]
```

— defun undo —

```
(defun |undo| (l)  
  (let (tmp1 key s undoWhen n)  
    (declare (special |$options| |$InteractiveFrame|))  
    (setq undoWhen '|after|)  
    (when  
      (and (consp |$options|)  
           (eq (qcdr |$options|) nil)  
           (progn  
             (setq tmp1 (qcar |$options|))  
             (and (consp tmp1)  
                  (eq (qcdr tmp1) nil)  
                  (progn (setq key (qcar tmp1)) t))))  
      (cond  
        ((|stringPrefix?| (setq s (pname key)) "redo")  
         (setq |$options| nil)  
         (|read| '(|redo.input|)))  
        ((null (|stringPrefix?| s "before"))  
         (|userError| "only option to undo is \"redo\""))  
        (t  
         (setq undoWhen '|before|))))))
```

```

(if (null l)
  (setq n (spaddifference 1))
  (setq n (car l)))
(when (identp n)
  (setq n (parse-integer (pname n)))
  (unless (integerp n)
    (userError| "undo argument must be an integer")))
(setq |$InteractiveFrame| (|undoSteps| (|undoCount| n) undoWhen))
nil))

```

54.4.7 defun recordFrame

```

[kar p??]
[diffAlist p922]
[seq p??]
[exit p??]
[$undoFlag p919]
[$frameRecord p919]
[$InteractiveFrame p??]
[$previousBindings p919]

```

— defun recordFrame —

```

(defun |recordFrame| (systemNormal)
  (prog (currentAlist delta)
    (declare (special |$undoFlag| |$frameRecord| |$InteractiveFrame|
      |$previousBindings|))
    (return
      (seq
        (cond
          ((null |$undoFlag|) nil)
          (t
            (setq currentAlist (kar |$frameRecord|))
            (setq delta
              (|diffAlist| (caar |$InteractiveFrame|) |$previousBindings|))
            (cond
              ((eq systemNormal '|system|)
                (cond
                  ((null delta)
                    (return nil)))
                (t
                  (setq delta (cons '|systemCommand| delta))))))
            (setq |$frameRecord| (cons delta |$frameRecord|))
            (setq |$previousBindings|
              (prog (tmp0)

```

```

(setq tmp0 nil)
(return
  (do ((tmp1 (caar |$InteractiveFrame|) (cdr tmp1)) (x nil))
      ((or (atom tmp1)
            (progn (setq x (car tmp1)) nil))
       (nreverse0 tmp0))
    (seq
      (exit
        (setq tmp0
          (cons
            (cons
              (car x)
              (prog (tmp2)
                    (setq tmp2 nil)
                    (return
                      (do ((tmp3 (cdr x) (cdr tmp3)) (y nil))
                          ((or (atom tmp3)
                                (progn (setq y (car tmp3)) nil))
                           (nreverse0 tmp2))
                    (seq
                      (exit
                        (setq tmp2 (cons (cons (car y) (cdr y)) tmp2))))))))
            tmp0))))))
    (car |$frameRecord|))))))

```

54.4.8 defun diffAlist

```

diffAlist(new,old) ==
--record only those properties which are different
for (pair := [name,:proplist]) in new repeat
  -- name has an entry both in new and old world
  -- (1) if the old world had no proplist for that variable, then
  --   record NIL as the value of each new property
  -- (2) if the old world does have a proplist for that variable, then
  --   a) for each property with a value: give the old value
  --   b) for each property missing:      give NIL as the old value
oldPair := ASSQ(name,old) =>
null (oldProplist := CDR oldPair) =>
--record old values of new properties as NIL
acc := [ [name,:[ [prop] for [prop,.] in proplist] ],:acc]
deltas := nil
for (propval := [prop,:val]) in proplist repeat
  null (oldPropval := ASSOC(prop,oldProplist)) => --missing property
    deltas := [ [prop],:deltas]
  EQ(CDR oldPropval,val) => 'skip
  deltas := [oldPropval,:deltas]

```

```

    deltas => acc := [ [name,:NREVERSE deltas],:acc]
    acc := [ [name,:[ [prop] for [prop,:.] in proplist] ],:acc]
--record properties absent on new list (say, from a )cl all)
for (oldPair := [name,:r]) in old repeat
  r and null LASSQ(name,new) =>
    acc := [oldPair,:acc]
  -- name has an entry both in new and old world
  -- (1) if the new world has no proplist for that variable
  --   (a) if the old world does, record the old proplist
  --   (b) if the old world does not, record nothing
  -- (2) if the new world has a proplist for that variable, it has
  --   been handled by the first loop.
res := NREVERSE acc
if BOUNDP '$reportUndo and $reportUndo then reportUndo res
res

```

```

[assq p1052]
[tmp1 p??]
[seq p??]
[exit p??]
[assoc p??]
[lassq p??]
[reportUndo p925]

```

— defun diffAlist —

```

(defun |diffAlist| (new old)
  (prog (proplist oldPair oldProplist val oldPropval deltas prop name r acc res)
    (return
      (seq
        (progn
          (do ((tmp0 new (cdr tmp0)) (pair nil))
            ((or (atom tmp0)
                 (progn (setq pair (car tmp0)) nil)
                 (progn
                     (progn
                       (setq name (car pair))
                       (setq proplist (cdr pair))
                       pair)
                     nil))
              nil)
          (seq
            (exit
              (cond
                ((setq oldPair (assq name old))
                 (cond
                   ((null (setq oldProplist (cdr oldPair)))
                    (setq acc
                      (cons

```

```

(cons
  name
  (prog (tmp1)
    (setq tmp1 nil)
    (return
      (do ((tmp2 proplist (cdr tmp2)) (tmp3 nil))
        ((or (atom tmp2)
              (progn (setq tmp3 (car tmp2)) nil)
              (progn
                (progn (setq prop (car tmp3)) tmp3)
                nil))
              (nreverse0 tmp1)))
        (seq
          (exit
            (setq tmp1 (cons (cons prop nil) tmp1)))))))
    acc)))
(t
  (setq deltas nil)
  (do ((tmp4 proplist (cdr tmp4)) (|propval| nil))
    ((or (atom tmp4)
          (progn (setq |propval| (car tmp4)) nil)
          (progn
            (progn
              (setq prop (car |propval|))
              (setq val (cdr |propval|))
              |propval|)
            nil))
          nil))
    nil)
  (seq
    (exit
      (cond
        ((null (setq oldPropval (|assoc| prop oldProplist)))
          (setq deltas (cons (cons prop nil) deltas)))
        ((eq (cdr oldPropval) val) '|skip|)
        (t (setq deltas (cons oldPropval deltas))))))
    (when deltas
      (setq acc
        (cons (cons name (nreverse deltas)) acc))))))
(t
  (setq acc
    (cons
      (cons
        name
        (prog (tmp5)
          (setq tmp5 nil)
          (return
            (do ((tmp6 proplist (cdr tmp6)) (tmp7 nil))
              ((or (atom tmp6)
                    (progn (setq tmp7 (CAR tmp6)) nil)
                    (progn

```



```

                (progn (setq prop (CAR tmp7)) tmp7)
                nil))
            (nreverse0 tmp5))
        (seq
         (exit
          (setq tmp5 (cons (cons prop nil) tmp5)))))))))
    acc))))))
(seq
 (do ((tmp8 old (cdr tmp8)) (oldPair nil))
      ((or (atom tmp8)
           (progn (setq oldPair (car tmp8)) nil)
                 (progn
                  (setq name (car oldPair))
                  (setq r (cdr oldPair))
                  oldPair)
              nil))
       nil))
  nil)
(seq
 (exit
  (cond
   ((and r (null (lassq name new)))
    (exit
     (setq acc (cons oldPair acc)))))))))
(setq res (nreverse acc))
(cond
 ((and (boundp '$reportUndo) |$reportUndo|)
  (|reportUndo| res)))
(exit res))))))

```

54.4.9 defun reportUndo

This function is enabled by setting `$reportUndo` to a non-nil value. An example of the output generated is:

```
r := binary(22/7)
```

```

---
(1)  11.001

```

Type: BinaryExpansion

Properties of % ::

value was: NIL

value is: ((|BinaryExpansion|) WRAPPED . #(1 (1 1) NIL (0 0 1)))

Properties of r ::

value was: NIL

```
[seq p??]  
[exit p??]  
[sayBrightly p??]  
[concat p1049]  
[pname p1047]  
[lassoc p??]  
[sayBrightlyNT p??]  
[pp p??]  
[$InteractiveFrame p??]
```

```
(defun |reportUndo| (acc)
  (prog (name proplist curproplist prop value)
    (declare (special |$InteractiveFrame|))
    (return
      (seq
        (do ((tmp0 acc (cdr tmp0)) (tmp1 nil))
          ((or (atom tmp0)
              (progn (setq tmp1 (car tmp0)) nil)
              (progn
                (progn
                  (setq name (car tmp1))
                  (setq proplist (cdr tmp1))
                  tmp1)
                nil))
            nil))
          nil)
        (seq
          (exit
            (progn
              (|sayBrightly|
                (concat ' |Properties of | (pname name) " ::"))
              (setq curproplist (lassoc name (caar |$InteractiveFrame|)))
              (do ((tmp2 proplist (cdr tmp2)) (tmp3 nil))
                ((or (atom tmp2)
                    (progn (setq tmp3 (car tmp2)) nil)
                    (progn
                      (progn
                        (setq prop (car tmp3))
                        (setq value (cdr tmp3))
                        tmp3)
                      nil))
                  nil)
                nil)
              (seq
                (exit
                  (progn
```

```
(|sayBrightlyNT|
  (cons " " (cons prop (cons " was: " nil))))
(|pp| value)
(|sayBrightlyNT|
  (cons " " (cons prop (cons " is: " nil))))
(|pp| (lassoc prop curproplist)))))))))
```

54.4.10 defun clearFrame

```
[clearCmdAll p501]
[$frameRecord p919]
[$previousBindings p919]
```

— defun clearFrame —

```
(defun |clearFrame| ()
  (declare (special |$frameRecord| |$previousBindings|))
  (|clearCmdAll|)
  (setq |$frameRecord| nil)
  (setq |$previousBindings| nil))
```

54.4.11 Undo previous n commands

```
[spaddifference p??]
[userError p??]
[concat p1049]
[$IOindex p??]
```

— defun undoCount —

```
(defun |undoCount| (n)
  "Undo previous n commands"
  (prog (m)
    (declare (special |$IOindex|))
    (return
      (progn
        (setq m
          (cond
            ((>= n 0) (spaddifference (spaddifference |$IOindex| n) 1))
            (t (spaddifference n))))
        (cond
```

```

((>= m |$IOindex|)
 (|userError|
  (concat "Magnitude of undo argument must be less than step number ("
    (princ-to-string |$IOindex|) ")."))))
(t m))))))

```

54.4.12 defun undoSteps

```

-- undoes m previous commands; if )before option, then undo one extra at end
--Example: if $IOindex now is 6 and m = 2 then general layout of $frameRecord,
-- after the call to recordFrame below will be:
-- (<change for systemcommands>
-- (<change for #5> <change for system commands>
-- (<change for #4> <change for system commands>
-- (<change for #3> <change for system commands>
-- <change for #2> <change for system commands>
-- <change for #1> <change for system commands>) where system
-- command entries are optional and identified by (systemCommand . change).
-- For a ")undo 3 )after", m = 2 and undoStep swill restore the environment
-- up to, but not including <change for #3>.
-- An "undo 3 )before" will additionally restore <change for #3>.
-- Thus, the later requires one extra undo at the end.

```

```

[writeInputLines p585]
[spaddifference p??]
[recordFrame p921]
[copy p??]
[undoSingleStep p929]
[qcdr p??]
[qcar p??]
[$IOindex p??]
[$InteractiveFrame p??]
[$frameRecord p919]

```

— defun undoSteps —

```

(defun |undoSteps| (m beforeOrAfter)
  (let (tmp1 tmp2 systemDelta lastTailSeen env)
    (declare (special |$IOindex| |$InteractiveFrame| |$frameRecord|))
    (|writeInputLines| '|redo| (spaddifference |$IOindex| m))
    (|recordFrame| '|normal|)
    (setq env (copy (caar |$InteractiveFrame|)))
    (do ((i 0 (1+ i)) (framelist |$frameRecord| (cdr framelist)))
        ((or (> i m) (atom framelist)) nil)

```

```

(setq env (|undoSingleStep| (CAR framelist) env))
(if (and (consp framelist)
        (progn
          (setq tmp1 (qcdr framelist))
          (and (consp tmp1)
                (progn
                  (setq tmp2 (qcar tmp1))
                  (and (consp tmp2)
                        (eq (qcar tmp2) '|systemCommand|)
                        (progn
                          (setq systemDelta (qcdr tmp2))
                          t)))))))
    (progn
      (setq framelist (cdr framelist))
      (setq env (|undoSingleStep| systemDelta env)))
    (setq lastTailSeen framelist)))
(cond
 ((eq beforeOrAfter '|before|)
  (setq env (|undoSingleStep| (car (cdr lastTailSeen)) env))))
(setq |$frameRecord| (cdr |$frameRecord|))
(setq |$InteractiveFrame| (list (list env))))

```

54.4.13 defun undoSingleStep

```

undoSingleStep(changes,env) ==
--Each change is a name-proplist pair. For each change:
-- (1) if there exists a proplist in env, then for each prop-value change:
--     (a) if the prop exists in env, RPLAC in the change value
--     (b) otherwise, CONS it onto the front of prop-values for that name
-- (2) add change to the front of env
-- pp '"----Undoing 1 step-----"
-- pp changes

```

```

[assq p1052]
[seq p??]
[exit p??]
[lassoc p??]
[undoLocalModemapHack p931]

```

— defun undoSingleStep —

```

(defun |undoSingleStep| (changes env)
  (prog (name changeList pairlist proplist prop value node)
    (return
      (seq

```

```

(progn
  (do ((tmp0 changes (cdr tmp0)) (|change| nil))
      ((or (atom tmp0)
            (progn (setq |change| (car tmp0)) nil)
            (progn
              (progn
                (setq name (car |change|))
                (setq changeList (cdr |change|))
                |change|)
              nil))
        nil)
    (seq
      (exit
        (progn
          (when (lassoc '|localModemap| changeList)
            (setq changeList (|undoLocalModemapHack| changeList)))
          (cond
            ((setq pairlist (assq name env))
              (cond
                ((setq proplist (cdr pairlist))
                  (do ((tmp1 changeList (cdr tmp1)) (pair nil))
                      ((or (atom tmp1)
                            (progn (setq pair (car tmp1)) nil)
                            (progn
                              (progn
                                (setq prop (car pair))
                                (setq value (cdr pair))
                                pair)
                              nil))
                      nil)
                  (seq
                    (exit
                      (cond
                        ((setq node (assq prop proplist))
                          (rplacd node value))
                        (t
                          (rplacd proplist
                                (cons (car proplist) (cdr proplist)))
                          (rplaca proplist pair))))))
                    (t (rplacd pairlist changeList))))
                  (t
                    (setq env (cons |change| env))))))))
      env))))

```

54.4.14 defun undoLocalModemapHack

```
[seq p??]
[exit p??]
```

— defun undoLocalModemapHack —

```
(defun |undoLocalModemapHack| (changeList)
  (prog (name value)
    (return
      (seq
        (prog (tmp0)
          (setq tmp0 nil)
          (return
            (do ((tmp1 changeList (cdr tmp1)) (pair nil))
              ((or (atom tmp1)
                   (progn (setq pair (car tmp1)) nil)
                   (progn
                     (setq name (car pair))
                     (setq value (cdr pair))
                     pair)
                   nil)))
              (nreverse0 tmp0)))
          (seq
            (exit
              (cond
                ((cond
                  ((eq name '|localModemap|) (cons name nil))
                  (t pair))
                 (setq tmp0
                   (cons
                     (cond
                       ((eq name '|localModemap|) (cons name nil))
                       (t pair)) tmp0))))))))))))))
```

—————

54.4.15 Remove undo lines from history write

Removing undo lines from)hist)write linelist [stringPrefix? p??]

```
[seq p??]
[exit p??]
[trimString p??]
[substring p??]
[charPosition p??]
[maxindex p??]
```

```
[undoCount p927]
[spaddifference p??]
[concat p1049]
[$currentLine p??]
[$IOindex p??]
```

— defun removeUndoLines —

```
(defun |removeUndoLines| (u)
  "Remove undo lines from history write"
  (prog (xtra savedIOindex s s1 m s2 x code c n acc)
    (declare (special |$currentLine| |$IOindex|))
    (return
      (seq
        (progn
          (setq xtra
            (cond
              ((stringp |$currentLine|) (cons |$currentLine| nil))
              (t (reverse |$currentLine|))))
          (setq xtra
            (prog (tmp0)
              (setq tmp0 nil)
              (return
                (do ((tmp1 xtra (cdr tmp1)) (x nil))
                  ((or (atom tmp1)
                      (progn (setq x (car tmp1)) nil))
                   (nreverse0 tmp0)))
                (seq
                  (exit
                    (cond
                      ((null (|stringPrefix?| ")history" x))
                      (setq tmp0 (cons x tmp0))))))))
              (setq u (append u xtra))
              (cond
                ((null
                  (prog (tmp2)
                    (setq tmp2 nil)
                    (return
                      (do ((tmp3 nil tmp2) (tmp4 u (cdr tmp4)) (x nil))
                        ((or tmp3 (atom tmp4) (progn (setq x (car tmp4)) nil)) tmp2)
                      (seq
                        (exit
                          (setq tmp2
                            (or tmp2 (|stringPrefix?| ")undo" x))))))))) u)
                  (t
                    (setq savedIOindex |$IOindex|)
                    (setq |$IOindex| 1)
                    (do ((y u (cdr y)))
                      ((atom y) nil))
```



```

(seq
  (exit
    (cond
      ((eq1 (elt (setq x (car y)) 0) #\ )
        (cond
          ((|stringPrefix?| ")undo"
            (setq s (|trimString| x)))
          (setq s1 (|trimString| (substring s 5 nil)))
          (cond
            ((not (string= s1 ")redo"))
              (setq m (|charPosition| #\ ) s1 0))
              (setq code
                (cond
                  ((> (maxindex s1) m) (elt s1 (1+ m)))
                  (t #\a)))
                (setq s2 (|trimString| (substring s1 0 m))))))
            (setq n
              (cond
                ((string= s1 ")redo")
                  0)
                ((not (string= s2 ""))
                  (|undoCount| (parse-integer s2)))
                (t -1)))
              (rplaca y
                (concat ">" code (princ-to-string n))))
            (t nil)))
          (t (setq |$IOindex| (1+ |$IOindex|))))))
    (setq acc nil)
    (do ((y (nreverse u) (cdr y)))
      ((atom y) nil)
      (seq
        (exit
          (cond
            ((eq1 (elt (setq x (car y)) 0) #\>)
              (setq code (elt x 1))
              (setq n (parse-integer (substring x 2 nil)))
              (setq y (cdr y))
              (do ()
                ((null y) nil)
                (seq
                  (exit
                    (progn
                      (setq c (car y))
                      (cond
                        ((or (eq1 (elt c 0) #\))
                          (eq1 (elt c 0) #\>))
                        (setq y (cdr y)))
                      ((eq1 n 0)
                        (return nil))
                      (t

```

```
(setq n (spaddifference n 1))
(setq y (cdr y))))))
(cond
  ((and y (not (eql code #\b)))
    (setq acc (cons c acc))))
  (t (setq acc (cons x acc))))))
(setq |$I0index| savedI0index)
acc))))))
```

—————→

Chapter 55

)what help page Command

55.1 what help page man page

— what.help —

```
=====
A.28. )what
=====
```

User Level Required: interpreter

Command Syntax:

```
- )what categories pattern1 [pattern2 ...]
- )what commands  pattern1 [pattern2 ...]
- )what domains   pattern1 [pattern2 ...]
- )what operations pattern1 [pattern2 ...]
- )what packages  pattern1 [pattern2 ...]
- )what synonym   pattern1 [pattern2 ...]
- )what things    pattern1 [pattern2 ...]
- )apropos        pattern1 [pattern2 ...]
```

Command Description:

This command is used to display lists of things in the system. The patterns are all strings and, if present, restrict the contents of the lists. Only those items that contain one or more of the strings as substrings are displayed. For example,

```
)what synonym
```

displays all command synonyms,

)what synonym ver

displays all command synonyms containing the substring ‘ver’,

)what synonym ver pr

displays all command synonyms containing the substring ‘ver’ or the substring ‘pr’. Output similar to the following will be displayed

----- System Command Synonyms -----

user-defined synonyms satisfying patterns:

ver pr

```
)apr ..... )what things
)apropos ..... )what things
)prompt ..... )set message prompt
)version ..... )lisp *yearweek*
```

Several other things can be listed with the)what command:

categories displays a list of category constructors.

commands displays a list of system commands available at your user-level. Your user-level is set via the)set userlevel command. To get a description of a particular command, such as ‘)what’, issue)help what.

domains displays a list of domain constructors.

operations displays a list of operations in the system library.

It is recommended that you qualify this command with one or more patterns, as there are thousands of operations available. For example, say you are looking for functions that involve computation of eigenvalues. To find their names, try)what operations eig. A rather large list of operations is loaded into the workspace when this command is first issued. This list will be deleted when you clear the workspace via)clear all or)clear completely. It will be re-created if it is needed again.

packages displays a list of package constructors.

synonym lists system command synonyms.

things displays all of the above types for items containing the pattern strings as substrings. The command synonym)apropos is equivalent to)what things.

Also See:

- o)display
- o)set
- o)show

1

55.1.1 defvar \$whatOptions

— initvars —

```
(defvar |$whatOptions| '(|operations| |categories| |domains| |packages|
                        |commands| |synonyms| |things|))
```

55.1.2 defun what

[whatSpad2Cmd p938]

— defun what —

```
(defun |what| (l)
  (|whatSpad2Cmd| l))
```

55.1.3 defun whatSpad2Cmd,fixpat

[qcar p??]
[downcase p??]

— defun whatSpad2Cmd,fixpat —

```
(defun |whatSpad2Cmd,fixpat| (x)
  (let (xp)
    (if (and (consp x) (progn (setq xp (qcar x)) t))
        (downcase xp)
        (downcase x))))
```

¹ “display” (30.2.1 p 533) “set” (46.36.1 p 805) “show” (47.1.1 p 812)

55.1.4 defun whatSpad2Cmd

```
[reportWhatOptions p939]
[selectOptionLC p477]
[sayKeyedMsg p329]
[seq p??]
[exit p??]
[whatSpad2Cmd,fixpat p937]
[whatSpad2Cmd p938]
[filterAndFormatConstructors p942]
[whatCommands p939]
[apropos p943]
[printSynonyms p472]
[$e p??]
[$whatOptions p937]
```

— defun whatSpad2Cmd —

```
(defun |whatSpad2Cmd| (arg)
  (prog (|$e| |key0| key args)
    (declare (special |$e| |$whatOptions|))
    (return
      (seq
        (progn
          (setq |$e| |$EmptyEnvironment|)
          (cond
            ((null arg) (|reportWhatOptions|))
            (t
              (setq |key0| (car arg))
              (setq args (cdr arg))
              (setq key (|selectOptionLC| |key0| |$whatOptions| nil))
              (cond
                ((null key) (|sayKeyedMsg| 's2iz0043 nil))
                (t
                  (setq args
                    (prog (t0)
                      (setq t0 nil)
                      (return
                        (do ((t1 args (cdr t1)) (p nil))
                          ((or (atom t1)
                                (progn (setq p (car t1)) nil))
                           (nreverse0 t0))
                        (seq
                          (exit
                            (setq t0 (cons (|whatSpad2Cmd,fixpat| p) t0))))))))
                    (seq
                      (exit
                        (setq t0 (cons (|whatSpad2Cmd,fixpat| p) t0)))))))
                  (seq
                    (cond
                      ((eq key '|things|)
```

```

(do ((t2 |$whatOptions| (cdr t2)) (opt nil))
  ((or (atom t2) (progn (setq opt (CAR t2)) nil)) nil)
  (seq
   (exit
    (cond
     ((null (member opt '(|things|)))
      (exit (|whatSpad2Cmd| (cons opt args)))))))
  ((eq key '|categories|)
   (|filterAndFormatConstructors| '|category| "Categories" args))
  ((eq key '|commands|) (|whatCommands| args))
  ((eq key '|domains|)
   (|filterAndFormatConstructors| '|domain| "Domains" args))
  ((eq key '|operations|)
   (|apropos| args))
  ((eq key '|packages|)
   (|filterAndFormatConstructors| '|package| "Packages" args))
  (t
   (cond ((eq key '|synonyms|)
          (|printSynonyms| args)))))))))

```

55.1.5 defun Show keywords for)what command

```

[sayBrightly p??]
[$whatOptions p937]

```

— defun reportWhatOptions —

```

(defun |reportWhatOptions| ()
  (let (optlist)
    (declare (special |$whatOptions|))
    (setq optlist
      (reduce #'append
        (mapcar #'(lambda (x) '(|%l| " " ,x)) |$whatOptions|)))
    (|sayBrightly|
      '(|%b| " )what" |%d| "argument keywords are" |%b| ,@optlist |%d|
        |%l| " or abbreviations thereof." |%l| |%l| " Issue" |%b| ")what ?"
        |%d| "for more information."))))

```

55.1.6 defun The)what commands implementation

```

[centerAndHighlight p??]
[streconc p??]

```

```
[specialChar p978]
[filterListOfStrings p940]
[commandsForUserLevel p446]
[sayMessage p??]
[blankList p??]
[sayAsManyPerLineAsPossible p??]
[say p??]
[sayKeyedMsg p329]
[$systemCommands p441]
[$linelength p771]
[$UserLevel p804]
```

— defun whatCommands —

```
(defun |whatCommands| (patterns)
  (let (label ell)
    (declare (special |$systemCommands| $linelength |$UserLevel|))
    (setq label
      (strconc '|System Commands for User Level: |
        (princ-to-string |$UserLevel|)))
    (|centerAndHighlight| label $linelength (|specialChar| '|hbar|))
    (setq ell
      (|filterListOfStrings| patterns
        (mapcar #'princ-to-string (|commandsForUserLevel| |$systemCommands|))))
    (when patterns
      (if ell
        (|sayMessage|
          '("System commands at this level matching patterns:" |%l| " " |%b|
            ,@(append (|blankList| patterns) (list '|%d|))))
        (|sayMessage|
          '("No system commands at this level matching patterns:" |%l| " " |%b|
            ,@(append (|blankList| patterns) (list '|%d|))))))
    (when ell
      (|sayAsManyPerLineAsPossible| ell)
      (say " "))
    (unless patterns (|sayKeyedMsg| 's2iz0046 nil))))
```

—————

55.1.7 defun Find all names contained in a pattern

Names and patterns are lists of strings. This returns a list of strings in names that contains any of the strings in the patterns [satisfiesRegularExpressions p941]

— defun filterListOfStrings —

```
(defun |filterListOfStrings| (patterns names)
```



```
(let (result)
  (if (or (null patterns) (null names))
      names
      (dolist (name (reverse names) result)
        (when (|satisfiesRegularExpressions| name patterns)
          (push name result))))))
```

55.1.8 defun Find function of names contained in pattern

The argument names and patterns are lists of strings. The argument fn is something like CAR or CADR This returns a list of strings in names that contains any of the strings in patterns [satisfiesRegularExpressions p941]

— defun filterListOfStringsWithFn —

```
(defun |filterListOfStringsWithFn| (patterns names fn)
  (let (result)
    (if (or (null patterns) (null names))
        names
        (dolist (name (reverse names) result)
          (when (|satisfiesRegularExpressions| (funcall fn name) patterns)
            (push name result))))))
```

55.1.9 defun satisfiesRegularExpressions

[strpos p1047]

— defun satisfiesRegularExpressions —

```
(defun |satisfiesRegularExpressions| (name patterns)
  (let ((dname (downcase (copy name))))
    (dolist (pattern patterns)
      (when (strpos pattern dname 0 "@")
        (return-from nil t)))))
```

55.1.10 defun filterAndFormatConstructors

[sayMessage p??]
 [blankList p??]
 [pp2Cols p??]
 [centerAndHighlight p??]
 [specialChar p978]
 [filterListOfStringsWithFn p941]
 [whatConstructors p943]
 [function p??]
 [\$linelength p771]

— defun filterAndFormatConstructors —

```
(defun |filterAndFormatConstructors| (constrType label patterns)
  (prog (1)
    (declare (special $linelength))
    (return
      (progn (|centerAndHighlight| label $linelength (|specialChar| '|hbar|))
        (setq 1
          (|filterListOfStringsWithFn| patterns
            (|whatConstructors| constrType)
            (|function| cdr)))
        (cond (patterns)
          (cond
            ((null 1)
              (|sayMessage|
                (cons " No "
                  (cons label
                    (cons " with names matching patterns:"
                      (cons '|%l|
                        (cons " "
                          (cons '|%b|
                            (append (|blankList| patterns)
                              (cons '|%d| nil)))))))))))
            (t
              (|sayMessage|
                (cons label
                  (cons " with names matching patterns:"
                    (cons '|%l|
                      (cons " "
                        (cons '|%b|
                          (append (|blankList| patterns)
                            (cons '|%d| nil))))))))))))
          (cond (1 (|pp2Cols| 1)))))))
```

55.1.11 defun whatConstructors

[boot-equal p??]

[getdatabase p1009]

[seq p??]

[msort p??]

[exit p??]

— defun whatConstructors —

```

(defun |whatConstructors| (constrType)
  (prog nil
    (return
      (seq
        (msort
          (prog (t0)
            (setq t0 nil)
            (return
              (do ((t1 (|allConstructors|) (cdr t1)) (|con| nil))
                ((or (atom t1) (progn (setq |con| (car t1)) nil)) (nreverse0 t0))
              (seq
                (exit
                  (cond
                    ((equal (getdatabase |con| 'constructorkind) constrType)
                     (setq t0
                       (cons
                        (cons
                          (getdatabase |con| 'abbreviation)
                          (string |con|))
                        t0))))))))))))))

```

—————

55.1.12 Display all operation names containing the fragment

Argument *l* is a list of operation name fragments. This displays all operation names containing these fragments [allOperations p1035]

[filterListOfStrings p940]

[seq p??]

[exit p??]

[downcase p??]

[sayMessage p??]

[sayAsManyPerLineAsPossible p??]

[msort p??]

[sayKeyedMsg p329]

— defun apropos —

```
(defun |apropos| (arg)
  "Display all operation names containing the fragment"
  (prog (ops)
    (return
      (seq
        (progn
          (setq ops
            (cond
              ((null arg) (|allOperations|))
              (t
               (|filterListOfStrings|
                (prog (t0)
                  (setq t0 nil)
                  (return
                     (do ((t1 arg (cdr t1)) (p nil))
                       ((or (atom t1) (progn (setq p (car t1)) nil))
                        (nreverse0 t0))
                     (seq (exit (setq t0 (cons (downcase (princ-to-string p)) t0))))))
                (|allOperations|))))))
          (cond
            (ops
             (|sayMessage| "Operations whose names satisfy the above pattern(s):")
             (|sayAsManyPerLineAsPossible| (msort ops))
             (|sayKeyedMsg| 's2if0011 (cons (car ops) nil)))
            (t
             (|sayMessage| "  There are no operations containing those patterns"
              nil))))))
```

—————

Chapter 56

)with help page Command

56.1 with help page man page

— with.help —

This command is obsolete.
This has been renamed)library.

See also:
o)library

1

56.1.1 defun with

[library p1013]

— defun with —

```
(defun |with| (args)
  (|library| args))
```

¹ “library” (67.1.34 p 1013)

Chapter 57

)workfiles help page Command

57.1 workfiles help page man page

57.1.1 defun workfiles

[workfilesSpad2Cmd p947]

— defun workfiles —

```
(defun |workfiles| (l)
  (|workfilesSpad2Cmd| l))
```

—————

57.1.2 defun workfilesSpad2Cmd

```
[throwKeyedMsg p??]
[selectOptionLC p477]
[pathname p1044]
[delete p??]
[makeInputFilename p981]
[sayKeyedMsg p329]
[namestring p1042]
[updateSourceFiles p544]
[say p??]
[centerAndHighlight p??]
[specialChar p978]
[sortby p??]
[sayBrightly p??]
```

```
[Options p??]
[sourceFiles p??]
[linelength p771]
```

— defun workfilesSpad2Cmd —

```
(defun |workfilesSpad2Cmd| (args)
  (let (deleteflag type flist type1 fl)
    (declare (special |Options| |sourceFiles| $linelength))
    (cond
      (args (|throwKeyedMsg| 's2iz0047 nil))
      (t
        (setq deleteflag nil)
        (do ((t0 |Options| (cdr t0)) (t1 nil))
          ((or (atom t0)
              (progn (setq t1 (car t0)) nil)
              (progn (progn (setq type (car t1)) t1) nil))
          nil)
          (setq type1
            (|selectOptionLC| type '(|boot| |lisp| |meta| |delete|) nil))
          (cond
            ((null type1) (|throwKeyedMsg| 's2iz0048 (cons type nil)))
            ((eq type1 '|delete|) (setq deleteflag t))))
        (do ((t2 |Options| (cdr t2)) (t3 nil))
          ((or (atom t2)
              (progn (setq t3 (CAR t2)) nil)
              (progn
                (progn
                  (setq type (car t3))
                  (setq flist (cdr t3)) t3)
                nil))
          nil)
          (setq type1 (|selectOptionLC| type '(|boot| |lisp| |meta| |delete|) nil))
          (unless (eq type1 '|delete|)
            (dolist (file flist)
              (setq fl (|pathname| (list file type1 "*")))
              (cond
                (deleteflag
                  (setq |sourceFiles| (|delete| fl |sourceFiles|)))
                ((null (makeInputFilename fl))
                  (|sayKeyedMsg| 's2iz0035 (list (|namestring| fl))))
                (t (|updateSourceFiles| fl))))))
          (say " ")
          (|centerAndHighlight|
            '| User-specified work files |
            $linelength
            (|specialChar| '|hbar|))
          (say " ")
          (if (null |sourceFiles|)
```



```
(say "  no files specified")
(progn
  (setq |$sourceFiles| (sortby '|pathnameType| |$sourceFiles|))
  (do ((t5 |$sourceFiles| (cdr t5)) (fl nil))
      ((or (atom t5) (progn (setq fl (car t5)) nil)) nil)
      (|sayBrightly| (list "  " (|namestring| fl))))))
```

Chapter 58

)zsystemdevelopment help page Command

58.1 zsystemdevelopment help page man page

58.1.1 defun zsystemdevelopment

[zsystemDevelopmentSpad2Cmd p951]

— defun zsystemdevelopment —

```
(defun |zsystemdevelopment| (arg)
  (|zsystemDevelopmentSpad2Cmd| arg))
```

—————

58.1.2 defun zsystemDevelopmentSpad2Cmd

[zsystemdevelopment1 p952]

[\$InteractiveMode p24]

— defun zsystemDevelopmentSpad2Cmd —

```
(defun |zsystemDevelopmentSpad2Cmd| (arg)
  (declare (special |$InteractiveMode|))
  (|zsystemdevelopment1| arg |$InteractiveMode|))
```

—————

58.1.3 defun zsystemdevelopment1

```
[filenam p??]
[selectOptionLC p477]
[/D,1 p??]
[/comp p??]
[version p??]
[defiostream p980]
[next p38]
[shut p980]
[kar p??]
[kadr p??]
[kaddr p??]
[sayMessage p??]
[sayBrightly p??]
[bright p??]
[$InteractiveMode p24]
[$options p??]
[/wsname p??]
[/version p??]
```

— defun zsystemdevelopment1 —

```
(defun |zsystemdevelopment1| (arg im)
  (let (|$InteractiveMode| fromopt opt optargs newopt opt1 constream upf fun)
    (declare (special |$InteractiveMode| /wsname /version |$options|))
    (setq |$InteractiveMode| im)
    (setq fromopt nil)
    (do ((t0 |$options| (cdr t0)) (t1 nil))
        ((or (atom t0)
              (progn (setq t1 (car t0)) nil)
              (progn
                 (progn
                  (setq opt (CAR t1))
                  (setq optargs (CDR t1))
                  t1)
                 nil)))
         nil)
      (setq opt1 (|selectOptionLC| opt '(|from|) nil))
      (when (eq opt1 '(|from|) (setq fromopt (cons (cons 'from optargs) nil))))
    (do ((t2 |$options| (cdr t2)) (t3 nil))
        ((or (atom t2)
              (progn (setq t3 (car t2)) nil)
              (progn
                 (progn
                  (setq opt (car t3))
                  (setq optargs (cdr t3))
                  t3)
                 nil)))
         nil))
```

```

        nil))
    nil)
  (unless optargs (setq optargs arg))
  (setq newopt (append optargs fromopt))
  (setq opt1 (|selectOptionLC| opt '(|from|) nil))
  (cond
   ((eq opt1 '|from|) nil)
   ((eq opt '|c|) (|/D,1| newopt (/COMP) nil nil))
   ((eq opt '|d|) (|/D,1| newopt 'define nil nil))
   ((eq opt '|dt|) (|/D,1| newopt 'define nil t))
   ((eq opt '|ct|) (|/D,1| newopt (/COMP) nil t))
   ((eq opt '|ctl|) (|/D,1| newopt (/COMP) nil 'tracelet))
   ((eq opt '|ec|) (|/D,1| newopt (/COMP) t nil))
   ((eq opt '|ect|) (|/D,1| newopt (/COMP) t t))
   ((eq opt '|el|) (|/D,1| newopt nil t nil))
   ((eq opt '|version|) (|version|))
   ((eq opt '|pause|)
    (setq constream
      (defiostream '((device . console) (qual . v)) 120 0))
    (next constream)
    (shut constream))
   ((or
    (eq opt '|update|)
    (eq opt '|patch|))
    (setq |$InteractiveMode| nil)
    (setq upf
      (cons
       (or (kar optargs) /version)
       (cons
        (or (kadr optargs) /wsname)
        (cons (or (kaddr optargs) '*) nil))))))
    (setq fun
      (cond
       ((eq opt '|patch|) '/update-lib-1)
       (t '/update-1)))
    (catch 'filenam (funcall fun upf))
    (|sayMessage| " Update/patch is completed.))
  ((null optargs)
   (|sayBrightly| '(" An argument is required for" ,@(|bright| opt))))
  (t
   (|sayMessage|
    '(" Unknown option:" ,@(|bright| opt)
      |%l| " Available options are"
      ,@(|bright|
        "c ct e ec ect cls pause update patch compare record"))))))))

```

Chapter 59

Handlers for Special Forms

This file contains the functions which do type analysis and evaluation of special functions in the interpreter. Special functions are ones which are not defined in the algebra code, such as assignment, construct, COLLECT and declaration.

Operators which require special handlers all have a LISP “up” property which is the name of the special handler, which is always the word “up” followed by the operator name. If an operator has this “up” property the handler is called automatically from bottomUp instead of general modemap selection.

The up handlers are usually split into two pieces, the first is the up function itself, which performs the type analysis, and an “eval” function, which generates (and executes, if required) the code for the function.

The up functions always take a single argument, which is the entire attributed tree for the operation, and return the modeSet of the node, which is a singleton list containing the type computed for the node.

The eval functions can take any arguments deemed necessary. Actual evaluation is done if `$genValue` is true, otherwise code is generated.

(See the function analyzeMap for other things that may affect what is generated in these functions.)

These functions are required to do two things:

1. do a putValue on the operator vector with the computed value of the node, which is a triple. This is usually done in the eval functions.
2. do a putModeSet on the operator vector with a list of the computed type of the node. This is usually done in the up functions.

There are several special modes used in these functions:

1. Void is the mode that should be used for all statements that do not otherwise return values, such as declarations, loops, IF-THEN's without ELSE's, etc..

2. `$NoValueMode` and `$ThrowAwayMode` used to be used in situations where `Void` is now used, and are being phased out completely.

59.0.4 `defun getAndEvalConstructorArgument`

```
[getValue p??]
[objMode p??]
[isWrapped p??]
[objVal p??]
[isLocalVar p??]
[compFailure p??]
[objNewWrap p??]
[timedEVALFUN p??]
```

— `defun getAndEvalConstructorArgument` —

```
(defun |getAndEvalConstructorArgument| (tree)
  (let (triple)
    (setq triple (|getValue| tree))
    (cond
      ((eq (|objMode| triple) '(|Domain|)) triple)
      ((|isWrapped| (|objVal| triple)) triple)
      ((|isLocalVar| (|objVal| triple))
       (|compFailure| " Local variable or parameter used in type"))
      (t
       (|objNewWrap| (|timedEVALFUN| (|objVal| triple)) (|objMode| triple))))))
```

59.0.5 `defun replaceSharps`

Replaces all sharps in `x` by the arguments of domain `d`. Replaces all replaces the triangle variables `[subCopy p??]`

```
[$TriangleVariableList p??]
[$FormalMapVariableList p??]
```

— `defun replaceSharps` —

```
(defun |replaceSharps| (x d)
  (let (sl)
    (declare (special |$TriangleVariableList| |$FormalMapVariableList|))
    (loop for e in (rest d) for var in |$FormalMapVariableList|
      do (setq sl (cons (cons var e) sl)))
    (setq x (|subCopy| x sl))
    (setq sl nil))
```



```
(loop for e in (rest d) for var in |$TriangleVariableList|
  do (setq sl (cons (cons var e) sl)))
(|subCopy| x sl)))
```

59.0.6 defun isDomainValuedVariable

Returns the value of form if form is a variable with a type value [identp p1048]

```
[get p??]
[member p1050]
[objMode p??]
[objValUnwrap p??]
[$e p??]
[$env p??]
[$InteractiveFrame p??]
```

— defun isDomainValuedVariable —

```
(defun |isDomainValuedVariable| (form)
  (let (val)
    (declare (special |$e| |$env| |$InteractiveFrame|))
    (when (and (identp form)
              (setq val
                    (or (|get| form '|value| |$InteractiveFrame|)
                        (and (consp |$env|) (|get| form '|value| |$env|))
                        (and (consp |$e|) (|get| form '|value| |$e|))))
          (|member| (|objMode| val) '((|Domain|) (|SubDomain| (|Domain|)))))
      (|objValUnwrap| val))))
```

59.0.7 defun evalCategory

```
[ofCategory p419]
[isPartialMode p420]
```

— defun evalCategory —

```
(defun |evalCategory| (d c)
  (or (|isPartialMode| d) (|ofCategory| d c)))
```

Chapter 60

Handling input files

60.0.8 defun Handle .axiom.input file

[/editfile p513]

— defun readSpadProfileIfThere —

```
(defun |readSpadProfileIfThere| ()  
  (let ((file (list '|.axiom| '|input|)))  
    (declare (special /editfile))  
    (when (makeInputFilename file) (setq /editfile file) (/rq))))
```

—————

60.0.9 defvar \$boot-line-stack

— initvars —

```
(defvar boot-line-stack nil "List of lines returned from preparse")
```

—————

60.0.10 defvar \$in-stream

— initvars —

```
(defvar in-stream t "Current input stream.")
```

60.0.11 defvar \$out-stream

— initvars —

```
(defvar out-stream t "Current output stream.")
```

60.0.12 defvar \$file-closed

— initvars —

```
(defvar file-closed nil "Way to stop EOF tests for console input.")
```

60.0.13 defvar \$echo-meta

— initvars —

```
(defvar echo-meta nil "T if you want a listing of what has been read.")
```

60.0.14 defvar \$noSubsumption

— initvars —

```
(defvar |$noSubsumption| t)
```

60.0.15 defvar \$envHashTable

The `$envHashTable` variable is a hashtable that optimizes lookups in the environment, which normally involve search. This gets populated in the `addBinding` function.

— **initvars** —

```
(defvar |$envHashTable| nil)
```

60.0.16 defun Dynamically add bindings to the environment

```
[getProplist p962]
[addBindingInteractive p965]
[hput p1046]
[$InteractiveMode p24]
[$envHashTable p961]
```

— **defun addBinding** —

```
(defun |addBinding| (var proplist e)
  (let (tailContour tailEnv tmp1 curContour lx)
    (declare (special |$InteractiveMode| |$envHashTable|))
    (setq curContour (caar e))
    (setq tailContour (cdar e))
    (setq tailEnv (cdr e))
    (cond
      ((eq proplist (|getProplist| var e)) e)
      (t
       (when |$envHashTable|
         (do ((prop proplist (cdr prop)) (u nil))
             ((or (atom prop)
                  (progn (setq u (car prop)) nil))
              nil)
          (hput |$envHashTable| (list var (car u)) t)))
        (cond
          (|$InteractiveMode| (|addBindingInteractive| var proplist e))
          (t
           (when (and (consp curContour)
                      (progn
                        (setq tmp1 (qcar curContour))
                        (and (consp tmp1) (equal (qcar tmp1) var))))
             (setq curContour (cdr curContour)))
           (setq lx (cons var proplist))
           (cons (cons (cons lx curContour) tailContour) tailEnv)))))))
```

60.0.17 defun Fetch a property list for a symbol from CategoryFrame

```
[getProplist p962]
[search p962]
[$CategoryFrame p??]
```

— defun getProplist —

```
(defun |getProplist| (x e)
  (let (u pl)
    (declare (special |$CategoryFrame|))
    (cond
      ((null (atom x)) (|getProplist| (car x) e))
      ((setq u (|search| x e)) u)
      ((setq pl (|search| x |$CategoryFrame|)) pl))))
```

—————

60.0.18 defun Search for a binding in the environment list

```
[searchCurrentEnv p962]
[searchTailEnv p963]
```

— defun search —

```
(defun |search| (x e)
  (let ((curEnv (car e)) (tailEnv (cdr e)))
    (or (|searchCurrentEnv| x curEnv) (|searchTailEnv| x tailEnv))))
```

—————

60.0.19 defun Search for a binding in the current environment

```
searchCurrentEnv(x,currentEnv) ==
  for contour in currentEnv repeat
    if u:= ASSQ(x,contour) then return (signal:= u)
  KDR signal
```

```
[assq p1052]
[kdr p??]
```

— defun searchCurrentEnv —

```
(defun |searchCurrentEnv| (x currentEnv)
```

```

(prog (u signal)
  (return
    (seq
      (progn
        (do ((thisenv currentEnv (cdr thisenv)) (contour nil))
          ((or (atom thisenv) (progn (setq contour (car thisenv)) nil)) nil)
        (seq
          (exit
            (cond
              ((setq u (assq x contour)) (return (setq signal u)))
              (t nil))))))
      (kdr signal))))))

```

60.0.20 defun searchTailEnv

```

;searchTailEnv(x,e) ==
; for env in e repeat
;   signal:=
;     for contour in env repeat
;       if (u:= ASSQ(x,contour)) and ASSQ("FLUID",u) then return (signal:= u)
;     if signal then return signal
; KDR signal

```

```

[assq p1052]
[kdr p??]

```

— defun searchTailEnv —

```

(defun |searchTailEnv| (x e)
  (prog (u signal)
    (return
      (seq
        (progn
          (do ((thise e (cdr thise)) (env nil))
            ((or (atom thise) (progn (setq env (car thise)) nil)) nil)
          (seq
            (exit
              (setq signal
                (progn
                  (do ((cone env (cdr cone)) (contour nil))
                    ((or (atom cone) (progn (setq contour (car cone)) nil)) nil)
                  (seq
                    (exit
                      (cond
                        ((and (setq u (assq x contour)) (assq 'fluid u))

```

```
        (return (setq signal u))
      (t nil))))
  (cond
    (signal (return signal))
    (t nil))))))
(kdr signal))))))
```

Chapter 61

File Parsing

61.0.21 defun Bind a variable in the interactive environment

[assq p1052]

— defun addBindingInteractive —

```
(defun |addBindingInteractive| (var proplist e)
  (let ((curContour (caar e)) u)
    (cond
      ((setq u (assq var curContour)) (rplacd u proplist) e)
      (t (rplac (caar e) (cons (cons var proplist) curContour)) e))))
```

—————

61.0.22 defvar \$line-handler

— initvars —

```
(defparameter line-handler 'next-META-line "Who grabs lines for us.")
```

—————

61.0.23 defvar \$spad-errors

— initvars —

```
(defvar $spad_errors (vector 0 0 0))
```

61.0.24 defvar \$xtokenreader

— initvars —

```
(defvar xtokenreader 'spadtok)
```

61.0.25 defun Initialize the spad reader

```
[next-lines-clear p970]
[ioclear p970]
[$spad-errors p965]
[spaderrorstream p??]
[*standard-output* p??]
[xtokenreader p966]
[line-handler p965]
[meta-error-handler p??]
[file-closed p960]
[boot-line-stack p959]
```

— defun init-boot/spad-reader —

```
(defun init-boot/spad-reader ()
  (declare (special $spad_errors spaderrorstream *standard-output*
                  xtokenreader line-handler meta-error-handler file-closed
                  boot-line-stack))
  (setq $spad_errors (vector 0 0 0))
  (setq spaderrorstream *standard-output*)
  (setq xtokenreader 'get-BOOT-token)
  (setq line-Handler 'next-BOOT-line)
  (setq meta-error-handler 'spad-syntax-error)
  (setq file-closed nil)
  (next-lines-clear)
  (ioclear))
```

61.0.26 defun spad-syntax-error

```
[bumperrorcount p??]
[consoleinputp p??]
[spad-long-error p967]
[spad-short-error p968]
[ioclear p970]
[debugmode p??]
[spad-reader p??]
```

— defun spad-syntax-error —

```
(defun spad-syntax-error (&rest byebye)
  "Print syntax error indication, underline character, scrub line."
  (declare (special debugmode))
  (bumperrorcount '|syntax|)
  (cond ((and (eq debugmode 'yes) (not(consoleinputp in-stream)))
    (spad-long-error))
    ((spad-short-error)))
  (ioclear)
  (throw 'spad_reader nil))
```

61.0.27 defun spad-long-error

```
[spad-error-loc p968]
[iostat p968]
[out-stream p960]
[spaderrorstream p??]
```

— defun spad-long-error —

```
(defun spad-long-error ()
  (declare (special spaderrorstream))
  (spad-error-loc spaderrorstream)
  (iostat)
  (unless (equal out-stream spaderrorstream)
    (spad-error-loc out-stream)
    (terpri out-stream)))
```

61.0.28 defun spad-short-error

```
[line-past-end-p p??]
[line-print p??]
[$current-line p??]
```

— defun spad-short-error —

```
(defun spad-short-error ()
  (if (line-past-end-p Current-Line)
      (format t "~&The current line is empty.~%")
      (progn
        (format t "~&The current line is:~%~%")
        (line-print current-line))))
```

—————

61.0.29 defun spad-error-loc

— defun spad-error-loc —

```
(defun spad-error-loc (str)
  (format str "***** Boot Syntax Error detected *****"))
```

—————

61.0.30 defun iostat

```
[line-past-end-p p??]
[line-print p??]
[token-stack-show p969]
[next-lines-show p969]
[$boot p25]
[$spad p20]
[$current-line p??]
```

— defun iostat —

```
(defun iostat ()
  "Tell me what the current state of the parsing world is."
  (declare (special $boot $spad))
  (if (line-past-end-p Current-Line)
      (format t "~&The current line is empty.~%")
```

```

(progn
  (format t "~&The current line is:~%~%")
  (line-print current-line)))
(if (or $boot $spad) (next-lines-show))
(token-stack-show)
nil)

```

61.0.31 defun next-lines-show

[boot-line-stack p959]

— defun next-lines-show —

```

(defun next-lines-show ()
  (declare (special boot-line-stack))
  (and boot-line-stack (format t "Currently prepared lines are:~%~%")
    (mapcar #'(lambda (line)
      (format t "~&~5D> ~A~%" (car line) (cdr line)))
      boot-line-stack))

```

61.0.32 defun token-stack-show

[token-type p??]
 [valid-tokens p??]
 [current-token p??]
 [next-token p??]
 [prior-token p??]

— defun token-stack-show —

```

(defun token-stack-show ()
  (if (= valid-tokens 0)
    (format t "~%There are no valid tokens.~%")
    (format t "~%The number of valid tokens is ~S.~%" valid-tokens))
  (when (> valid-tokens 0)
    (format t "The current token is~%")
    (describe current-token))
  (when (> valid-tokens 1)
    (format t "The next token is~%")
    (describe next-token))
  (when (token-type prior-token)

```

```
(format t "The prior token was~%")
(describe prior-token))
```

61.0.33 defun ioclear

The IO state manipulation routines assume that

- one I/O stream pair is in effect at any moment
- there is a current line
- there is a current token and a next token
- there is a reduction stack

```
[line-clear p??]
[reduce-stack-clear p??]
[current-fragment p??]
[current-line p??]
[$boot p25]
[$spad p20]
```

— defun ioclear —

```
(defun ioclear (&optional (in t) (out t))
  (declare (special current-fragment current-line $boot $spad)
    (ignore in out))
  (setq current-fragment nil)
  (line-clear current-line)
  (token-install nil nil current-token nil)
  (token-install nil nil next-token nil)
  (token-install nil nil prior-token nil)
  (reduce-stack-clear)
  (if (or $boot $spad) (next-lines-clear))
  nil)
```

61.0.34 defun Set boot-line-stack to nil

```
[boot-line-stack p959]
```

— defun next-lines-clear —

```
(defun next-lines-clear ()  
  (setq boot-line-stack nil))
```

Chapter 62

Handling output

62.1 Special Character Tables

62.1.1 `defvar $defaultSpecialCharacters`

— initvars —

```
(defvar |$defaultSpecialCharacters| (list
  (int-char 28)    ; upper left corner
  (int-char 27)    ; upper right corner
  (int-char 30)    ; lower left corner
  (int-char 31)    ; lower right corner
  (int-char 79)    ; vertical bar
  (int-char 45)    ; horizontal bar
  (int-char 144)   ; APL quad
  (int-char 173)   ; left bracket
  (int-char 189)   ; right bracket
  (int-char 192)   ; left brace
  (int-char 208)   ; right brace
  (int-char 59)    ; top    box tee
  (int-char 62)    ; bottom box tee
  (int-char 63)    ; right  box tee
  (int-char 61)    ; left   box tee
  (int-char 44)    ; center box tee
  (int-char 224))) ; back slash
```

62.1.2 defvar \$plainSpecialCharacters0

— initvars —

```
(defvar |$plainSpecialCharacters0| (list
  (int-char 78)      ; upper left corner  (+)
  (int-char 78)      ; upper right corner (+)
  (int-char 78)      ; lower left corner  (+)
  (int-char 78)      ; lower right corner (+)
  (int-char 79)      ; vertical bar
  (int-char 96)      ; horizontal bar      (-)
  (int-char 111)     ; APL quad            (?)
  (int-char 173)     ; left bracket
  (int-char 189)     ; right bracket
  (int-char 192)     ; left brace
  (int-char 208)     ; right brace
  (int-char 78)      ; top    box tee      (+)
  (int-char 78)      ; bottom box tee      (+)
  (int-char 78)      ; right  box tee      (+)
  (int-char 78)      ; left   box tee      (+)
  (int-char 78)      ; center box tee      (+)
  (int-char 224))) ; back slash
```

—————

62.1.3 defvar \$plainSpecialCharacters1

— initvars —

```
(defvar |$plainSpecialCharacters1| (list
  (int-char 107)     ; upper left corner  (,)
  (int-char 107)     ; upper right corner (,)
  (int-char 125)     ; lower left corner  (')
  (int-char 125)     ; lower right corner (')
  (int-char 79)      ; vertical bar
  (int-char 96)      ; horizontal bar      (-)
  (int-char 111)     ; APL quad            (?)
  (int-char 173)     ; left bracket
  (int-char 189)     ; right bracket
  (int-char 192)     ; left brace
  (int-char 208)     ; right brace
  (int-char 78)      ; top    box tee      (+)
  (int-char 78)      ; bottom box tee      (+)
  (int-char 78)      ; right  box tee      (+)
  (int-char 78)      ; left   box tee      (+)
```

```
(int-char 78)      ; center box tee      (+)
(int-char 224)))   ; back slash
```

62.1.4 defvar \$plainSpecialCharacters2

— initvars —

```
(defvar |$plainSpecialCharacters2| (list
  (int-char 79)      ; upper left corner  (|)
  (int-char 79)      ; upper right corner (|)
  (int-char 79)      ; lower left corner  (|)
  (int-char 79)      ; lower right corner (|)
  (int-char 79)      ; vertical bar
  (int-char 96)      ; horizontal bar      (-)
  (int-char 111)     ; APL quad           (?)
  (int-char 173)     ; left bracket
  (int-char 189)     ; right bracket
  (int-char 192)     ; left brace
  (int-char 208)     ; right brace
  (int-char 78)      ; top    box tee      (+)
  (int-char 78)      ; bottom box tee      (+)
  (int-char 78)      ; right  box tee      (+)
  (int-char 78)      ; left   box tee      (+)
  (int-char 78)      ; center box tee      (+)
  (int-char 224)))   ; back slash
```

62.1.5 defvar \$plainSpecialCharacters3

— initvars —

```
(defvar |$plainSpecialCharacters3| (list
  (int-char 96)      ; upper left corner  (-)
  (int-char 96)      ; upper right corner (-)
  (int-char 96)      ; lower left corner  (-)
  (int-char 96)      ; lower right corner (-)
  (int-char 79)      ; vertical bar
  (int-char 96)      ; horizontal bar      (-)
  (int-char 111)     ; APL quad           (?)
  (int-char 173)     ; left bracket
```

```

(int-char 189)    ; right bracket
(int-char 192)    ; left brace
(int-char 208)    ; right brace
(int-char 78)     ; top    box tee      (+)
(int-char 78)     ; bottom box tee      (+)
(int-char 78)     ; right  box tee      (+)
(int-char 78)     ; left   box tee      (+)
(int-char 78)     ; center box tee      (+)
(int-char 224)))  ; back slash

```

62.1.6 defvar \$plainRTspecialCharacters

— initvars —

```

(defvar |$plainRTspecialCharacters| (list
  (QUOTE +)      ; upper left corner  (+)
  (QUOTE +)      ; upper right corner (+)
  (QUOTE +)      ; lower left corner  (+)
  (QUOTE +)      ; lower right corner (+)
  (QUOTE |\\|)   ; vertical bar
  (QUOTE -)      ; horizontal bar      (-)
  (QUOTE ?)      ; APL quad            (?)
  (QUOTE [)      ; left bracket
  (QUOTE ])      ; right bracket
  (QUOTE {)      ; left brace
  (QUOTE })      ; right brace
  (QUOTE +)      ; top    box tee      (+)
  (QUOTE +)      ; bottom box tee      (+)
  (QUOTE +)      ; right  box tee      (+)
  (QUOTE +)      ; left   box tee      (+)
  (QUOTE +)      ; center box tee      (+)
  (QUOTE |\\|))) ; back slash

```

62.1.7 defvar \$RTspecialCharacters

— initvars —

```

(defvar |$RTspecialCharacters| (list
  (intern (string (code-char 218))) ;-- upper left corner  (+)

```

```

(intern (string (code-char 191))) ;-- upper right corner (+)
(intern (string (code-char 192))) ;-- lower left corner (+)
(intern (string (code-char 217))) ;-- lower right corner (+)
(intern (string (code-char 179))) ;-- vertical bar
(intern (string (code-char 196))) ;-- horizontal bar      (-)
(list (code-char #x1d) (code-char #xe2))
                                ;-- APL quad             (?)
(QUOTE [])                     ;-- left bracket
(QUOTE ])                     ;-- right bracket
(QUOTE {)                     ;-- left brace
(QUOTE })                     ;-- right brace
(intern (string (code-char 194))) ;-- top box tee        (+)
(intern (string (code-char 193))) ;-- bottom box tee     (+)
(intern (string (code-char 180))) ;-- right box tee      (+)
(intern (string (code-char 195))) ;-- left box tee       (+)
(intern (string (code-char 197))) ;-- center box tee     (+)
(QUOTE \\|))                  ;-- back slash

```

62.1.8 defvar \$specialCharacters

— initvars —

```
(defvar |$specialCharacters| |$RTspecialCharacters|)
```

62.1.9 defvar \$specialCharacterAlist

— initvars —

```

(defvar |$specialCharacterAlist|
  '([|ulc| . 0)
    [|urc| . 1)
    [|llc| . 2)
    [|lrc| . 3)
    [|vbar| . 4)
    [|hbar| . 5)
    [|quad| . 6)
    [|lbrk| . 7)
    [|rbrk| . 8)
    [|lbrc| . 9)

```

```
(|rbrcl| . 10)
(|ttee| . 11)
(|btee| . 12)
(|rtee| . 13)
(|ltee| . 14)
(|ctee| . 15)
(|bslash| . 16)))
```

62.1.10 defun Look up a special character code for a symbol

This function looks up a symbol in `$specialCharacterAlist`, gets the index into the EBCDIC table, and returns the appropriate character. **TPDHERE: Make this more international, not EBCDIC** [ifcdr p??]

```
[assq p1052]
[$specialCharacters p977]
[$specialCharacterAlist p977]
```

— defun specialChar —

```
(defun |specialChar| (symbol)
  (let (code)
    (declare (special |$specialCharacters| |$specialCharacterAlist|))
    (if (setq code (ifcdr (assq symbol |$specialCharacterAlist|)))
        (elt |$specialCharacters| code)
        "?")))
```

Chapter 63

Stream and File Handling

63.0.11 defun make-instream

[makeInputFilename p981]

— defun make-instream —

```
(defun make-instream (filespec &optional (recnum 0))
  (declare (ignore recnum))
  (cond ((numberp filespec) (make-synonym-stream '*terminal-io*))
        ((null filespec) (error "not handled yet"))
        (t (open (makeInputFilename filespec)
                  :direction :input :if-does-not-exist nil))))
```

—————

63.0.12 defun make-outstream

[make-filename p??]

— defun make-outstream —

```
(defun make-outstream (filespec &optional (width nil) (recnum 0))
  (declare (ignore width) (ignore recnum))
  (cond ((numberp filespec) (make-synonym-stream '*terminal-io*))
        ((null filespec) (error "not handled yet"))
        (t (open (make-filename filespec) :direction :output))))
```

—————

63.0.13 defun make-appendstream

[make-filename p??]

— defun make-appendstream —

```
(defun make-appendstream (filespec &optional (width nil) (recnum 0))
  "fortran support"
  (declare (ignore width) (ignore recnum))
  (cond
    ((numberp filespec) (make-synonym-stream '*terminal-io*))
    ((null filespec) (error "make-appendstream: not handled yet"))
    ('else (open (make-filename filespec) :direction :output
                  :if-exists :append :if-does-not-exist :create))))
```

63.0.14 defun defiostream

— defun defiostream —

```
(defun defiostream (stream-alist buffer-size char-position)
  (declare (ignore buffer-size))
  (let ((mode (or (cdr (assoc 'mode stream-alist)) 'input))
        (filename (cdr (assoc 'file stream-alist)))
        (dev (cdr (assoc 'device stream-alist))))
    (if (eq dev 'console) (make-synonym-stream '*terminal-io*)
        (let ((strm (case mode
                      ((output o) (open (make-filename filename)
                                           :direction :output))
                      ((input i) (open (makeInputFilename filename)
                                           :direction :input)))))
          (if (and (numberp char-position) (> char-position 0))
              (file-position strm char-position)
              strm))))
```

63.0.15 defun shut

[shut is-console (vol9)]

— defun shut —


```
(defun shut (st)
  (if (is-console st)
      st
      (if (streamp st) (close st) -1)))
```

63.0.16 defun eofp

— defun eofp —

```
(defun eofp (stream) (null (peek-char nil stream nil nil)))
```

63.0.17 defun makeStream

```
[make-appendstream p980]
[make-outstream p979]
```

— defun makeStream —

```
(defun |makeStream| (append filename i j)
  (if append
      (make-appendstream filename i j)
      (make-outstream filename i j)))
```

63.0.18 defun Construct a new input file name

— defun makeInputFilename —

```
(defun makeInputFilename (filearg &optional (filetype nil))
  (let*
    ((filename (make-filename filearg filetype))
     (dirname (pathname-directory filename))
     (ft (pathname-type filename))
     (dirs (getDirectoryList ft))
     (newfn nil))
    (if (or (null dirname) (eqcar dirname :relative))
```

```
(dolist (dir dirs (probeName filename))
  (when (probe-file (setq newfn (concatenate 'string dir filename)))
    (return newfn)))
(probeName filename))))
```

63.0.19 defun getDirectoryList

[*\$current-directory* p7]
 [*\$UserLevel* p804]
 [*\$library-directory-list* p9]
 [*\$directory-list* p8]

— defun getDirectoryList —

```
(defun getDirectoryList (ft &aux (cd (namestring $current-directory)))
  (declare (special $current-directory |$UserLevel| $library-directory-list
    $directory-list))
  (if (member ft '("nrlib" "daase" "exposed")) :test #'string=)
    (if (eq |$UserLevel| '|development|)
      (cons cd $library-directory-list)
      $library-directory-list)
    (adjoin cd
      (adjoin (namestring (user-homedir-pathname)) $directory-list
        :test #'string=)
      :test #'string=)))
```

63.0.20 defun probeName

Sometimes we are given a file and sometimes we are given the name of an Axiom KAF (Keyed-Access File). KAF files are actually directories with a single file called “index.kaf”. We check for the latter case and return the directory name as the filename, per Axiom convention.

— defun probeName —

```
(defun probeName (file)
  (when (or (probe-file file)
    (probe-file (concatenate 'string (namestring file) "/index.kaf")))
    (namestring file)))
```

63.0.21 defun makeFullNamestring

— defun makeFullNamestring —

```
(defun makeFullNamestring (filearg &optional (filetype nil))
  (namestring (merge-pathnames (make-filename filearg filetype))))
```

—————

63.0.22 defun Replace a file by erase and rename

[makeFullNamestring p983]

— defun replaceFile —

```
(defun replaceFile (filespec1 filespec2)
  ($erase (setq filespec1 (makeFullNamestring filespec1)))
  (rename-file (makeFullNamestring filespec2) filespec1))
```

—————

Chapter 64

The Spad Server Mechanism

64.0.23 defun openserver

This is a cover function for the C code used for communication interface.

— **defun openserver** —

```
(defun openserver (name)
  (open_server name))
```

—————

Chapter 65

Axiom Build-time Functions

65.0.24 defun spad-save

The **spad-save** function is just a cover function for more lisp system specific save functions. There is no standard name for saving a lisp image so we make one and conditionalize it at compile time.

This function is passed the name of an image that will be saved. The saved image contains all of the loaded functions.

This is used in the `src/interp/Makefile.pamphlet` in three places:

- creating `depsys`, an image for compiling axiom.

Some of the Common Lisp code we compile uses macros which are assumed to be available at compile time. The **DEPSYS** image is created to contain the compile time environment and saved. We pipe compile commands into this environment to compile from Common Lisp to machine dependent code.

```
DEPSYS=${OBJ}/${SYS}/bin/depsys
```

- creating `savesys`, an image for running axiom.

Once we've compile all of the Common Lisp files we fire up a clean lisp image called **LOADSYS**, load all of the final executable code and save it out as **SAVESYS**. The **SAVESYS** image is copied to the `${MNT}/${SYS}/bin` subdirectory and becomes the axiom executable image.

```
LOADSYS= ${OBJ}/${SYS}/bin/lisp
SAVESYS= ${OBJ}/${SYS}/bin/interpsys
AXIOMSYS= ${MNT}/${SYS}/bin/AXIOMsys
```

- creating `debugsys`, an image with all interpreted functions loaded.

Occasionally we need to really get into the system internals. The best way to do this is to run almost all of the lisp code interpreted rather than compiled (note that `cfuncs.lisp` and `sockio.lisp` still need to be loaded in compiled form as they depend on the loader to link with lisp internals). This image is nothing more than a load of the file `src/interp/debugsys.lisp.pamphlet`. If you need to make test modifications you can add code to that file and it will show up here.

```
DEBUGSYS=${OBJ}/${SYS}/bin/debugsys
```

```
[save-system p??]
[$SpadServer p12]
[$openServerIfTrue p10]
```

— defun spad-save —

```
(defun user::spad-save (save-file)
  (declare (special |$SpadServer| $openServerIfTrue))
  (setq |$SpadServer| nil)
  (setq $openServerIfTrue t)
  #+:AKCL
  (system::save-system save-file)
  #+:allegro
  (if (fboundp 'boot::restart)
      (excl::dumplisp :name save-file :restart-function #'boot::restart)
      (excl::dumplisp :name save-file))
  #+:Lucid
  (if (fboundp 'boot::restart)
      (sys::disksave save-file :restart-function #'boot::restart)
      (sys::disksave save-file))
  #+:CCL
  (preserve)
)
```

Chapter 66

Exposure Groups

Exposure groups are a way of controlling the namespace available to the user. Certain algebra files are only useful for internal purposes but they contain functions have common names (like “map”). In order to separate the user visible functions from the internal functions the algebra files are collected into “exposure groups”. These large groups are grouped into sets in the variable `$globalExposureGroupAlist`.

Exposure group information is kept in the local frame. For more information “The Frame Mechanism” 33.3.1 on page 550.

Chapter 67

Databases

67.1 Database structure

In order to understand this program you need to understand some details of the structure of the databases it reads. Axiom has 5 databases, the `interp.daase`, `operation.daase`, `category.daase`, `compress.daase`, and `browse.daase`. The `compress.daase` is special and does not follow the normal database format.

67.1.1 kaf File Format

This documentation refers to kaf files which are random access files. `nrllib` files are kaf files (look for `nrllib/index.kaf`) The format of a random access file is

```
byte-offset-of-key-table
first-entry
second-entry
...
last-entry
((key1 . first-entry-byte-address)
 (key2 . second-entry-byte-address)
 ...
 (keyN . last-entry-byte-address))
```

The key table is a standard lisp alist.

To open a database you fetch the first number, seek to that location, and `(read)` which returns the key-data alist. To look up data you index into the key-data alist, find the `ith-entry-byte-address`, seek to that address, and `(read)`.

For instance, see `src/share/algebra/users.daase/index.kaf`

One existing optimization is that if the data is a simple thing like a symbol then the `nth-entry-byte-address` is replaced by immediate data.

Another existing one is a compression algorithm applied to the data so that the very long names don't take up so much space. We could probably remove the compression algorithm as 64k is no longer considered 'huge'. The database-abbreviation routine handles this on read and write-compress handles this on write. The squeeze routine is used to compress the keys, the unsqueeze routine uncompresses them. Making these two routines disappear should remove all of the compression.

Indeed, a faster optimization is to simply read the whole database into the image before it is saved. The system would be easier to understand and the interpreter would be faster.

The fastest optimization is to fix the time stamp mechanism which is currently broken. Making this work requires a small bit of coordination at 'make' time which I forgot to implement.

67.1.2 Database Files

Database files are very similar to kaf files except that there is an optimization (currently broken) which makes the first item a pair of two numbers. The first number in the pair is the offset of the key-value table, the second is a time stamp. If the time stamp in the database matches the time stamp in the image the database is not needed (since the internal hash tables already contain all of the information). When the database is built the time stamp is saved in both the gcl image and the database.

Regarding the 'ancestors field for a category: At database build time there exists a `*ancestors-hash*` hash table that gets filled with CATEGORY (not domain) ancestor information. This later provides the information that goes into `interp.daase`. This `*ancestors-hash*` does not exist at normal runtime (it can be made by a call to `genCategoryTable`). Note that the ancestor information in `*ancestors-hash*` (and hence `interp.daase`) involves #1, #2, etc instead of R, Coef, etc. The latter thingies appear in all `.nrlib/index.kaf` files. So we need to be careful when we `)lib` categories and update the ancestor info.

This file contains the code to build, open and access the `.daase` files. This file contains the code to `)library` `nrlibs` and `asy` files

There is a major issue about the data that resides in these databases. the fundamental problem is that the system requires more information to build the databases than it needs to run the interpreter. in particular, `modemap.daase` is constructed using properties like "modemaps" but the interpreter will never ask for this information.

So, the design is as follows:

- the `modemap.daase` needs to be built. this is done by doing a `)library` on ALL of the `nrlib` files that are going into the system. this will bring in "modemap" information and add it to the `*modemaps-hash*` hashtable.
- database build proceeds, accessing the "modemap" property from the hashtables. once this completes this information is never used again.
- the `interp.daase` database is built. this contains only the information necessary to run the interpreter. note that during the running of the interpreter users can extend the

system by do a)library on a new nrlib file. this will cause fields such as "modemap" to be read and hashed.

Each constructor (e.g. LIST) had one library directory (e.g. LIST.nrlib). This directory contained a random access file called the index.kaf file. These files contain runtime information such as the operationAlist and the ConstructorModemap. At system build time we merge all of these .nrlib/index.kaf files into one database, INTERP.daase. Requests to get information from this database are cached so that multiple references do not cause additional disk i/o.

This database is left open at all times as it is used frequently by the interpreter. one minor complication is that newly compiled files need to override information that exists in this database.

The design calls for constructing a random read (kaf format) file that is accessed by functions that cache their results. when the database is opened the list of constructor-index pairs is hashed by constructor name. a request for information about a constructor causes the information to replace the index in the hash table. since the index is a number and the data is a non-numeric sexpr there is no source of confusion about when the data needs to be read.

The format of this new database is as follows:

```
first entry:
  an integer giving the byte offset to the constructor alist
  at the bottom of the file
second and subsequent entries (one per constructor)
  (operationAlist)
  (constructorModemap)
  ....
last entry: (pointed at by the first entry)
  an alist of (constructor . index) e.g.
    ( (PI offset-of-operationAlist offset-of-constructorModemap)
      (NNI offset-of-operationAlist offset-of-constructorModemap)
      ....)
This list is read at open time and hashed by the car of each item.
```

The system has been changed to use the property list of the symbols rather than hash tables. since we already hashed once to get the symbol we need only an offset to get the property list. this also has the advantage that eq hash tables no longer need to be moved during garbage collection.

There are 3 potential speedups that could be done.

- the best would be to use the value cell of the symbol rather than the property list but i'm unable to determine all uses of the value cell at the present time.
- a second speedup is to guarantee that the property list is a single item, namely the database structure. this removes an assoc but leaves one open to breaking the system if someone adds something to the property list. this was not done because of the danger mentioned.

- a third speedup is to make the `getdatabase` call go away, either by making it a macro or eliding it entirely. this was not done because we want to keep the flexibility of changing the database forms.

The new design does not use hash tables. the database structure contains an entry for each item that used to be in a hash table. initially the structure contains file-position pointers and these are replaced by real data when they are first looked up. the database structure is kept on the property list of the constructor, thus, `(get '—DenavitHartenbergMatrix— 'database)` will return the database structure object.

Each operation has a property on its symbol name called `'operation` which is a list of all of the signatures of operations with that name.

67.1.3 `defstruct $database`

— initvars —

```
(defstruct database
  abbreviation      ; interp.
  ancestors         ; interp.
  constructor       ; interp.
  constructorcategory ; interp.
  constructorkind   ; interp.
  constructormodemap ; interp.
  cosig            ; interp.
  defaultdomain    ; interp.
  modemaps         ; interp.
  niladic          ; interp.
  object           ; interp.
  operationalist    ; interp.
  documentation     ; browse.
  constructorform   ; browse.
  attributes        ; browse.
  predicates        ; browse.
  sourcefile        ; browse.
  parents           ; browse.
  users             ; browse.
  dependents        ; browse.
  spare             ; superstition
) ; database structure
```

67.1.4 defvar *\$*defaultdomain-list**

There are only a small number of domains that have default domains. rather than keep this slot in every domain we maintain a list here.

— **initvars** —

```
(defvar *defaultdomain-list* '(
  (|MultisetAggregate| |Multiset|)
  (|FunctionSpace| |Expression|)
  (|AlgebraicallyClosedFunctionSpace| |Expression|)
  (|ThreeSpaceCategory| |ThreeSpace|)
  (|DequeAggregate| |Deque|)
  (|ComplexCategory| |Complex|)
  (|LazyStreamAggregate| |Stream|)
  (|AssociationListAggregate| |AssociationList|)
  (|QuaternionCategory| |Quaternion|)
  (|PriorityQueueAggregate| |Heap|)
  (|PointCategory| |Point|)
  (|PlottableSpaceCurveCategory| |Plot3D|)
  (|PermutationCategory| |Permutation|)
  (|StringCategory| |String|)
  (|FileNameCategory| |FileName|)
  (|OctonionCategory| |Octonion|)))
```

—————

67.1.5 defvar *\$*operation-hash**

— **initvars** —

```
(defvar *operation-hash* nil "given an operation name, what are its modemaps?")
```

—————

67.1.6 defvar *\$*hasCategory-hash**

This hash table is used to answer the question“does domain x have category y?”. this is answered by constructing a pair of (x . y) and doing an equal hash into this table.

— **initvars** —

```
(defvar *hasCategory-hash* nil "answers x has y category questions")
```

—————

67.1.7 defvar `*miss*`

This variable is used for debugging. If a hash table lookup fails and this variable is non-nil then a message is printed.

— initvars —

```
(defvar *miss* nil "print out cache misses on getdatabase calls")
```

Note that constructorcategory information need only be kept for items of type category. this will be fixed in the next iteration when the need for the various caches are reviewed

Note that the `*modemaps-hash*` information does not need to be kept for system files. these are precomputed and kept in `modemap.daase` however, for user-defined files these are needed. Currently these are added to the database for 2 reasons; there is a still-unresolved issue of user database extensions and this information is used during database build time

67.1.8 Database streams

This are the streams for the databases. They are always open. There is an optimization for speeding up system startup. If the database is opened and the `..stream-stamp*` variable matches the position information in the database then the database is NOT read in and is assumed to match the in-core version

67.1.9 defvar `*compressvector*`

— initvars —

```
(defvar *compressvector* nil "a vector of things to compress in the databases")
```

67.1.10 defvar `*compressVectorLength*`

— initvars —

```
(defvar *compressVectorLength* 0 "length of the compress vector")
```

67.1.11 defvar \$*compress-stream*

— initvars —

```
(defvar *compress-stream* nil "an stream containing the compress vector")
```

—————

67.1.12 defvar \$*compress-stream-stamp*

— initvars —

```
(defvar *compress-stream-stamp* 0 "*compress-stream* (position . time)")
```

—————

67.1.13 defvar \$*interp-stream*

— initvars —

```
(defvar *interp-stream* nil "an open stream to the interpreter database")
```

—————

67.1.14 defvar \$*interp-stream-stamp*

— initvars —

```
(defvar *interp-stream-stamp* 0 "*interp-stream* (position . time)")
```

—————

67.1.15 defvar \$*operation-stream*

This is indexed by operation, not constructor

— initvars —

```
(defvar *operation-stream* nil "the stream to operation.daase")
```

67.1.16 defvar \$*operation-stream-stamp*

— initvars —

```
(defvar *operation-stream-stamp* 0 "*operation-stream* (position . time)")
```

67.1.17 defvar \$*browse-stream*

— initvars —

```
(defvar *browse-stream* nil "an open stream to the browser database")
```

67.1.18 defvar \$*browse-stream-stamp*

— initvars —

```
(defvar *browse-stream-stamp* 0 "*browse-stream* (position . time)")
```

67.1.19 defvar \$*category-stream*

This is indexed by (domain . category)

— initvars —

```
(defvar *category-stream* nil "an open stream to the category table")
```

67.1.20 defvar \$*category-stream-stamp*

— initvars —

```
(defvar *category-stream-stamp* 0 "category-stream* (position . time)")
```

—————

67.1.21 defvar \$*allconstructors*

— initvars —

```
(defvar *allconstructors* nil "a list of all the constructors in the system")
```

—————

67.1.22 defvar \$*allOperations*

— initvars —

```
(defvar *allOperations* nil "a list of all the operations in the system")
```

—————

67.1.23 defun Reset all hash tables before saving system

```
[compressopen p??]
[interpopen p??]
[operationopen p??]
[browseopen p??]
[categoryopen p??]
[initial-getdatabase p1000]
[*sourcefiles* p??]
[*interp-stream* p997]
[*operation-stream* p997]
[*category-stream* p998]
[*browse-stream* p998]
[*category-stream-stamp* p999]
[*operation-stream-stamp* p998]
```

```
[*interp-stream-stamp* p997]
[*compress-stream-stamp* p997]
[*compressvector* p996]
[*allconstructors* p999]
[*operation-hash* p995]
[*hascategory-hash* p??]
```

— defun resethashtables —

```
(defun resethashtables ()
  "set all -hash* to clean values. used to clean up core before saving system"
  (declare (special *sourcefiles* *interp-stream* *operation-stream*
                    *category-stream* *browse-stream* *category-stream-stamp*
                    *operation-stream-stamp* *interp-stream-stamp*
                    *compress-stream-stamp* *compressvector*
                    *allconstructors* *operation-hash* *hascategory-hash*))
  (setq *hascategory-hash* (make-hash-table :test #'equal))
  (setq *operation-hash* (make-hash-table))
  (setq *allconstructors* nil)
  (setq *compressvector* nil)
  (setq *sourcefiles* nil)
  (setq *compress-stream-stamp* '(0 . 0))
  (compressopen)
  (setq *interp-stream-stamp* '(0 . 0))
  (interpopen)
  (setq *operation-stream-stamp* '(0 . 0))
  (operationopen)
  (setq *browse-stream-stamp* '(0 . 0))
  (browseopen)
  (setq *category-stream-stamp* '(0 . 0))
  (categoryopen) ;note: this depends on constructorform in browse.daase
  (initial-getdatabase)
  (close *interp-stream*)
  (close *operation-stream*)
  (close *category-stream*)
  (close *browse-stream*)
  (gbc t))
```

—

67.1.24 defun Preload algebra into saved system

```
[getdatabase p1009]
[getEnv p??]
```

— defun initial-getdatabase —

```

(defun initial-getdatabase ()
  "fetch data we want in the saved system"
  (let (hascategory constructormodemapAndoperationalist operation constr)
    (format t "Initial getdatabase~%" )
    (setq hascategory '(
      (|Equation| . |Ring|)
      (|Expression| . |CoercibleTo|) (|Expression| . |CommutativeRing|)
      (|Expression| . |IntegralDomain|) (|Expression| . |Ring|)
      (|Float| . |RetractableTo|)
      (|Fraction| . |Algebra|) (|Fraction| . |CoercibleTo|)
      (|Fraction| . |OrderedSet|) (|Fraction| . |RetractableTo|)
      (|Integer| . |Algebra|) (|Integer| . |CoercibleTo|)
      (|Integer| . |ConvertibleTo|) (|Integer| . |LinearlyExplicitRingOver|)
      (|Integer| . |RetractableTo|)
      (|List| . |CoercibleTo|) (|List| . |FiniteLinearAggregate|)
      (|List| . |OrderedSet|)
      (|Polynomial| . |CoercibleTo|) (|Polynomial| . |CommutativeRing|)
      (|Polynomial| . |ConvertibleTo|) (|Polynomial| . |OrderedSet|)
      (|Polynomial| . |RetractableTo|)
      (|Symbol| . |CoercibleTo|) (|Symbol| . |ConvertibleTo|)
      (|Variable| . |CoercibleTo|)))
    (dolist (pair hascategory) (getdatabase pair 'hascategory))
    (setq constructormodemapAndoperationalist '(
      |BasicOperator| |Boolean|
      |CardinalNumber| |Color| |Complex|
      |Database|
      |Equation| |EquationFunctions2| |Expression|
      |Float| |Fraction| |FractionFunctions2|
      |Integer| |IntegralDomain|
      |Kernel|
      |List|
      |Matrix| |MappingPackage1|
      |Operator| |OutputForm|
      |NonNegativeInteger|
      |ParametricPlaneCurve| |ParametricSpaceCurve| |Point| |Polynomial|
      |PolynomialFunctions2| |PositiveInteger|
      |Ring|
      |SetCategory| |SegmentBinding| |SegmentBindingFunctions2| |DoubleFloat|
      |SparseMultivariatePolynomial| |SparseUnivariatePolynomial| |Segment|
      |String| |Symbol|
      |UniversalSegment|
      |Variable| |Vector|))
    (dolist (con constructormodemapAndoperationalist)
      (getdatabase con 'constructormodemap)
      (getdatabase con 'operationalist))
    (setq operation '(
      |+| |-| |*| |/| |**| |coerce| |convert| |elt| |equation|
      |float| |sin| |cos| |map| |SEGMENT|))
    (dolist (op operation) (getdatabase op 'operation))
    (setq constr '( ;these are sorted least-to-most freq. delete early ones first

```

```

|Factored| |SparseUnivariatePolynomialFunctions2| |TableAggregate&| | | | |
|RetractableTo&| |RecursiveAggregate&| |UserDefinedPartialOrdering|
|None| |UnivariatePolynomialCategoryFunctions2| |IntegerPrimesPackage|
|SetCategory&| |IndexedExponents| |QuotientFieldCategory&| |Polynomial|
|EltableAggregate&| |PartialDifferentialRing&| |Set|
|UnivariatePolynomialCategory&| |FlexibleArray|
|SparseMultivariatePolynomial| |PolynomialCategory&|
|DifferentialExtension&| |IndexedFlexibleArray| |AbelianMonoidRing&|
|FiniteAbelianMonoidRing&| |DivisionRing&| |FullyLinearlyExplicitRingOver&|
|IndexedVector| |IndexedOneDimensionalArray| |LocalAlgebra| |Localize|
|Boolean| |Field&| |Vector| |IndexedDirectProductObject| |Aggregate&|
|PolynomialRing| |FreeModule| |IndexedDirectProductAbelianGroup|
|IndexedDirectProductAbelianMonoid| |SingletonAsOrderedSet|
|SparseUnivariatePolynomial| |Fraction| |Collection&| |HomogeneousAggregate&|
|RepeatedSquaring| |IntegerNumberSystem&| |AbelianSemiGroup&|
|AssociationList| |OrderedRing&| |SemiGroup&| |Symbol|
|UniqueFactorizationDomain&| |EuclideanDomain&| |IndexedAggregate&|
|GcdDomain&| |IntegralDomain&| |DifferentialRing&| |Monoid&| |Reference|
|UnaryRecursiveAggregate&| |OrderedSet&| |AbelianGroup&| |Algebra&|
|Module&| |Ring&| |StringAggregate&| |AbelianMonoid&|
|ExtensibleLinearAggregate&| |PositiveInteger| |StreamAggregate&|
|IndexedString| |IndexedList| |ListAggregate&| |LinearAggregate&|
|Character| |String| |NonNegativeInteger| |SingleInteger|
|OneDimensionalArrayAggregate&| |FiniteLinearAggregate&| |PrimitiveArray|
|Integer| |List| |OutputForm|))
(dolist (con constr)
  (let ((c (concatenate 'string
                        (|getEnv| "AXIOM") "/algebra/"
                        (string (getdatabase con 'abbreviation)) ".o")))
    (format t "  preloading ~a.." c)
    (if (probe-file c)
        (progn
          (put con 'loaded c)
          (load c)
          (format t "loaded.~%"))
        (format t "skipped.~%"))))
  (format t "~%"))

```

67.1.25 defun Open the interp database

Format of an entry in interp.daase:

```

(constructor-name
 operationalist
 constructormodemap
 modemaps -- this should not be needed. eliminate it.

```

```

object          -- the name of the object file to load for this con.
constructorcategory -- note that this info is the cadar of the
                    constructormodemap for domains and packages so it is stored
                    as NIL for them. it is valid for categories.
niladic         -- t or nil directly
unused
cosig           -- kept directly
constructorkind  -- kept directly
defaultdomain   -- a short list, for %i
ancestors       -- used to compute new category updates
)

[unsqueeze p1026]
[make-database p??]
[DaaseName p1022]
[$spadroot p12]
[*allconstructors* p999]
[*interp-stream* p997]
[*interp-stream-stamp* p997]

```

— defun interpOpen —

```

(defun interpOpen ()
  "open the interpreter database and hash the keys"
  (declare (special $spadroot *allconstructors* *interp-stream*
                    *interp-stream-stamp*))
  (let (constructors pos stamp dbstruct)
    (setq *interp-stream* (open (DaaseName "interp.daase" nil)))
    (setq stamp (read *interp-stream*))
    (unless (equal stamp *interp-stream-stamp*)
      (format t "  Re-reading interp.daase")
      (setq *interp-stream-stamp* stamp)
      (setq pos (car stamp))
      (file-position *interp-stream* pos)
      (setq constructors (read *interp-stream*))
      (dolist (item constructors)
        (setq item (unsqueeze item))
        (setq *allconstructors* (adjoin (first item) *allconstructors*))
        (setq dbstruct (make-database))
        (setf (get (car item) 'database) dbstruct)
        (setf (database-operationalist dbstruct) (second item))
        (setf (database-constructormodemap dbstruct) (third item))
        (setf (database-modemaps dbstruct) (fourth item))
        (setf (database-object dbstruct) (fifth item))
        (setf (database-constructorcategory dbstruct) (sixth item))
        (setf (database-niladic dbstruct) (seventh item))
        (setf (database-abbreviation dbstruct) (eighth item))
        (setf (get (eighth item) 'abbreviationfor) (first item)) ;invert
        (setf (database-cosig dbstruct) (ninth item)))

```

```

      (setf (database-constructorkind dbstruct) (tenth item))
      (setf (database-ancestors dbstruct) (nth 11 item)))
    (format t "~&"))

```

This is an initialization function for the constructor database it sets up 2 hash tables, opens the database and hashes the index values.

There is a slight asymmetry in this code. The sourcefile information for system files is only the filename and extension. For user files it contains the full pathname. when the database is first opened the sourcefile slot contains system names. The lookup function has to prefix the “\$spadroot” information if the directory-namestring is null (we don’t know the real root at database build time).

An object-hash table is set up to look up nrlib and ao information. this slot is empty until a user does a)library call. We remember the location of the nrlib or ao file for the users local library at that time. A NIL result from this probe means that the library is in the system-specified place. When we get into multiple library locations this will also contain system files.

67.1.26 defun Open the browse database

Format of an entry in browse.daase:

```

( constructorname
  sourcefile
  constructorform
  documentation
  attributes
  predicates
)

```

```

[unsqueeze p1026]
[$spadroot p12]
[*allconstructors* p999]
[*browse-stream* p998]
[*browse-stream-stamp* p998]

```

— defun browseOpen —

```

(defun browseOpen ()
  "open the constructor database and hash the keys"
  (declare (special $spadroot *allconstructors* *browse-stream*
                    *browse-stream-stamp*))
  (let (constructors pos stamp dbstruct)
    (setq *browse-stream* (open (DaaseName "browse.daase" nil))))

```



```

(setq stamp (read *browse-stream*))
(unless (equal stamp *browse-stream-stamp*)
  (format t "    Re-reading browse.daase")
  (setq *browse-stream-stamp* stamp)
  (setq pos (car stamp))
  (file-position *browse-stream* pos)
  (setq constructors (read *browse-stream*))
  (dolist (item constructors)
    (setq item (unsqueeze item))
    (unless (setq dbstruct (get (car item) 'database))
      (format t "browseOpen:~%")
      (format t "the browse database contains a constructor ~a~%" item)
      (format t "that is not in the interp.daase file. we cannot~%")
      (format t "get the database structure for this constructor and~%")
      (warn "will create a new one~%")
      (setf (get (car item) 'database) (setq dbstruct (make-database)))
      (setq *allconstructors* (adjoin item *allconstructors*)))
    (setf (database-sourcefile dbstruct) (second item))
    (setf (database-constructorform dbstruct) (third item))
    (setf (database-documentation dbstruct) (fourth item))
    (setf (database-attributes dbstruct) (fifth item))
    (setf (database-predicates dbstruct) (sixth item))
    (setf (database-parents dbstruct) (seventh item))))
  (format t "~&"))

```

67.1.27 defun Open the category database

```

[unsqueeze p1026]
[$spadroot p12]
[*hasCategory-hash* p995]
[*category-stream* p998]
[*category-stream-stamp* p999]

```

— defun categoryOpen —

```

(defun categoryOpen ()
  "open category.daase and hash the keys"
  (declare (special $spadroot *hasCategory-hash* *category-stream*
                    *category-stream-stamp*))
  (let (pos keys stamp)
    (setq *category-stream* (open (DaaseName "category.daase" nil)))
    (setq stamp (read *category-stream*))
    (unless (equal stamp *category-stream-stamp*)
      (format t "    Re-reading category.daase")
      (setq *category-stream-stamp* stamp)

```

```

(setq pos (car stamp))
(file-position *category-stream* pos)
(setq keys (read *category-stream*))
(setq *hasCategory-hash* (make-hash-table :test #'equal))
(dolist (item keys)
  (setq item (unsqueeze item))
  (setf (gethash (first item) *hasCategory-hash*) (second item))))
(format t "~&"))

```

67.1.28 defun Open the operations database

```

[unsqueeze p1026]
[$spadroot p12]
[*operation-hash* p995]
[*operation-stream* p997]
[*operation-stream-stamp* p998]

```

— defun operationOpen —

```

(defun operationOpen ()
  "read operation database and hash the keys"
  (declare (special $spadroot *operation-hash* *operation-stream*
                    *operation-stream-stamp*))
  (let (operations pos stamp)
    (setq *operation-stream* (open (DaaseName "operation.daase" nil)))
    (setq stamp (read *operation-stream*))
    (unless (equal stamp *operation-stream-stamp*)
      (format t "  Re-reading operation.daase")
      (setq *operation-stream-stamp* stamp)
      (setq pos (car stamp))
      (file-position *operation-stream* pos)
      (setq operations (read *operation-stream*))
      (dolist (item operations)
        (setq item (unsqueeze item))
        (setf (gethash (car item) *operation-hash*) (cdr item))))
    (format t "~&"))

```

67.1.29 defun Add operations from newly compiled code

```

[getdatabase p1009]
[*operation-hash* p995]

```

— defun addoperations —

```
(defun addoperations (constructor oldmaps)
  "add ops from a )library domain to *operation-hash*"
  (declare (special *operation-hash*))
  (dolist (map oldmaps) ; out with the old
    (let (oldop op)
      (setq op (car map))
      (setq oldop (getdatabase op 'operation))
      (setq oldop (lisp::delete (cdr map) oldop :test #'equal))
      (setf (gethash op *operation-hash*) oldop)))
  (dolist (map (getdatabase constructor 'modemaps)) ; in with the new
    (let (op newmap)
      (setq op (car map))
      (setq newmap (getdatabase op 'operation))
      (setf (gethash op *operation-hash*) (cons (cdr map) newmap)))))
```

67.1.30 defun Show all database attributes of a constructor

[getdatabase p1009]

— defun showdatabase —

```
(defun showdatabase (constructor)
  (format t "~&~a: ~a%" 'constructorkind
    (getdatabase constructor 'constructorkind))
  (format t "~&~a: ~a%" 'cosig
    (getdatabase constructor 'cosig))
  (format t "~&~a: ~a%" 'operation
    (getdatabase constructor 'operation))
  (format t "~&~a: ~%" 'constructormodemap)
  (pprint (getdatabase constructor 'constructormodemap))
  (format t "~&~a: ~%" 'constructorcategory)
  (pprint (getdatabase constructor 'constructorcategory))
  (format t "~&~a: ~%" 'operationalist)
  (pprint (getdatabase constructor 'operationalist))
  (format t "~&~a: ~%" 'modemaps)
  (pprint (getdatabase constructor 'modemaps))
  (format t "~&~a: ~a%" 'hascategory
    (getdatabase constructor 'hascategory))
  (format t "~&~a: ~a%" 'object
    (getdatabase constructor 'object))
  (format t "~&~a: ~a%" 'niladic
    (getdatabase constructor 'niladic))
```

```

(format t "~&~a: ~a~%" 'abbreviation
  (getdatabase constructor 'abbreviation))
(format t "~&~a: ~a~%" 'constructor?
  (getdatabase constructor 'constructor?))
(format t "~&~a: ~a~%" 'constructor
  (getdatabase constructor 'constructor))
(format t "~&~a: ~a~%" 'defaultdomain
  (getdatabase constructor 'defaultdomain))
(format t "~&~a: ~a~%" 'ancestors
  (getdatabase constructor 'ancestors))
(format t "~&~a: ~a~%" 'sourcefile
  (getdatabase constructor 'sourcefile))
(format t "~&~a: ~a~%" 'constructorform
  (getdatabase constructor 'constructorform))
(format t "~&~a: ~a~%" 'constructorargs
  (getdatabase constructor 'constructorargs))
(format t "~&~a: ~a~%" 'attributes
  (getdatabase constructor 'attributes))
(format t "~&~a: ~%" 'predicates)
(pprint (getdatabase constructor 'predicates))
(format t "~&~a: ~a~%" 'documentation
  (getdatabase constructor 'documentation))
(format t "~&~a: ~a~%" 'parents
  (getdatabase constructor 'parents)))

```

67.1.31 defun Set a value for a constructor key in the database

[make-database p??]

— defun setdatabase —

```

(defun setdatabase (constructor key value)
  (let (struct)
    (when (symbolp constructor)
      (unless (setq struct (get constructor 'database))
        (setq struct (make-database))
        (setf (get constructor 'database) struct)))
    (case key
      (abbreviation
       (setf (database-abbreviation struct) value)
       (when (symbolp value)
        (setf (get value 'abbreviationfor) constructor)))
      (constructorkind
       (setf (database-constructorkind struct) value))))))

```

67.1.32 defun Delete a value for a constructor key in the database

— defun deldatabase —

```
(defun deldatabase (constructor key)
  (when (symbolp constructor)
    (case key
      (abbreviation
       (setf (get constructor 'abbreviationfor) nil))))))
```

67.1.33 defun Get constructor information for a database key

```
[warn p??]
[unsqueeze p1026]
[$spadroot p12]
[*miss* p996]
[*hascategory-hash* p??]
[*operation-hash* p995]
[*browse-stream* p998]
[*defaultdomain-list* p995]
[*interp-stream* p997]
[*category-stream* p998]
[*hasCategory-hash* p995]
[*operation-stream* p997]
```

— defun getdatabase —

```
(defun getdatabase (constructor key)
  (declare (special $spadroot) (special *miss*))
  (when (eq *miss* t) (format t "getdatabase call: ~20a ~a~%" constructor key))
  (let (data table stream ignore struct)
    (declare (ignore ignore)
      (special *hascategory-hash* *operation-hash*
        *browse-stream* *defaultdomain-list* *interp-stream*
        *category-stream* *hasCategory-hash* *operation-stream*))
    (when (or (symbolp constructor)
      (and (eq key 'hascategory) (consp constructor))))
      (case key
        ; note that abbreviation, constructorkind and cosig are heavy hitters
        ; thus they occur first in the list of things to check
```

```

(abbreviation
  (setq stream *interp-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-abbreviation struct))))
(constructorkind
  (setq stream *interp-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-constructorkind struct))))
(cosig
  (setq stream *interp-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-cosig struct))))
(operation
  (setq stream *operation-stream*)
  (setq data (gethash constructor *operation-hash*)))
(constructormodemap
  (setq stream *interp-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-constructormodemap struct))))
(constructcategory
  (setq stream *interp-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-constructcategory struct))
    (when (null data) ;domain or package then subfield of constructormodemap
      (setq data (cadar (getdatabase constructor 'constructormodemap))))))
(operationalist
  (setq stream *interp-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-operationalist struct))))
(modemaps
  (setq stream *interp-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-modemaps struct))))
(hascategory
  (setq table *hasCategory-hash*)
  (setq stream *category-stream*)
  (setq data (gethash constructor table)))
(object
  (setq stream *interp-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-object struct))))
(asharp?
  (setq stream *interp-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-object struct))))
(niladic
  (setq stream *interp-stream*)
  (when (setq struct (get constructor 'database))
    (setq data (database-niladic struct))))
(constructor?

```

```

    (when (setq struct (get constructor 'database))
      (setq data (when (database-operationalist struct) t)))
  (superdomain ; only 2 superdomains in the world
    (case constructor
      (|NonNegativeInteger|
        (setq data '((|Integer|) (IF (< |#1| 0) |false| |true|))))
      (|PositiveInteger|
        (setq data '((|NonNegativeInteger|) (< 0 |#1|)))))
  (constructor
    (when (setq data (get constructor 'abbreviationfor))))
  (defaultdomain
    (setq data (cadr (assoc constructor *defaultdomain-list*))))
  (ancestors
    (setq stream *interp-stream*)
    (when (setq struct (get constructor 'database))
      (setq data (database-ancestors struct))))
  (sourcefile
    (setq stream *browse-stream*)
    (when (setq struct (get constructor 'database))
      (setq data (database-sourcefile struct))))
  (constructorform
    (setq stream *browse-stream*)
    (when (setq struct (get constructor 'database))
      (setq data (database-constructorform struct))))
  (constructorargs
    (setq data (cdr (getdatabase constructor 'constructorform))))
  (attributes
    (setq stream *browse-stream*)
    (when (setq struct (get constructor 'database))
      (setq data (database-attributes struct))))
  (predicates
    (setq stream *browse-stream*)
    (when (setq struct (get constructor 'database))
      (setq data (database-predicates struct))))
  (documentation
    (setq stream *browse-stream*)
    (when (setq struct (get constructor 'database))
      (setq data (database-documentation struct))))
  (parents
    (setq stream *browse-stream*)
    (when (setq struct (get constructor 'database))
      (setq data (database-parents struct))))
  (users
    (setq stream *browse-stream*)
    (when (setq struct (get constructor 'database))
      (setq data (database-users struct))))
  (dependents
    (setq stream *browse-stream*)
    (when (setq struct (get constructor 'database))
      (setq data (database-dependents struct))))

```

```

(otherwise (warn "~%(GETDATABASE ~a ~a) failed~%" constructor key)))
(when (numberp data) ;fetch the real data
  (when *miss* (format t "getdatabase miss: ~20a ~a~%" constructor key))
  (file-position stream data)
  (setq data (unsqueeze (read stream))))
(case key ; cache the result of the database read
  (operation (setf (gethash constructor *operation-hash*) data))
  (hascategory (setf (gethash constructor *hascategory-hash*) data))
  (constructorkind (setf (database-constructorkind struct) data))
  (cosig (setf (database-cosig struct) data))
  (constructormodemap (setf (database-constructormodemap struct) data))
  (constructorcategory (setf (database-constructorcategory struct) data))
  (operationalist (setf (database-operationalist struct) data))
  (modemaps (setf (database-modemaps struct) data))
  (object (setf (database-object struct) data))
  (niladic (setf (database-niladic struct) data))
  (abbreviation (setf (database-abbreviation struct) data))
  (constructor (setf (database-constructor struct) data))
  (ancestors (setf (database-ancestors struct) data))
  (constructorform (setf (database-constructorform struct) data))
  (attributes (setf (database-attributes struct) data))
  (predicates (setf (database-predicates struct) data))
  (documentation (setf (database-documentation struct) data))
  (parents (setf (database-parents struct) data))
  (users (setf (database-users struct) data))
  (dependents (setf (database-dependents struct) data))
  (sourcefile (setf (database-sourcefile struct) data))))
(case key ; fixup the special cases
  (sourcefile
    (when (and data (string= (directory-namestring data) ""))
      (string= (pathname-type data) "spad"))
    (setq data
      (concatenate 'string $spadroot "/../src/algebra/" data))))
  (asharp? ; is this asharp code?
    (if (consp data)
      (setq data (cdr data))
      (setq data nil)))
  (object ; fix up system object pathname
    (if (consp data)
      (setq data
        (if (string= (directory-namestring (car data)) "")
          (concatenate 'string $spadroot "/algebra/" (car data) ".o")
          (car data)))
      (when (and data (string= (directory-namestring data) ""))
        (setq data (concatenate 'string $spadroot "/algebra/" data ".o"))))))
  data))

```

67.1.34 defun The)library top level command

[localdatabase p1013]
 [extendLocalLibdb p??]
 [tersyscommand p450]
 [\$newConlist p??]
 [\$options p??]

— defun library —

```
(defun |library| (args)
  (let (original-directory)
    (declare (special |$options| |$newConlist|))
    (setq original-directory (get-current-directory))
    (setq |$newConlist| nil)
    (localdatabase args |$options|)
    (|extendLocalLibdb| |$newConlist|)
    (system::chdir original-directory)
    (tersyscommand)))
```

67.1.35 defun Read a local filename and update the hash tables

The localdatabase function tries to find files in the order of:

- nrlib/index.kaf
- .asy
- .ao,
- asharp to .asy

[sayKeyedMsg p329]
 [localnrlib p1015]
 [\$forceDatabaseUpdate p??]
 [\$ConstructorCache p??]
 [*index-filename* p??]

— defun localdatabase —

```
(defun localdatabase (filelist options &optional (make-database? nil))
  "read a local filename and update the hash tables"
  (labels (
    (processOptions (options)
      (let (only dir noexpose)
```

```

(when (setq only (assoc '|only| options))
  (setq options (lisp::delete only options :test #'equal))
  (setq only (cdr only)))
(when (setq dir (assoc '|dir| options))
  (setq options (lisp::delete dir options :test #'equal))
  (setq dir (second dir))
  (when (null dir)
    (|sayKeyedMsg| 'S2IU0002 nil) ))
(when (setq noexpose (assoc '|noexpose| options))
  (setq options (lisp::delete noexpose options :test #'equal))
  (setq noexpose 't) )
(when options
  (format t " Ignoring unknown )library option: ~a~%" options))
(values only dir noexpose)))
(processDir (dirarg thisdir)
  (let (allfiles)
    (declare (special vmlisp::*index-filename*))
    (system:chdir (string dirarg))
    (setq allfiles (directory "*"))
    (system:chdir thisdir)
    (mapcan #'(lambda (f)
      (when (string-equal (pathname-type f) "nrllib")
        (list (concatenate 'string (namestring f) "/"
          vmlisp::*index-filename*))) allfiles))))
(let (thisdir nrlibs object only dir key (|$forceDatabaseUpdate| t) noexpose)
  (declare (special |$forceDatabaseUpdate| vmlisp::*index-filename*
    |$ConstructorCache|))
  (setq thisdir (namestring (truename ".")))
  (setq noexpose nil)
  (multiple-value-setq (only dir noexpose) (processOptions options))
  ;don't force exposure during database build
  (if make-database? (setq noexpose t))
  (when dir (setq nrlibs (processDir dir thisdir)))
  (dolist (file filelist)
    (let ((filename (pathname-name file))
      (namedir (directory-namestring file)))
      (unless namedir (setq thisdir (concatenate 'string thisdir "/")))
      (cond
        ((setq file (probe-file
          (concatenate 'string namedir filename ".nrllib/"
            vmlisp::*index-filename*)))
          (push (namestring file) nrlibs))
        ('else (format t " )library cannot find the file ~a.~%" filename))))))
  (dolist (file (nreverse nrlibs))
    (setq key (pathname-name (first (last (pathname-directory file)))))
    (setq object (concatenate 'string (directory-namestring file) "code"))
    (localnrllib key file object make-database? noexpose))
  (clrhash |$ConstructorCache|)))

```

67.1.36 defun Update the database from an nrlib index.kaf file

```
[getdatabase p1009]
[make-database p??]
[addoperations p1006]
[sublislis p??]
[updateDatabase p1017]
[installConstructor p??]
[updateCategoryTable p??]
[categoryForm? p??]
[setExposeAddConstr p698]
[startTimingProcess p??]
[loadLibNoUpdate p1039]
[sayKeyedMsg p329]
[$FormalMapVariableList p??]
[*allOperations* p999]
[*allconstructors* p999]
```

— defun localnrlib —

```
(defun localnrlib (key nrlib object make-database? noexpose)
  "given a string pathname of an index.kaf and the object update the database"
  (labels (
    (fetchdata (alist in index)
      (let (pos)
        (setq pos (third (assoc index alist :test #'string=)))
        (when pos
          (file-position in pos)
          (read in))))))
    (let (alist kind (systemdir? nil) pos constructorform oldmaps abbrev dbstruct)
      (declare (special *allOperations* *allconstructors*
        |$FormalMapVariableList|))
      (with-open-file (in nrlib)
        (file-position in (read in))
        (setq alist (read in))
        (setq pos (third (assoc "constructorForm" alist :test #'string=)))
        (file-position in pos)
        (setq constructorform (read in))
        (setq key (car constructorform))
        (setq oldmaps (getdatabase key 'modemaps))
        (setq dbstruct (make-database))
        (setq *allconstructors* (adjoin key *allconstructors*))
        (setf (get key 'database) dbstruct) ; store the struct, side-effect it...
        (setf (database-constructorform dbstruct) constructorform)
        (setq *allOperations* nil) ; force this to recompute
```

```

(setf (database-object dbstruct) object)
(setq abbrev
  (intern (pathname-name (first (last (pathname-directory object))))))
(setf (database-abbreviation dbstruct) abbrev)
(setf (get abbrev 'abbreviationfor) key)
(setf (database-operationalist dbstruct) nil)
(setf (database-operationalist dbstruct)
  (fetchdata alist in "operationAlist"))
(setf (database-constructormodemap dbstruct)
  (fetchdata alist in "constructorModemap"))
(setf (database-modemaps dbstruct) (fetchdata alist in "modemaps"))
(setf (database-sourcefile dbstruct) (fetchdata alist in "sourceFile"))
(when make-database?
  (setf (database-sourcefile dbstruct)
    (file-namestring (database-sourcefile dbstruct))))
(setf (database-constructorkind dbstruct)
  (setq kind (fetchdata alist in "constructorKind")))
(setf (database-constructorcategory dbstruct)
  (fetchdata alist in "constructorCategory"))
(setf (database-documentation dbstruct)
  (fetchdata alist in "documentation"))
(setf (database-attributes dbstruct)
  (fetchdata alist in "attributes"))
(setf (database-predicates dbstruct)
  (fetchdata alist in "predicates"))
(setf (database-niladic dbstruct)
  (when (fetchdata alist in "NILADIC") t))
(addoperations key oldmaps)
(unless make-database?
  (if (eq kind '|category|)
    (setf (database-ancestors dbstruct)
      (sublislis |$FormalMapVariableList|
        (cdr constructorform) (fetchdata alist in "ancestors"))))
  (|updateDatabase| key key systemdir?) ;makes many hashtables???
  (|installConstructor| key kind) ;used to be key cname ...
  (|updateCategoryTable| key kind)
  (if |$InteractiveMode| (setq |$CategoryFrame| |$EmptyEnvironment|)))
(setf (database-cosig dbstruct)
  (cons nil (mapcar #'|categoryForm?|
    (cddar (database-constructormodemap dbstruct)))))
(remprop key 'loaded)
(if (null noexpose) (|setExposeAddConstr| (cons key nil)))
(setf (symbol-function key) ; sets the autoload property for cname
  #'(lambda (&rest args)
    (unless (get key 'loaded)
      (|startTimingProcess| '|load|)
      (|loadLibNoUpdate| key key object)) ; used to be cname key
    (apply key args)))
(|sayKeyedMsg| 'S2IU0001 (list key object))))

```

67.1.37 defun updateDatabase

For now in NRUNTIME do database update only if forced [constructor? p??]

```
[clearClams p??]
[clearAllSlams p??]
[$forceDatabaseUpdate p??]
```

— defun updateDatabase —

```
(defun |updateDatabase| (fname cname systemdirp)
  (declare (ignore fname))
  (declare (special |$forceDatabaseUpdate|))
  (when |$forceDatabaseUpdate|
    (when (|constructor?| cname)
      (|clearClams|)
      (|clearAllSlams| nil)
      (when (get1 cname 'loaded) (|clearConstructorCaches|)))
    (when (or |$forceDatabaseUpdate| (null systemdirp))
      (|clearClams|)
      (|clearAllSlams| nil))))
```

67.1.38 defun Make new databases

Making new databases consists of:

1. reset all of the system hash tables
2. set up Union, Record and Mapping
3. map)library across all of the system files (fills the databases)
4. loading some normally autoloaded files
5. making some database entries that are computed (like ancestors)
6. writing out the databases
7. write out 'warm' data to be loaded into the image at build time

Note that this process should be done in a clean image followed by a rebuild of the system image to include the new index pointers (e.g. *interp-stream-stamp*)

The system will work without a rebuild but it needs to re-read the databases on startup. Rebuilding the system will cache the information into the image and the databases are opened

but not read, saving considerable startup time. Also note that the order the databases are written out is critical. The `interp.daase` depends on prior computations and has to be written out last.

The `build-name-to-pamphlet-hash` builds a hash table whose key-`i` value is:

- abbreviation -`i` pamphlet file name
- abbreviation-line -`i` pamphlet file position
- constructor -`i` pamphlet file name
- constructor-line -`i` pamphlet file position

is the symbol of the constructor name and whose value is the name of the source file without any path information. We hash the constructor abbreviation to pamphlet file name. [local-database p1013]

```
[getEnv p??]
[browserAutoloadOnceTrigger p??]
[mkTopicHashTable p??]
[buildLibdb p??]
[dbSplitLibdb p??]
[mkUsersHashTable p??]
[saveUsersHashTable p1022]
[mkDependentsHashTable p??]
[saveDependentsHashTable p1021]
[write-compress p1024]
[write-browsedb p1032]
[write-operationdb p1034]
[write-categorydb p1033]
[allConstructors p1035]
[categoryForm? p??]
[domainsOf p??]
[getConstructorForm p??]
[write-interpdb p1030]
[write-warmdata p1035]
[$constructorList p??]
[*sourcefiles* p??]
[*compressvector* p996]
[*allconstructors* p999]
[*operation-hash* p995]
```

— **defun make-databases** —

```
(defun make-databases (ext dirlst)
  (labels (
    (build-name-to-pamphlet-hash (dir)
      (let ((ht (make-hash-table)) (eof '(done)) point mark abbrev name file ns)
```

```

(dolist (fn (directory dir))
  (with-open-file (f fn)
    (do ((ln (read-line f nil eof) (read-line f nil eof))
        (line 0 (incf line)))
      ((eq ln eof))
      (when (and (setq mark (search ")abb" ln)) (= mark 0))
        (setq mark (position #\space ln :from-end t))
        (setq name (intern (string-trim '(\space) (subseq ln mark))))
        (cond
          ((setq mark (search "domain" ln)) (setq mark (+ mark 7)))
          ((setq mark (search "package" ln)) (setq mark (+ mark 8)))
          ((setq mark (search "category" ln)) (setq mark (+ mark 9))))
        (setq point (position #\space ln :start (+ mark 1)))
        (setq abbrev
          (intern (string-trim '(\space) (subseq ln mark point))))
        (setq ns (namestring fn))
        (setq mark (position #\/ ns :from-end t))
        (setq file (subseq ns (+ mark 1)))
        (setf (gethash abbrev ht) file)
        (setf (gethash (format nil "~a-line" abbrev) ht) line)
        (setf (gethash name ht) file)
        (setf (gethash (format nil "~a-line" name) ht) line))))
  ht))
;; these are types which have no library object associated with them.
;; we store some constructed data to make them perform like library
;; objects, the *operationalist-hash* key entry is used by allConstructors
(withSpecialConstructors ()
  (declare (special *allconstructors*))
  ; note: if item is not in *operationalist-hash* it will not be written
  ; Category
  (setf (get '|Category| 'database)
    (make-database :operationalist nil :niladic t))
  (push '|Category| *allconstructors*)
  ; UNION
  (setf (get '|Union| 'database)
    (make-database :operationalist nil :constructorkind '|domain|))
  (push '|Union| *allconstructors*)
  ; RECORD
  (setf (get '|Record| 'database)
    (make-database :operationalist nil :constructorkind '|domain|))
  (push '|Record| *allconstructors*)
  ; MAPPING
  (setf (get '|Mapping| 'database)
    (make-database :operationalist nil :constructorkind '|domain|))
  (push '|Mapping| *allconstructors*)
  ; ENUMERATION
  (setf (get '|Enumeration| 'database)
    (make-database :operationalist nil :constructorkind '|domain|))
  (push '|Enumeration| *allconstructors*)
  )

```

```

    (final-name (root)
      (format nil "~a.daase~a" root ext))
  )
  (let (d)
    (declare (special |$constructorList| *sourcefiles* *compressvector*
      *allconstructors* *operation-hash*))
    (do-symbols (symbol)
      (when (get symbol 'database)
        (setf (get symbol 'database) nil)))
    (setq *hascategory-hash* (make-hash-table :test #'equal))
    (setq *operation-hash* (make-hash-table))
    (setq *allconstructors* nil)
    (setq *compressvector* nil)
    (withSpecialConstructors)
    (localdatabase nil
      (list (list 'dir| (namestring (truename "./*")) ))
      'make-database)
    (dolist (dir dirlist)
      (localdatabase nil
        (list (list 'dir| (namestring (truename (format nil "./*" dir))))))
        'make-database)))
;browse.daase
  (load (concatenate 'string (|getEnv| "AXIOM") "/autoload/topics")) ;; hack
  (|browserAutoloadOnceTrigger|)
  (|mkTopicHashTable|)
  (setq |$constructorList| nil) ;; affects buildLibdb
  (setq *sourcefiles* (build-name-to-pamphlet-hash
    (concatenate 'string (|getEnv| "AXIOM")
      "/*/*/*src/algebra/*.pamphlet")))
  (|buildLibdb|)
  (|dbSplitLibdb|)
; (|dbAugmentConstructorDataTable|)
  (|mkUsersHashTable|)
  (|saveUsersHashTable|)
  (|mkDependentsHashTable|)
  (|saveDependentsHashTable|)
; (|buildGloss|)
  (write-compress)
  (write-browsedb)
  (write-operationdb)
; note: genCategoryTable creates a new *hascategory-hash* table
; this smashes the existing table and regenerates it.
; write-categorydb does getdatabase calls to write the new information
  (write-categorydb)
  (dolist (con (|allConstructors|))
    (let (dbstruct)
      (when (setq dbstruct (get con 'database))
        (setf (database-cosig dbstruct)
          (cons nil (mapcar #'|categoryForm?|
            (cddar (database-constructormodemap dbstruct))))))

```



```

      (when (and (|categoryForm?| con)
                 (= (length (setq d (|domainsOf| (list con) NIL NIL))) 1))
            (setq d (caar d))
            (when (= (length d) (length (|getConstructorForm| con)))
              (format t "  ~a has a default domain of ~a~%" con (car d))
              (setf (database-defaultdomain dbstruct) (car d))))))
    ; note: genCategoryTable creates *ancestors-hash*. write-interpdb
    ; does gethash calls into it rather than doing a getdatabase call.
  (write-interpdb)
  (write-warndata)
  (when (probe-file (final-name "compress"))
    (delete-file (final-name "compress")))
  (rename-file "compress.build" (final-name "compress"))
  (when (probe-file (final-name "interp"))
    (delete-file (final-name "interp")))
  (rename-file "interp.build" (final-name "interp"))
  (when (probe-file (final-name "operation"))
    (delete-file (final-name "operation")))
  (rename-file "operation.build" (final-name "operation"))
  (when (probe-file (final-name "browse"))
    (delete-file (final-name "browse")))
  (rename-file "browse.build"
               (final-name "browse"))
  (when (probe-file (final-name "category"))
    (delete-file (final-name "category")))
  (rename-file "category.build"
               (final-name "category"))))

```

67.1.39 defun saveDependentsHashTable

```

[erase p??]
[writeLib1 p??]
[msort p??]
[hkeys p1046]
[rwrite p602]
[hget p1046]
[rshut p??]
[$depTb p??]
[$erase p??]

```

— defun saveDependentsHashTable —

```

(defun |saveDependentsHashTable| ()
  (let (stream)
    (declare (special |$depTb| $erase))

```

```

($erase '|dependents| 'database '|a|)
(setq stream (|writeLib1| '|dependents| 'database '|a|))
(dolist (k (msort (hkeys |$depTb|)))
  (|rwrite| k (hget |$depTb| k) stream))
(rshut stream))

```

67.1.40 defun saveUsersHashTable

```

[erase p??]
[writeLib1 p??]
[msort p??]
[hkeys p1046]
[rwrite p602]
[hget p1046]
[rshut p??]
[$erase p??]
[$usersTb p??]

```

— defun saveUsersHashTable —

```

(defun |saveUsersHashTable| ()
  (let (stream)
    (declare (special |$usersTb| $erase))
    ($erase '|users| 'database '|a|)
    (setq stream (|writeLib1| '|users| 'database '|a|))
    (dolist (k (msort (hkeys |$usersTb|)))
      (|rwrite| k (HGET |$usersTb| k) stream))
    (rshut stream)))

```

67.1.41 defun Construct the proper database full pathname

```

[getEnv p??]
[$spadroot p12]

```

— defun DaaseName —

```

(defun DaaseName (name erase?)
  (let (daase filename)
    (declare (special $spadroot))
    (if (setq daase (|getEnv| "DAASE"))

```

```
(progn
  (setq filename (concatenate 'string daase "/algebra/" name))
  (format t "    Using local database ~a.." filename))
  (setq filename (concatenate 'string $spadroot "/algebra/" name)))
(when erase? (system::system (concatenate 'string "rm -f " filename)))
filename))
```

67.1.42 compress.daase

The compress database is special. It contains a list of symbols. The character string name of a symbol in the other databases is represented by a negative number. To get the real symbol back you take the absolute value of the number and use it as a byte index into the compress database. In this way long symbol names become short negative numbers.

67.1.43 defun Set up compression vectors for the databases

```
[DaaseName p1022]
[$spadroot p12]
[*compressvector* p996]
[*compressVectorLength* p996]
[*compress-stream* p997]
[*compress-stream-stamp* p997]
```

— defun compressOpen —

```
(defun compressOpen ()
  (let (lst stamp pos)
    (declare (special $spadroot *compressvector* *compressVectorLength*
                      *compress-stream* *compress-stream-stamp*))
    (setq *compress-stream*
          (open (DaaseName "compress.daase" nil) :direction :input))
    (setq stamp (read *compress-stream*))
    (unless (equal stamp *compress-stream-stamp*)
      (format t "    Re-reading compress.daase")
      (setq *compress-stream-stamp* stamp)
      (setq pos (car stamp))
      (file-position *compress-stream* pos)
      (setq lst (read *compress-stream*))
      (setq *compressVectorLength* (car lst))
      (setq *compressvector*
            (make-array (car lst) :initial-contents (cdr lst))))))
```

67.1.44 defvar \$*attributes*

— initvars —

```
(defvar *attributes*
  '(|nil| |infinite| |arbitraryExponent| |approximate| |complex|
    |shallowMutable| |canonical| |noetherian| |central|
    |partiallyOrderedSet| |arbitraryPrecision| |canonicalsClosed|
    |noZeroDivisors| |rightUnitary| |leftUnitary|
    |additiveValuation| |unitsKnown| |canonicalUnitNormal|
    |multiplicativeValuation| |finiteAggregate| |shallowlyMutable|
    |commutative|) "The list of known algebra attributes")
```

—————

67.1.45 defun Write out the compress database

```
[allConstructors p1035]
[allOperations p1035]
[*compress-stream* p997]
[*attributes* p1024]
[*compressVectorLength* p996]
```

— defun write-compress —

```
(defun write-compress ()
  (let (compresslist masterpos out)
    (declare (special *compress-stream* *attributes* *compressVectorLength*))
    (close *compress-stream*)
    (setq out (open "compress.build" :direction :output))
    (princ " " out)
    (finish-output out)
    (setq masterpos (file-position out))
    (setq compresslist
      (append (|allConstructors|) (|allOperations|) *attributes*))
    (push "algebra" compresslist)
    (push "failed" compresslist)
    (push 'signature compresslist)
    (push '|ofType| compresslist)
    (push '|Join| compresslist)
    (push 'and compresslist)
    (push '|nobranch| compresslist)
    (push 'category compresslist)
    (push '|category| compresslist)
    (push '|domain| compresslist)
    (push '|package| compresslist)
```

```

(push 'attribute compresslist)
(push '|isDomain| compresslist)
(push '|ofCategory| compresslist)
(push '|Union| compresslist)
(push '|Record| compresslist)
(push '|Mapping| compresslist)
(push '|Enumeration| compresslist)
(setq *compressVectorLength* (length compresslist))
(setq *compressvector*
  (make-array *compressVectorLength* :initial-contents compresslist))
(print (cons (length compresslist) compresslist) out)
(finish-output out)
(file-position out 0)
(print (cons masterpos (get-universal-time)) out)
(finish-output out)
(close out)))

```

67.1.46 defun Compress an expression using the compress vector

This function is used to minimize the size of the databases by replacing symbols with indexes into the compression vector. [**compressvector** p996]

— defun squeeze —

```

(defun squeeze (expr)
  (declare (special *compressvector*))
  (let (leaves pos (bound (length *compressvector*)))
    (labels (
      (flat (expr)
        (when (and (numberp expr) (< expr 0) (>= expr bound))
          (print expr)
          (break "squeeze found a negative number")))
      (if (atom expr)
        (unless (or (null expr)
                    (and (symbolp expr) (char= (schar (symbol-name expr) 0) #\*)))
          (setq leaves (adjoin expr leaves)))
        (progn
          (flat (car expr))
          (flat (cdr expr))))))
      (setq leaves nil)
      (flat expr)
      (dolist (leaf leaves)
        (when (setq pos (position leaf *compressvector*))
          (nsubst (- pos) leaf expr)))
      expr)))

```

67.1.47 defun Uncompress an expression using the compress vector

This function is used to recover symbols from the databases by using integers as indexes into the compression vector. [**compressvector** p996]

— defun unsqueeze —

```
(defun unsqueeze (expr)
  (declare (special *compressvector*))
  (cond ((atom expr)
        (cond ((and (numberp expr) (<= expr 0))
              (svref *compressvector* (- expr)))
              (t expr)))
        (t (rplaca expr (unsqueeze (car expr)))
            (rplacd expr (unsqueeze (cdr expr)))
            expr)))
```

67.1.48 Building the interp.daase from hash tables

format of an entry in interp.daase:

```
(constructor-name
 operationalist
 constructormodemap
 modemaps          -- this should not be needed. eliminate it.
 object            -- the name of the object file to load for this con.
 constructorcategory -- note that this info is the cadar of the
                    constructormodemap for domains and packages so it is stored
                    as NIL for them. it is valid for categories.
 niladic           -- t or nil directly
 unused
 cosig             -- kept directly
 constructorkind   -- kept directly
 defaultdomain    -- a short list, for %i
 ancestors         -- used to compute new category updates
)
```

Here I'll try to outline the interp database write procedure

```
(defun write-interpdb ()
  "build interp.daase from hash tables"
  (declare (special $spadroot *ancestors-hash*))
  (let (opalistpos modemapspos cmodemappos master masterpos obj *print-pretty*
```

```

      concategory categorypos kind niladic cosig abbrev defaultdomain
      ancestors ancestorspos out)
(declare (special *print-pretty*))
(print "building interp.daase")

; 1. We open the file we're going to create

(setq out (open "interp.build" :direction :output))

; 2. We reserve some space at the top of the file for the key-time pair
;    We will overwrite these spaces just before we close the file.

(princ "                                " out)

; 3. Make sure we write it out
(finish-output out)

; 4. For every constructor in the system we write the parts:

(dolist (constructor (|allConstructors|))
  (let (struct)

; 4a. Each constructor has a property list. A property list is a list
;     of (key . value) pairs. The property we want is called 'database
;     so there is a ('database . something) in the property list

    (setq struct (get constructor 'database))

; 5 We write the "operationsalist"
; 5a. We remember the current file position before we write
;     We need this information so we can seek to this position on read

    (setq opalistpos (file-position out))

; 5b. We get the "operationalist", compress it, and write it out

    (print (squeeze (database-operationalist struct)) out)

; 5c. We make sure it was written

    (finish-output out)

; 6 We write the "constructormodemap"
; 6a. We remember the current file position before we write

    (setq cmodemappos (file-position out))

; 6b. We get the "constructormodemap", compress it, and write it out

    (print (squeeze (database-constructormodemap struct)) out)

```

```

; 6c. We make sure it was written

    (finish-output out)

; 7. We write the "modemaps"
; 7a. We remember the current file position before we write

    (setq modemapspos (file-position out))

; 7b. We get the "modemaps", compress it, and write it out

    (print (squeeze (database-modemaps struct)) out)

; 7c. We make sure it was written

    (finish-output out)

; 8. We remember source file pathnames in the obj variable

    (if (consp (database-object struct)) ; if asharp code ...
        (setq obj
            (cons (pathname-name (car (database-object struct)))
                  (cdr (database-object struct))))
        (setq obj
            (pathname-name
             (first (last (pathname-directory (database-object struct)))))))

; 9. We write the "constructorcategory", if it is a category, else nil
; 9a. Get the constructorcategory and compress it

    (setq concategory (squeeze (database-constructorcategory struct)))

; 9b. If we have any data we write it out, else we don't write it
;     Note that if there is no data then the byte index for the
;     constructorcatagory will not be a number but will be nil.

    (if concategory ; if category then write data else write nil
        (progn
            (setq categorypos (file-position out))
            (print concategory out)
            (finish-output out))
        (setq categorypos nil))

; 10. We get a set of properties which are kept as "immediate" data
;     This means that the key table will hold this data directly
;     rather than as a byte index into the file.
; 10a. niladic data

    (setq niladic (database-niladic struct))

```



```

; 10b. abbreviation data (e.g. POLY for polynomial)

    (setq abbrev (database-abbreviation struct))

; 10c. cosig data

    (setq cosig (database-cosig struct))

; 10d. kind data

    (setq kind (database-constructorkind struct))

; 10e. defaultdomain data

    (setq defaultdomain (database-defaultdomain struct))

; 11. The ancestor data might exist. If it does we fetch it,
;     compress it, and write it out. If it does not we place
;     and immediate value of nil in the key-value table

    (setq ancestors (squeeze (gethash constructor *ancestors-hash*))) ;cattable.boot
    (if ancestors
        (progn
            (setq ancestorspos (file-position out))
            (print ancestors out)
            (finish-output out))
        (setq ancestorspos nil))

; 12. "master" is an alist. Each element of the alist has the name of
;     the constructor and all of the above attributes. When the loop
;     finishes we will have constructed all of the data for the key-value
;     table

    (push (list constructor opalistpos cmodemappos modemapspos
        obj categorypos niladic abbrev cosig kind defaultdomain
        ancestorspos) master))

; 13. The loop is done, we make sure all of the data is written

    (finish-output out)

; 14. We remember where the key-value table will be written in the file

    (setq masterpos (file-position out))

; 15. We compress and print the key-value table

    (print (mapcar #'squeeze master) out)

```

```

; 16. We make sure we write the table

    (finish-output out)

; 17. We go to the top of the file

    (file-position out 0)

; 18. We write out the (master-byte-position . universal-time) pair
;     Note that if the universal-time value matches the value of
;     *interp-stream-stamp* then there is no reason to read the
;     interp database because all of the data is already cached in
;     the image. This happens if you build a database and immediatly
;     save the image. The saved image already has the data since we
;     just wrote it out. If the *interp-stream-stamp* and the database
;     time stamp differ we "reread" the database on startup. Actually
;     we just open the database and fetch as needed. You can see fetches
;     by setting the *miss* variable non-nil.

    (print (cons masterpos (get-universal-time)) out)

; 19. We make sure we write it.

    (finish-output out)

; 20 And we are done

    (close out)))

```

67.1.49 defun Write the interp database

```

[squeeze p1025]
[$spadroot p12]
[*ancestors-hash* p??]
[*print-pretty* p??]

```

— defun write-interpdb —

```

(defun write-interpdb ()
  "build interp.daase from hash tables"
  (declare (special $spadroot *ancestors-hash*))
  (let (opalistpos modemapspos cmodemappos master masterpos obj *print-pretty*
        concategory categorypos kind niladic cosig abbrev defaultdomain
        ancestors ancestorspos out)
    (declare (special *print-pretty*))
    (print "building interp.daase")
    (setq out (open "interp.build" :direction :output))
    (princ " " out)

```

```

(finish-output out)
(dolist (constructor (|allConstructors|))
  (let (struct)
    (setq struct (get constructor 'database))
    (setq opalistpos (file-position out))
    (print (squeeze (database-operationalist struct)) out)
    (finish-output out)
    (setq cmodemappos (file-position out))
    (print (squeeze (database-constructormodemap struct)) out)
    (finish-output out)
    (setq modemapspos (file-position out))
    (print (squeeze (database-modemaps struct)) out)
    (finish-output out)
    (if (consp (database-object struct)) ; if asharp code ...
        (setq obj
          (cons (pathname-name (car (database-object struct)))
                (cdr (database-object struct))))
        (setq obj
          (pathname-name
            (first (last (pathname-directory (database-object struct)))))))
    (setq concategory (squeeze (database-constructorscategory struct)))
    (if concategory ; if category then write data else write nil
        (progn
          (setq categorypos (file-position out))
          (print concategory out)
          (finish-output out))
        (setq categorypos nil))
    (setq niladic (database-niladic struct))
    (setq abbrev (database-abbreviation struct))
    (setq cosig (database-cosig struct))
    (setq kind (database-constructorkind struct))
    (setq defaultdomain (database-defaultdomain struct))
    (setq ancestors
      (squeeze (gethash constructor *ancestors-hash*))) ;cattable.boot
    (if ancestors
        (progn
          (setq ancestorspos (file-position out))
          (print ancestors out)
          (finish-output out))
        (setq ancestorspos nil))
    (push (list constructor opalistpos cmodemappos modemapspos
      obj categorypos niladic abbrev cosig kind defaultdomain
      ancestorspos) master)))
(finish-output out)
(setq masterpos (file-position out))
(print (mapcar #'squeeze master) out)
(finish-output out)
(file-position out 0)
(print (cons masterpos (get-universal-time)) out)
(finish-output out)

```

```
(close out)))
```

67.1.50 Building the browse.daase from hash tables

```
format of an entry in browse.daase:
( constructorname
  sourcefile
  constructorform
  documentation
  attributes
  predicates
)
```

This is essentially the same overall process as write-interpdb.

We reserve some space for the (key-table-byte-position . timestamp)

We loop across the list of constructors dumping the data and remembering the byte positions in a key-value pair table.

We dump the final key-value pair table, write the byte position and time stamp at the top of the file and close the file.

67.1.51 defun Write the browse database

```
[allConstructors p1035]
[squeeze p1025]
[$spadroot p12]
[*sourcefiles* p??]
[*print-pretty* p??]
```

— defun write-browsedb —

```
(defun write-browsedb ()
  "make browse.daase from hash tables"
  (declare (special $spadroot *sourcefiles*))
  (let (master masterpos src formpos docpos attpos predpos *print-pretty* out)
    (declare (special *print-pretty*))
    (print "building browse.daase")
    (setq out (open "browse.build" :direction :output))
    (princ " " out)
    (finish-output out)
    (dolist (constructor (|allConstructors|))
      (let (struct)
        (setq struct (get constructor 'database))
```

```

; sourcefile is small. store the string directly
(setq src (gethash constructor *sourcefiles*))
(setq formpos (file-position out))
(print (squeeze (database-constructorform struct)) out)
(finish-output out)
(setq docpos (file-position out))
(print (database-documentation struct) out)
(finish-output out)
(setq attpos (file-position out))
(print (squeeze (database-attributes struct)) out)
(finish-output out)
(setq predpos (file-position out))
(print (squeeze (database-predicates struct)) out)
(finish-output out)
(push (list constructor src formpos docpos attpos predpos) master)))
(finish-output out)
(setq masterpos (file-position out))
(print (mapcar #'squeeze master) out)
(finish-output out)
(file-position out 0)
(print (cons masterpos (get-universal-time)) out)
(finish-output out)
(close out)))

```

67.1.52 Building the category.daase from hash tables

This is a single table of category hash table information, dumped in the database format.

67.1.53 defun Write the category database

```

[genCategoryTable p??]
[squeeze p1025]
[*print-pretty* p??]
[*hasCategory-hash* p995]

```

— defun write-categorydb —

```

(defun write-categorydb ()
  "make category.daase from scratch. contains the *hasCategory-hash* table"
  (let (out master pos *print-pretty*)
    (declare (special *print-pretty* *hasCategory-hash*))
    (print "building category.daase")
    (|genCategoryTable|)
    (setq out (open "category.build" :direction :output))

```

```

(princ "                                " out)
(finish-output out)
(maphash #'(lambda (key value)
  (if (or (null value) (eq value t))
      (setq pos value)
      (progn
        (setq pos (file-position out))
        (print (squeeze value) out)
        (finish-output out)))
    (push (list key pos) master))
  *hasCategory-hash*)
(setq pos (file-position out))
(print (mapcar #'squeeze master) out)
(finish-output out)
(file-position out 0)
(print (cons pos (get-universal-time)) out)
(finish-output out)
(close out)))

```

67.1.54 Building the operation.daase from hash tables

This is a single table of operations hash table information, dumped in the database format.

67.1.55 defun Write the operations database

```

[squeeze p1025]
[*operation-hash* p995]

```

— defun write-operationdb —

```

(defun write-operationdb ()
  (let (pos master out)
    (declare (special leaves *operation-hash*))
    (setq out (open "operation.build" :direction :output))
    (princ "                                " out)
    (finish-output out)
    (maphash #'(lambda (key value)
      (setq pos (file-position out))
      (print (squeeze value) out)
      (finish-output out)
      (push (cons key pos) master))
      *operation-hash*)
    (finish-output out)
    (setq pos (file-position out))

```

```
(print (mapcar #'squeeze master) out)
(file-position out 0)
(print (cons pos (get-universal-time)) out)
(finish-output out)
(close out)))
```

67.1.56 Database support operations

67.1.57 defun Data preloaded into the image at build time

```
[$topicHash p??]
```

— defun write-warmdata —

```
(defun write-warmdata ()
  "write out information to be loaded into the image at build time"
  (declare (special |$topicHash|))
  (with-open-file (out "warm.data" :direction :output)
    (format out "(in-package \"BOOT\")~%")
    (format out "(setq |$topicHash| (make-hash-table))~%"
              (maphash #'(lambda (k v)
                           (format out "(setf (gethash '~a| |$topicHash|) ~a)~%" k v)) |$topicHash|)))
```

67.1.58 defun Return all constructors

```
[*allconstructors* p999]
```

— defun allConstructors —

```
(defun |allConstructors| ()
  (declare (special *allconstructors*))
  *allconstructors*)
```

67.1.59 defun Return all operations

```
[*allOperations* p999]
[*operation-hash* p995]
```

— defun allOperations —

```
(defun |allOperations| ()  
  (declare (special *allOperations* *operation-hash*))  
  (unless *allOperations*  
    (maphash #'(lambda (k v) (declare (ignore v)) (push k *allOperations*))  
              *operation-hash*))  
  *allOperations*)
```

—————

Chapter 68

System Statistics

[gbc-time p??]

— defun statisticsInitialization —

```
(defun |statisticsInitialization| ()  
  "initialize the garbage collection timer"  
  #+:akcl (system:gbc-time 0)  
  nil)
```

—————

68.1 Lisp Library Handling

68.1.1 defun loadLib

```
[startTimingProcess p??]  
[getdatabase p1009]  
[isSystemDirectory p1038]  
[pathnameDirectory p1043]  
[loadLibNoUpdate p1039]  
[sayKeyedMsg p329]  
[namestring p1042]  
[clearConstructorCache p??]  
[updateDatabase p1017]  
[installConstructor p??]  
[updateCategoryTable p??]  
[categoryForm? p??]  
[remprop p??]
```

```
[stopTimingProcess p??]
[$InteractiveMode p24]
[$printLoadMsgs p733]
[$forceDatabaseUpdate p??]
[$CategoryFrame p??]
```

— defun loadLib —

```
(defun |loadLib| (cname)
  (let (fullLibName systemdir? update? kind u sig coSig)
    (declare (special |$CategoryFrame| |$InteractiveMode| |$printLoadMsgs|
                      |$forceDatabaseUpdate|))
    (|startTimingProcess| '|load|)
    (when (setq fullLibName (getdatabase cname 'object))
      (setq systemdir? (|isSystemDirectory| (|pathnameDirectory| fullLibName)))
      (setq update? (or |$forceDatabaseUpdate| (null systemdir?)))
      (cond
        ((null update?) (|loadLibNoUpdate| cname cname fullLibName))
        (t
         (setq kind (getdatabase cname 'constructorkind))
         (when |$printLoadMsgs|
           (|sayKeyedMsg| 'S2IL0002 (list (|namestring| fullLibName) kind cname)))
         (load fullLibName)
         (|clearConstructorCache| cname)
         (|updateDatabase| cname cname systemdir?)
         (|installConstructor| cname kind)
         (setq u (getdatabase cname 'constructormodemap))
         (|updateCategoryTable| cname kind)
         (setq coSig
          (when u
           (setq sig (cdar u))
           (cons nil (loop for x in (cdr sig) collect (|categoryForm?| x))))))
         (if (null (cdr (getdatabase cname 'constructorform)))
           (setf (get cname 'niladic) t)
           (remprop cname 'niladic))
         (setf (get cname 'loaded) fullLibName)
         (when |$InteractiveMode| (setq |$CategoryFrame| (list (list nil))))
         (|stopTimingProcess| '|load|)
         t))))))
```

68.1.2 defun isSystemDirectory

```
[function p??]
[$spadroot p12]
```

— defun isSystemDirectory —

```
(defun |isSystemDirectory| (dir)
  (declare (special $spadroot))
  (every (|function| char=) $spadroot dir))
```

—————

68.1.3 defun loadLibNoUpdate

```
[getdatabase p1009]
[sayKeyedMsg p329]
[toplevel p??]
[clearConstructorCache p??]
[installConstructor p??]
[stopTimingProcess p??]
[$printLoadMsgs p733]
[$InteractiveMode p24]
[$CategoryFrame p??]
```

— defun loadLibNoUpdate —

```
(defun |loadLibNoUpdate| (cname libName fullLibName)
  (declare (ignore libName))
  (let (kind)
    (declare (special |$CategoryFrame| |$InteractiveMode| |$printLoadMsgs|))
    (setq kind (getdatabase cname 'constructorkind))
    (when |$printLoadMsgs|
      (|sayKeyedMsg| 'S2IL0002 (list (|namestring| fullLibName) kind cname)))
    (cond
      ((equal (catch 'versioncheck (load fullLibName)) (- 1))
        (princ "    wrong library version...recompile ")
        (princ fullLibName)
        (terpri)
        (toplevel)))
      (t
        (|clearConstructorCache| cname)
        (|installConstructor| cname kind)
        (setf (get cname 'loaded) fullLibName)
        (when |$InteractiveMode| (setq |$CategoryFrame| (list (list nil))))
        (|stopTimingProcess| '|load|)))
    t))
```

—————

68.1.4 defun loadFunctor

```
[loadFunctor p1040]  
[loadLibIfNotLoaded p??]
```

— defun loadFunctor —

```
(defun |loadFunctor| (u)  
  (cond  
    ((null (atom u)) (|loadFunctor| (car u)))  
    (t  
     (|loadLibIfNotLoaded| u)  
     u)))
```

—————▶

Chapter 69

Special Lisp Functions

69.1 Axiom control structure macros

Axiom used various control structures in the boot code which are not available in Common Lisp. We write some macros here to make the boot to lisp translations easier to read.

69.1.1 defun put

— **defun put** —

```
(defun put (sym ind val) (setf (get sym ind) val))
```

—————

69.1.2 defmacro while

While the condition is true, repeat the body. When the condition is false, return t.

— **defmacro while** —

```
(defmacro while (condition &rest body)
  '(loop (if (not ,condition) (return t)) ,@body))
```

—————

69.1.3 `defmacro whileWithResult`

While the condition is true, repeat the body. When the condition is false, return the result form's value.

— `defmacro whileWithResult` —

```
(defmacro whileWithResult (condition result &rest body)
  '(loop (if (not ,condition) ,@result) ,@body))
```

—————

69.2 Filename Handling

This code implements the Common Lisp pathname functions for Lisp/VM. On VM, a filename is 3-list consisting of the filename, filetype and filemode. We also UPCASE everything.

69.2.1 `defun namestring`

[pathname p1044]

— `defun namestring` —

```
(defun |namestring| (arg)
  (namestring (|pathname| arg)))
```

—————

69.2.2 `defun pathnameName`

[pathname p1044]

— `defun pathnameName` —

```
(defun |pathnameName| (arg)
  (pathname-name (|pathname| arg)))
```

—————

69.2.3 `defun pathnameType`

[pathname p1044]

— **defun pathnameType** —

```
(defun |pathnameType| (arg)
  (pathname-type (|pathname| arg)))
```

—————

69.2.4 **defun pathnameTypeId**

```
[upcase p??]
[object2Identifier p??]
[pathnameType p1042]
```

— **defun pathnameTypeId** —

```
(defun |pathnameTypeId| (arg)
  (upcase (|object2Identifier| (|pathnameType| arg))))
```

—————

69.2.5 **defun mergePathnames**

```
[pathnameName p1042]
[pathnameType p1042]
[pathnameDirectory p1043]
```

— **defun mergePathnames** —

```
(defun |mergePathnames| (a b)
  (let (fn ft fm)
    (cond
      ((string= (setq fn (|pathnameName| a)) "*") b)
      ((not (equal fn (|pathnameName| b))) a)
      ((string= (setq ft (|pathnameType| a)) "*") b)
      ((not (equal ft (|pathnameType| b))) a)
      ((equal (setq fm (|pathnameDirectory| a)) (list "*" )) b)
      (t a))))
```

—————

69.2.6 **defun pathnameDirectory**

```
[pathname p1044]
```

— defun pathnameDirectory —

```
(defun |pathnameDirectory| (arg)
  (namestring (make-pathname :directory (pathname-directory (|pathname| arg)))))
```

—————

69.2.7 defun Axiom pathnames

```
[pathname p1044]
[make-filename p??]
```

— defun pathname —

```
(defun |pathname| (p)
  (cond
    ((null p) p)
    ((pathnamep p) p)
    ((null (consp p)) (pathname p))
    (t
     (when (> (|#| p) 2) (setq p (cons (elt p 0) (cons (elt p 1) nil))))
     (pathname (apply #'make-filename p)))))
```

—————

69.2.8 defun makePathname

```
[pathname p1044]
[object2String p??]
```

— defun makePathname —

```
(defun |makePathname| (name type dir)
  (declare (ignore dir))
  (|pathname| (list (|object2String| name) (|object2String| type))))
```

—————

69.2.9 defun Delete a file

```
[erase p??]
[pathname p1044]
```



```
[$erase p??]
```

— **defun deleteFile** —

```
(defun |deleteFile| (arg)
  (declare (special $erase))
  ($erase (|pathname| arg)))
```

69.2.10 **defun wrap**

```
[lotsof p1045]
[wrap p1045]
```

— **defun wrap** —

```
(defun wrap (list-of-items wrapper)
  (prog nil
    (cond
      ((or (not (consp list-of-items)) (not wrapper))
        (return list-of-items))
      ((not (consp wrapper))
        (setq wrapper (lotsof wrapper))))
    (return
      (cons
        (if (first wrapper)
          '(', (first wrapper) ), (first list-of-items))
        (first list-of-items))
      (wrap (cdr list-of-items) (cdr wrapper))))))
```

69.2.11 **defun lotsof**

— **defun lotsof** —

```
(defun lotsof (&rest items)
  (setq items (copy-list items))
  (nconc items items))
```

69.2.12 defmacro startsId?

— defmacro startsId? —

```
(defmacro |startsId?| (x)
  '(or (alpha-char-p ,x) (member ,x '(#\? #\% #\!) :test #'char=)))
```

69.2.13 defun hput

— defun hput —

```
(defun hput (table key value)
  (setf (gethash key table) value))
```

69.2.14 defmacro hget

— defmacro hget —

```
(defmacro HGET (table key &rest default)
  '(gethash ,key ,table ,@default))
```

69.2.15 defun hkeys

— defun hkeys —

```
(defun hkeys (table)
  (let (keys)
    (maphash
     #'(lambda (key val) (declare (ignore val)) (push key keys)) table)
    keys))
```

69.2.16 defun digitp

[digitp p1047]

— defun digitp —

```
(defun digitp (x)
  (or (and (symbolp x) (digitp (symbol-name x)))
      (and (characterp x) (digit-char-p x))
      (and (stringp x) (= (length x) 1) (digit-char-p (char x 0)))))
```

—————

69.2.17 defun pname

Note it is important that PNAME returns nil not an error for non-symbols

— defun pname 0 —

```
(defun pname (x)
  (cond ((symbolp x) (symbol-name x))
        ((characterp x) (string x))
        (t nil)))
```

—————

69.2.18 defun size

— defun size —

```
(defun size (l)
  (cond
    ((vectorp l) (length l))
    ((consp l) (list-length l))
    (t 0)))
```

—————

69.2.19 defun strpos

— defun strpos —

```
(defun strpos (what in start dontcare)
  (setq what (string what) in (string in))
  (if dontcare
    (progn
      (setq dontcare (character dontcare))
      (search what in :start2 start
               :test #'(lambda (x y) (or (eql x dontcare) (eql x y)))))
    (if (= start 0)
      (search what in)
      (search what in :start2 start)))))
```

69.2.20 defun strposl

Note that this assumes “table” is a string.

— defun strposl —

```
(defun strposl (table cvec sint item)
  (setq cvec (string cvec))
  (if (not item)
    (position table cvec :test #'(lambda (x y) (position y x)) :start sint)
    (position table cvec :test-not #'(lambda (x y) (position y x)) :start sint)))
```

69.2.21 defun qenum

— defun qenum 0 —

```
(defun qenum (cvec ind)
  (char-code (char cvec ind)))
```

69.2.22 defmacro identp

— defmacro identp 0 —

```
(defmacro identp (x)
  (if (atom x)
```

```

'(and ,x (symbolp ,x))
  (let ((xx (gensym)))
    '(let ((,xx ,x))
      (and ,xx (symbolp ,xx))))))

```

69.2.23 defun concat

[string-concatenate p??]

— defun concat 0 —

```

(defun concat (a b &rest l)
  (if (bit-vector-p a)
      (if l
          (apply #'concatenate 'bit-vector a b l)
          (concatenate 'bit-vector a b))
      (if l
          (apply #'system:string-concatenate a b l)
          (system:string-concatenate a b))))

```

69.2.24 defun functionp

[identp p1048]

— defun functionp —

```

(defun |functionp| (fn)
  (if (identp fn)
      (and (fboundp fn) (not (macro-function fn)))
      (functionp fn)))

```

;; —————; NEW DEFINITION (override in msgdb.boot.pamphlet)

69.2.25 defun brightprint

[messageprint p1050]

— defun brightprint —

```
(defun brightprint (x)
  (messageprint x))
```

;; -----j, NEW DEFINITION (override in msgdb.boot.pamphlet)

69.2.26 defun brightprint-0

```
[messageprint-1 p1051]
```

— defun brightprint-0 —

```
(defun brightprint-0 (x)
  (messageprint-1 x))
```

69.2.27 defun member

— defun member 0 —

```
(defun |member| (item sequence)
  (cond
    ((symbolp item) (member item sequence :test #'eq))
    ((stringp item) (member item sequence :test #'equal))
    ((and (atom item) (not (arrayp item))) (member item sequence))
    (t (member item sequence :test #'equalp))))
```

69.2.28 defun messageprint

— defun messageprint —

```
(defun messageprint (x)
  (mapc #'messageprint-1 x))
```

69.2.29 defun messageprint-1

```
[identp p1048]
[messageprint-1 p1051]
[messageprint-2 p1051]
```

— defun messageprint-1 —

```
(defun messageprint-1 (x)
  (cond
    ((or (eq x '|%l|) (equal x "%l")) (terpri))
    ((stringp x) (princ x))
    ((identp x) (princ x))
    ((atom x) (princ x))
    ((princ "(")
     (messageprint-1 (car x))
     (messageprint-2 (cdr x))
     (princ ")"))))
```

—————

69.2.30 defun messageprint-2

```
[messageprint-1 p1051]
[messageprint-2 p1051]
```

— defun messageprint-2 —

```
(defun messageprint-2 (x)
  (if (atom x)
      (unless x (progn (princ " . ") (messageprint-1 x)))
      (progn (princ " ") (messageprint-1 (car x)) (messageprint-2 (cdr x)))))
```

—————

69.2.31 defun sayBrightly1

```
[brightprint-0 p1050]
[brightprint p1049]
```

— defun sayBrightly1 —

```
(defun sayBrightly1 (x *standard-output*)
  (if (atom x)
```

```
(progn (brightprint-0 x) (terpri) (force-output))  
(progn (brightprint x) (terpri) (force-output)))
```

69.2.32 defmacro assq

TPDHERE: This could probably be replaced by the default `assoc` using `eql`
— defmacro `assq` —

```
(defmacro assq (a b)  
  '(assoc ,a ,b :test #'eq))
```

Chapter 70

Record, Union, Mapping, and Enumeration

— postvars —

```
(eval-when (eval load)
  (mapcar #'(lambda (alist)
    (setf (get (first alist) '|makeFunctionList|) (second alist)))
    '((|Record| |mkRecordFunList|)
      (|Union| |mkUnionFunList|)
      (|Mapping| |mkMappingFunList|)
      (|Enumeration| |mkEnumerationFunList|))))
```

—————

Chapter 71

Common Lisp Algebra Support

These functions are called directly from the algebra source code. They fall into two basic categories, one are the functions that are raw Common Lisp calls and the other are Axiom specific functions or macros.

Raw function calls are used where there is an alignment of the Axiom type and the underlying representation in Common Lisp. These form the support pillars upon which Axiom rests. For instance, the 'EQ' function is called to support the Axiom equivalent 'eq?' function.

Macros are used to add type information in order to make low level operations faster. An example is the use of macros in DoubleFloat to add Common Lisp type information. Since DoubleFloat is machine arithmetic we give the compiler explicit type information so it can generate fast code.

Functions are used to do manipulations which are Common Lisp operations but the Axiom semantics are not the same. Because Axiom was originally written in Maclisp, then VMLisp, and then Common Lisp some of these old semantics survive.

71.1 InputForm

71.1.1 defun unparseInputForm

This fixes bug 7217. The default title generation is bogus. This is called from the unparse function in InputForm, bookvol10.3 Given a form, *u*, we try to recover the input line that created it. [\$InteractiveMode p24]

[\$formatSigAsTeX p??]

— defun unparseInputForm —

```
(defun |unparseInputForm| (u)
  (let (|$formatSigAsTeX| |$InteractiveMode|)
    (declare (special |$formatSigAsTeX| |$InteractiveMode|))
```

```
(setq |$formatSigAsTeX| 1)
(setq |$InteractiveMode| nil)
(|form2StringLocal| u))
```

71.2 Void

71.2.1 defun voidValue

```
— defun voidValue —

(defun |voidValue| () "()")
```

71.3 U32Vector

71.3.1 defun getrefv32

```
— defun getrefv32 —

(defun getrefv32 (n x)
  (make-array n :initial-element x :element-type '(unsigned-byte 32)))
```

71.3.2 defmacro qv32len

```
— defmacro qv32len —

(defmacro qv32len (v)
  '(length (the (simple-array (unsigned-byte 32) (*)) ,v)))
```

71.3.3 defmacro elt32

— defmacro elt32 —

```
(defmacro elt32 (v i)
  '(aref (the (simple-array (unsigned-byte 32) (*)) ,v) ,i))
```

—————

71.3.4 defmacro setelt32

— defmacro setelt32 —

```
(defmacro setelt32 (v i s)
  '(setf (aref (the (simple-array (unsigned-byte 32) (*)) ,v) ,i), s))
```

—————

71.4 DirectProduct**71.4.1 defun vec2list**

— defun vec2list —

```
(defun vec2list (vec) (coerce vec 'list))
```

—————

71.5 AlgebraicFunction**71.5.1 defun retract**

```
[objMode p??]
[objVal p??]
[isWrapped p??]
[qcar p??]
[retract1 p??]
```

```
[objNew p??]
[$EmptyMode p??]
```

— defun retract —

```
(defun |retract| (object)
  (labels (
    (retract1 (object)
      (let (type val underDomain objectp)
        (declare (special |$SingleInteger| |$Integer| |$NonNegativeInteger|
                          |$PositiveInteger|))
        (setq type (|objModel| object))
        (cond
          ((stringp type) '|failed|)
          (t
           (setq val (|objVal| object))
           (cond
            ((equal type |$PositiveInteger|) (|objNew| val |$NonNegativeInteger|))
            ((equal type |$NonNegativeInteger|) (|objNew| val |$Integer|))
            ((and (equal type |$Integer|) (typep (|unwrap| val) 'fixnum))
             (|objNew| val |$SingleInteger|))
            (t
             (cond
              ((or (eql 1 (|#| type))
                   (and (consp type) (eq (qcar type) '|Union|))
                   (and (consp type) (eq (qcar type) '|FunctionCalled|)
                        (and (consp (qcdr type)) (eq (qcddr type) nil)))
                   (and (consp type) (eq (qcar type) '|OrderedVariableList|)
                        (and (consp (qcdr type)) (eq (qcddr type) nil)))
                   (and (consp type) (eq (qcar type) '|Variable|)
                        (and (consp (qcdr type)) (eq (qcddr type) nil))))
              (if (setq objectp (|retract2Specialization| object))
                  objectp
                  '|failed|))
             (null (setq underDomain (|underDomainOf| type)))
             '|failed|)
           ; try to retract the "coefficients", e.g. P RN -> P I or M RN -> M I
           (t
            (setq objectp (|retractUnderDomain| object type underDomain))
            (cond
             ((not (eq objectp '|failed|)) objectp)
             ; see if we can use the retract functions
             ((setq objectp (|coerceRetract| object underDomain)) objectp)
             ; see if we have a special case here
             ((setq objectp (|retract2Specialization| object)) objectp)
             (t '|failed|))))))
    (let (type val ans)
      (declare (special |$EmptyMode|))
      (setq type (|objModel| object))
      (cond
```

```

((stringp type) '|failed|)
(equal type |$EmptyMode|) '|failed|)
(t
 (setq val (|objVal| object))
 (cond
  ((and (null (|isWrapped| val))
        (null (and (consp val) (eq (qcar val) 'map)))))
   '|failed|)
 (t
  (cond
   ((eq (setq ans (retract1 (|objNew| val type))) '|failed|)
    ans)
   (t
    (|objNew| (|objVal| ans) (|objMode| ans))))))))))

```

71.6 Any

71.6.1 defun spad2BootCoerce

— defun spad2BootCoerce —

```

(defun |spad2BootCoerce| (x source target)
  (let (xp)
    (cond
     ((null (|isValidType| source)) (|throwKeyedMsg| 'S2IE0004 (list source)))
     ((null (|isValidType| target)) (|throwKeyedMsg| 'S2IE0004 (list target)))
     ((setq xp (|coerceInteractive| (|objNewWrap| x source) target))
      (|objValUnwrap| xp))
     (t
      (|throwKeyedMsgCannotCoerceWithValue| (|wrap| x) source target)))))

```

71.7 ParametricLinearEquations

71.7.1 defun algCoerceInteractive

— defun algCoerceInteractive —

```
(defun |algCoerceInteractive| (p source target)
  (let (|$useConvertForCoercions| u)
    (declare (special |$useConvertForCoercions|))
    (setq |$useConvertForCoercions| t)
    (setq source (|devaluate| source))
    (setq target (|devaluate| target))
    (setq u (|coerceInteractive| (|objNewWrap| p source) target))
    (if u
      (|objValUnwrap| u)
      (|error| (list "can't convert" p "of mode" source "to mode" target))))))
```

71.8 NumberFormats

71.8.1 defun ncParseFromString

— defun ncParseFromString —

```
(defun |ncParseFromString| (s)
  (|zeroOneTran| (catch 'SPAD_READER (|parseFromString| s))))
```

71.9 SingleInteger

71.9.1 defun qsquotient

— defun qsquotient 0 —

```
(defun qsquotient (a b)
  (the fixnum (truncate (the fixnum a) (the fixnum b))))
```

71.9.2 defun qsremainder

— defun qsremainder 0 —


```
(defun qsremainder (a b)
  (the fixnum (rem (the fixnum a) (the fixnum b))))
```

71.9.3 defmacro qsdifference

— defmacro qsdifference 0 —

```
(defmacro qsdifference (x y)
  '(the fixnum (- (the fixnum ,x) (the fixnum ,y))))
```

71.9.4 defmacro qslessp

— defmacro qslessp 0 —

```
(defmacro qslessp (a b)
  '(< (the fixnum ,a) (the fixnum ,b)))
```

71.9.5 defmacro qsadd1

— defmacro qsadd1 0 —

```
(defmacro qsadd1 (x)
  '(the fixnum (1+ (the fixnum ,x))))
```

71.9.6 defmacro qssub1

— defmacro qssub1 0 —

```
(defmacro qssub1 (x)
  '(the fixnum (1- (the fixnum ,x))))
```

71.9.7 defmacro qsminus

— defmacro qsminus 0 —

```
(defmacro qsminus (x)
  '(the fixnum (minus (the fixnum ,x))))
```

71.9.8 defmacro qsplus

— defmacro qsplus 0 —

```
(defmacro qsplus (x y)
  '(the fixnum (+ (the fixnum ,x) (the fixnum ,y))))
```

71.9.9 defmacro qstimes

— defmacro qstimes 0 —

```
(defmacro qstimes (x y)
  '(the fixnum (* (the fixnum ,x) (the fixnum ,y))))
```

71.9.10 defmacro qsabsval

— defmacro qsabsval 0 —

```
(defmacro qsabsval (x)
  '(the fixnum (abs (the fixnum ,x))))
```

71.9.11 defmacro qsoddp

— defmacro qsoddp 0 —

```
(defmacro qsoddp (x)
  '(oddp (the fixnum ,x)))
```

71.9.12 defmacro qszerop

— defmacro qszerop 0 —

```
(defmacro qszerop (x)
  '(zerop (the fixnum ,x)))
```

71.9.13 defmacro qsmax

— defmacro qsmax 0 —

```
(defmacro qsmax (x y)
  '(the fixnum (max (the fixnum ,x) (the fixnum ,y))))
```

71.9.14 defmacro qsmin

— defmacro qsmin 0 —

```
(defmacro qsmín (x y)
  '(the fixnum (min (the fixnum ,x) (the fixnum ,y))))
```

71.10 Boolean

71.10.1 defun The Boolean = function support

```
— defun BooleanEquality 0 —

(defun |BooleanEquality| (x y) (if x y (null y)))
```

71.11 IndexedBits

71.11.1 defmacro truth-to-bit

IndexedBits new function support

```
— defmacro truth-to-bit —

(defmacro truth-to-bit (x) '(cond (,x 1) ('else 0)))
```

71.11.2 defun IndexedBits new function support

```
— defun bvec-make-full 0 —

(defun bvec-make-full (n x)
  (make-array (list n) :element-type 'bit :initial-element x))
```

71.11.3 defmacro bit-to-truth

IndexedBits elt function support

— **defmacro bit-to-truth 0** —

```
(defmacro bit-to-truth (b) '(eq ,b 1))
```

71.11.4 defmacro bvec-elt

IndexedBits elt function support

— **defmacro bvec-elt 0** —

```
(defmacro bvec-elt (bv i) '(sbit ,bv ,i))
```

71.11.5 defmacro bvec-setelt

IndexedBits setelt function support

— **defmacro bvec-setelt** —

```
(defmacro bvec-setelt (bv i x) '(setf (sbit ,bv ,i) ,x))
```

71.11.6 defmacro bvec-size

IndexedBits length function support

— **defmacro bvec-size** —

```
(defmacro bvec-size (bv) '(size ,bv))
```

71.11.7 defun IndexedBits concat function support— **defun bvec-concat 0** —

```
(defun bvec-concat (bv1 bv2) (concatenate '(vector bit) bv1 bv2))
```

71.11.8 defun IndexedBits copy function support

— defun bvec-copy 0 —

```
(defun bvec-copy (bv) (copy-seq bv))
```

71.11.9 defun IndexedBits = function support

— defun bvec-equal 0 —

```
(defun bvec-equal (bv1 bv2) (equal bv1 bv2))
```

71.11.10 defun IndexedBits < function support

— defun bvec-greater 0 —

```
(defun bvec-greater (bv1 bv2)
  (let ((pos (mismatch bv1 bv2)))
    (cond ((or (null pos) (>= pos (length bv1))) nil)
          ((< pos (length bv2)) (> (bit bv1 pos) (bit bv2 pos)))
          ((find 1 bv1 :start pos) t)
          (t nil))))
```

71.11.11 defun IndexedBits And function support

— defun bvec-and 0 —

```
(defun bvec-and (bv1 bv2) (bit-and bv1 bv2))
```

71.11.12 defun IndexedBits Or function support

— defun bvec-or 0 —

```
(defun bvec-or (bv1 bv2) (bit-ior bv1 bv2))
```

71.11.13 defun IndexedBits xor function support

— defun bvec-xor 0 —

```
(defun bvec-xor (bv1 bv2) (bit-xor bv1 bv2))
```

71.11.14 defun IndexedBits nand function support

— defun bvec-nand 0 —

```
(defun bvec-nand (bv1 bv2) (bit-nand bv1 bv2))
```

71.11.15 defun IndexedBits nor function support

— defun bvec-nor 0 —

```
(defun bvec-nor (bv1 bv2) (bit-nor bv1 bv2))
```

71.11.16 defun IndexedBits not function support

— defun bvec-not 0 —

```
(defun bvec-not (bv) (bit-not bv))
```

71.12 KeyedAccessFile**71.12.1 defun KeyedAccessFile defstream function support**

This is a simpler interface to RDEFIOSTREAM [rdefiostream p??]

— defun rdefinstream —

```
(defun rdefinstream (&rest fn)
  ;; following line prevents rdefiostream from adding a default filetype
  (unless (rest fn) (setq fn (list (pathname (car fn)))))
  (rdefiostream (list (cons 'file fn) '(mode . input))))
```

71.12.2 defun KeyedAccessFile defstream function support

[rdefiostream p??]

— defun rdefoutstream —

```
(defun rdefoutstream (&rest fn)
  ;; following line prevents rdefiostream from adding a default filetype
  (unless (rest fn) (setq fn (list (pathname (car fn)))))
  (rdefiostream (list (cons 'FILE fn) '(mode . OUTPUT))))
```

71.13 Table

71.13.1 defun Table InnerTable support

We look inside the Key domain given to Table and find if there is an equality predicate associated with the domain. If found then Table will use a HashTable representation, otherwise it will use an AssociationList representation [knownEqualPred p??]

[compiledLookup p1069]

[Boolean p??]

[bpiname p??]

[knownEqualPred p??]

— defun hashable —

```
(defun |hashable| (dom)
  (labels (
    (|knownEqualPred| (dom)
      (let ((fun (|compiledLookup| '= '(|Boolean|) $ $) dom)))
      (if fun
        (get (bpiname (car fun)) '|SPADreplace|)
        nil))))
    (member (|knownEqualPred| dom) '(eq eql equal))))
```

—————

71.13.2 defun compiledLookup

[isDomain p??]

[NRTevalDomain p1073]

— defun compiledLookup —

```
(defun |compiledLookup| (op sig dollar)
  (unless (|isDomain| dollar) (setq dollar (|NRTevalDomain| dollar)))
  (|basicLookup| op sig dollar dollar))
```

—————

71.13.3 defun basicLookup

[spadcall p??]

[hashCode? p??]

[opIsHasCat p??]

[HasCategory p??]

```

[hashType p??]
[hashString p??]
[error p??]
[vecp p??]
[isNewWorldDomain p??]
[oldCompLookup p1072]
[lookupInDomainVector p1071]
[$hashSeg p??]
[$hashOpSet p??]
[$hashOpApply p??]
[$hashOp0 p??]
[$hashOp1 p??]

```

— defun basicLookup —

```

(defun |basicLookup| (op sig domain dollar)
  (let (hashPercent box dispatch lookupFun hashSig val boxval)
    (declare (special |$hashSeg| |$hashOpSet| |$hashOpApply| |$hashOp0|
                      |$hashOp1|))
    (cond
      ((vecp domain)
       (if (|isNewWorldDomain| domain)
           (|oldCompLookup| op sig domain dollar)
           (|lookupInDomainVector| op sig domain dollar)))
      (t
       (setq hashPercent
              (if (vecp dollar)
                  (|hashType| (elt dollar 0) 0)
                  (|hashType| dollar 0)))
       (setq box (cons nil nil))
       (cond
         ((null (vecp (setq dispatch (car domain))))
          (|error| '|bad domain format|))
         (t
          (setq lookupFun (elt dispatch 3))
          (cond
            ((eq1 (elt dispatch 0) 0)
             (setq hashSig
                    (cond
                     ((|hashCode?| sig) sig)
                     ((|opIsHasCat| op) (|hashType| sig hashPercent))
                     (t (|hashType| (cons '|Mapping| sig) hashPercent))))
              (when (symbolp op)
                (cond
                 ((eq op '|Zero|) (setq op |$hashOp0|))
                 ((eq op '|One|) (setq op |$hashOp1|))
                 ((eq op '|elt|) (setq op |$hashOpApply|))
                 ((eq op '|setelt|) (setq op |$hashOpSet|))
                 (t (setq op (|hashString| (symbol-name op)))))))

```

```

(cond
  ((setq val
    (car
      (spadcall (cdr domain) dollar op hashSig box nil lookupFun)))
    val)
  ((|hashCode?| sig) nil)
  ((or (> (|#| sig) 1) (|opIsHasCat| op)) nil)
  ((setq boxval
    (spadcall (cdr dollar) dollar op
      (|hashType| (car sig) hashPercent)
      box nil lookupFun))
    (cons #'identity (car boxval)))
  (t nil)))
((|opIsHasCat| op) (|HasCategory| domain sig))
(t
  (when (|hashCode?| op)
    (cond
      ((eq1 op |$hashOp1|) (setq op '|One|))
      ((eq1 op |$hashOp0|) (setq op '|Zero|))
      ((eq1 op |$hashOpApply|) (setq op '|elt|))
      ((eq1 op |$hashOpSet|) (setq op '|setelt|))
      ((eq1 op |$hashSeg|) (setq op '|segment|))))
    (cond
      ((and (|hashCode?| sig) (eq1 sig hashPercent))
        (spadcall
          (car (spadcall (cdr dollar) dollar op '($) box nil lookupFun))))
      (t
        (car
          (spadcall (cdr dollar) dollar op sig box nil lookupFun))))))))))

```

71.13.4 defun lookupInDomainVector

[basicLookupCheckDefaults p1072]

[spadcall p??]

— defun lookupInDomainVector —

```

(defun |lookupInDomainVector| (op sig domain dollar)
  (if (consp domain)
    (|basicLookupCheckDefaults| op sig domain domain)
    (spadcall op sig dollar (elt domain 1))))

```

71.13.5 defun basicLookupCheckDefaults

```
[vecp p??]
[error p??]
[hashType p??]
[hashCode? p??]
[hashString p??]
[spadcall p??]
[$lookupDefaults p??]
```

— defun basicLookupCheckDefaults —

```
(defun |basicLookupCheckDefaults| (op sig domain dollar)
  (declare (ignore domain))
  (let (box dispatch lookupFun hashPercent hashSig)
    (declare (special |$lookupDefaults|))
    (setq box (cons nil nil))
    (cond
      ((null (vecp (setq dispatch (car dollar))))
        (|error| '|bad domain format|))
      (t
        (setq lookupFun (elt dispatch 3))
        (cond
          ((eql (elt dispatch 0) 0)
            (setq hashPercent
              (if (vecp dollar)
                (|hashType| (elt dollar 0) 0)
                (|hashType| dollar 0)))
            (setq hashSig
              (if (|hashCode?| sig)
                sig
                (|hashType| (cons '|Mapping| sig) hashPercent)))
            (when (symbolp op) (setq op (|hashString| (symbol-name op))))
            (car (spadcall (cdr dollar) dollar op hashSig
                          box (null |$lookupDefaults|) lookupFun)))
          (t
            (car (spadcall (cdr dollar) dollar op sig box
                          (null |$lookupDefaults|) lookupFun)))))))
```

—————

71.13.6 defun oldCompLookup

```
[lookupInDomainVector p1071]
[$lookupDefaults p??]
```

— defun oldCompLookup —

```
(defun |oldCompLookup| (op sig domvec dollar)
  (let (|$lookupDefaults| u)
    (declare (special |$lookupDefaults|))
    (setq |$lookupDefaults| nil)
    (cond
      ((setq u (|lookupInDomainVector| op sig domvec dollar))
       u)
      (t
       (setq |$lookupDefaults| t)
       (|lookupInDomainVector| op sig domvec dollar))))))
```

71.13.7 defun NRTEvalDomain

```
[qcar p??]
[eval p??]
[evalDomain p911]
```

— defun NRTEvalDomain —

```
(defun |NRTEvalDomain| (form)
  (if (and (consp form) (eq (qcar form) 'setelt))
      (|eval| form)
      (|evalDomain| form)))
```

71.14 Plot3d

We catch numeric errors and throw a different failure than normal. The `trapNumericErrors` macro will return a pair of the the form `Union(type-of-form, "failed")`. This pair is tested for eq-ness so it has to be unique. It lives in the defvar `$numericFailure`. The old value of the `$BreakMode` variable is saved in a defvar named `$oldBreakMode`.

71.14.1 defvar \$numericFailure

This is a failed union branch which is the value returned for numeric failure.

— initvars —

```
(defvar |$numericFailure| (cons 1 "failed"))
```

71.14.2 defvar \$oldBreakMode

— initvars —

```
(defvar |$oldBreakMode| nil "the old value of the $BreakMode variable")
```

71.14.3 defmacro trapNumericErrors

The following macro evaluates form returning Union(type-of form, "failed"). It is used in the myTrap local function in Plot3d.

— defmacro trapNumericErrors —

```
(defmacro |trapNumericErrors| (form)
  '(let ((|$oldBreakMode| |$BreakMode|) (|$BreakMode| '|trapNumerics|) (val))
    (declare (special |$BreakMode| |$numericFailure| |$oldBreakMode|))
    (setq val (catch '|trapNumerics| ,form))
    (if (eq val |$numericFailure|) val (cons 0 val))))
```

71.15 DoubleFloatVector

Double Float Vectors are simple arrays of lisp double-floats made available at the Spad language level. Note that these vectors are 0 based whereas other Spad language vectors are 1-based.

71.15.1 defmacro dlen

DoubleFloatVector Qsize function support

— defmacro dlen —

```
(defmacro dlen (v)
  '(length (the (simple-array double-float (*)) ,v)))
```

71.15.2 defmacro make-double-vector

DoubleFloatVector Qnew function support

— **defmacro make-double-vector** —

```
(defmacro make-double-vector (n)
  '(make-array (list ,n) :element-type 'double-float))
```

71.15.3 defmacro make-double-vector1

DoubleFloatVector Qnew1 function support

— **defmacro make-double-vector1** —

```
(defmacro make-double-vector1 (n s)
  '(make-array (list ,n) :element-type 'double-float :initial-element ,s))
```

71.15.4 defmacro delt

DoubleFloatVector Qelt1 function support

— **defmacro delt** —

```
(defmacro delt (v i)
  '(aref (the (simple-array double-float (*)) ,v) ,i))
```

71.15.5 defmacro dsetelt

DoubleFloatVector Qsetelt1 function support

— **defmacro dsetelt** —

```
(defmacro dsetelt (v i s)
  '(setf (aref (the (simple-array double-float (*)) ,v) ,i) ,s))
```

71.16 ComplexDoubleFloatVector

Complex Double Float Vectors are simple arrays of lisp double-floats made available at the Spad language level. Note that these vectors are 0 based whereas other Spad language vectors are 1-based. Complex array is implemented as an array of doubles. Each complex number occupies two positions in the real array.

71.16.1 defmacro make-cdouble-vector

ComplexDoubleFloatVector Qnew function support
— **defmacro make-cdouble-vector** —

```
(defmacro make-cdouble-vector (n)
  '(make-array (list (* 2 ,n)) :element-type 'double-float))
```

71.16.2 defmacro cdelt

ComplexDoubleFloatVector Qelt1 function support
— **defmacro cdelt** —

```
(defmacro CDELT(ov oi)
  (let ((v (gensym))
        (i (gensym)))
    '(let ((,v ,ov)
          (,i ,oi))
      (cons
        (aref (the (simple-array double-float (*)) ,v) (* 2 ,i))
        (aref (the (simple-array double-float (*)) ,v) (+ (* 2 ,i) 1))))))
```

71.16.3 defmacro cdsetelt

ComplexDoubleFloatVector Qsetelt1 function support
— **defmacro cdsetelt** —

```
(defmacro cdsetelt(ov oi os)
  (let ((v (gensym))
        (i (gensym))
        (s (gensym)))
    '(let ((,v ,ov)
          (,i ,oi)
          (,s ,os))
      (setf (aref (the (simple-array double-float (*)) ,v) (* 2 ,i))
            (aref (the (simple-array double-float (*)) ,s) (* 2 ,i))
            (aref (the (simple-array double-float (*)) ,s) (+ (* 2 ,i) 1))))))
```



```

      (,i ,oi)
      (,s ,os))
    (setf (aref (the (simple-array double-float (*)) ,v) (* 2 ,i))
      (car ,s))
    (setf (aref (the (simple-array double-float (*)) ,v) (+ (* 2 ,i) 1))
      (cdr ,s))
    ,s)))

```

71.16.4 defmacro cdlen

ComplexDoubleFloatVector Qsize function support

— **defmacro cdlen** —

```

(defmacro cdlen(v)
  '(truncate (length (the (simple-array double-float (*)) ,v)) 2))

```

71.17 DoubleFloatMatrix

71.17.1 defmacro make-double-matrix

DoubleFloatMatrix qnew function support

— **defmacro make-double-matrix** —

```

(defmacro make-double-matrix (n m)
  '(make-array (list ,n ,m) :element-type 'double-float))

```

71.17.2 defmacro make-double-matrix1

DoubleFloatMatrix new function support

— **defmacro make-double-matrix1** —

```

(defmacro make-double-matrix1 (n m s)
  '(make-array (list ,n ,m) :element-type 'double-float
    :initial-element ,s))

```

71.17.3 defmacro daref2

DoubleFloatMatrix qelt function support

— **defmacro daref2** —

```
(defmacro daref2 (v i j)
  '(aref (the (simple-array double-float (* *)) ,v) ,i ,j))
```

71.17.4 defmacro dsetaref2

DoubleFloatMatrix qsetelt! function support

— **defmacro dsetaref2** —

```
(defmacro dsetaref2 (v i j s)
  '(setf (aref (the (simple-array double-float (* *)) ,v) ,i ,j)
    ,s))
```

71.17.5 defmacro danrows

DoubleFloatMatrix nrows function support

— **defmacro danrows** —

```
(defmacro danrows (v)
  '(array-dimension (the (simple-array double-float (* *)) ,v) 0))
```

71.17.6 defmacro dancols

DoubleFloatMatrix ncols function support

— **defmacro dancols** —

```
(defmacro dancols (v)
  '(array-dimension (the (simple-array double-float (* *)) ,v) 1))
```

71.18 ComplexDoubleFloatMatrix

71.18.1 defmacro make-cdouble-matrix

ComplexDoubleFloatMatrix function support

— **defmacro make-cdouble-matrix** —

```
(defmacro make-cdouble-matrix (n m)
  '(make-array (list ,n (* 2 ,m)) :element-type 'double-float))
```

71.18.2 defmacro cdaref2

ComplexDoubleFloatMatrix function support

— **defmacro cdaref2** —

```
(defmacro cdaref2 (ov oi oj)
  (let ((v (gensym))
        (i (gensym))
        (j (gensym)))
    '(let ((,v ,ov)
          (,i ,oi)
          (,j ,oj))
      (cons
        (aref (the (simple-array double-float (* *)) ,v) ,i (* 2 ,j))
        (aref (the (simple-array double-float (* *)) ,v)
              ,i (+ (* 2 ,j) 1))))))
```

71.18.3 defmacro cdsetaref2

ComplexDoubleFloatMatrix function support

— **defmacro cdsetaref2** —

```
(defmacro cdsetaref2 (ov oi oj os)
  (let ((v (gensym))
        (i (gensym))
        (j (gensym))
        (s (gensym)))
    '(let ((,v ,ov)
          (,i ,oi)
          (,j ,oj)
          (,s ,os))
```

```

(s ,os))
(setf (aref (the (simple-array double-float (* *)) ,v) ,i (* 2 ,j))
      (car ,s))
(setf (aref (the (simple-array double-float (* *)) ,v)
          ,i (+ (* 2 ,j) 1))
      (cdr ,s))
,s)))

```

71.18.4 defmacro cdanrows

ComplexDoubleFloatMatrix function support

— **defmacro cdanrows** —

```

(defmacro cdanrows (v)
  '(array-dimension (the (simple-array double-float (* *)) ,v) 0))

```

71.18.5 defmacro cdancols

ComplexDoubleFloatMatrix function support

— **defmacro cdancols** —

```

(defmacro cdancols (v)
  '(truncate
    (array-dimension (the (simple-array double-float (* *)) ,v) 1) 2))

```

71.19 Integer

71.19.1 defun Integer divide function support

Note that this is defined as a SPADReplace function in Integer so that algebra code that uses the Integer divide function actually inlines a call to this code. The Integer domain contains the line:

```
(PUT (QUOTE |INT;divide;2$R;44|) (QUOTE |SPADreplace|) (QUOTE DIVIDE2))
```

— **defun divide2 0** —

```
(defun divide2 (x y)
  (multiple-value-call #'cons (truncate x y)))
```

71.19.2 defun Integer quo function support

Note that this is defined as a SPADReplace function in Integer so that algebra code that uses the Integer quo function actually inlines a call to this code. The Integer domain contains the line:

```
(PUT (QUOTE |INT;rem;3$;46|) (QUOTE |SPADreplace|) (QUOTE REMAINDER2))
```

Because these are identical except for name we make the symbol-functions equivalent. This was done in the original code for efficiency.

— defun remainder2 0 —

```
(setf (symbol-function 'remainder2) #'rem)
```

71.19.3 defun Integer quo function support

Note that this is defined as a SPADReplace function in Integer so that algebra code that uses the Integer quo function actually inlines a call to this code. The Integer domain contains the line:

```
(PUT (QUOTE |INT;quo;3$;45|) (QUOTE |SPADreplace|) (QUOTE QUOTIENT2))
```

— defun quotient2 0 —

```
(defun quotient2 (x y)
  (values (truncate x y)))
```

71.19.4 defun Integer random function support

This is used for calls to random with no arguments. If an argument is supplied to random then the common lisp random function is called directly. This could be lifted up into the spad code.

— defun random 0 —

```
(defun |random| () (random (expt 2 26)))
```

71.20 IndexCard

71.20.1 defun IndexCard origin function support

```
[dbPart p??]  
[charPosition p??]  
[substring p??]
```

— defun alqlGetOrigin —

```
(defun |alqlGetOrigin| (x)  
  (let (field k)  
    (setq field (|dbPart| x 5 1))  
    (setq k (|charPosition| #\ ( field 2))  
    (substring field 1 (1- k))))
```

71.20.2 defun IndexCard origin function support

```
[dbPart p??]  
[charPosition p??]  
[substring p??]
```

— defun alqlGetParams —

```
(defun |alqlGetParams| (x)  
  (let (field k)  
    (setq field (|dbPart| x 5 1))  
    (setq k (|charPosition| #\ ( field 2))  
    (substring field k nil)))
```

71.20.3 defun IndexCard elt function support

```
[dbPart p??]  
[substring p??]
```

— defun alqlGetKindString —

```
(defun |alqlGetKindString| (x)
  (if (or (char= (elt x 0) #\a) (char= (elt x 0) #\o))
      (substring (|dbPart| x 5 1) 0 1)
      (substring x 0 1))))
```

—————

71.21 OperationsQuery

71.21.1 defun OperationQuery getDatabase function support

This function, called as `getBrowseDatabase(arg)` returns a list of appropriate entries in the browser database. The legal values for `arg` are

- “o” (operations)
- “k” (constructors)
- “d” (domains)
- “c” (categories)
- “p” (packages)

```
[member p1050]
[grepConstruct p??]
[$includeUnexposed? p??]
```

— defun getBrowseDatabase —

```
(defun |getBrowseDatabase| (kind)
  (let (|$includeUnexposed?|)
    (declare (special |$includeUnexposed?|))
    (setq |$includeUnexposed?| t)
    (when (|member| kind '("o" "k" "c" "d" "p"))
      (|grepConstruct| "*" (intern kind)))))
```

—————

71.22 Database

71.22.1 defun Database elt function support

```
[basicMatch? p??]
```

— defun stringMatches? —

```
(defun |stringMatches?| (pattern subject)
  (when (integerp (|basicMatch?| pattern subject)) t))
```

71.23 FileName

71.23.1 defun FileName filename function implementation

```
[StringToDir p1084]
```

— defun fnameMake —

```
(defun |fnameMake| (d n e)
  (if (string= e "") (setq e nil))
  (make-pathname :directory (|StringToDir| d) :name n :type e))
```

71.23.2 defun FileName filename support function

```
[lastc p??]
```

— defun StringToDir —

```
(defun |StringToDir| (s)
  (cond
    ((string= s "/" ) '(:root))
    ((string= s "") nil)
    (t
     (let ((lastc (aref s (- (length s) 1))))
       (if (char= lastc #\/)
           (pathname-directory (concat s "name.type"))
           (pathname-directory (concat s "/name.type")) ))) ))
```

71.23.3 defun FileName directory function implementation

[DirToString p1085]

— defun fnameDirectory —

```
(defun |fnameDirectory| (f)
  (|DirToString| (pathname-directory f)))
```

—————

71.23.4 defun FileName directory function support

For example, “/” “/u/smwatt” “../src”

— defun DirToString 0 —

```
(defun |DirToString| (d)
  (cond
    ((equal d '(:root)) "/")
    ((null d) "")
    ('t (string-right-trim "/" (namestring (make-pathname :directory d))))))
```

—————

71.23.5 defun FileName name function implementation

— defun fnameName 0 —

```
(defun |fnameName| (f)
  (let ((s (pathname-name f)))
    (if s s "")))
```

—————

71.23.6 defun FileName extension function implementation

— defun fnameType 0 —

```
(defun |fnameType| (f)
  (let ((s (pathname-type f)))
    (if s s "")))
```

71.23.7 defun FileName exists? function implementation

— defun fnameExists? 0 —

```
(defun |fnameExists?| (f)
  (if (probe-file (namestring f)) 't nil))
```

71.23.8 defun FileName readable? function implementation

— defun fnameReadable? 0 —

```
(defun |fnameReadable?| (f)
  (let ((s (open f :direction :input :if-does-not-exist nil)))
    (cond (s (close s) t) (t nil)) ))
```

71.23.9 defun FileName writeable? function implementation

[myWriteable? p??]

— defun fnameWritable? —

```
(defun |fnameWritable?| (f)
  (|myWritable?| (namestring f)) )
```

71.23.10 defun FileName writeable? function support

```
[error p??]
[fnameExists? p1086]
[fnameDirectory p1085]
[writeablep p??]
```

— defun myWritable? —

```
(defun |myWritable?| (s)
  (if (not (stringp s)) (|error| "'myWritable?' requires a string arg."))
  (if (string= s "") (setq s "."))
  (if (not (|fnameExists?| s)) (setq s (|fnameDirectory| s)))
  (if (string= s "") (setq s "."))
  (if (> (|writeablep| s) 0) 't nil) )
```

71.23.11 defun FileName new function implementation

[fnameMake p1084]

— defun fnameNew —

```
(defun |fnameNew| (d n e)
  (if (not (|myWritable?| d))
      nil
      (do ((fn))
          (nil)
          (setq fn (|fnameMake| d (string (gensym n)) e))
          (if (not (probe-file (namestring fn)))
              (return-from |fnameNew| fn) ))))
```

71.24 DoubleFloat

These macros wrap their arguments with strong type information in order to optimize doublefloat computations. They are used directly in the DoubleFloat domain (see Volume 10.3).

71.24.1 defmacro DFLessThan

Compute a strongly typed doublefloat comparison See Steele Common Lisp 1990 p293

— defmacro DFLessThan —

```
(defmacro DFLessThan (x y)
  '(< (the double-float ,x) (the double-float ,y)))
```

71.24.2 defmacro DUnaryMinus

Compute a strongly typed unary doublefloat minus See Steele Common Lisp 1990 p295

— **defmacro DUnaryMinus** —

```
(defmacro DUnaryMinus (x)
  '(the double-float (- (the double-float ,x))))
```

—————

71.24.3 defmacro DFMinusp

Compute a strongly typed unary doublefloat test for negative See Steele Common Lisp 1990 p292

— **defmacro DFMinusp** —

```
(defmacro DFMinusp (x)
  '(minusp (the double-float ,x)))
```

—————

71.24.4 defmacro DFZerop

Compute a strongly typed unary doublefloat test for zero See Steele Common Lisp 1990 p292

— **defmacro DFZerop** —

```
(defmacro DFZerop (x)
  '(zerop (the double-float ,x)))
```

—————

71.24.5 defmacro DFAdd

Compute a strongly typed doublefloat addition See Steele Common Lisp 1990 p295

— **defmacro DFAdd** —

```
(defmacro DFAdd (x y)
  '(the double-float (+ (the double-float ,x) (the double-float ,y))))
```

—————

71.24.6 defmacro DFSubtract

Compute a strongly typed doublefloat subtraction See Steele Common Lisp 1990 p295

— **defmacro DFSubtract** —

```
(defmacro DFSubtract (x y)
  '(the double-float (- (the double-float ,x) (the double-float ,y))))
```

—————

71.24.7 defmacro DFMultiply

Compute a strongly typed doublefloat multiplication See Steele Common Lisp 1990 p296

— **defmacro DFMultiply** —

```
(defmacro DFMultiply (x y)
  '(the double-float (* (the double-float ,x) (the double-float ,y))))
```

—————

71.24.8 defmacro DFIntegerMultiply

Compute a strongly typed doublefloat multiplication by an integer. See Steele Common Lisp 1990 p296

— **defmacro DFIntegerMultiply** —

```
(defmacro DFIntegerMultiply (i y)
  '(the double-float (* (the integer ,i) (the double-float ,y))))
```

—————

71.24.9 defmacro DFMax

Choose the maximum of two doublefloats. See Steele Common Lisp 1990 p294

— **defmacro DFMax** —

```
(defmacro DFMax (x y)
  '(the double-float (max (the double-float ,x) (the double-float ,y))))
```

—————

71.24.10 defmacro DFMin

Choose the minimum of two doublefloats. See Steele Common Lisp 1990 p294

— **defmacro DFMin** —

```
(defmacro DFMin (x y)
  '(the double-float (min (the double-float ,x) (the double-float ,y))))
```

71.24.11 defmacro DFEq

Compare two doublefloats for equality, where equality is eq, or numbers of the same type with the same value. See Steele Common Lisp 1990 p105

— **defmacro DFEq** —

```
(defmacro DFEq (x y)
  '(eq (the double-float ,x) (the double-float ,y)))
```

71.24.12 defmacro DFDivide

Divide a doublefloat by a doublefloat See Steele Common Lisp 1990 p296

— **defmacro DFDivide** —

```
(defmacro DFDivide (x y)
  '(the double-float (/ (the double-float ,x) (the double-float ,y))))
```

71.24.13 defmacro DFIntegerDivide

Divide a doublefloat by an integer See Steele Common Lisp 1990 p296

— **defmacro DFIntegerDivide** —

```
(defmacro DFIntegerDivide (x i)
  '(the double-float (/ (the double-float ,x) (the integer ,i))))
```

71.24.14 defmacro DFSqrt

Compute the doublefloat square root of x . The result will be complex if the argument is negative. See Steele Common Lisp 1990 p302

— **defmacro DFSqrt** —

```
(defmacro DFSqrt (x)
  '(sqrt (the double-float ,x)))
```

71.24.15 defmacro DFLogE

Compute the doublefloat log of x with the base e . The result will be complex if the argument is negative. See Steele Common Lisp 1990 p301

— **defmacro DFLogE** —

```
(defmacro DFLogE (x)
  '(log (the double-float ,x)))
```

71.24.16 defmacro DFLog

Compute the doublefloat log of x with a given base b . The result will be complex if x is negative. See Steele Common Lisp 1990 p301

— **defmacro DFLog** —

```
(defmacro DFLog (x b)
  '(log (the double-float ,x) (the fixnum ,b)))
```

71.24.17 defmacro DFIntegerExpt

Compute the doublefloat expt of x with a given integer power i See Steele Common Lisp 1990 p300

— **defmacro DFIntegerExpt** —

```
(defmacro DFIntegerExpt (x i)
  '(the double-float (expt (the double-float ,x) (the integer ,i))))
```

71.24.18 defmacro DFExpt

Compute the doublefloat expt of x with a given power p . The result could be complex if the base is negative and the power is not an integer. See Steele Common Lisp 1990 p300

— **defmacro DFExpt** —

```
(defmacro DFExpt (x p)
  '(expt (the double-float ,x) (the double-float ,p)))
```

—————

71.24.19 defmacro DFExp

Compute the doublefloat exp with power e See Steele Common Lisp 1990 p300

— **defmacro DFExp** —

```
(defmacro DFExp (x)
  '(the double-float (exp (the double-float ,x))))
```

—————

71.24.20 defmacro DFSin

Compute a strongly typed doublefloat sin See Steele Common Lisp 1990 p304

— **defmacro DFSin** —

```
(defmacro DFSin (x)
  '(the double-float (sin (the double-float ,x))))
```

—————

71.24.21 defmacro DFCos

Compute a strongly typed doublefloat cos See Steele Common Lisp 1990 p304

— **defmacro DFCos** —

```
(defmacro DFCos (x)
  '(the double-float (cos (the double-float ,x))))
```

—————

71.24.22 defmacro DFTan

Compute a strongly typed doublefloat tan See Steele Common Lisp 1990 p304

— **defmacro DFTan** —

```
(defmacro DFTan (x)
  '(the double-float (tan (the double-float ,x))))
```

71.24.23 defmacro DFAsin

Compute a strongly typed doublefloat asin. The result is complex if the absolute value of the argument is greater than 1. See Steele Common Lisp 1990 p305

— **defmacro DFAsin** —

```
(defmacro DFAsin (x)
  '(asin (the double-float ,x)))
```

71.24.24 defmacro DFAcos

Compute a strongly typed doublefloat acos. The result is complex if the absolute value of the argument is greater than 1. See Steele Common Lisp 1990 p305

— **defmacro DFAcos** —

```
(defmacro DFAcos (x)
  '(acos (the double-float ,x)))
```

71.24.25 defmacro DFAtan

Compute a strongly typed doublefloat atan See Steele Common Lisp 1990 p305

— **defmacro DFAtan** —

```
(defmacro DFAtan (x)
  '(the double-float (atan (the double-float ,x))))
```

71.24.26 defmacro DFAtan2

Compute a strongly typed doublefloat atan with 2 arguments

$y = 0$	$x > 0$	Positive x-axis	0
$y > 0$	$x > 0$	Quadrant I	$0 < \text{result} < \pi/2$
$y > 0$	$x = 0$	Positive y-axis	$\pi/2$
$y > 0$	$x < 0$	Quadrant II	$\pi/2 < \text{result} < \pi$
$y = 0$	$x < 0$	Negative x-axis	π
$y < 0$	$x < 0$	Quadrant III	$-\pi < \text{result} < -\pi/2$
$y < 0$	$x = 0$	Negative y-axis	$-\pi/2$
$y < 0$	$x > 0$	Quadrant IV	$-\pi/2 < \text{result} < 0$
$y = 0$	$x = 0$	Origin	error

See Steele Common Lisp 1990 p306

— **defmacro DFAtan2** —

```
(defmacro DFAtan2 (y x)
  '(the double-float (atan (the double-float ,x) (the double-float ,y))))
```

—————

71.24.27 defmacro DFSinh

Compute a strongly typed doublefloat sinh

$$(e^z - e^{-z})/2$$

See Steele Common Lisp 1990 p308

— **defmacro DFSinh** —

```
(defmacro DFSinh (x)
  '(the double-float (sinh (the double-float ,x))))
```

—————

71.24.28 defmacro DFCosh

Compute a strongly typed doublefloat cosh

$$(e^z + e^{-z})/2$$

See Steele Common Lisp 1990 p308

— **defmacro DFCosh** —

```
(defmacro DFCosh (x)
  '(the double-float (cosh (the double-float ,x))))
```

71.24.29 defmacro DFTanh

Compute a strongly typed doublefloat tanh

$$(e^z - e^{-z}) / (e^z + e^{-z})$$

See Steele Common Lisp 1990 p308

— **defmacro DFTanh** —

```
(defmacro DFTanh (x)
  '(the double-float (tanh (the double-float ,x))))
```

71.24.30 defmacro DFAsinh

Compute the inverse hyperbolic sin.

$$\log \left(z + \sqrt{1 + z^2} \right)$$

See Steele Common Lisp 1990 p308

— **defmacro DFAsinh** —

```
(defmacro DFAsinh (x)
  '(the double-float (asinh (the double-float ,x))))
```

71.24.31 defmacro DFAcosh

Compute the inverse hyperbolic cos. Note that the acosh function will return a complex result if the argument is less than 1.

$$\log \left(z + (z + 1) \sqrt{(z - 1) / (z + 1)} \right)$$

See Steele Common Lisp 1990 p308

— **defmacro DFAcosh** —

```
(defmacro DFAcosh (x)
  '(acosh (the double-float ,x)))
```

71.24.32 defmacro DFAtanh

Compute the inverse hyperbolic tan. Note that the acosh function will return a complex result if the argument is greater than 1.

$$\log \left((1+z) \sqrt{1/(1-z^2)} \right)$$

See Steele Common Lisp 1990 p308

— **defmacro DFAtanh** —

```
(defmacro DFAtanh (x)
  '(atanh (the double-float ,x)))
```

71.24.33 defun Machine specific float numerator

This is used in the DoubleFloat integerDecode function

— **defun integer-decode-float-numerator 0** —

```
(defun integer-decode-float-numerator (x)
  (integer-decode-float x))
```

71.24.34 defun Machine specific float denominator

This is used in the DoubleFloat integerDecode function

— **defun integer-decode-float-denominator 0** —

```
(defun integer-decode-float-denominator (x)
  (multiple-value-bind (mantissa exponent sign) (integer-decode-float x)
    (declare (ignore mantissa sign)) (expt 2 (abs exponent)))))
```

71.24.35 defun Machine specific float sign

This is used in the DoubleFloat integerDecode function

— **defun integer-decode-float-sign 0** —

```
(defun integer-decode-float-sign (x)
  (multiple-value-bind (mantissa exponent sign) (integer-decode-float x)
    (declare (ignore mantissa exponent)) sign))
```

71.24.36 defun Machine specific float bit length

This is used in the DoubleFloat integerDecode function

— **defun integer-decode-float-exponent 0** —

```
(defun integer-decode-float-exponent (x)
  (multiple-value-bind (mantissa exponent sign) (integer-decode-float x)
    (declare (ignore mantissa sign)) exponent))
```

71.24.37 defun Decode floating-point values

This function is used by DoubleFloat to implement the “mantissa” and “exponent” functions.

— **defun manexp 0** —

```
(defun manexp (u)
  (multiple-value-bind (f e s)
    (decode-float u)
    (cons (* s f) e)))
```

71.24.38 defun The cotangent routine

The cotangent function is defined as

$$\cot(z) = \frac{1}{\tan(z)}$$

— **defun cot 0** —

```
(defun cot (a)
  (if (or (> a 1000.0) (< a -1000.0))
      (/ (cos a) (sin a))
      (/ 1.0 (tan a))))
```

71.24.39 defun The inverse cotangent function

The inverse cotangent (arc-cotangent) function is defined as

$$acot(z) = cot^{-1}(z) = tan^{-1}\left(\frac{1}{z}\right)$$

See Steele Common Lisp 1990 pp305-307

— defun acot 0 —

```
(defun acot (a)
  (if (> a 0.0)
      (if (> a 1.0)
          (atan (/ 1.0 a))
          (- (/ pi 2.0) (atan a)))
      (if (< a -1.0)
          (- pi (atan (/ -1.0 a)))
          (+ (/ pi 2.0) (atan (- a))))))
```

71.24.40 defun The secant function

$$sec(x) = \frac{1}{cos(x)}$$

— defun sec 0 —

```
(defun sec (x) (/ 1 (cos x)))
```

71.24.41 defun The inverse secant function

$$asec(x) = acos\left(\frac{1}{x}\right)$$

— defun asec 0 —

```
(defun asec (x) (acos (/ 1 x)))
```

—————

71.24.42 defun The cosecant function

$$\operatorname{csc}(x) = \frac{1}{\sin(x)}$$

— defun csc 0 —

```
(defun csc (x) (/ 1 (sin x)))
```

—————

71.24.43 defun The inverse cosecant function

$$\operatorname{acsc}(x) = \frac{1}{\operatorname{asin}(x)}$$

— defun acsc 0 —

```
(defun acsc (x) (asin (/ 1 x)))
```

—————

71.24.44 defun The hyperbolic cosecant function

$$\operatorname{csch}(x) = \frac{1}{\sinh(x)}$$

— defun csch 0 —

```
(defun csch (x) (/ 1 (sinh x)))
```

—————

71.24.45 defun The hyperbolic cotangent function

$$\coth(x) = \cosh(x)\operatorname{csch}(x)$$

— defun coth 0 —

```
(defun coth (x) (* (cosh x) (csch x)))
```

71.24.46 defun The hyperbolic secant function

$$\operatorname{sech}(x) = \frac{1}{\cosh(x)}$$

— defun sech 0 —

```
(defun sech (x) (/ 1 (cosh x)))
```

71.24.47 defun The inverse hyperbolic cosecant function

$$\operatorname{acsch}(x) = \operatorname{asinh}\left(\frac{1}{x}\right)$$

— defun acsch 0 —

```
(defun acsch (x) (asinh (/ 1 x)))
```

71.24.48 defun The inverse hyperbolic cotangent function

$$\operatorname{acoth}(x) = \operatorname{atanh}\left(\frac{1}{x}\right)$$

— defun acoth 0 —


```
(defun acoth (x) (atanh (/ 1 x)))
```

71.24.49 defun The inverse hyperbolic secant function

$$asech(x) = acosh\left(\frac{1}{x}\right)$$

— defun asech 0 —

```
(defun asech (x) (acosh (/ 1 x)))
```

Chapter 72

OpenMath

72.1 A Technical Overview[4]

OpenMath is a standard for representing mathematical data in as unambiguous a way as possible. It can be used to exchange mathematical objects between software packages or via email, or as a persistent data format in a database. It is tightly focussed on representing semantic information and is not intended to be used directly for presentation, although tools exist to facilitate this.

The original motivation for OpenMath came from the Computer Algebra community. Computer Algebra packages were getting bigger and more unwieldy, and it seemed reasonable to adopt a generic "plug and play" architecture to allow specialised programs to be used from general purpose environments. There were plenty of mechanisms for connecting software components together, but no common format for representing the underlying data objects. It quickly became clear that any standard had to be vendor-neutral and that objects encoded in OpenMath should not be too verbose. This has led to the design outlined below.

In 1998, the Worldwide Web Consortium (W3C) produced its first recommendation for the Extensible Markup Language (XML), intended to be a universal format for representing structured information on the worldwide web. It was swiftly followed by the first MathML recommendation which is an XML application oriented mainly towards the presentation (i.e. the rendering) of mathematical expressions.

The formal definition of OpenMath is contained within The OpenMath Standard and its accompanying documents, and the reader is referred there for more details.

72.1.1 The OpenMath Architecture

The OpenMath representation of a mathematical structure is referred to as an OpenMath object. This is an abstract structure which is represented concretely via an OpenMath encoding. These encoded objects are what an OpenMath application would read and write,

and in practice the OpenMath objects themselves almost never exist, except on paper. The advantage of this is that OpenMath is not tied to any one underlying mechanism: in the past we have used functional, SGML and binary encodings. The current favourite is XML, as described below, and we will tend to use XML notation when describing OpenMath objects (even though strictly speaking the XML representation is an encoding). OpenMath Objects

Formally, an OpenMath object is a labelled tree whose leaves are the basic OpenMath objects integers, IEEE double precision floats, unicode strings, byte arrays, variables or symbols. Of these, symbols are the most interesting since they consist of a name and a reference to a definition in an external document called a content dictionary (or CD). Using XML notation where the element name OMS indicates an OpenMath symbol, the following:

```
<OMS name="sin" cd="transc1"/>
```

represents the usual sine function, as defined in the CD "transc1". A basic OpenMath object is an OpenMath object, although its XML representation will be:

```
<OMOBJ>
  <OMS name="sin" cd="transc1"/>
</OMOBJ>
```

OpenMath objects can be built up recursively in a number of ways. The simplest is function application, for example the expression $\sin(x)$ can be represented by the XML:

```
<OMOBJ>
  <OMA>
    <OMS name="sin" cd="transc1"/>
    <OMV name="x"/>
  </OMA>
</OMOBJ>
```

where OMV introduces a variable and OMA is the application element. Another straightforward method is attribution which as the name suggests can be used to add additional information (for example "the AXIOM command which generated me was ...") to an object without altering its fundamental meaning. More interesting are binding objects which are used to represent an expression containing bound variables, for example:

```
<OMOBJ>
  <OMA>
    <OMS cd="calculus1" name="int"/>
    <OMS cd="transc1" name="sin"/>
  </OMA>
</OMOBJ>
```

represents the integral of the sin function, but the encoding:

```
<OMOBJ>
  <OMA>
```

```

<OMS cd="calculus1" name="int"/>
<OMBIND>
  <OMS cd="fns1" name="lambda"/>
  <OMBVAR> <OMV name="x"/> </OMBVAR>
  <OMA>
    <OMS name="sin" cd="transc1"/>
    <OMV name="x"/>
  </OMA>
</OMBIND>
</OMA>
</OMOBJ>

```

represents $\sin(x)dx$. This may appear overly complicated but it is useful, for example when searching in a database for expressions which match $\sin(y)dy$. The definition of a symbol in the CD specifies whether or not it may be used to bind variables, which is why

```
<OMS cd="calculus1" name="int"/>
```

cannot be used as a binding symbol.

The final kind of OpenMath object is an error which is built up from a symbol describing the error and a sequence of OpenMath objects. For example:

```

<OMOBJ>
  <OME>
    <OMS name="unexpected_symbol" cd="error1">
    <OMS name="sine" cd="transc1">
  </OME>
</OMOBJ>

```

represents the error which might be generated when an application sees a symbol it doesn't recognise from a CD it thought it knew about.

72.1.2 OpenMath Encodings

We have already seen some examples of the XML encoding, but it is by no means the only encoding. In the past there was a functional encoding (which looked like Lisp) and an SGML encoding which evolved into the current XML. Both of these are now obsolete, but there is still a binary encoding described in the standard, which is much more compact than the XML one.

In fact the XML encoding is not 100% XML. When XML was in its infancy the developers of OpenMath realised that it might become significant and decided to add some XML-like features to the SGML encoding so that an OpenMath object could be encoded as valid XML. Thus it is currently the case that any well-formed OpenMath object encoded using the XML encoding as described in the standard is a valid XML document. However, if one uses standard XML tools to generate an OpenMath object in the XML encoding from the DTD given in chapter 4 of the standard, it is possible that the result will not be valid OpenMath,

although in practice this is highly unlikely. To cover all the possibilities allowed by XML would make it much more complicated to write an application to read any OpenMath object from scratch. Whether to adopt XML completely remains a hot topic of debate within the OpenMath community!

Generally speaking, it is not intended that the existing encodings should be readable by a human user or writable by hand. It is desirable that they be compact and it is also desirable that they be linear, but neither of these is a requirement. It is a property of encodings that it is possible to convert between them with no loss of information.

72.1.3 Content Dictionaries

Content Dictionaries (or CDs for short) are the most important, and the most interesting, aspect of OpenMath because they define the meaning of the objects being transmitted. A CD is a collection of related symbols and their definitions, encoded in an XML format. Defining the meaning of a symbol is not a trivial task, and even referring to well-known references can be fraught with pitfalls. Formal definitions and properties can be very useful but time-consuming to produce and verbose, not to mention difficult to get right. A symbol definition in an OpenMath CD consists of the following pieces of information:

- the symbol name;
- a description in plain text;
- optionally, a set of this symbol's properties in plain text
(Commented Mathematical Properties, or CMPs);
- optionally, a set of this symbol's properties encoded in OpenMath
(Formal Mathematical Properties, or FMPs);
- optionally, one or more examples of its use (encoded in OpenMath).

In practice the CMPs and FMPs can come as pairs, and often serve in the place of examples.

A very simple instance of a CD definition is:

```
<CDDefinition>
<Name> log </Name>

<Description>
This symbol represents a binary log function; the first argument is
the base, to which the second argument is log'ed.
It is defined in Abramowitz and Stegun, Handbook of Mathematical
Functions, section 4.1
</Description>
<CMP>
  a^b = c implies log_a c = b
</CMP>
<FMP>
  <OMOBJ>
    <OMA>
      <OMS cd="logic1" name="implies"/>
    </OMA>
  </OMOBJ>
</FMP>
</CDDefinition>
```

```

    <OMS cd="relation1" name="eq"/>

    <OMA>
      <OMS cd="arith1" name="power"/>
      <OMV name="a"/>
      <OMV name="b"/>
    </OMA>
    <OMV name="c"/>
  </OMA>
</OMA>
<OMS cd="relation1" name="eq"/>

  <OMA>
    <OMS cd="transc1" name="log"/>
    <OMV name="a"/>
    <OMV name="c"/>
  </OMA>
  <OMV name="b"/>
</OMA>
</OMA>
</OMOBJ>

</FMP>

<Example>
log 100 to base 10 (which is 2).
<OMOBJ>
  <OMA>
    <OMS cd="transc1" name="log"/>
    <OMF dec="10"/>
    <OMF dec="100"/>
  </OMA>
</OMOBJ>
</Example>

</CDDefinition>

```

Another example would be to print the list

[1, 1/2]

as

```

<OMOBJ>
  <OMA>
    <OMS cd="list1" name="list"/>
    <OMI>1</OMI>
  </OMA>
  <OMS cd="nums1" name="rational"/>
  <OMI>1</OMI>

```

```

    <OMI>2</OMI>
  </OMA>
</OMA>
</OMOBJ>

```

This provides a symbol to represent the log function by giving a pointer to a standard reference book. It provides the property that:

$$a^b = c \rightarrow \log_a(c) = b$$

both as plain text and as OpenMath, and also gives an example of how the symbol is used.

CDs usually consist of related symbols and collections of related CDs can be grouped together, for convenience, as CD Groups. One very important CD Group is that corresponding to the content part of MathML.

It is possible to associate extra information with CDs, in particular type information. Since there are many type systems available, each of which has its own strengths and advocates, the OpenMath community does not mandate any single system. Simple signatures can be encoded using the Simple Type System, while more formal definitions are possible using the Extended Calculus of Constructors. Other associated information can include style sheets for rendering OpenMath symbols in MathML, and mathematical definitions to be used by formal logic systems.

Given the evolutionary nature of mathematics, it is clear that the set of CDs should be forever growing and never complete. Currently there are CDs for high-school mathematics, linear algebra, polynomials and group theory to name a few, and new contributions are always welcome. There is no requirement that applications use the standard set of CDs and it is often very useful to design a "private" CD for a specific purpose.

72.1.4 OpenMath in Action

There is no definitive way in which OpenMath should be used, as the protocol has been designed to be as flexible as possible. Nevertheless many OpenMath applications share common characteristics which we shall discuss here.

Suppose that we wish to have two applications communicating by sending OpenMath objects to each other, e.g. a client program and a computational server. It is unlikely that the internal data structures used by the applications will be OpenMath, and so translation between the internal representations and OpenMath (almost certainly OpenMath encodings rather than objects) will have to take place. The piece of software which does this is usually referred to as a phrase-book.

It is possible to write a generic phrase-book which can handle any piece of OpenMath, but applications where this makes sense are few and far between. In practice an OpenMath phrase book will usually only handle a fixed set of CDs (and hence a fixed set of symbols). What "handle" means will vary from case to case: a computer algebra system will usually try and evaluate its input and return a result or an error, while a typesetter will print its input according to some rendering rules and not return anything. OpenMath carefully avoids

defining what the “right” behaviour is in a given circumstance, and leaves that up to the phrase-book writer. Indeed it is quite possible that a piece of software could have multiple phrase-books associated with it for different purposes. OpenMath symbols should not be regarded as verbs since they are used to construct objects rather than to send commands, and the presence of both nouns and verbs in a CD (e.g. “integral” and “integrate”) is strongly discouraged.

Writing a phrase-book may be non-trivial, and requires an understanding of the semantics of the underlying software. An OpenMath object may not map directly into a private object and vice-versa, for example in some systems a rational number might have to be represented by a float, or a sparse matrix by a dense one.

The OpenMath standard includes a section on compliance, which describes the behaviour of an OpenMath application when certain errors occur. It also insists that all compliant software has the capability to use the XML encoding, to guarantee a degree of interoperability. This is an area where the standard is expected to evolve as more OpenMath applications become available.

72.2 Technical Details[3]

This chapter describes the Axiom implementation of the OpenMath project at INRIA [3]. The code enables the exchange of OpenMath objects between two processes and more generally the input and output of OpenMath objects. First we describe the library API and then we implement the functions used by Axiom.

72.3 The Structure of the API

The library and its API are logically structured in four parts:

- Functions that deal with *devices*, the abstraction from which OpenMath objects are read and written to.
- Functions that read from and write to OpenMath devices. These functions use a simple model that read and write tokens.
- Functions that create I/O structures to be used by devices, so that, for example, an OpenMath object can be read from a file or a socket. This part is extensible by the user.
- Functions that deal with interprocess communication.

72.4 OpenMath Expressions

72.4.1 Expressions

The library understands the following kinds of basic OpenMath expressions:

- integers
- double precision floating-point numbers (64 bits, following IEEE 754)
- byte arrays
- character strings
- symbols
- variables

and the four kinds of constructions:

- applications $e_0(e_1, \dots, e_n)$
- errors $s(e_1, \dots, e_n)$
- binders $e_1, (v_1, \dots, v_n), e_2$
- attributed expressions $[s_1 e_1, \dots, s_n e_n]e$

where e_i are OpenMath expressions, v_i are OpenMath variables and s and s_i are OpenMath symbols.

72.4.2 Symbols

Symbols are constructed from a content dictionary (abbreviated as CD in the sequel) and a name. A content dictionary is identified by its name. The API permits the creation of any symbol in any content dictionary: there is nothing that prevents creating symbols that do not belong to a known CD.

72.4.3 Encoding and Decoding OpenMath Expressions

An OpenMath object is encoded as a sequence of bytes that is read and written sequentially. The library views this sequence as a stream of tokens. Expressions are linearized in a way that looks like Lisp with typed parenthesis. For example, the linearization of the application of S to $E_1 \dots E_n$ is:

- indicating that this is an application (a “begin application” token)
- linearizing S

- linearizing E_1, \dots, E_n
- indicating that all arguments have been given (an “end application” token)

The other constructions are linearized the same way (each one with its own begin and end tokens). Note that there is no explicit arity indication so that we don’t have to introduce a special mechanism when we don’t know beforehand how many arguments there are.

To give attributes to an expression, the attributes and their associated values are put before the expression. To give the attributes a_i with values v_i (where a_i are symbols and v_i are OpenMath expressions) to an expression E the process is:

- put a “begin attributed expression” token
- put a “begin attribute pairs” token
- put the symbol a_1 followed by the linearization of v_1 etc
- put an “end attribute pairs” token
- linearize E
- put an “end attributed expression” token

Decoding is done by first querying the type of the next OpenMath token and then invoking the right function to get this particular kind of token.

72.5 Big Integers

The library supports big integers that can potentially be given in various formats. The `OMBigIntType` describes the different possible formats.

```
typedef enum OMBigIntType {
    OMBIunknown = 0, /* this is base 10, digits in normal order */
    OMBIbase10      /* this is base 16, digits in normal order (MSB) */
    OMBigIntBase16
} OMBigIntType;
```

72.6 Functions Dealing with OpenMath Devices

OpenMath expressions are read and written through *devices*. Basically, an OpenMath device has an associated encoding and an I/O method. There are basically two encodings defined and implemented. The first one is a human readable and writable one that can be used for example as the encoding for sending OpenMath objects via e-mail or storing OpenMath objects to files. This encoding is SGML compatible in the sense that it can be used to represent OpenMath objects in SGML texts. I has an XML variant. The second encoding

is a binary one that can be used when compactness and speed of encoding and decoding is important. The encodings are defined by the `OMencodingType` type which is an enumerated type defined as

```
typedef enum OMencodingType
{
    OMencodingUnknown,
    OMencodingBinary,
    OMencodingSGML,
    OMencodingXML} OMencodingType;
```

`OMencodingUnknown` is to be used when creating a device that does not know which kind of encoding will be used. It must be used only for input devices.

A device is created with the following function, given an encoding and an appropriate I/O method:

- `OMdev OMmakeDevice(OMencodingType encoding, OMIO IO)`

Devices are closed with the following function

- `void OMcloseDevice(OMdev dev)`

Whether a device could be used both for reading and writing is entirely dependent on its I/O method.

The user can define its own I/O method as a function returning an `OMIO` object. This could enable him, for example, to use an existing transport protocol to exchange OpenMath expressions or to implement cut-and-paste of OpenMath expression by writing I/O structures that input and output to strings. The I/O section describes the available I/O structures in the library.

An `OMdev` object is a pointer to a structure that contains a lot of state. Almost all functions taking an `OMdev` object modify it. Likewise, an `OMIO` object carries a lot of state.

72.7 Functions to Write OpenMath Expressions to Devices

72.7.1 Beginning and Ending Objects

The following two functions mark the beginning and end of an OpenMath object.

- `OMstatus OMputObject(OMdev dev)`
- `OMstatus OMputEndObject(OMdev dev)`

These functions should be called before and after an OpenMath object is constructed in a device. In particular, the `OMputEndObject` function insures that the object has been completely written if any buffering was used.

72.7.2 Writing Basic Objects

Basic OpenMath objects are written using these functions:

- `OMstatus OMputInt32(OMdev dev, int n)`
- `OMstatus OMputBigInt(OMdev dev, const char *data, int len, int sign, OMbigIntType format)`
- `OMstatus OMputFloat64(OMdev dev, double *f)`
- `OMstatus OMputByteArray(OMdev dev, const char *data, int len)`
- `OMstatus OMputString(OMdev dev, const char *s)`
- `OMstatus OMputVar(OMdev dev, const char *name)`
- `OMstatus OMputSymbol(OMdev dev, const char *cd, const char *name)`

The `char *` arguments of `OMputString`, `OMputVar` and `OMputSymbol` are null-terminated strings. There are other functions that accept non null-terminated arrays of characters with their length. These are

- `OMstatus OMputStringN(OMdev dev, const char *str, int len)`
- `OMstatus OMputVarN(OMdev dev, const char *var, int len)`
- `OMstatus OMputSymbolN(OMdev dev, const char *cd, int clen, const char *name, int nlen)`

The format for the `data` argument of the `OMputBigInt` function is given by `format`. When `format` is `OMBIbase10`, it is the sequence of character of its base 10 representation without sign (most significant digit first). The sign of the big integer is given by the `sign` argument that should be an integer greater or equal to zero for a positive integer and less than zero for a negative one. For example, the following line outputs the value of $20!$ to `dev`:

```
OMputBigInt(dev, "265252859812191058636308480000000", 33, 1, OMBIbase10);
```

72.7.3 Writing Structured Objects

The following functions are used to mark the beginning and end of the structured objects. They should be called in nested pairs, correctly bracketed:

- `OMstatus OMputApp(OMdev dev)`
- `OMstatus OMputEndApp(OMdev dev)`
- `OMstatus OMputAttr(OMdev dev)`
- `OMstatus OMputEndAttr(OMdev dev)`

- `OMstatus OMputBind(OMdev dev)`
- `OMstatus OMputEndBind(OMdev dev)`
- `OMstatus OMputBVar(OMdev dev)`
- `OMstatus OMputEndBVar(OMdev dev)`
- `OMstatus OMputAtp(OMdev dev)`
- `OMstatus OMputEndAtp(OMdev dev)`
- `OMstatus OMputError(OMdev dev)`
- `OMstatus OMputEndError(OMdev dev)`

Here is an example showing how to use these functions to output $\sin x + y$, where x and y are represented as variables and \sin is the symbol whose name is `sin` in the `Basic` content dictionary. This can be done using the following sequence:

```
OMputObject(dev);
OMputApp(dev);
  OMputSymbol(dev, "Basic", "sin");
  OMputApp(dev)
    OMputSymbol(dev, "Basic", "+");
    OMputVar(dev, "x");
    OMputVar(dev, "y");
  OMputEndApp(dev);
OMputEndApp(dev);
OMputEndObject(dev);
```

72.8 Functions to Extract OpenMath Expressions from Devices

72.8.1 Testing the type of the current token

The first step in decoding an expression from a device is to call the `OMgetType` function

- `OMstatus OMgetType(OMdev dev, OMtokenType *type)`

so that the correct function can be called to recover the current token.

`OMgetType` returns via its `type` argument an `OMtokenType` object indicating the type of the next object to be read from the device. `OMtokenType` is an enumerated type defined as

```
typedef enum OMtokenType {
  OMtokenUnknown, /* error catching trick */
  OMtokenInt32,
```

```

OMtokenBigInt,
OMtokenFloat64,
OMtokenByteArray,
OMtokenVar,
OMtokenString,
OMtokenSymbol,
OMtokenComment,
OMtokenApp,    OMtokenEndApp,
OMtokenAttr,   OMtokenEndAttr,
OMtokenAtp,    OMtokenEndAtp,
OMtokenError,  OMtokenEndError,
OMtokenObject, OMtokenEndObject,
OMtokenBind,   OMtokenEndBind,
OMtokenBVar,   OMtokenEndBVar,
} OMTokenType;

```

Note that the type of the current token can be tested multiple times. Two successive calls to `OMgetType` will always return the same result if no other `OMget...` function was called in between.

72.8.2 Extracting the current token

The following functions are used to read the basic OpenMath objects from devices:

- `OMstatus OMgetInt32(OMdev dev, int *i)`
- `OMstatus OMgetFloat64(OMdev dev, double *d)`
- `OMstatus OMgetBigInt(OMdev dev, char **data, int *len, int *sign, OMbigIntType *fmt)`
- `OMstatus OMgetBigIntN(OMdev dev, char *data, int len, int *sign, OMbigIntType *fmt)`
- `OMstatus OMgetByteArray(OMdev dev, char **data, int *len)`
- `OMstatus OMgetByteArrayN(OMdev dev, char *data, int len)`
- `OMstatus OMgetString(OMdev dev, char **str)`
- `OMstatus OMgetStringN(OMdev dev, char *str, int len)`
- `OMstatus OMgetVar(OMdev dev, char **var)`
- `OMstatus OMgetVarN(OMdev dev, char *var, int len)`
- `OMstatus OMgetSymbol(OMdev dev, char **cd, char **name)`
- `OMstatus OMgetSymbolN(OMdev dev, char *cd, int clen, char *name, int nlen)`

The functions that return variable size data exist in two versions. A simple version that does the necessary memory allocation itself (using `OMmalloc`) and a version (suffixed with `N`) that lets the user do the allocation itself. The size of the needed area can be determined with the following function:

- `int OMgetLength(OMdev dev)` returns the length of the next object.

that works for big integers, byte arrays, strings and variables. For symbols, the following function returns both the length of the content dictionary name and the length of the symbol name:

- `OMstatus OMgetSymbolLength(OMdev dev, int *clen, int *nlen)`

When the current token does not carry any data i.e. when `OMgetType` returns a marker, i.e. one of:

- `OMtokenApp,`
- `OMtokenEndApp,`
- `OMtokenAttr,`
- `OM tokenEndAttr,`
- `OMtokenAtp,`
- `OMtokenEndAtp,`
- `OMtokenError,`
- `OMtokenEndError,`
- `OMtokenObject,`
- `OMtokenEndObject,`
- `OMtokenBind,`
- `OMtokenEndBind,`
- `OMtokenBVar`
- `OMtokenEndBVar`

it is necessary to call the correct function to remove the marker. The available functions are

- `OMstatus OMgetObject(OMdev dev)`
- `OMstatus OMgetEndObject(OMdev dev)`
- `OMstatus OMgetApp(OMdev dev)`

72.8. FUNCTIONS TO EXTRACT OPENMATH EXPRESSIONS FROM DEVICES1117

- OMstatus OMgetEndApp(OMdev dev)
- OMstatus OMgetAttr(OMdev dev)
- OMstatus OMgetEndAttr(OMdev dev)
- OMstatus OMgetAtp(OMdev dev)
- OMstatus OMgetEndAtp(OMdev dev)
- OMstatus OMgetBind(OMdev dev)
- OMstatus OMgetEndBind(OMdev dev)
- OMstatus OMgetBVar(OMdev dev)
- OMstatus OMgetEndBVar(OMdev dev)
- OMstatus OMgetError(OMdev dev)
- OMstatus OMgetEndError(OMdev dev)

All the previous functions return OMsuccess when they succeed. When they return something else, there has been a problem such as calling the wrong function (OMgetApp when there is not a “beginning of application” mark) or a system error.

The sequence of calls to read an expression is thus completely similar (if we omit the calls to OMgetType) to the sequence of calls to write the expression. For example, the previous expression $(\sin x + y)$ can be recovered via the sequence:

```
OMgetObject(dev);
OMgetApp(dev);
  OMgetSymbol(dev, ...);
  OMgetApp(dev);
    OMgetSymbol(dev, ...);
    OMgetVar(dev, ...);
    OMgetVar(dev, ...);
  OMgetEndApp(dev);
OMgetEndApp(dev);
OMgetEndObject(dev);
```

OMgetInt32(OMdev dev, int *i) returns the integer through its i argument.

OMgetBigInt(OMdev dev, char **data, int *len, int *sign, OMbigIntType *fmt)

returns the data corresponding to the big integer in data, its length in len, its sign in sign and its format in fmt.

OMgetBigIntN(OMdev dev, char *data, int len, int *sign, OMbigIntType *fmt)

copies the data corresponding to the big integer in **data** buffer that should be (at least) **len** characters long. The sign and format are returned in the **sign** and **fmt** arguments.

OMgetByteArray(OMdev dev, char **data, int *len) returns the byte array through its **data** argument. Its length is returned via the **len** argument.

OMgetByteArrayN(OMdev dev, char *data, int len) copies the byte array in the **data** buffer that should be (at least) **len** characters long.

OMgetString(OMdev dev, char **str) returns the string through its **str** argument.

OMgetStringN(OMdev dev, char *str, int len) copies the string in the **str** buffer whose length should be (at least) **len**. If **len** is greater than the actual length of the string, a null character is added at the end of **str**.

OMgetVar(OMdev dev, char **var) returns the name of the variable (as a null-terminated string) in its **var** argument

OMgetVarN(OMdev dev, char *var, int len) copies the name of the variable in the **var** buffer, whose length should be (at least) **len**. If **len** is greater than the actual length of the variable name, a null character is added at the end of **var**.

OMgetSymbol(OMdev dev, char **cd, char **name) returns the content dictionary and the name of the symbol through the **cd** and **name** arguments.

OMgetSymbolN(OMdev dev, char *cd, int clen, char *name, int nlen) copies the content dictionary and the name of the symbols in the **cd** and **name** buffers. **cd** should be at least **clen** character long and **name** should be at least **nlen** long. When there is enough room (based on **clen** or **nlen**) a null character is added after the last character of the name (**cd** or **name**).

72.9 Comments in the SGML/XML Encodings

The library can also output and read comments (SGML/XML comments) with the following functions:

- **OMstatus OMputComment**(OMdev dev, char *comment)
- **OMstatus OMputCommentN**(OMdev dev, char *comment, int len)
- **OMstatus OMgetComment**(OMdev dev, char **comment)
- **OMstatus OMgetCommentN**(OMdev dev, char *comment, int len)

By default, comments are silently ignored by the library when reading OpenMath objects (and writing them using the binary encoding). The function

- **OMbool OMignoreComment**(OMdev dev, OMbool set)

changes this behaviour. When called with **OMfalse**, comments are passed to the application: the **OMgetType** function will return **OMtokenComment** when the current token is a comment and the **OMgetComment** or **OMgetCommentN** functions should be used to get the comments. When **OMignoreComment** is called with **OMtrue**, comments are ignored.

72.10 I/O Functions for Devices

We provide four functions that produce OMIO objects for devices. These functions provide I/O through the `stdio` library (on FILE object), file descriptors and character strings.

- OMIO `OMmakeIOFile(FILE *f)` associates the device with the file pointer `f`.
- OMIO `OMmakeIOfd(int fd)` associates the device with the file descriptor `fd`.
- OMIO `OMmakeIOHandle(HANDLE handle)` associates the device with a file handle *Windows specific version of `OMmakeIOfd().fd`.
- OMIO `OMmakeIOString(char **s)` associates the device with a string.

For example, the following code opens a device that reads from standard input:

```
dev = OMmakeDevice(OMencodingSGML, OMmakeIOFile(stdin));
```

The `OMmakeIOString` builds an input device that reads from a string or an output device that writes to a string. For input, `s` must point to a character string (null terminated). For output, `s` will point to a string allocated by the library (note that the string `s` points to can be reallocated by the library).

72.11 Communications

A communication layer can be put above the device layer. In fact, the I/O structure in a device provides all the necessary support to use any transmission or communication means. This library directly provides some connection-oriented, client-server facilities (based on TCP).

A set of functions are used to set up connections. Connections are described by the `OMconn` type. An `OMconn` is a (pointer to a) structure with two user-accessible fields `in` and `out`. `in` is a pointer to a device to be used for input. `out` is pointer to a device to be used for output. These devices use the binary encoding.

An `OMconn` object is made with the following function:

- OMconn `OMmakeConn(int timeout)`

where `timeout` is a timeout for the connection, expressed in milliseconds.

- OMdev `OMconnIn(OMconn conn)` returns the input device associated with the connection.
- OMdev `OMconnOut(OMconn conn)` returns the output device associated with the connection.

72.11.1 Functions to Initiate an OMconn

The functions we provide can be divided in two classes. The first one simply establishes an interprocess communication using IP addresses. The second one provides functions that can be used to launch a server. The addresses used are then generated by the library.

Simple Connections Functions

The following functions allow a client OpenMath application to contact an OpenMath server at a specified address:

- `OMstatus OMconnTCP(OMconn conn, char *machine, int port)`
- `OMstatus OMconnUnix(OMconn conn, char *file)`

These functions first physically establish the connection. Then, they enter negotiation with the server (they send the first message). When they return, the negotiation is finished and the devices in the `conn` argument are ready.

On the server side, the following functions provide bindings at specified addresses and take care of the negotiation:

- `OMstatus OMbindTCP(OMconn conn, int port)`
- `OMstatus OMbindUnix(OMconn conn, char *file)`

All four the previous functions block until the connection is established (and negotiation is over) or the timeout of the `conn` argument is reached.

The following function returns the file descriptor associated with a device. This is intended to be used when there is a need to poll the device (through the `select` or `poll` system calls).

- `OMdeviceFd(OMdev dev)`

Functions that Launch Servers

These functions provide the same functionalities for launching a server that were provided in the ASAP library.

In this model, the client calls `OMlaunch` with a machine name `mach` and a string `cmd` that is executed via `rsh` on machine `mach` as a shell command line. This command is supposed to launch the server program. The command is executed in an environment (in the UNIX sense) where some variables are associated with an address on the machine that runs the client. The server can then connect to the client with the `OMserveClient` function.

If the machine name is `localhost`, the command is started on the same machine (without calling `rsh`).

- `OMstatus OMlaunchEnv(OMconn conn, char *machine, char *command, char *env)`

- `OMstatus OMlaunch(OMconn conn, char *machine, char *command)`
- `OMstatus OMserveClient(OMconn conn)`

The environment variables passed to the server (launched program) are `OM_CALLER_UNIX_SOCKET` (when a local connection is required) and `OM_CALLER_MACHINE` and `OM_CALLER_PORT` (for internet connections).

The `OMlaunchEnv` function enables the command to be run with a particular environment (in the UNIX sense). For example to run a `plot` server on the `kama` machine, we could use a piece of code such as

```
conn = OMmakeConn(2000);
OMlaunchEnv(conn, "kama", "plot", "DISPLAY=rati:0 PATH=/users/bin");
```

Termination

- `OMstatus OMconnClose(OMconn conn)`

72.12 Parameters

The library internally uses three functions that can be supplied by the user.

- `extern void *(*OMmalloc) (size_t size)`
- `extern void *(*OMrealloc) (void *ptr, size_t size)`
- `extern void (*OMfree) (void *ptr)`
- `OMmalloc` is used for all memory allocations in the library. The default value is the `malloc` function.
- `OMfree` is used for deallocations. The default value is the `free` function.
- `OMfatal` is invoked when a fatal error is detected in the library (for example when memory allocation failed or when an inconsistency is detected in the library code data structures). The default value just does an `exit`.

`OMfatal` is declared as `extern void (*OMfatal)(OMstatus status)`. All memory allocations and deallocations in the library are done through the `OMmalloc` and `OMfree` functions.

72.13 Miscellaneous Functions and Variables

- `char *OMstatusToString(OMstatus status)` converts a status to a human readable string.

- `char *OMtokenTypeToString(OMtokenType ttype)` converts a `tokenType` to a human readable string.
- `OMencodingType OMgetDeviceEncoding(OMdev dev)` returns the encoding actually used by the device.
- `char *OMlibDynamicInfo(void)`
- `extern const char *OMlibVersion` is the version of the library.
- `extern const char *OMlibInfo` contains some textual information about the library.

72.14 The OM.h header file

```
#ifndef __OM_h__
#define __OM_h__

/*
 *
 *          All types used through API.
 */

/* These types are anonymized by the mean of a generic pointer.
 * You should not allocate or dereference objects of these types.
 * API (hopefully) provides you with all needed methods.
 * If you find any that are not included, please refer to
 * us rather than using private structures.
 * ie: If you need to do something like
 *   malloc(sizeof(OMdevStruct));
 * or
 *   OMdevStruct * pDev;
 *   pDev->anyField = something;
 * this probably means we need to discuss your problem.
 */

/* A device is an abstraction for put/get of OpenMath tokens */
typedef struct OMdevStruct *OMdev;

/* IO is a device field, (the physical IO channel) */
typedef struct OMIOStruct *OMIO;

/* Error status that may be returned
 */
typedef enum OMstatus {
    /* Last call was successful. */
    OMsuccess = 0,
    /* Last call failed for some undetermined reason. */
    OMfailed = 1,
    /* Last call failed for memory reasons. */

```

```

OMnoMem,
/* Last call failed during some system call. */
OMerrorSys,
/* Last call to some OMget* function failed due to an unexpected EOF
   on input IO. */
OMemptyIO,
/* Last call to some OMget* function failed because there is no more
   token on device. */
OMnoMoreToken,
/* Last call to some OMget* function timedout. */
OMtimeoutedRead,
/* Last call to some OMget* function failed due to malformed input.
   (this error covers all low level lexical or syntactic problems). */
OMmalformedInput,
/* Last call to OMbindTCP failed because address is already in use
   (EADDRINUSE). */
OMaddrInUse,
/* Last call to OMconnTCP failed to set connection. */
OMconnectFailed,
/* Last call triggered some not (yet) implemented code in this lib. */
OMnotImplemented,
/* Last call caused some internal trouble. */
OMinternalError
} OMstatus;

/* All OpenMath token kinds are identified by one of these types.
 * Values given in this enum have been chosen to:
 * - avoid conflicts with specific XML characters
 *   to help automatic detection of encoding type.
 * (no: '\t'(9) '\r'(13) '\n'(10) '<'(60) or ' '(32))
 * - keep some bits (3) available for special encodings purpose
 * (eg: sharing or big len flags in binary encoding)
 */
typedef enum OMtokenType {
  OMtokenUnknown = 0, /* error catching trick */
  OMtokenInt32 = 1,
  OMtokenBigInt = 2,
  OMtokenFloat64 = 3,
  OMtokenByteArray = 4,
  OMtokenVar = 5,
  OMtokenString = 6,
  OMtokenWCString = 7,
  OMtokenSymbol = 8,
  OMtokenComment = 15,
  OMtokenApp = 16, OMtokenEndApp = 17,
  OMtokenAttr = 18, OMtokenEndAttr = 19,
  OMtokenAtp = 20, OMtokenEndAtp = 21,
  OMtokenError = 22, OMtokenEndError = 23,
  OMtokenObject = 24, OMtokenEndObject = 25,
  OMtokenBind = 26, OMtokenEndBind = 27,

```

```

    OMtokenBVar = 28,    OMtokenEndBVar = 29
} OMtokenType;

typedef enum OMbigIntType {
    OMbigIntUnknown = 0,
    /* this is base 10, digits in normal order (MSB) */
    OMbigIntBase10,
    /* this is base 16, digits in normal order (MSB) */
    OMbigIntBase16
} OMbigIntType;

/* Encodings should not be "user visible"
 * We thus refer to encoding as "symbolic constants" from this enum type. */
typedef enum OMencodingType {
    /* You may set an input stream to "unknown encoding".
     * By doing this, you let library auto detect the
     * encoding type of the device during first token input.*/
    OMencodingUnknown = 0,
    /* Binary encoding, more compact than XML one. */
    OMencodingBinary,
    /* XML-like encoding, human readable. */
    OMencodingXML,
} OMencodingType;

/* This is a portable equivalent to wchar_t for unicode strings */
typedef unsigned short OMUCS2;

/* Replacment for lacking C bools */
typedef unsigned char OMbool;
#define OMfalse (0)
#define OMtrue  (1)

/*
 *
 *                      Some global variables
 */

/* Version of this lib (eg: "1.0") */
extern const char *OMlibVersion;

/* Some textual information about this lib (eg: "debug is on" */
extern const char *OMlibInfo;

/* These pointers allow you to redefine memory managment functions
   used in lib. */
extern void *(*OMmalloc) (size_t size);
extern void *(*OMrealloc) (void *ptr, size_t size);
extern void (*OMfree) (void *ptr);

/* If set, this function will be called by OMfatal, thus you may use it for
   error handling (by default it is set to exit()) */

```



```

extern void (*OMfatal) (OMstatus status);

/* for C++ includes */
#ifdef __cplusplus
#define OMbeginPrototypes    extern "C" {
#define OMendPrototypes      }
#else /*__cplusplus */
#define OMbeginPrototypes
#define OMendPrototypes
#endif /*__cplusplus */

/*
 *                      Prototypes of OpenMath API
 */

/* Prototypes that are spread along all headers are repeated here.
 * - This should ease the API users.
 *   (docs are fine but source is always the ultimate help)
 * - This allow a cleaner embedding of library
 *   (no need to install all .h! just take this one and the .a)
 */
OMbeginPrototypes
#ifndef OM_DEV
/* this part is automatically updated, do NOT edit below */
/** Prototypes */
/* OMPut* functions.
 *   They all take a device <dev> to put token to.
 *   Some of them need more parameters to define the token content.
 *   They are thoroughly documented in OpenMath Specification shipped
 *   with the library.
 * return: a status that reflect the operation success.
 */
extern OMstatus OMputInt32(OMdev dev, int n);
extern OMstatus OMputFloat64(OMdev dev, double *d);
extern OMstatus OMputBigInt(OMdev dev, const char *data, int len,
                           int sign, OMbigIntType format);
extern OMstatus OMputByteArray(OMdev dev, const char *data, int len);
/* OMputString*
 *   If you want to output plain 8bits C like strings there is no need
 *   to use the OMputWCString* functions. This one is more efficient
 *   (faster and more compact output for some encodings)
 */
extern OMstatus OMputString(OMdev dev, const char *str);
extern OMstatus OMputStringN(OMdev dev, const char *str, int len);
/* OMputWCString
 *   If you are using wide char strings you need to output them
 *   with that function rather than with OMputString.
 *   (It takes endianness into account)

```

```

*/
extern OMstatus OMputWCString(OMdev dev, const OMUCS2 * wcstr);
extern OMstatus OMputVar(OMdev dev, const char *var);
extern OMstatus OMputVarN(OMdev dev, const char *var, int len);
extern OMstatus OMputSymbol(OMdev dev, const char *cd, const char *name);
extern OMstatus OMputSymbolN(OMdev dev, const char *cd, int clen,
                             const char *name, int nlen);

extern OMstatus OMputApp(OMdev dev);
extern OMstatus OMputEndApp(OMdev dev);
extern OMstatus OMputAttr(OMdev dev);
extern OMstatus OMputEndAttr(OMdev dev);
extern OMstatus OMputAtp(OMdev dev);
extern OMstatus OMputEndAtp(OMdev dev);
extern OMstatus OMputBind(OMdev dev);
extern OMstatus OMputEndBind(OMdev dev);
extern OMstatus OMputBVar(OMdev dev);
extern OMstatus OMputEndBVar(OMdev dev);
extern OMstatus OMputObject(OMdev dev);
extern OMstatus OMputEndObject(OMdev dev);
extern OMstatus OMputError(OMdev dev);
extern OMstatus OMputEndError(OMdev dev);
extern OMstatus OMputComment(OMdev dev, const char *comment);
extern OMstatus OMputCommentN(OMdev dev, const char *comment, int len);
/* OMgetType
 * Get the type of the current token on device <dev>/
 * dev: device to look at.
 * type: where to store returned type.
 * return: 0 or some error code
 */
extern OMstatus OMgetType(OMdev dev, OMtokenType * type);
/* OMgetLength
 * Get the current token length.
 * dev: device to read from
 * len: where to put the token length
 * the last '\0' for string like tokens is not counted
 * (rem: for WCString it is the number of bytes not the number of
 * wide chars)
 * return: 0 or some error code
 */
extern OMstatus OMgetLength(OMdev dev, int *len);
/* OMgetSymbolLength
 * Get the current token (wich is assumed to be a symbol) lengths.
 * dev: device to read from
 * clen: where to put the cd length (not counting the last '\0')
 * nlen: where to put the name length (not counting the last '\0')
 * return: 0 or some error code
 */
extern OMstatus OMgetSymbolLength(OMdev dev, int *clen, int *nlen);
/* OMGet* functions.
 * They all take a device <dev> to get token from.

```

```

*   Some of them need more parameters to fill with the token content.
*   They are thoroughly documented in OpenMath Specification shipped with
*   the library.
*   return: a status that reflect the operation success.
*/
extern OMstatus OMgetInt32(OMdev dev, int *i);
extern OMstatus OMgetFloat64(OMdev dev, double *d);
extern OMstatus OMgetBigInt(OMdev dev, char **data, int *len, int *sign,
                             OMbigIntType * format);
extern OMstatus OMgetBigIntN(OMdev dev, char *data, int len, int *sign,
                              OMbigIntType * format);
extern OMstatus OMgetByteArray(OMdev dev, char **data, int *len);
extern OMstatus OMgetByteArrayN(OMdev dev, char *data, int len);
/* OMgetString*
*   Beware! You are not supposed to use these functions unless you know
*   for sure you are reading plain 8bits strings.
*   Thus it is here only for speed/space consideration in very
*   specific applications.
*   If input is a 16 bit char string and you read it with these
*   functions you will lose the 8 most significant bits of each char.
*   You should rather refer to OMgetWCString* functions.
*/
extern OMstatus OMgetString(OMdev dev, char **str);
extern OMstatus OMgetStringN(OMdev dev, char *str, int len);
/* OMgetWCString*
*   These functions return 16 bits wide strings. (regardless input
*   was done in 8 or 16 bits mode).
*   Thus, most if not all applications should use these functions
*   preferably to OMgetString*.
*/
extern OMstatus OMgetWCString(OMdev dev, OMUCS2 ** wctr);
/* BEWARE: the <len> is supposed to be the length in bytes for the
*   preallocated buffer <wctr> (not the length in number of wide chars)
*/
extern OMstatus OMgetWCStringN(OMdev dev, OMUCS2 * wctr, int len);
extern OMstatus OMgetVar(OMdev dev, char **var);
extern OMstatus OMgetVarN(OMdev dev, char *var, int len);
extern OMstatus OMgetSymbol(OMdev dev, char **cd, char **name);
extern OMstatus OMgetSymbolN(OMdev dev, char *cd, int clen, char *name,
                              int nlen);
extern OMstatus OMgetApp(OMdev dev);
extern OMstatus OMgetEndApp(OMdev dev);
extern OMstatus OMgetAttr(OMdev dev);
extern OMstatus OMgetEndAttr(OMdev dev);
extern OMstatus OMgetAtp(OMdev dev);
extern OMstatus OMgetEndAtp(OMdev dev);
extern OMstatus OMgetBind(OMdev dev);
extern OMstatus OMgetEndBind(OMdev dev);
extern OMstatus OMgetBVar(OMdev dev);
extern OMstatus OMgetEndBVar(OMdev dev);

```

```

extern OMstatus OMgetObject(OMdev dev);
extern OMstatus OMgetEndObject(OMdev dev);
extern OMstatus OMgetError(OMdev dev);
extern OMstatus OMgetEndError(OMdev dev);
extern OMstatus OMgetComment(OMdev dev, char **comment);
extern OMstatus OMgetCommentN(OMdev dev, char *comment, int len);
/* OMbeginObject
 *   Must be called before every new OpenMath object put.
 *   (Not before every token!)
 *   dev: device where new object is to be put.
 *   return: status describing operation success
 */
extern OMstatus OMbeginObject(OMdev dev);
/* OMendObject
 *   Must be called after every OpenMath object put.
 *   (Not after every token!)
 *   dev: device where object has been put.
 *   return: status describing operation success
 */
extern OMstatus OMendObject(OMdev dev);
/* OMignoreComment
 *   Set behavior of a device concerning comments.
 *   (Comments on an input device may safely be ignored.)
 *   dev: device to modify
 *   set: If set == OMtrue then device will ignore incoming comments
 *        If set == OMfalse then device will process incoming comments
 *        like other tokens.
 *        By default comments are ignored.
 *        Whatever is <set> value, output of comments is always done.
 *   return: previous value
 */
extern OMbool OMignoreComment(OMdev dev, OMbool set);
/* OMtokenCount
 *   Reports the number of tokens that have been in/output on a device
 *   dev: device to examine
 *   inTokenNb: where to store number of input tokens (if not NULL)
 *   outTokenNb: where to store number of output tokens (if not NULL)
 */
extern void OMtokenCount(OMdev dev, int *inTokenNb, int *outTokenNb);
/* OMgetDeviceEncoding
 *   Get the current encoding used by a device
 *   dev: device to examine
 *   return: current encoding
 */
extern OMencodingType OMgetDeviceEncoding(OMdev dev);
/* OMsetDeviceEncoding
 *   Set the encoding that will be used on a device
 *   BEWARE: changing encoding on a device that has already been used
 *           for IO is unsafe.
 *   but setting encoding on a new device is safe.

```

```

*   (in some occasions, it is not easy to know which encoding to
*   use at device creation)
* dev: device to modify
* encoding: encoding to use
*/
extern void OMsetDeviceEncoding(OMdev dev, OMencodingType encoding);
/* OMmakeDevice
*   Create a device from a low level IO
*   Warning: "IO" should be a "generated" (new) structure as it contains some
*   state that is private to the device. It is very dangerous for two devices
*   to share the same "IO" structure.
* encoding: encoding scheme used by device
* IO: low level I/O support for device
* return: a newly allocated device
*/
extern OMdev OMmakeDevice(OMencodingType encoding, OMIO IO);
/* OMcloseDevice
*   Close a device previously created with OMmakeDevice
*   (embedded IO is closed too)
* dev: device to close
*/
extern void OMcloseDevice(OMdev dev);
/* OMmakeIOFd
*   Create a low level IO object from a file descriptor.
*   (May be used on socket for instance.)
* fd: file descriptor to wrap into the OpenMath IO object.
* return: a newly allocated IO object.
*/
extern OMIO OMmakeIOFd(int fd);
/* OMmakeIOFile
*   Create a low level IO object from a FILE*.
*   (May be used on stdin for instance.)
* fd: FILE* to wrap into the OpenMath IO object.
* return: a newly allocated IO object.
*/
extern OMIO OMmakeIOFile(FILE * f);
/* OMmakeIOString
*   Create a low level IO object from a string (NUL terminator is not needed).
*   (May be used for copy/paste for instance.)
* s: pointer to string to use into the OpenMath IO object.
*   - In case of input device the string must be NUL terminated.
*   - In case of output device string may be reallocated
*     to fit size of outgoing objects.
* return: a newly allocated IO object.
*/
extern OMIO OMmakeIOString(char **s);
/* OMstatusToString
*   Convert a status to a human readable string that explain its meaning
* status: status to explain
* return: corresponding string

```

```

*/
extern char *OMstatusToString(OMstatus status);
/* OMtokenTypeToString
 * Convert a tokenType to a human readable string
 * ttype: type to convert
 * return: corresponding string
 */
extern char *OMtokenTypeToString(OMtokenType ttype);
/* OMsetVerbosityLevel
 * When using API some infos may be logged.
 * This set the required verbosity level.
 * level: level of verbosity.
 * 0 means nothing is nether printed
 * 1 everything is printed (default)
 * 2,... less verbose
 * return: last verbosity level
 */
extern int OMsetVerbosityLevel(int level);
/* OMsetVerbosityOutput
 * When using API some infos may be logged.
 * This set the destination for logs.
 * logFile: where to output logs (default is stderr)
 * return: last output
 */
extern FILE *OMsetVerbosityOutput(FILE * logFile);
/* OMlibDynamicInfo
 * Gather some informations about lib that can't be statically determined.
 * Complete them with some relevant static information too.
 * return: a newly allocated string
 */
extern char *OMlibDynamicInfo(void);
/**** End Prototypes */
/* end of automatically updated part */

#ifdef WIN32
#include "windows.h"

/* OMmakeIOHandle
 * Create a low level IO object from a widows handle.
 * handle: windows handle to wrap into the OpenMath IO object.
 * return: a newly allocated IO object.
 */
extern OMIO OMmakeIOHandle(HANDLE handle);
extern void OMfreeIOHandle(OMIO io);
#endif

#else /* OM_DEV */
/* The prototypes above are in fact collected from all these .h files */
#include "OMbase.h"
#include "OMdev.h"

```

```

#include "OMdevFd.h"
#include "OMdevFile.h"
#include "OMdevString.h"
#include "OMdevHandle.h"
#include "OMencBin.h"
#include "OMencXml.h"
#include "OMmisc.h"
#include "OMutf7.h"
#endif /* OM_DEV */

```

```
OMendPrototypes
```

```
#endif /* __OM_h__ */
```

72.15 Axiom OpenMath stub functions

These stub functions will eventually be expanded to handle OpenMath. See the OpenMath-Device domain in Volume 10.3. Note that the argument list for the Spad functions does not always match the argument list specified in the OpenMath specification.

There are 4 known OpenMath encodings which are set up in the OpenMathEncoding domain in Volume 10.3.

- Unknown
- Binary
- XML
- SGML

72.15.1 Axiom specific functions

This is used in OpenMathPackage in Volume 10.4.

```

(read OMdev)           -> LispObject
(listCDs)              -> List(String)
(listSymbols)          -> List(String)
(supportsCD cd)        -> Boolean
(supportsSymbol cd name) -> Boolean

```

72.15.2 defun om-Read

Read an OpenMath object from dev.
 — defun om-Read —

```
(defun om-Read (dev)
  (declare (ignore dev)))
```

72.15.3 defun om-listCDs

Lists all of the CDs supported by Axiom.

— **defun om-listCDs** —

```
(defun om-listCDs ())
```

72.15.4 defun om-listSymbols

Lists all the symbols in CD

— **defun om-listSymbols** —

```
(defun om-listSymbols ())
```

72.15.5 defun om-supportsCD

Return true if Axiom supports this CD.

— **defun om-supportsCD** —

```
(defun om-supportsCD (cd)
  (declare (ignore cd)))
```

72.15.6 defun om-supportsSymbol

— **defun om-supportsSymbol** —

```
(defun om-supportsSymbol (cd name)
  (declare (ignore cd name)))
```

72.15.7 Lisp conversion functions

The lisp conversion functions are:

(toDev	LispObject)	-> OMdev
(fromDev	OMdev)	-> LispObject
(toStatus	LispObject)	-> LispObject
(fromStatus	OMstatus)	-> LispObject
(toEncodingType	LispObject)	-> OMencodingType
(fromEncodingType	OMencodingType)	-> LispObject
(toBigNumStr	LispObject)	-> char *
(fromBigNumStr	char *,int,int, OMbigIntType)	-> LispObject
(toConn	LispObject)	-> OMconn
(fromConn	OMconn)	-> LispObject
(toCString	LispObject)	-> char **
(fromCString	char **)	-> LispObject
(lispStringFromCString	LispObject)	-> LispObject
(cStringFromLispString	LispObject)	-> LispObject

72.15.8 defun om-setDevEncoding

This sets the encoding used for reading or writing OpenMath objects to or from dev to enc.

— defun om-setDevEncoding —

```
(defun om-setDevEncoding (dev enc)
  (declare (ignore dev enc)))
```

72.15.9 Device manipulation functions

(openFileDev	LispObject, ints, ...)	-> LispObject
(openStrDev	LispObject, LispObject, LispObject)	-> LispObject
(closeDev	LispObject, LispObject)	-> LispObject

72.15.10 defun om-openFileDev

This opens file fname for reading or writing OpenMath objects. The mode can be “r” for read, “w” for write, or “a” for append.

— defun om-openFileDev —

```
(defun om-openFileDev (fname fmode enc)
  (declare (ignore fname fmode enc)))
```

72.15.11 defun om-openStringDev

This opens the string str for reading and writing OpenMath objects in encoding enc.

— **defun om-openStringDev** —

```
(defun om-openStringDev (str enc)
  (declare (ignore str enc)))
```

—————

72.15.12 defun om-closeDev

This closes dev, flushing output if necessary.

— **defun om-closeDev** —

```
(defun om-closeDev (dev)
  (declare (ignore dev)))
```

—————

72.15.13 Connection manipulation functions

These are covered in the OpenMathConnection domain in Volume 10.3.

```
(makeConn      LispObject, LispObject) -> LispObject
(closeConn     LispObject, LispObject) -> LispObject
(getConnInDev  LispObject, LispObject) -> LispObject
(getConnOutDev LispObject, LispObject) -> LispObject
```

72.15.14 defun om-makeConn

— **defun om-makeConn** —

```
(defun om-makeConn (conn)
  (declare (ignore conn)))
```

—————

72.15.15 defun om-closeConn

— **defun om-closeConn** —

```
(defun om-closeConn (conn)
  (declare (ignore conn)))
```

72.15.16 defun om-getConnInDev

— defun om-getConnInDev —

```
(defun om-getConnInDev (conn)
  (declare (ignore conn)))
```

72.15.17 defun om-getConnOutDev

— defun om-getConnOutDev —

```
(defun om-getConnOutDev (conn)
  (declare (ignore conn)))
```

72.15.18 Client/Server functions

These are covered in the OpenMathConnection domain in Volume 10.3. See OMconn.h

```
(bindTCP   LispObject, LispObject, LispObject) -> LispObject
(connectTCP LispObject, int, ...)               -> LispObject
```

72.15.19 defun om-bindTCP

— defun om-bindTCP —

```
(defun om-bindTCP (conn port)
  (declare (ignore conn port)))
```

72.15.20 defun om-connectTCP

— defun om-connectTCP —

```
(defun om-connectTCP (conn host port)
  (declare (ignore conn host port)))
```

—————

72.15.21 Device input/output functions

Most of these functions are in the OpenMathDevice domain in Volume 10.3. The only exception seems to be the om-stringPtrToString and om-stringToStringPtr functions which are called in the domains that export primitives. Currently these are:

- Complex (10.3)
- DoubleFloat (10.3)
- Float (10.3)
- Fraction (10.3)
- Integer (10.3)
- List (10.3)
- SingleInteger (10.3)
- String (10.3)
- Symbol (10.3)
- ExpressionToOpenMath (10.4)
- OpenMathPackage (10.4)

Note that putSymbol2 is not implemented.

(getApp	LispObject, LispObject)	-> LispObject
(getAtp	LispObject, LispObject)	-> LispObject
(getAttr	LispObject, LispObject)	-> LispObject
(getBind	LispObject, LispObject)	-> LispObject
(getBVar	LispObject, LispObject)	-> LispObject
(getByteArray	LispObject, LispObject)	-> LispObject
(getEndApp	LispObject, LispObject)	-> LispObject
(getEndAtp	LispObject, LispObject)	-> LispObject
(getEndAttr	LispObject, LispObject)	-> LispObject

```

(getEndBind      LispObject, LispObject) -> LispObject
(getEndBVar     LispObject, LispObject) -> LispObject
(getEndError     LispObject, LispObject) -> LispObject
(getEndObject    LispObject, LispObject) -> LispObject
(getError       LispObject, LispObject) -> LispObject
(getFloat       LispObject, LispObject) -> LispObject
(getInt         LispObject, LispObject) -> LispObject
(getObject      LispObject, LispObject) -> LispObject
(getString      LispObject, LispObject) -> LispObject
(getSymbol      LispObject, LispObject) -> LispObject
(getType        LispObject, LispObject) -> LispObject
(getVar         LispObject, LispObject) -> LispObject
(putApp         LispObject, LispObject) -> LispObject
(putAtp         LispObject, LispObject) -> LispObject
(putAttr        LispObject, LispObject) -> LispObject
(putBind        LispObject, LispObject) -> LispObject
(putBVar        LispObject, LispObject) -> LispObject
(putByteArray   LispObject, LispObject, LispObject) -> LispObject
(putEndApp      LispObject, LispObject) -> LispObject
(putEndAtp      LispObject, LispObject) -> LispObject
(putEndAttr     LispObject, LispObject) -> LispObject
(putEndBind     LispObject, LispObject) -> LispObject
(putEndBVar     LispObject, LispObject) -> LispObject
(putEndError    LispObject, LispObject) -> LispObject
(putEndObject   LispObject, LispObject) -> LispObject
(putError       LispObject, LispObject) -> LispObject
(putFloat       LispObject, LispObject, LispObject) -> LispObject
(putInt         LispObject, LispObject, LispObject) -> LispObject
(putObject      LispObject, LispObject) -> LispObject
(putString      LispObject, LispObject, LispObject) -> LispObject
(putSymbol      LispObject, LispObject, LispObject) -> LispObject
(putSymbol2     LispObject, int nargs, ...) -> LispObject
(putVar         LispObject, LispObject, LispObject) -> LispObject
(stringPtrToString LispObject, LispObject) -> LispObject
(stringToStringPtr LispObject, LispObject) -> LispObject

```

72.15.22 defun om-getApp

Reads a begin application token from dev.

— **defun om-getApp** —

```

(defun om-getApp (dev)
  (declare (ignore dev)))

```

—

72.15.23 defun om-getAtp

Reads a begin attribute pair token from dev.

— **defun om-getAtp** —

```
(defun om-getAtp (dev)
  (declare (ignore dev)))
```

72.15.24 defun om-getAttr

Reads a begin attribute token from dev

— **defun om-getAttr** —

```
(defun om-getAttr (dev)
  (declare (ignore dev)))
```

72.15.25 defun om-getBind

Reads a begin binder token from dev.

— **defun om-getBind** —

```
(defun om-getBind (dev)
  (declare (ignore dev)))
```

72.15.26 defun om-getBVar

Reads a begin bound variable list token from dev.

— **defun om-getBVar** —

```
(defun om-getBVar (dev)
  (declare (ignore dev)))
```

72.15.27 defun om-getByteArray

Reads a byte array from dev.

— **defun om-getByteArray** —

```
(defun om-getByteArray (dev))
```

72.15.28 defun om-getEndApp

Reads an end application token from dev

— **defun om-getEndApp** —

```
(defun om-getEndApp (dev)
  (declare (ignore dev)))
```

72.15.29 defun om-getEndAtp

Reads an end attribute pair token from dev.

— **defun om-getEndAtp** —

```
(defun om-getEndAtp (dev)
  (declare (ignore dev)))
```

72.15.30 defun om-getEndAttr

Reads an end attribute token from dev.

— **defun om-getEndAttr** —

```
(defun om-getEndAttr (dev)
  (declare (ignore dev)))
```

72.15.31 defun om-getEndBind

Reads an end binder token from dev.

— **defun om-getEndBind** —

```
(defun om-getEndBind (dev)
  (declare (ignore dev)))
```

72.15.32 defun om-getEndBVar

Reads an end bound variable list token from dev.

— **defun om-getEndBVar** —

```
(defun om-getEndBVar (dev)
  (declare (ignore dev)))
```

72.15.33 defun om-getEndError

Reads an end error token from dev.

— **defun om-getEndError** —

```
(defun om-getEndError (dev)
  (declare (ignore dev)))
```

72.15.34 defun om-getEndObject

Reads an end object token from dev.

— **defun om-getEndObject** —

```
(defun om-getEndObject (dev)
  (declare (ignore dev)))
```

72.15.35 defun om-getError

Reads a begin error token from dev.

— **defun om-getError** —

```
(defun om-getError (dev)
  (declare (ignore dev)))
```

—————

72.15.36 defun om-getFloat

Reads a float from dev.

— **defun om-getFloat** —

```
(defun om-getFloat (dev)
  (declare (ignore dev)))
```

—————

72.15.37 defun om-getInt

Reads an integer from dev.

— **defun om-getInt** —

```
(defun om-getInt (dev)
  (declare (ignore dev)))
```

—————

72.15.38 defun om-getObject

Reads a begin object token from dev.

— **defun om-getObject** —

```
(defun om-getObject (dev)
  (declare (ignore dev)))
```

—————

72.15.39 defun om-getString

Reads a string from dev.

— **defun om-getString** —

```
(defun om-getString (dev)
  (declare (ignore dev)))
```

72.15.40 defun om-getSymbol

Reads a symbol from dev.

— **defun om-getSymbol** —

```
(defun om-getSymbol (dev)
  (declare (ignore dev)))
```

72.15.41 defun om-getType

Returns the type of the next object on dev.

— **defun om-getType** —

```
(defun om-getType (dev)
  (declare (ignore dev)))
```

72.15.42 defun om-getVar

Reads a variable from dev.

— **defun om-getVar** —

```
(defun om-getVar (dev)
  (declare (ignore dev)))
```

72.15.43 defun om-putApp

Writes a begin application token to dev.

— **defun om-putApp** —

```
(defun om-putApp (dev)
  (declare (ignore dev)))
```

—————

72.15.44 defun om-putAtp

This writea a begin application pair token to dev.

— **defun om-putAtp** —

```
(defun om-putAtp (dev)
  (declare (ignore dev)))
```

—————

72.15.45 defun om-putAttr

This writes a begin attribute token to dev.

— **defun om-putAttr** —

```
(defun om-putAttr (dev)
  (declare (ignore dev)))
```

—————

72.15.46 defun om-putBind

This writes a begin binder token to dev.

— **defun om-putBind** —

```
(defun om-putBind (dev)
  (declare (ignore dev)))
```

—————

72.15.47 defun om-putBVar

This writes a begin bound variable list token to dev.

— **defun om-putBVar** —

```
(defun om-putBVar (dev)
  (declare (ignore dev)))
```

—————

72.15.48 defun om-putByteArray

This writes a byte array to dev.

— **defun om-putByteArray** —

```
(defun om-putByteArray (dev b)
  (declare (ignore dev b)))
```

—————

72.15.49 defun om-putEndApp

This writes an end application token to dev.

— **defun om-putEndApp** —

```
(defun om-putEndApp (dev)
  (declare (ignore dev)))
```

—————

72.15.50 defun om-putEndAtp

This writes an end attribute pair to dev.

— **defun om-putEndAtp** —

```
(defun om-putEndAtp (dev)
  (declare (ignore dev)))
```

—————

72.15.51 defun om-putEndAttr

This writes an end attribute token to dev.

— **defun om-putEndAttr** —

```
(defun om-putEndAttr (dev)
  (declare (ignore dev)))
```

—————

72.15.52 defun om-putEndBind

This writes an end binder token to dev.

— **defun om-putEndBind** —

```
(defun om-putEndBind (dev)
  (declare (ignore dev)))
```

—————

72.15.53 defun om-putEndBVar

This writes and end bound variable list token to dev

— **defun om-putEndBVar** —

```
(defun om-putEndBVar (dev)
  (declare (ignore dev)))
```

—————

72.15.54 defun om-putEndError

This writes an end error token to dev

— **defun om-putEndError** —

```
(defun om-putEndError (dev)
  (declare (ignore dev)))
```

—————

72.15.55 defun om-putEndObject

This writes an end object token to dev.

— **defun om-putEndObject** —

```
(defun om-putEndObject (dev)
  (declare (ignore dev)))
```

72.15.56 defun om-putError

This writes a begin error token to dev.

— **defun om-putError** —

```
(defun om-putError (dev)
  (declare (ignore dev)))
```

72.15.57 defun om-putFloat

This writes the float f to dev.

— **defun om-putFloat** —

```
(defun om-putFloat (dev f)
  (declare (ignore dev f)))
```

72.15.58 defun om-putInt

This writes the integer i to dev

— **defun om-putInt** —

```
(defun om-putInt (dev i)
  (declare (ignore dev i)))
```

72.15.59 defun om-putObject

This writes a begin object token to dev.

— **defun om-putObject** —

```
(defun om-putObject (dev)
  (declare (ignore dev)))
```

—————

72.15.60 defun om-putString

This writes the string s to dev.

— **defun om-putString** —

```
(defun om-putString (dev s)
  (declare (ignore dev s)))
```

—————

72.15.61 defun om-putSymbol

This writes the symbol nm using semantics from cd to dev.

— **defun om-putSymbol** —

```
(defun om-putSymbol (dev cd nm)
  (declare (ignore dev cd nm)))
```

—————

72.15.62 defun om-putVar

This writes the variable v to dev.

— **defun om-putVar** —

```
(defun om-putVar (dev v)
  (declare (ignore dev v)))
```

—————

72.15.63 defun om-stringToStringPtr

This is used in the SingleInteger domain in Volume 10.3. This is supposed to return the string from its address? It would appear to be a nop in lisp.

— **defun om-stringToStringPtr** —

```
(defun om-stringToStringPtr (str)
  (declare (ignore str)))
```

72.15.64 defun om-stringPtrToString

This is used in the SingleInteger domain in Volume 10.3. This is supposed to return the string address from a string? It would appear to be a nop in lisp.

— **defun om-stringPtrToString** —

```
(defun om-stringPtrToString (str)
  (declare (ignore str)))
```

Chapter 73

NRLIB code.lisp support code

73.0.65 defun makeByteWordVec2

— defun makeByteWordVec2 0 —

```
(defun |makeByteWordVec2| (maxelement initialvalue)
  (let ((n (cond ((null initialvalue) 7) ('t maxelement))))
    (make-array (length initialvalue)
      :element-type (list 'mod (1+ n))
      :initial-contents initialvalue)))
```

—————

73.0.66 defmacro spadConstant

— defmacro spadConstant 0 —

```
(defmacro |spadConstant| (dollar n)
  '(spadcall (svref ,dollar (the fixnum ,n))))
```

—————

Chapter 74

Monitoring execution

MONITOR

This file contains a set of function for monitoring the execution of the functions in a file. It constructs a hash table that contains the function name as the key and monitor-data structures as the value

The technique is to use a :cond parameter on trace to call the monitor-incr function to incr the count every time a function is called

```
*monitor-table*                                HASH TABLE
  is the monitor table containing the hash entries
*monitor-nrlibs*                               LIST of STRING
  list of nrlib filenames that are monitored
*monitor-domains*                             LIST of STRING
  list of domains to monitor-report (default is all exposed domains)
monitor-data                                  STRUCTURE
  is the defstruct name of records in the table
  name is the first field and is the name of the monitored function
  count contains a count of times the function was called
  monitorp is a flag that skips counting if nil, counts otherwise
  sourcefile is the name of the file that contains the source code
```

***** SETUP, SHUTDOWN *****

```
monitor-inittable ()                          FUNCTION
  creates the hashtable and sets *monitor-table*
  note that it is called every time this file is loaded
monitor-end ()                                FUNCTION
  unhooks all of the trace hooks
```

***** TRACE, UNTRACE *****

```

monitor-add (name &optional sourcefile)      FUNCTION
  sets up the trace and adds the function to the table
monitor-delete (fn)                          FUNCTION
  untraces a function and removes it from the table
monitor-enable (&optional fn)                FUNCTION
  starts tracing for all (or optionally one) functions that
  are in the table
monitor-disable (&optional fn)              FUNCTION
  stops tracing for all (or optionally one) functions that
  are in the table

***** COUNTING, RECORDING *****

monitor-reset (&optional fn)                FUNCTION
  reset the table count for the table (or optionally, for a function)
monitor-incr (fn)                            FUNCTION
  increments the count information for a function
  it is called by trace to increment the count
monitor-decr (fn)                            FUNCTION
  decrements the count information for a function
monitor-info (fn)                            FUNCTION
  returns the monitor-data structure for a function

***** FILE IO *****

monitor-write (items file)                  FUNCTION
  writes a list of symbols or structures to a file
monitor-file (file)                         FUNCTION
  will read a file, scan for defuns, monitor each defun
  NOTE: monitor-file assumes that the file has been loaded

***** RESULTS *****

monitor-results ()                           FUNCTION
  returns a list of the monitor-data structures
monitor-untested ()                         FUNCTION
  returns a list of files that have zero counts
monitor-tested (&optional delete)           FUNCTION
  returns a list of files that have nonzero counts
  optionally calling monitor-delete on those functions

***** CHECKPOINT/RESTORE *****

monitor-checkpoint (file)                   FUNCTION
  save the *monitor-table* in a loadable form
monitor-restore (file)                      FUNCTION
  restore a checkpointed file so that everything is monitored

***** ALGEBRA *****

monitor-autoload ()                         FUNCTION
  traces autoload of algebra to monitor corresponding source files

```

NOTE: this requires the /spad/int/algebra directory

```
monitor-dirname (args)          FUNCTION
    expects a list of 1 libstream (loadvol's arglist) and monitors the source
    this is a function called by monitor-autoload
monitor-nrllib (nrllib)        FUNCTION
    takes an nrllib name as a string (eg POLY) and returns a list of
    monitor-data structures from that source file
monitor-report ()              FUNCTION
    generate a report of the monitored activity for domains in
    *monitor-domains*
monitor-spadfile (name)        FUNCTION
    given a spad file, report all nrllibs it creates
    this adds each nrllib name to *monitor-domains* but does not
    trace the functions from those domains
monitor-percent ()             FUNCTION
    ratio of (functions executed)/(functions traced)
monitor-apropos (str)          FUNCTION
    given a string, find all monitored symbols containing the string
    the search is case-insensitive. returns a list of monitor-data items
```

for example:

suppose we have a file "/u/daly/testmon.lisp" that contains:

```
(defun foo1 () (print 'foo1))
(defun foo2 () (print 'foo2))
(defun foo3 () (foo1) (foo2) (print 'foo3))
(defun foo4 () (print 'foo4))
```

an example session is:

```
; FIRST WE LOAD THE FILE (WHICH INITIS *monitor-table*)
```

```
>(load "/u/daly/monitor.lisp")
Loading /u/daly/monitor.lisp
Finished loading /u/daly/monitor.lisp
T
```

```
; SECOND WE LOAD THE TESTMON FILE
```

```
>(load "/u/daly/testmon.lisp")
T
```

```
; THIRD WE MONITOR THE FILE
```

```
>(monitor-file "/u/daly/testmon.lisp")
monitoring "/u/daly/testmon.lisp"
NIL
```

```
; FOURTH WE CALL A FUNCTION FROM THE FILE (BUMP ITS COUNT)
```

```
>(foo1)
```

```
F001
```

```
F001
```

```

; AND ANOTHER FUNCTION (BUMP ITS COUNT)
>(foo2)

FOO2
FOO2

; AND A THIRD FUNCTION THAT CALLS THE OTHER TWO (BUMP ALL THREE)
>(foo3)

FOO1
FOO2
FOO3
FOO3

; CHECK THAT THE RESULTS ARE CORRECT

>(monitor-results)
(#S(MONITOR-DATA NAME FOO1 COUNT 2 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME FOO2 COUNT 2 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME FOO3 COUNT 1 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp"))
#S(MONITOR-DATA NAME FOO4 COUNT 0 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp"))

; STOP COUNTING CALLS TO FOO2

>(monitor-disable 'foo2)
NIL

; INVOKE FOO2 THRU FOO3

>(foo3)

FOO1
FOO2
FOO3
FOO3

; NOTICE THAT FOO1 AND FOO3 WERE BUMPED BUT NOT FOO2
>(monitor-results)
(#S(MONITOR-DATA NAME FOO1 COUNT 3 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME FOO2 COUNT 2 MONITORP NIL SOURCEFILE
    "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME FOO3 COUNT 2 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp"))
#S(MONITOR-DATA NAME FOO4 COUNT 0 MONITORP T SOURCEFILE

```

```

"/u/daly/testmon.lisp"))

; TEMPORARILY STOP ALL MONITORING

>(monitor-disable)
NIL

; CHECK THAT NOTHING CHANGES

>(foo3)

F001
F002
F003
F003

; NO COUNT HAS CHANGED

>(monitor-results)
(#S(MONITOR-DATA NAME F001 COUNT 3 MONITORP NIL SOURCEFILE
    "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME F002 COUNT 2 MONITORP NIL SOURCEFILE
    "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME F003 COUNT 2 MONITORP NIL SOURCEFILE
    "/u/daly/testmon.lisp"))
 #S(MONITOR-DATA NAME F004 COUNT 0 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp"))

; MONITOR ONLY CALLS TO F001

>(monitor-enable 'foo1)
T

; F003 CALLS F001

>(foo3)

F001
F002
F003
F003

; F001 HAS CHANGED BUT NOT F002 OR F003

>(monitor-results)
(#S(MONITOR-DATA NAME F001 COUNT 4 MONITORP T SOURCEFILE
    "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME F002 COUNT 2 MONITORP NIL SOURCEFILE
    "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME F003 COUNT 2 MONITORP NIL SOURCEFILE
    "/u/daly/testmon.lisp"))

```

```

        "/u/daly/testmon.lisp"))
#S(MONITOR-DATA NAME F004 COUNT 0 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp"))

; MONITOR EVERYBODY

>(monitor-enable)
NIL

; CHECK THAT EVERYBODY CHANGES

>(foo3)

F001
F002
F003
F003

; EVERYBODY WAS BUMPED

>(monitor-results)
(#S(MONITOR-DATA NAME F001 COUNT 5 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME F002 COUNT 3 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME F003 COUNT 3 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp"))
#S(MONITOR-DATA NAME F004 COUNT 0 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp"))

; WHAT FUNCTIONS WERE TESTED?

>(monitor-tested)
(F001 F002 F003)

; WHAT FUNCTIONS WERE NOT TESTED?

>(monitor-untested)
(F004)

; UNTRACE THE WHOLE WORLD, MONITORING CANNOT RESTART

>(monitor-end)
NIL

; CHECK THE RESULTS

>(monitor-results)
(#S(MONITOR-DATA NAME F001 COUNT 5 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp")

```



```

#S(MONITOR-DATA NAME F002 COUNT 3 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp")
#S(MONITOR-DATA NAME F003 COUNT 3 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp"))
#S(MONITOR-DATA NAME F004 COUNT 0 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp"))

; CHECK THAT THE FUNCTIONS STILL WORK

>(foo3)

F001
F002
F003
F003

; CHECK THAT MONITORING IS NOT OCCURING

>(monitor-results)
(#S(MONITOR-DATA NAME F001 COUNT 5 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME F002 COUNT 3 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp")
 #S(MONITOR-DATA NAME F003 COUNT 3 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp"))
 #S(MONITOR-DATA NAME F004 COUNT 0 MONITORP T SOURCEFILE
   "/u/daly/testmon.lisp"))

```

74.0.67 defvar `*monitor-domains*`

— initvars —

```
(defvar *monitor-domains* nil "a list of domains to report")
```

74.0.68 defvar `*monitor-nrlibs*`

— initvars —

```
(defvar *monitor-nrlibs* nil "a list of nrlibs that have been traced")
```

74.0.69 defvar \$*monitor-table*

— initvars —

```
(defvar *monitor-table* nil "a table of all of the monitored data")
```

—————

— postvars —

```
(eval-when (eval load)
  (unless *monitor-table* (monitor-inittable)))
```

—————

74.0.70 defstruct \$monitor-data

— initvars —

```
(defstruct monitor-data name count monitorp sourcefile)
```

—————

74.0.71 defstruct \$libstream

— initvars —

```
(defstruct libstream mode dirname (indextable nil) (indexstream nil))
```

—————

74.0.72 defun Initialize the monitor statistics hashtable

```
[*monitor-table* p1158]
```

— defun monitor-inittable 0 —

```
(defun monitor-inittable ()
  "initialize the monitor statistics hashtable"
  (declare (special *monitor-table*))
  (setq *monitor-table* (make-hash-table)))
```

74.0.73 defun End the monitoring process, we cannot restart

[*monitor-table* p1158]

— defun monitor-end 0 —

```
(defun monitor-end ()
  "End the monitoring process. we cannot restart"
  (declare (special *monitor-table*))
  (maphash
    #'(lambda (key value)
        (declare (ignore value))
        (eval '(untrace ,key)))
    *monitor-table*))
```

74.0.74 defun Return a list of the monitor-data structures

[*monitor-table* p1158]

— defun monitor-results 0 —

```
(defun monitor-results ()
  "return a list of the monitor-data structures"
  (let (result)
    (declare (special *monitor-table*))
    (maphash
      #'(lambda (key value)
          (declare (ignore key))
          (push value result))
      *monitor-table*)
    (mapcar #'(lambda (x) (pprint x))
      (sort result #'string-lessp :key #'monitor-data-name))))
```

74.0.75 defun Add a function to be monitored

```
[monitor-delete p1160]
[make-monitor-data p??]
[*monitor-table* p1158]
```

— defun monitor-add 0 —

```
(defun monitor-add (name &optional sourcefile)
  "add a function to be monitored"
  (declare (special *monitor-table*))
  (unless (fboundp name) (load sourcefile))
  (when (gethash name *monitor-table*)
    (monitor-delete name))
  (eval '(trace (,name :cond (progn (monitor-incr ',name) nil))))
  (setf (gethash name *monitor-table*)
    (make-monitor-data
      :name name :count 0 :monitorp t :sourcefile sourcefile))))
```

—————

74.0.76 defun Remove a function being monitored

```
[*monitor-table* p1158]
```

— defun monitor-delete 0 —

```
(defun monitor-delete (fn)
  "Remove a function being monitored"
  (declare (special *monitor-table*))
  (eval '(untrace ,fn))
  (remhash fn *monitor-table*))
```

—————

74.0.77 defun Enable all (or optionally one) function for monitoring

```
[*monitor-table* p1158]
```

— defun monitor-enable 0 —

```
(defun monitor-enable (&optional fn)
  "enable all (or optionally one) function for monitoring"
  (declare (special *monitor-table*))
  (if fn
```

```
(progn
  (eval '(trace (,fn :cond (progn (monitor-incr ',fn) nil))))
  (setf (monitor-data-monitorp (gethash fn *monitor-table*)) t))
(maphash
 #'(lambda (key value)
   (declare (ignore value))
   (eval '(trace (,key :cond (progn (monitor-incr ',key) nil))))
   (setf (monitor-data-monitorp (gethash key *monitor-table*)) t))
 *monitor-table*))
```

74.0.78 defun Disable all (optionally one) function for monitoring

[*monitor-table* p1158]

— defun monitor-disable 0 —

```
(defun monitor-disable (&optional fn)
  "disable all (optionally one) function for monitoring"
  (declare (special *monitor-table*))
  (if fn
    (progn
      (eval '(untrace ,fn))
      (setf (monitor-data-monitorp (gethash fn *monitor-table*)) nil))
    (maphash
     #'(lambda (key value)
       (declare (ignore value))
       (eval '(untrace ,key))
       (setf (monitor-data-monitorp (gethash key *monitor-table*)) nil))
     *monitor-table*)))
```

74.0.79 defun Reset the table count for the table (or a function)

[*monitor-table* p1158]

— defun monitor-reset 0 —

```
(defun monitor-reset (&optional fn)
  "reset the table count for the table (or a function)"
  (declare (special *monitor-table*))
  (if fn
    (setf (monitor-data-count (gethash fn *monitor-table*)) 0)
```

```
(maphash
  #'(lambda (key value)
    (declare (ignore value))
    (setf (monitor-data-count (gethash key *monitor-table*)) 0))
  *monitor-table*))
```

74.0.80 defun Incr the count of fn by 1

```
[*monitor-table* p1158]
```

— defun monitor-incr 0 —

```
(defun monitor-incr (fn)
  "incr the count of fn by 1"
  (let (data)
    (declare (special *monitor-table*))
    (setq data (gethash fn *monitor-table*))
    (if data
      (incf (monitor-data-count data)) ;; change table entry by side-effect
      (warn "~s is monitored but not in table..do (untrace ~s)~%" fn fn))))
```

74.0.81 defun Decr the count of fn by 1

```
[*monitor-table* p1158]
```

— defun monitor-decr 0 —

```
(defun monitor-decr (fn)
  "decr the count of fn by 1"
  (let (data)
    (declare (special *monitor-table*))
    (setq data (gethash fn *monitor-table*))
    (if data
      (decf (monitor-data-count data)) ;; change table entry by side-effect
      (warn "~s is monitored but not in table..do (untrace ~s)~%" fn fn))))
```

74.0.82 defun Return the monitor information for a function

[*monitor-table* p1158]

— defun monitor-info 0 —

```
(defun monitor-info (fn)
  "return the monitor information for a function"
  (declare (special *monitor-table*))
  (gethash fn *monitor-table*))
```

74.0.83 defun Hang a monitor call on all of the defuns in a file

```
[done p??]
[done p??]
[monitor-add p1160]
```

— defun monitor-file 0 —

```
(defun monitor-file (file)
  "hang a monitor call on all of the defuns in a file"
  (let (expr (package "BOOT"))
    (format t "monitoring ~s~%" file)
    (with-open-file (in file)
      (catch 'done
        (loop
          (setq expr (read in nil 'done))
          (when (eq expr 'done) (throw 'done nil))
          (if (and (consp expr) (eq (car expr) 'in-package))
              (if (and (consp (second expr)) (eq (first (second expr)) 'quote))
                  (setq package (string (second (second expr))))
                  (setq package (second expr)))
              (when (and (consp expr) (eq (car expr) 'defun))
                (monitor-add (intern (string (second expr)) package) file))))))))))
```

74.0.84 defun Return a list of the functions with zero count fields

[*monitor-table* p1158]

— defun monitor-untested 0 —

```
(defun monitor-untested ()
  "return a list of the functions with zero count fields"
  (let (result)
    (declare (special *monitor-table*))
    (maphash
      #'(lambda (key value)
        (if (and (monitor-data-monitorp value) (= (monitor-data-count value) 0))
            (push key result)))
      *monitor-table*))
  (sort result #'string-lessp)))
```

74.0.85 defun Return a list of functions with non-zero counts

[monitor-delete p1160]
 [*monitor-table*) p??]

— defun monitor-tested 0 —

```
(defun monitor-tested (&optional delete)
  "return a list of functions with non-zero counts, optionally deleting them"
  (let (result)
    (declare (special *monitor-table*))
    (maphash
      #'(lambda (key value)
        (when (and (monitor-data-monitorp value)
                    (> (monitor-data-count value) 0))
          (when delete (monitor-delete key))
          (push key result)))
      *monitor-table*))
  (sort result #'string-lessp)))
```

74.0.86 defun Write out a list of symbols or structures to a file

— defun monitor-write 0 —

```
(defun monitor-write (items file)
  "write out a list of symbols or structures to a file"
  (with-open-file (out file :direction :output)
    (dolist (item items)
      (if (symbolp item)
```



```
(format out "~s~%" item)
(format out "~s~50t~s~100t~s~%"
  (monitor-data-sourcefile item)
  (monitor-data-name item)
  (monitor-data-count item))))))
```

74.0.87 defun Save the **monitor-table** in loadable form

```
[*monitor-table* p1158]
[*print-package* p??]
```

— defun monitor-checkpoint 0 —

```
(defun monitor-checkpoint (file)
  "save the *monitor-table* in loadable form"
  (let ((*print-package* t))
    (declare (special *print-package* *monitor-table*))
    (with-open-file (out file :direction :output)
      (format out "(in-package \"BOOT\")~%" )
      (format out "(monitor-inittable)~%" )
      (dolist (data (monitor-results))
        (format out "(monitor-add '~s ~s)~%"
          (monitor-data-name data)
          (monitor-data-sourcefile data))
        (format out "(setf (gethash '~s *monitor-table*)
          (make-monitor-data :name '~s :count ~s :monitorp ~s
            :sourcefile ~s))~%"
          (monitor-data-name data)
          (monitor-data-name data)
          (monitor-data-count data)
          (monitor-data-monitorp data)
          (monitor-data-sourcefile data))))))
```

74.0.88 defun restore a checkpointed file

— defun monitor-restore 0 —

```
(defun monitor-restore (file)
  "restore a checkpointed file"
  (load file))
```

74.0.89 defun Printing help documentation

— defun monitor-help 0 —

```
(defun monitor-help ()
  (format t "%
;;; MONITOR
;;;
;;; This file contains a set of function for monitoring the execution
;;; of the functions in a file. It constructs a hash table that contains
;;; the function name as the key and monitor-data structures as the value
;;;
;;; The technique is to use a :cond parameter on trace to call the
;;; monitor-incr function to incr the count every time a function is called
;;;
;;; *monitor-table*                                HASH TABLE
;;;   is the monitor table containing the hash entries
;;; *monitor-nrlibs*                                LIST of STRING
;;;   list of nrllib filenames that are monitored
;;; *monitor-domains*                                LIST of STRING
;;;   list of domains to monitor-report (default is all exposed domains)
;;; monitor-data                                    STRUCTURE
;;;   is the defstruct name of records in the table
;;;   name is the first field and is the name of the monitored function
;;;   count contains a count of times the function was called
;;;   monitorp is a flag that skips counting if nil, counts otherwise
;;;   sourcefile is the name of the file that contains the source code
;;;
;;; ***** SETUP, SHUTDOWN *****
;;;
;;; monitor-inittable ()                            FUNCTION
;;;   creates the hashtable and sets *monitor-table*
;;;   note that it is called every time this file is loaded
;;; monitor-end ()                                  FUNCTION
;;;   unhooks all of the trace hooks
;;;
;;; ***** TRACE, UNTRACE *****
;;;
;;; monitor-add (name &optional sourcefile)          FUNCTION
;;;   sets up the trace and adds the function to the table
;;; monitor-delete (fn)                              FUNCTION
;;;   untraces a function and removes it from the table
;;; monitor-enable (&optional fn)                    FUNCTION
;;;   starts tracing for all (or optionally one) functions that
;;;   are in the table
;;; monitor-disable (&optional fn)                  FUNCTION
```

```

;;; stops tracing for all (or optionally one) functions that
;;; are in the table
;;;
;;; ***** COUNTING, RECORDING *****
;;;
;;; monitor-reset (&optional fn)                FUNCTION
;;; reset the table count for the table (or optionally, for a function)
;;; monitor-incr (fn)                            FUNCTION
;;; increments the count information for a function
;;; it is called by trace to increment the count
;;; monitor-decr (fn)                            FUNCTION
;;; decrements the count information for a function
;;; monitor-info (fn)                            FUNCTION
;;; returns the monitor-data structure for a function
;;;
;;; ***** FILE IO *****
;;;
;;; monitor-write (items file)                   FUNCTION
;;; writes a list of symbols or structures to a file
;;; monitor-file (file)                         FUNCTION
;;; will read a file, scan for defuns, monitor each defun
;;; NOTE: monitor-file assumes that the file has been loaded
;;;
;;; ***** RESULTS *****
;;;
;;; monitor-results ()                           FUNCTION
;;; returns a list of the monitor-data structures
;;; monitor-untested ()                         FUNCTION
;;; returns a list of files that have zero counts
;;; monitor-tested (&optional delete)          FUNCTION
;;; returns a list of files that have nonzero counts
;;; optionally calling monitor-delete on those functions
;;;
;;; ***** CHECKPOINT/RESTORE *****
;;;
;;; monitor-checkpoint (file)                   FUNCTION
;;; save the *monitor-table* in a loadable form
;;; monitor-restore (file)                     FUNCTION
;;; restore a checkpointed file so that everything is monitored
;;;
;;; ***** ALGEBRA *****
;;;
;;; monitor-autoload ()                         FUNCTION
;;; traces autoload of algebra to monitor corresponding source files
;;; NOTE: this requires the /spad/int/algebra directory
;;; monitor-dirname (args)                     FUNCTION
;;; expects a list of 1 libstream (loadvol's arglist) and monitors the source
;;; this is a function called by monitor-autoload
;;; monitor-nrllib (nrllib)                   FUNCTION
;;; takes an nrllib name as a string (eg POLY) and returns a list of

```

```

;;; monitor-data structures from that source file
;;; monitor-report () FUNCTION
;;; generate a report of the monitored activity for domains in
;;; *monitor-domains*
;;; monitor-spadfile (name) FUNCTION
;;; given a spad file, report all nrlibs it creates
;;; this adds each nrlib name to *monitor-domains* but does not
;;; trace the functions from those domains
;;; monitor-percent () FUNCTION
;;; ratio of (functions executed)/(functions traced)
;;; monitor-apropos (str) FUNCTION
;;; given a string, find all monitored symbols containing the string
;;; the search is case-insensitive. returns a list of monitor-data items
") nil)

```

74.0.90 Monitoring algebra files

74.0.91 defun Monitoring algebra code.lsp files

[*monitor-nrlibs* p1157]

— defun monitor-dirname 0 —

```

(defun monitor-dirname (args)
  "expects a list of 1 libstream (loadvol's arglist) and monitors the source"
  (let (name)
    (declare (special *monitor-nrlibs*))
    (setq name (libstream-dirname (car args)))
    (setq name (file-namestring name))
    (setq name (concatenate 'string "/spad/int/algebra/" name "/code.lsp"))
    (when (probe-file name)
      (push name *monitor-nrlibs*)
      (monitor-file name))))

```

74.0.92 defun Monitor autoloaded files

— defun monitor-autoload 0 —

```

(defun monitor-autoload ()

```

```
"traces autoload of algebra to monitor corresponding source files"
(trace (vmlisp::loadvol
      :entrycond nil
      :exitcond (progn (monitor-dirname system::arglist) nil))))
```

74.0.93 defun Monitor an nrlib

[*monitor-table* p1158]

— defun monitor-nrlib 0 —

```
(defun monitor-nrlib (nrlib)
  "takes an nrlib name as a string (eg POLY) and returns a list of
  monitor-data structures from that source file"
  (let (result)
    (declare (special *monitor-table*))
    (maphash
      #'(lambda (k v)
          (declare (ignore k))
          (when (string= nrlib
                        (pathname-name (car (last
                                           (pathname-directory (monitor-data-sourcefile v))))))
              (push v result))))
      *monitor-table*)
    result))
```

74.0.94 defun Given a monitor-data item, extract the nrlib name

— defun monitor-libname 0 —

```
(defun monitor-libname (item)
  "given a monitor-data item, extract the nrlib name"
  (pathname-name (car (last
                       (pathname-directory (monitor-data-sourcefile item))))))
```

74.0.95 defun Is this an exposed algebra function?

— defun monitor-exposedp 0 —

```
(defun monitor-exposedp (fn)
  "exposed functions have more than 1 semicolon. given a symbol, count them"
  (> (count #\; (symbol-name fn)) 1))
```

74.0.96 defun Monitor exposed domains

TPDHERE: note that the file `interp.exposed` no longer exists. The exposure information is now in `bookvol5`. This needs to work off the internal exposure list, not the file.

```
[done p??]
[done p??]
[*monitor-domains* p1157]
```

— defun monitor-readinterp 0 —

```
(defun monitor-readinterp ()
  "read interp.exposed to initialize *monitor-domains* to exposed domains.
  this is the default action. adding or deleting domains from the list
  will change the report results"
  (let (skip expr name)
    (declare (special *monitor-domains*))
    (setq *monitor-domains* nil)
    (with-open-file (in "/spad/src/algebra/interp.exposed")
      (read-line in)
      (read-line in)
      (read-line in)
      (read-line in)
      (catch 'done
        (loop
          (setq expr (read-line in nil "done"))
          (when (string= expr "done") (throw 'done nil))
          (cond
            ((string= expr "basic") (setq skip nil))
            ((string= expr "categories") (setq skip t))
            ((string= expr "hidden") (setq skip t))
            ((string= expr "defaults") (setq skip nil)))
          (when (and (not skip) (> (length expr) 58))
            (setq name (subseq expr 58 (length expr)))
            (setq name (string-right-trim '("#\space") name))
            (when (> (length name) 0)
              (push name *monitor-domains*))))))))))
```

74.0.97 defun Generate a report of the monitored domains

[monitor-readinterp p1170]
 [*monitor-domains* p1157]

— defun monitor-report 0 —

```
(defun monitor-report ()
  "generate a report of the monitored activity for domains in *monitor-domains*"
  (let (nrlibs nonzero total)
    (declare (special *monitor-domains*))
    (unless *monitor-domains* (monitor-readinterp))
    (setq nonzero 0)
    (setq total 0)
    (maphash
     #'(lambda (k v)
         (declare (ignore k))
         (let (nextlib point)
           (when (> (monitor-data-count v) 0) (incf nonzero))
           (incf total)
           (setq nextlib (monitor-libname v))
           (setq point (member nextlib nrlibs :test #'string= :key #'car))
           (if point
               (setf (cdr (first point)) (cons v (cdr (first point))))
               (push (cons nextlib (list v)) nrlibs))))
      *monitor-table*)
    (format t "~d of ~d (~d percent) tested~%" nonzero total
            (round (/ (* 100.0 nonzero) total)))
    (setq nrlibs (sort nrlibs #'string< :key #'car))
    (dolist (pair nrlibs)
      (let ((exposedcount 0) (testcount 0))
        (when (member (car pair) *monitor-domains* :test #'string=)
          (format t "for library ~s~%" (car pair))
          (dolist (item (sort (cdr pair) #'> :key #'monitor-data-count))
            (when (monitor-exposedp (monitor-data-name item))
              (incf exposedcount)
              (when (> (monitor-data-count item) 0) (incf testcount))
              (format t "~5d ~s~%"
                      (monitor-data-count item)
                      (monitor-data-name item))))
          (if (= exposedcount testcount)
              (format t "~a has all exposed functions tested~%" (car pair))
              (format t "Daly bug:~a has untested exposed functions~%" (car pair))))))
      nil))
```

74.0.98 defun Parse an)abbrev expression for the domain name

— defun monitor-parse 0 —

```
(defun monitor-parse (expr)
  (let (point1 point2)
    (setq point1 (position #\space expr :test #'char=))
    (setq point1 (position #\space expr :start point1 :test-not #'char=))
    (setq point1 (position #\space expr :start point1 :test #'char=))
    (setq point1 (position #\space expr :start point1 :test-not #'char=))
    (setq point2 (position #\space expr :start point1 :test #'char=))
    (subseq expr point1 point2)))
```

74.0.99 defun Given a spad file, report all nrlibs it creates

```
[done p??]
[done p??]
[monitor-parse p1172]
[*monitor-domains* p1157]
```

— defun monitor-spadfile 0 —

```
(defun monitor-spadfile (name)
  "given a spad file, report all nrlibs it creates"
  (let (expr)
    (declare (special *monitor-domains*))
    (with-open-file (in name)
      (catch 'done
        (loop
          (setq expr (read-line in nil 'done))
          (when (eq expr 'done) (throw 'done nil))
          (when (and (> (length expr) 4) (string= (subseq expr 0 4) ")abb"))
            (setq *monitor-domains*
                  (adjoin (monitor-parse expr) *monitor-domains* :test #'string=)))))))
```

74.0.100 defun Print percent of functions tested

[*monitor-table* p1158]

— defun monitor-percent 0 —

```
(defun monitor-percent ()
  "Print percent of functions tested"
  (let (nonzero total)
    (declare (special *monitor-table*))
    (setq nonzero 0)
    (setq total 0)
    (maphash
     #'(lambda (k v)
         (declare (ignore k))
         (when (> (monitor-data-count v) 0) (incf nonzero))
         (incf total)))
     *monitor-table*)
    (format t "~d of ~d (~d percent) tested~%" nonzero total
            (round (/ (* 100.0 nonzero) total)))))
```

74.0.101 defun Find all monitored symbols containing the string

[*monitor-table* p1158]

— defun monitor-afropos 0 —

```
(defun monitor-afropos (str)
  "given a string, find all monitored symbols containing the string
   the search is case-insensitive. returns a list of monitor-data items"
  (let (result)
    (maphash
     #'(lambda (k v)
         (when
          (search (string-upcase str)
                  (string-upcase (symbol-name k))
                  :test #'string=)
          (push v result))))
     *monitor-table*)
    result))
```

Chapter 75

The Interpreter

— Interpreter —

```
(setq *print-array* nil)
(setq *print-circle* nil)
(setq *print-pretty* nil)

(in-package "BOOT")
\getchunk{initvars}

;;; level 0 macros

\getchunk{defmacro bit-to-truth 0}
\getchunk{defmacro bvec-elt 0}
\getchunk{defmacro idChar? 0}
\getchunk{defmacro identp 0}
\getchunk{defmacro qsabsval 0}
\getchunk{defmacro qsadd1 0}
\getchunk{defmacro qsdifference 0}
\getchunk{defmacro qslessp 0}
\getchunk{defmacro qsmax 0}
\getchunk{defmacro qsmin 0}
\getchunk{defmacro qsminus 0}
\getchunk{defmacro qsoddp 0}
\getchunk{defmacro qsplus 0}
\getchunk{defmacro qssub1 0}
\getchunk{defmacro qstimes 0}
\getchunk{defmacro qszerop 0}
\getchunk{defmacro spadConstant 0}

;;; above level 0 macros
```

```

\getchunk{defmacro assq}
\getchunk{defmacro bvec-setelt}
\getchunk{defmacro bvec-size}
\getchunk{defmacro cdaref2}
\getchunk{defmacro cdelt}
\getchunk{defmacro cdlen}
\getchunk{defmacro cdancols}
\getchunk{defmacro cdanrows}
\getchunk{defmacro cdsetaref2}
\getchunk{defmacro cdsetelt}
\getchunk{defmacro danrows}
\getchunk{defmacro dancols}
\getchunk{defmacro daref2}
\getchunk{defmacro delt}
\getchunk{defmacro DFAdd}
\getchunk{defmacro DFAcos}
\getchunk{defmacro DFAcosh}
\getchunk{defmacro DFAsin}
\getchunk{defmacro DFAsinh}
\getchunk{defmacro DFAtan}
\getchunk{defmacro DFAtan2}
\getchunk{defmacro DFAtanh}
\getchunk{defmacro DFCos}
\getchunk{defmacro DFCosh}
\getchunk{defmacro DFDivide}
\getchunk{defmacro DFEql}
\getchunk{defmacro DFExp}
\getchunk{defmacro DFExpt}
\getchunk{defmacro DFIntegerDivide}
\getchunk{defmacro DFIntegerExpt}
\getchunk{defmacro DFIntegerMultiply}
\getchunk{defmacro DFLessThan}
\getchunk{defmacro DFLog}
\getchunk{defmacro DFLogE}
\getchunk{defmacro DFMax}
\getchunk{defmacro DFMin}
\getchunk{defmacro DFMinusp}
\getchunk{defmacro DFMultiply}
\getchunk{defmacro DFSin}
\getchunk{defmacro DFSinh}
\getchunk{defmacro DFSqrt}
\getchunk{defmacro DFSubtract}
\getchunk{defmacro DFTan}
\getchunk{defmacro DFTanh}
\getchunk{defmacro DFUnaryMinus}
\getchunk{defmacro DFZerop}
\getchunk{defmacro dlen}
\getchunk{defmacro dsetaref2}
\getchunk{defmacro dsetelt}
\getchunk{defmacro elt32}

```

```

\getchunk{defmacro funfind}
\getchunk{defmacro hget}
\getchunk{defmacro make-cdouble-matrix}
\getchunk{defmacro make-cdouble-vector}
\getchunk{defmacro make-double-matrix}
\getchunk{defmacro make-double-matrix1}
\getchunk{defmacro make-double-vector}
\getchunk{defmacro make-double-vector1}
\getchunk{defmacro qv32len}
\getchunk{defmacro Rest}
\getchunk{defmacro startsId?}
\getchunk{defmacro setelt32}
\getchunk{defmacro trapNumericErrors}
\getchunk{defmacro truth-to-bit}
\getchunk{defmacro while}
\getchunk{defmacro whileWithResult}

;;; layer 0 (all common lisp)

\getchunk{defun acot 0}
\getchunk{defun acoth 0}
\getchunk{defun acsc 0}
\getchunk{defun acsch 0}
\getchunk{defun asec 0}
\getchunk{defun asech 0}
\getchunk{defun axiomVersion 0}

\getchunk{defun BooleanEquality 0}
\getchunk{defun bvec-and 0}
\getchunk{defun bvec-concat 0}
\getchunk{defun bvec-copy 0}
\getchunk{defun bvec-equal 0}
\getchunk{defun bvec-greater 0}
\getchunk{defun bvec-make-full 0}
\getchunk{defun bvec-nand 0}
\getchunk{defun bvec-nor 0}
\getchunk{defun bvec-not 0}
\getchunk{defun bvec-or 0}
\getchunk{defun bvec-xor 0}

\getchunk{defun cleanupLine 0}
\getchunk{defun clearMacroTable 0}
\getchunk{defun concat 0}
\getchunk{defun cot 0}
\getchunk{defun coth 0}
\getchunk{defun createCurrentInterpreterFrame 0}
\getchunk{defun credits 0}
\getchunk{defun csc 0}
\getchunk{defun csch 0}

```

```

\getchunk{defun Delay 0}
\getchunk{defun desiredMsg 0}
\getchunk{defun DirToString 0}
\getchunk{defun divide2 0}
\getchunk{defun dqAppend 0}
\getchunk{defun dqToList 0}
\getchunk{defun dqUnit 0}

\getchunk{defun emptyInterpreterFrame 0}

\getchunk{defun fin 0}
\getchunk{defun findFrameInRing 0}
\getchunk{defun flatten 0}
\getchunk{defun fnameExists? 0}
\getchunk{defun fnameName 0}
\getchunk{defun fnameReadable? 0}
\getchunk{defun fnameType 0}
\getchunk{defun frameExposureData 0}
\getchunk{defun frameHiFiAccess 0}
\getchunk{defun frameHistList 0}
\getchunk{defun frameHistListAct 0}
\getchunk{defun frameHistListLen 0}
\getchunk{defun frameHistoryTable 0}
\getchunk{defun frameHistRecord 0}
\getchunk{defun frameInteractive 0}
\getchunk{defun frameIOIndex 0}
\getchunk{defun frameName 0}
\getchunk{defun frameNames 0}
\getchunk{defun From 0}
\getchunk{defun FromTo 0}

\getchunk{defun get-current-directory 0}
\getchunk{defun getenviron 0}
\getchunk{defun getLinePos 0}
\getchunk{defun getLineText 0}
\getchunk{defun getMsgArgL 0}
\getchunk{defun getMsgKey 0}
\getchunk{defun getMsgKey? 0}
\getchunk{defun getMsgPrefix 0}
\getchunk{defun getMsgPosTagOb 0}
\getchunk{defun getMsgPrefix? 0}
\getchunk{defun getMsgTag 0}
\getchunk{defun getMsgTag? 0}
\getchunk{defun getMsgText 0}
\getchunk{defun getParserMacroNames 0}
\getchunk{defun getPreStL 0}

\getchunk{defun hasOptArgs? 0}

\getchunk{defun incActive? 0}

```

```

\getchunk{defun incCommand? 0}
\getchunk{defun incDrop 0}
\getchunk{defun incHandleMessage 0}
\getchunk{defun inclmsgConsole 0}
\getchunk{defun inclmsgFinSkipped 0}
\getchunk{defun inclmsgPrematureEOF 0}
\getchunk{defun inclmsgCmdBug 0}
\getchunk{defun inclmsgIfBug 0}
\getchunk{defun incPrefix? 0}
\getchunk{defun init-memory-config 0}
\getchunk{defun insertPos 0}
\getchunk{defun integer-decode-float-denominator 0}
\getchunk{defun integer-decode-float-exponent 0}
\getchunk{defun integer-decode-float-sign 0}
\getchunk{defun integer-decode-float-numerator 0}
\getchunk{defun intloopPrefix? 0}
\getchunk{defun isIntegerString 0}

\getchunk{defun keyword 0}
\getchunk{defun keyword? 0}

\getchunk{defun lfcomment 0}
\getchunk{defun lferror 0}
\getchunk{defun lffloat 0}
\getchunk{defun lfid 0}
\getchunk{defun lfinteger 0}
\getchunk{defun lfnegcomment 0}
\getchunk{defun lfrinteger 0}
\getchunk{defun lfspaces 0}
\getchunk{defun lfstring 0}
\getchunk{defun lnCreate 0}
\getchunk{defun lnExtraBlanks 0}
\getchunk{defun lnFileName? 0}
\getchunk{defun lnGlobalNum 0}
\getchunk{defun lnImmediate? 0}
\getchunk{defun lnLocalNum 0}
\getchunk{defun lnPlaceOfOrigin 0}
\getchunk{defun lnSetGlobalNum 0}
\getchunk{defun lnString 0}

\getchunk{defun mac0Define 0}
\getchunk{defun mac0InfiniteExpansion,name 0}
\getchunk{defun make-absolute-filename 0}
\getchunk{defun makeByteWordVec2 0}
\getchunk{defun makeInitialModemapFrame 0}
\getchunk{defun manexp 0}
\getchunk{defun member 0}
\getchunk{defun monitor-add 0}
\getchunk{defun monitor-apropos 0}
\getchunk{defun monitor-autoload 0}

```

```

\getchunk{defun monitor-checkpoint 0}
\getchunk{defun monitor-decr 0}
\getchunk{defun monitor-delete 0}
\getchunk{defun monitor-dirname 0}
\getchunk{defun monitor-disable 0}
\getchunk{defun monitor-enable 0}
\getchunk{defun monitor-end 0}
\getchunk{defun monitor-exposedp 0}
\getchunk{defun monitor-file 0}
\getchunk{defun monitor-help 0}
\getchunk{defun monitor-incr 0}
\getchunk{defun monitor-info 0}
\getchunk{defun monitor-inittable 0}
\getchunk{defun monitor-libname 0}
\getchunk{defun monitor-nrlib 0}
\getchunk{defun monitor-parse 0}
\getchunk{defun monitor-percent 0}
\getchunk{defun monitor-readinterp 0}
\getchunk{defun monitor-report 0}
\getchunk{defun monitor-reset 0}
\getchunk{defun monitor-restore 0}
\getchunk{defun monitor-results 0}
\getchunk{defun monitor-spadfile 0}
\getchunk{defun monitor-tested 0}
\getchunk{defun monitor-untested 0}
\getchunk{defun monitor-write 0}

\getchunk{defun ncError 0}
\getchunk{defun ncloopEscaped 0}
\getchunk{defun ncloopPrefix? 0}
\getchunk{defun ncloopPrintLines 0}
\getchunk{defun nonBlank 0}
\getchunk{defun npAnyNo 0}
\getchunk{defun npboot 0}
\getchunk{defun npEqPeek 0}
\getchunk{defun nplisp 0}
\getchunk{defun npPop1 0}
\getchunk{defun npPop2 0}
\getchunk{defun npPop3 0}
\getchunk{defun npPush 0}

\getchunk{defun opTran 0}

\getchunk{defun pfAndLeft 0}
\getchunk{defun pfAndRight 0}
\getchunk{defun pfAppend 0}
\getchunk{defun pfApplicationArg 0}
\getchunk{defun pfApplicationOp 0}
\getchunk{defun pfAssignLhsItems 0}
\getchunk{defun pf0AssignLhsItems 0}

```



```

\getchunk{defun pfAssignRhs 0}
\getchunk{defun pfBreakFrom 0}
\getchunk{defun pfCoercetoExpr 0}
\getchunk{defun pfCoercetoType 0}
\getchunk{defun pfCollectBody 0}
\getchunk{defun pfCollectIterators 0}
\getchunk{defun pfDefinitionLhsItems 0}
\getchunk{defun pfDefinitionRhs 0}
\getchunk{defun pfDoBody 0}
\getchunk{defun pfExitCond 0}
\getchunk{defun pfExitExpr 0}
\getchunk{defun pfFirst 0}
\getchunk{defun pfFreeItems 0}
\getchunk{defun pfForinLhs 0}
\getchunk{defun pfForinWhole 0}
\getchunk{defun pfFromdomDomain 0}
\getchunk{defun pfFromdomWhat 0}
\getchunk{defun pfIfCond 0}
\getchunk{defun pfIfElse 0}
\getchunk{defun pfIfThen 0}
\getchunk{defun pfLambdaArgs 0}
\getchunk{defun pfLambdaBody 0}
\getchunk{defun pfLambdaRets 0}
\getchunk{defun pfLiteral? 0}
\getchunk{defun pfLocalItems 0}
\getchunk{defun pfLoopIterators 0}
\getchunk{defun pfMacroLhs 0}
\getchunk{defun pfMacroRhs 0}
\getchunk{defun pfMLambdaArgs 0}
\getchunk{defun pfMLambdaBody 0}
\getchunk{defun pfNotArg 0}
\getchunk{defun pfNovalueExpr 0}
\getchunk{defun pfOrLeft 0}
\getchunk{defun pfOrRight 0}
\getchunk{defun pfParts 0}
\getchunk{defun pfPile 0}
\getchunk{defun pfPretendExpr 0}
\getchunk{defun pfPretendType 0}
\getchunk{defun pfRestrictExpr 0}
\getchunk{defun pfRestrictType 0}
\getchunk{defun pfReturnExpr 0}
\getchunk{defun pfRuleLhsItems 0}
\getchunk{defun pfRuleRhs 0}
\getchunk{defun pfSecond 0}
\getchunk{defun pfSequenceArgs 0}
\getchunk{defun pfSuchthatCond 0}
\getchunk{defun pfTaggedExpr 0}
\getchunk{defun pfTaggedTag 0}
\getchunk{defun pfTree 0}
\getchunk{defun pfTypedId 0}

```

```

\getchunk{defun pfTypedType 0}
\getchunk{defun pfTupleParts 0}
\getchunk{defun pfWhereContext 0}
\getchunk{defun pfWhereExpr 0}
\getchunk{defun pfWhileCond 0}
\getchunk{defun pmDontQuote? 0}
\getchunk{defun poCharPosn 0}
\getchunk{defun poGetLineObject 0}
\getchunk{defun poNopos? 0}
\getchunk{defun poNoPosition 0}
\getchunk{defun poNoPosition? 0}
\getchunk{defun printAsTeX 0}
\getchunk{defun pname 0}

\getchunk{defun qenum 0}
\getchunk{defun qsquotient 0}
\getchunk{defun qsremainder 0}
\getchunk{defun quotient2 0}

\getchunk{defun random 0}
\getchunk{defun rdigit? 0}
\getchunk{defun reclaim 0}
\getchunk{defun remainder2 0}
\getchunk{defun remLine 0}
\getchunk{defun rep 0}
\getchunk{defun resetStackLimits 0}

\getchunk{defun sameUnionBranch 0}
\getchunk{defun satisfiesUserLevel 0}
\getchunk{defun scanCloser? 0}
\getchunk{defun sec 0}
\getchunk{defun sech 0}
\getchunk{defun setCurrentLine 0}
\getchunk{defun setMsgPrefix 0}
\getchunk{defun setMsgText 0}
\getchunk{defun set-restart-hook 0}
\getchunk{defun showMsgPos? 0}
\getchunk{defun StreamNull 0}
\getchunk{defun stripLisp 0}
\getchunk{defun stripSpaces 0}

\getchunk{defun theid 0}
\getchunk{defun thefname 0}
\getchunk{defun theorigin 0}
\getchunk{defun tokPart 0}
\getchunk{defun To 0}
\getchunk{defun Top? 0}
\getchunk{defun trademark 0}

\getchunk{defun zeroOneTran 0}

```

```

;;; above level 0

\getchunk{defun abbQuery}
\getchunk{defun abbreviations}
\getchunk{defun abbreviationsSpad2Cmd}
\getchunk{defun addBinding}
\getchunk{defun addBindingInteractive}
\getchunk{defun addInputLibrary}
\getchunk{defun addNewInterpreterFrame}
\getchunk{defun addOperations}
\getchunk{defun addTraceItem}
\getchunk{defun algCoerceInteractive}
\getchunk{defun allConstructors}
\getchunk{defun allOperations}
\getchunk{defun alqlGetOrigin}
\getchunk{defun alqlGetParams}
\getchunk{defun alqlGetKindString}
\getchunk{defun alreadyOpened?}
\getchunk{defun apropos}
\getchunk{defun assertCond}
\getchunk{defun augmentTraceNames}

\getchunk{defun basicLookup}
\getchunk{defun basicLookupCheckDefaults}
\getchunk{defun break}
\getchunk{defun breaklet}
\getchunk{defun brightprint}
\getchunk{defun brightprint-0}
\getchunk{defun browse}
\getchunk{defun browseOpen}

\getchunk{defun cacheKeyedMsg}
\getchunk{defun categoryOpen}
\getchunk{defun changeHistListLen}
\getchunk{defun changeToNamedInterpreterFrame}
\getchunk{defun charDigitVal}
\getchunk{defun cleanline}
\getchunk{defun clear}
\getchunk{defun clearCmdAll}
\getchunk{defun clearCmdCompletely}
\getchunk{defun clearCmdExcept}
\getchunk{defun clearCmdParts}
\getchunk{defun clearCmdSortedCaches}
\getchunk{defun clearFrame}
\getchunk{defun clearParserMacro}
\getchunk{defun clearSpad2Cmd}
\getchunk{defun close}
\getchunk{defun closeInterpreterFrame}
\getchunk{defun cmpnote}

```

```

\getchunk{defun coerceSpadArgs2E}
\getchunk{defun coerceSpadFunValue2E}
\getchunk{defun coerceTraceArgs2E}
\getchunk{defun coerceTraceFunValue2E}
\getchunk{defun commandAmbiguityError}
\getchunk{defun commandError}
\getchunk{defun commandErrorIfAmbiguous}
\getchunk{defun commandErrorMessage}
\getchunk{defun commandsForUserLevel}
\getchunk{defun commandUserLevelError}
\getchunk{defun compareposns}
\getchunk{defun compileBoot}
\getchunk{defun compiledLookup}
\getchunk{defun compiledLookupCheck}
\getchunk{defun compressOpen}
\getchunk{defun constoken}
\getchunk{defun constructSubst}
\getchunk{defun containsVars}
\getchunk{defun containsVars1}
\getchunk{defun copyright}
\getchunk{defun countCache}

\getchunk{defun DaaseName}
\getchunk{defun decideHowMuch}
\getchunk{defun defaultTargetFE}
\getchunk{defun defiostream}
\getchunk{defun deldatabase}
\getchunk{defun deleteFile}
\getchunk{defun describe}
\getchunk{defun describeFortPersistence}
\getchunk{defun describeInputLibraryArgs}
\getchunk{defun describeOutputLibraryArgs}
\getchunk{defun describeSetFortDir}
\getchunk{defun describeSetFortTmpDir}
\getchunk{defun describeSetFunctionsCache}
\getchunk{defun describeSetLinkerArgs}
\getchunk{defun describeSetNagHost}
\getchunk{defun describeSetOutputAlgebra}
\getchunk{defun describeSetOutputFormula}
\getchunk{defun describeSetOutputFortran}
\getchunk{defun describeSetOutputHtml}
\getchunk{defun describeSetOutputMathml}
\getchunk{defun describeSetOutputOpenMath}
\getchunk{defun describeSetOutputTex}
\getchunk{defun describeSetStreamsCalculate}
\getchunk{defun describeSpad2Cmd}
\getchunk{defun dewritify}
\getchunk{defun dewritify,dewritifyInner}
\getchunk{defun diffAlist}
\getchunk{defun digit?}

```

```

\getchunk{defun digitp}
\getchunk{defun disableHist}
\getchunk{defun display}
\getchunk{defun displayCondition}
\getchunk{defun displayExposedConstructors}
\getchunk{defun displayExposedGroups}
\getchunk{defun displayFrameNames}
\getchunk{defun displayHiddenConstructors}
\getchunk{defun displayMacro}
\getchunk{defun displayMacros}
\getchunk{defun displayMode}
\getchunk{defun displayModemap}
\getchunk{defun displayOperations}
\getchunk{defun displayOperationsFromLisplib}
\getchunk{defun displayParserMacro}
\getchunk{defun displayProperties}
\getchunk{defun displayProperties,sayFunctionDeps}
\getchunk{defun displaySetOptionInformation}
\getchunk{defun displaySetVariableSettings}
\getchunk{defun displaySpad2Cmd}
\getchunk{defun displayType}
\getchunk{defun displayValue}
\getchunk{defun displayWorkspaceNames}
\getchunk{defun domainToGenvar}
\getchunk{defun domArg}
\getchunk{defun domArg2}
\getchunk{defun doSystemCommand}
\getchunk{defun dqConcat}
\getchunk{defun dropInputLibrary}
\getchunk{defun dumbTokenize}

\getchunk{defun edit}
\getchunk{defun editFile}
\getchunk{defun editSpad2Cmd}
\getchunk{defun Else?}
\getchunk{defun Elseif?}
\getchunk{defun enPile}
\getchunk{defun eofp}
\getchunk{defun eqpileTree}
\getchunk{defun erMsgCompare}
\getchunk{defun erMsgSep}
\getchunk{defun erMsgSort}
\getchunk{defun evalCategory}
\getchunk{defun evalDomain}
\getchunk{defun evaluateSignature}
\getchunk{defun evaluateType}
\getchunk{defun evaluateType1}
\getchunk{defun ExecuteInterpSystemCommand}
\getchunk{defun executeQuietCommand}

```

```

\getchunk{defun fetchKeyedMsg}
\getchunk{defun fetchOutput}
\getchunk{defun fillerSpaces}
\getchunk{defun filterAndFormatConstructors}
\getchunk{defun filterListOfStrings}
\getchunk{defun filterListOfStringsWithFn}
\getchunk{defun firstTokPosn}
\getchunk{defun fixObjectForPrinting}
\getchunk{defun flattenOperationAlist}
\getchunk{defun float2Sex}
\getchunk{defun fnameDirectory}
\getchunk{defun fnameMake}
\getchunk{defun fnameNew}
\getchunk{defun fnameWritable?}
\getchunk{defun frame}
\getchunk{defun frameEnvironment}
\getchunk{defun frameSpad2Cmd}
\getchunk{defun functionp}
\getchunk{defun funfind,LAM}

\getchunk{defun genDomainTraceName}
\getchunk{defun gensymInt}
\getchunk{defun getAliasIfTracedMapParameter}
\getchunk{defun getAndEvalConstructorArgument}
\getchunk{defun getAndSay}
\getchunk{defun getBpiNameIfTracedMap}
\getchunk{defun getBrowseDatabase}
\getchunk{defun getdatabase}
\getchunk{defun getDirectoryList}
\getchunk{defun getFirstWord}
\getchunk{defun getKeyedMsg}
\getchunk{defun getMapSig}
\getchunk{defun getMapSubNames}
\getchunk{defun getMsgCatAttr}
\getchunk{defun getMsgFTTag?}
\getchunk{defun getMsgInfoFromKey}
\getchunk{defun getMsgLitSym}
\getchunk{defun getMsgPos}
\getchunk{defun getMsgPos2}
\getchunk{defun getMsgToWhere}
\getchunk{defun getOplistForConstructorForm}
\getchunk{defun getOplistWithUniqueSignatures}
\getchunk{defun getOption}
\getchunk{defun getPosStL}
\getchunk{defun getPreviousMapSubNames}
\getchunk{defun getProplist}
\getchunk{defun getrefv32}
\getchunk{defun getStFromMsg}
\getchunk{defun getSystemCommandLine}
\getchunk{defun getTraceOption}

```

```

\getchunk{defun getTraceOption,hn}
\getchunk{defun getTraceOptions}
\getchunk{defun getWorkspaceNames}

\getchunk{defun handleNoParseCommands}
\getchunk{defun handleParsedSystemCommands}
\getchunk{defun handleTokenSizeSystemCommands}
\getchunk{defun hasAtt}
\getchunk{defun hasAttSig}
\getchunk{defun hasCatExpression}
\getchunk{defun hasCate}
\getchunk{defun hasCateSpecial}
\getchunk{defun hasCateSpecialNew}
\getchunk{defun hasCate1}
\getchunk{defun hasCaty}
\getchunk{defun hasCaty1}
\getchunk{defun hashable}
\getchunk{defun hasOption}
\getchunk{defun hasPair}
\getchunk{defun hasSig}
\getchunk{defun hasSigAnd}
\getchunk{defun hasSigOr}
\getchunk{defun help}
\getchunk{defun helpSpad2Cmd}
\getchunk{defun histFileErase}
\getchunk{defun histFileName}
\getchunk{defun histInputFileName}
\getchunk{defun history}
\getchunk{defun historySpad2Cmd}
\getchunk{defun hkeys}
\getchunk{defun hput}

\getchunk{defun If?}
\getchunk{defun ifCond}
\getchunk{defun importFromFrame}
\getchunk{defun incAppend}
\getchunk{defun incAppend1}
\getchunk{defun incBiteOff}
\getchunk{defun incClassify}
\getchunk{defun incCommandTail}
\getchunk{defun incConsoleInput}
\getchunk{defun incFileInput}
\getchunk{defun incFileName}
\getchunk{defun incIgen}
\getchunk{defun incIgen1}
\getchunk{defun inclFname}
\getchunk{defun incLine}
\getchunk{defun incLine1}
\getchunk{defun inclmsgCannotRead}
\getchunk{defun inclmsgFileCycle}

```

```

\getchunk{defun inclmsgPrematureFin}
\getchunk{defun include}
\getchunk{defun include1}
\getchunk{defun inclmsgConActive}
\getchunk{defun inclmsgConStill}
\getchunk{defun inclmsgIfSyntax}
\getchunk{defun inclmsgNoSuchFile}
\getchunk{defun inclmsgSay}
\getchunk{defun incNConsoles}
\getchunk{defun incRenumber}
\getchunk{defun incRenumberItem}
\getchunk{defun incRenumberLine}
\getchunk{defun incRgen}
\getchunk{defun incRgen1}
\getchunk{defun incStream}
\getchunk{defun incString}
\getchunk{defun incZip}
\getchunk{defun incZip1}
\getchunk{defun init-boot/spad-reader}
\getchunk{defun initHist}
\getchunk{defun initHistList}
\getchunk{defun initial-getdatabase}
\getchunk{defun initializeInterpreterFrameRing}
\getchunk{defun initializeSetVariables}
\getchunk{defun initImPr}
\getchunk{defun initroot}
\getchunk{defun initToWhere}
\getchunk{defun insertAlist}
\getchunk{defun insertpile}
\getchunk{defun InterpExecuteSpadSystemCommand}
\getchunk{defun interpFunctionDepAlists}
\getchunk{defun interpOpen}
\getchunk{defun interpret}
\getchunk{defun interpret1}
\getchunk{defun interpret2}
\getchunk{defun interpretTopLevel}
\getchunk{defun intInterpretPform}
\getchunk{defun intloop}
\getchunk{defun intloopEchoParse}
\getchunk{defun intloopInclude}
\getchunk{defun intloopInclude0}
\getchunk{defun intnplisp}
\getchunk{defun intloopProcess}
\getchunk{defun intloopProcessString}
\getchunk{defun intloopReadConsole}
\getchunk{defun intloopSpadProcess}
\getchunk{defun intloopSpadProcess,interp}
\getchunk{defun intProcessSynonyms}
\getchunk{defun ioclear}
\getchunk{defun iostat}

```



```

\getchunk{defun isDomainOrPackage}
\getchunk{defun isDomainValuedVariable}
\getchunk{defun isEqualOrSubDomain}
\getchunk{defun isExposedConstructor}
\getchunk{defun isgenvar}
\getchunk{defun isInterpOnlyMap}
\getchunk{defun isListOfIdentifiers}
\getchunk{defun isListOfIdentifiersOrStrings}
\getchunk{defun isPartialMode}
\getchunk{defun isSharpVar}
\getchunk{defun isSharpVarWithNum}
\getchunk{defun isSubForRedundantMapName}
\getchunk{defun isSystemDirectory}
\getchunk{defun isTraceGensym}
\getchunk{defun isUncompiledMap}

\getchunk{defun justifyMyType}

\getchunk{defun KeepPart?}

\getchunk{defun lassocSub}
\getchunk{defun lastTokPosn}
\getchunk{defun leader?}
\getchunk{defun leaveScratchpad}
\getchunk{defun letPrint}
\getchunk{defun letPrint2}
\getchunk{defun letPrint3}
\getchunk{defun lfkey}
\getchunk{defun library}
\getchunk{defun line?}
\getchunk{defun lineoftoks}
\getchunk{defun listConstructorAbbreviations}
\getchunk{defun listDecideHowMuch}
\getchunk{defun listOutputter}
\getchunk{defun lnFileName}
\getchunk{defun load}
\getchunk{defun loadFunctor}
\getchunk{defun loadLib}
\getchunk{defun loadLibNoUpdate}
\getchunk{defun localdatabase}
\getchunk{defun localnrlib}
\getchunk{defun lookupInDomainVector}
\getchunk{defun loopIters2Sex}
\getchunk{defun lotsof}
\getchunk{defun ltrace}

\getchunk{defun macApplication}
\getchunk{defun macExpand}
\getchunk{defun macId}
\getchunk{defun macLambda}

```

```

\getchunk{defun macLambda,mac}
\getchunk{defun macLambdaParameterHandling}
\getchunk{defun macMacro}
\getchunk{defun macSubstituteId}
\getchunk{defun macSubstituteOuter}
\getchunk{defun macroExpanded}
\getchunk{defun macWhere}
\getchunk{defun macWhere,mac}
\getchunk{defun macOExpandBody}
\getchunk{defun macOGet}
\getchunk{defun macOGetName}
\getchunk{defun macOInfiniteExpansion}
\getchunk{defun macOMLambdaApply}
\getchunk{defun macOSubstituteOuter}
\getchunk{defun make-appendstream}
\getchunk{defun make-databases}
\getchunk{defun makeFullNamestring}
\getchunk{defun makeHistFileName}
\getchunk{defun makeInputFilename}
\getchunk{defun make-instream}
\getchunk{defun makeLeaderMsg}
\getchunk{defun makeMsgFromLine}
\getchunk{defun makeOrdinal}
\getchunk{defun make-outstream}
\getchunk{defun makePathname}
\getchunk{defun makeStream}
\getchunk{defun mapLetPrint}
\getchunk{defun mergePathnames}
\getchunk{defun messageprint}
\getchunk{defun messageprint-1}
\getchunk{defun messageprint-2}
\getchunk{defun mkDomPvar}
\getchunk{defun mkEvalable}
\getchunk{defun mkEvalableMapping}
\getchunk{defun mkEvalableRecord}
\getchunk{defun mkEvalableUnion}
\getchunk{defun mkLineList}
\getchunk{defun mkprompt}
\getchunk{defun msgCreate}
\getchunk{defun msgImPr?}
\getchunk{defun msgNoRep?}
\getchunk{defun msgOutputter}
\getchunk{defun msgText}
\getchunk{defun myWritable?}

\getchunk{defun namestring}
\getchunk{defun ncAList}
\getchunk{defun ncBug}
\getchunk{defun ncConversationPhase}
\getchunk{defun ncConversationPhase,wrapup}

```

```

\getchunk{defun ncEltQ}
\getchunk{defun ncHardError}
\getchunk{defun ncIntLoop}
\getchunk{defun ncloopCommand}
\getchunk{defun ncloopDQlines}
\getchunk{defun ncloopIncFileName}
\getchunk{defun ncloopInclude}
\getchunk{defun ncloopInclude0}
\getchunk{defun ncloopInclude1}
\getchunk{defun ncloopParse}
\getchunk{defun ncParseFromString}
\getchunk{defun ncPutQ}
\getchunk{defun ncSoftError}
\getchunk{defun ncTag}
\getchunk{defun ncTopLevel}
\getchunk{defun newHelpSpad2Cmd}
\getchunk{defun next}
\getchunk{defun next1}
\getchunk{defun nextInterpreterFrame}
\getchunk{defun nextline}
\getchunk{defun next-lines-clear}
\getchunk{defun next-lines-show}
\getchunk{defun npAdd}
\getchunk{defun npADD}
\getchunk{defun npAmpersand}
\getchunk{defun npAmpersandFrom}
\getchunk{defun npAndOr}
\getchunk{defun npAngleBared}
\getchunk{defun npApplication}
\getchunk{defun npApplication2}
\getchunk{defun npArith}
\getchunk{defun npAssign}
\getchunk{defun npAssignment}
\getchunk{defun npAssignVariable}
\getchunk{defun npAtom1}
\getchunk{defun npAtom2}
\getchunk{defun npBacksetElse}
\getchunk{defun npBackTrack}
\getchunk{defun npBDefinition}
\getchunk{defun npBPileDefinition}
\getchunk{defun npBraced}
\getchunk{defun npBracked}
\getchunk{defun npBracketed}
\getchunk{defun npBreak}
\getchunk{defun npBy}
\getchunk{defun npCategory}
\getchunk{defun npCategoryL}
\getchunk{defun npCoerceTo}
\getchunk{defun npColon}
\getchunk{defun npColonQuery}

```

```
\getchunk{defun npComma}  
\getchunk{defun npCommaBackSet}  
\getchunk{defun npCompMissing}  
\getchunk{defun npConditional}  
\getchunk{defun npConditionalStatement}  
\getchunk{defun npConstTok}  
\getchunk{defun npDDInfKey}  
\getchunk{defun npDecl}  
\getchunk{defun npDef}  
\getchunk{defun npDefaultDecl}  
\getchunk{defun npDefaultItem}  
\getchunk{defun npDefaultItemList}  
\getchunk{defun npDefaultValue}  
\getchunk{defun npDefinition}  
\getchunk{defun npDefinitionItem}  
\getchunk{defun npDefinitionlist}  
\getchunk{defun npDefinitionOrStatement}  
\getchunk{defun npDefn}  
\getchunk{defun npDefTail}  
\getchunk{defun npDiscrim}  
\getchunk{defun npDisjand}  
\getchunk{defun npDollar}  
\getchunk{defun npDotted}  
\getchunk{defun npElse}  
\getchunk{defun npEncAp}  
\getchunk{defun npEncl}  
\getchunk{defun npEnclosed}  
\getchunk{defun npEqKey}  
\getchunk{defun npExit}  
\getchunk{defun npExpress}  
\getchunk{defun npExpress1}  
\getchunk{defun npExport}  
\getchunk{defun npFirstTok}  
\getchunk{defun npFix}  
\getchunk{defun npForIn}  
\getchunk{defun npFree}  
\getchunk{defun npFromdom}  
\getchunk{defun npFromdom1}  
\getchunk{defun npGives}  
\getchunk{defun npId}  
\getchunk{defun npImport}  
\getchunk{defun npInfGeneric}  
\getchunk{defun npInfixOp}  
\getchunk{defun npInfixOperator}  
\getchunk{defun npInfKey}  
\getchunk{defun npInline}  
\getchunk{defun npInterval}  
\getchunk{defun npItem}  
\getchunk{defun npItem1}  
\getchunk{defun npIterate}
```

```

\getchunk{defun npIterator}
\getchunk{defun npIterators}
\getchunk{defun npLambda}
\getchunk{defun npLeftAssoc}
\getchunk{defun npLet}
\getchunk{defun npLetQualified}
\getchunk{defun npList}
\getchunk{defun npListAndRecover}
\getchunk{defun npListing}
\getchunk{defun npListofFun}
\getchunk{defun npLocal}
\getchunk{defun npLocalDecl}
\getchunk{defun npLocalItem}
\getchunk{defun npLocalItemlist}
\getchunk{defun npLogical}
\getchunk{defun npLoop}
\getchunk{defun npMacro}
\getchunk{defun npMatch}
\getchunk{defun npMdef}
\getchunk{defun npMDEF}
\getchunk{defun npMDEFinition}
\getchunk{defun npMissing}
\getchunk{defun npMissingMate}
\getchunk{defun npMoveTo}
\getchunk{defun npName}
\getchunk{defun npNext}
\getchunk{defun npNull}
\getchunk{defun npParened}
\getchunk{defun npParenthesize}
\getchunk{defun npParenthesized}
\getchunk{defun npParse}
\getchunk{defun npPDefinition}
\getchunk{defun npPileBracketed}
\getchunk{defun npPileDefinitionlist}
\getchunk{defun npPileExit}
\getchunk{defun npPower}
\getchunk{defun npPP}
\getchunk{defun npPPf}
\getchunk{defun npPPff}
\getchunk{defun npPPg}
\getchunk{defun npPrefixColon}
\getchunk{defun npPretend}
\getchunk{defun npPrimary}
\getchunk{defun npPrimary1}
\getchunk{defun npPrimary2}
\getchunk{defun npProcessSynonym}
\getchunk{defun npProduct}
\getchunk{defun npPushId}
\getchunk{defun npRelation}
\getchunk{defun npRemainder}

```

```

\getchunk{defun npQualDef}
\getchunk{defun npQualified}
\getchunk{defun npQualifiedDefinition}
\getchunk{defun npQualType}
\getchunk{defun npQualTypelist}
\getchunk{defun npQuiver}
\getchunk{defun npRecoverTrap}
\getchunk{defun npRestore}
\getchunk{defun npRestrict}
\getchunk{defun npReturn}
\getchunk{defun npRightAssoc}
\getchunk{defun npRule}
\getchunk{defun npSCategory}
\getchunk{defun npSDefaultItem}
\getchunk{defun npSegment}
\getchunk{defun npSelector}
\getchunk{defun npSemiBackSet}
\getchunk{defun npSemiListing}
\getchunk{defun npSigDecl}
\getchunk{defun npSigItem}
\getchunk{defun npSigItemList}
\getchunk{defun npSignature}
\getchunk{defun npSignatureDefinee}
\getchunk{defun npSingleRule}
\getchunk{defun npSLocalItem}
\getchunk{defun npSQualTypelist}
\getchunk{defun npStatement}
\getchunk{defun npSuch}
\getchunk{defun npSuchThat}
\getchunk{defun npSum}
\getchunk{defun npsynonym}
\getchunk{defun npSymbolVariable}
\getchunk{defun npSynthetic}
\getchunk{defun npsystem}
\getchunk{defun npState}
\getchunk{defun npTagged}
\getchunk{defun npTerm}
\getchunk{defun npTrap}
\getchunk{defun npTrapForm}
\getchunk{defun npTuple}
\getchunk{defun npType}
\getchunk{defun npTypedForm}
\getchunk{defun npTypedForm1}
\getchunk{defun npTypeStyle}
\getchunk{defun npTypified}
\getchunk{defun npTyping}
\getchunk{defun npTypeVariable}
\getchunk{defun npTypeVariablelist}
\getchunk{defun npVariable}
\getchunk{defun npVariablelist}

```

```

\getchunk{defun npVariableName}
\getchunk{defun npVoid}
\getchunk{defun npWConditional}
\getchunk{defun npWhile}
\getchunk{defun npWith}
\getchunk{defun npZeroOrMore}
\getchunk{defun NRTevalDomain}

\getchunk{defun ofCategory}
\getchunk{defun oldCompLookup}
\getchunk{defun oldHistFileName}
\getchunk{defun om-bindTCP}
\getchunk{defun om-closeConn}
\getchunk{defun om-closeDev}
\getchunk{defun om-connectTCP}
\getchunk{defun om-getApp}
\getchunk{defun om-getAtp}
\getchunk{defun om-getAttr}
\getchunk{defun om-getBind}
\getchunk{defun om-getBVar}
\getchunk{defun om-getConnInDev}
\getchunk{defun om-getConnOutDev}
\getchunk{defun om-getEndApp}
\getchunk{defun om-getEndAtp}
\getchunk{defun om-getEndAttr}
\getchunk{defun om-getEndBind}
\getchunk{defun om-getEndBVar}
\getchunk{defun om-getEndError}
\getchunk{defun om-getEndObject}
\getchunk{defun om-getError}
\getchunk{defun om-getFloat}
\getchunk{defun om-getInt}
\getchunk{defun om-getObject}
\getchunk{defun om-getString}
\getchunk{defun om-getSymbol}
\getchunk{defun om-getType}
\getchunk{defun om-getVar}
\getchunk{defun om-listCDs}
\getchunk{defun om-listSymbols}
\getchunk{defun om-makeConn}
\getchunk{defun om-openFileDev}
\getchunk{defun om-openStringDev}
\getchunk{defun om-putApp}
\getchunk{defun om-putAtp}
\getchunk{defun om-putAttr}
\getchunk{defun om-putBind}
\getchunk{defun om-putBVar}
\getchunk{defun om-putByteArray}
\getchunk{defun om-putEndApp}
\getchunk{defun om-putEndAtp}

```

```

\getchunk{defun om-putEndAttr}
\getchunk{defun om-putEndBind}
\getchunk{defun om-putEndBVar}
\getchunk{defun om-putEndError}
\getchunk{defun om-putEndObject}
\getchunk{defun om-putError}
\getchunk{defun om-putFloat}
\getchunk{defun om-putInt}
\getchunk{defun om-putObject}
\getchunk{defun om-putString}
\getchunk{defun om-putSymbol}
\getchunk{defun om-putVar}
\getchunk{defun om-Read}
\getchunk{defun om-setDevEncoding}
\getchunk{defun om-stringPtrToString}
\getchunk{defun om-stringToStringPtr}
\getchunk{defun om-supportsCD}
\getchunk{defun om-supportsSymbol}
\getchunk{defun openOutputLibrary}
\getchunk{defun openserver}
\getchunk{defun operationOpen}
\getchunk{defun optionError}
\getchunk{defun optionUserLevelError}
\getchunk{defun orderBySlotNumber}

\getchunk{defun parseAndInterpret}
\getchunk{defun parseFromString}
\getchunk{defun parseSystemCmd}
\getchunk{defun pathname}
\getchunk{defun pathnameDirectory}
\getchunk{defun pathnameName}
\getchunk{defun pathnameType}
\getchunk{defun pathnameTypeId}
\getchunk{defun patternVarsOf}
\getchunk{defun patternVarsOf1}
\getchunk{defun pcounters}
\getchunk{defun pfAbSynOp}
\getchunk{defun pfAbSynOp?}
\getchunk{defun pfAdd}
\getchunk{defun pfAnd}
\getchunk{defun pfAnd?}
\getchunk{defun pfApplication}
\getchunk{defun pfApplication?}
\getchunk{defun pfApplication2Sex}
\getchunk{defun pfAssign}
\getchunk{defun pfAssign?}
\getchunk{defun pfAttribute}
\getchunk{defun pfBrace}
\getchunk{defun pfBraceBar}
\getchunk{defun pfBracket}

```



```

\getchunk{defun pfBracketBar}
\getchunk{defun pfBreak}
\getchunk{defun pfBreak?}
\getchunk{defun pfCharPosn}
\getchunk{defun pfCheckArg}
\getchunk{defun pfCheckMacroOut}
\getchunk{defun pfCheckId}
\getchunk{defun pfCheckItOut}
\getchunk{defun pfCoerceto}
\getchunk{defun pfCoerceto?}
\getchunk{defun pfCollect}
\getchunk{defun pfCollect?}
\getchunk{defun pfCollect1?}
\getchunk{defun pfCollectArgTran}
\getchunk{defun pfCollectVariable1}
\getchunk{defun pfCollect2Sex}
\getchunk{defun pfCopyWithPos}
\getchunk{defun pfDefinition}
\getchunk{defun pfDefinition?}
\getchunk{defun pfDefinition2Sex}
\getchunk{defun pfDo}
\getchunk{defun pfDo?}
\getchunk{defun pfDocument}
\getchunk{defun pfEnSequence}
\getchunk{defun pfExit}
\getchunk{defun pfExit?}
\getchunk{defun pfExport}
\getchunk{defun pfExpression}
\getchunk{defun pfFileName}
\getchunk{defun pfFix}
\getchunk{defun pfFlattenApp}
\getchunk{defun pfFree}
\getchunk{defun pfFree?}
\getchunk{defun pfForin}
\getchunk{defun pfForin?}
\getchunk{defun pfFromDom}
\getchunk{defun pfFromdom}
\getchunk{defun pfFromdom?}
\getchunk{defun pfGlobalLinePosn}
\getchunk{defun pfHide}
\getchunk{defun pfId}
\getchunk{defun pfId?}
\getchunk{defun pfIdPos}
\getchunk{defun pfIdSymbol}
\getchunk{defun pfIf}
\getchunk{defun pfIf?}
\getchunk{defun pfIfThenOnly}
\getchunk{defun pfImport}
\getchunk{defun pfInline}
\getchunk{defun pfInfApplication}

```

```

\getchunk{defun pfIterate}
\getchunk{defun pfIterate?}
\getchunk{defun pfLam}
\getchunk{defun pfLambda}
\getchunk{defun pfLambdaTran}
\getchunk{defun pfLambda?}
\getchunk{defun pfLambda2Sex}
\getchunk{defun pfLeaf}
\getchunk{defun pfLeaf?}
\getchunk{defun pfLeafPosition}
\getchunk{defun pfLeafToken}
\getchunk{defun pfLhsRule2Sex}
\getchunk{defun pfLinePosn}
\getchunk{defun pfListOf}
\getchunk{defun pfLiteralClass}
\getchunk{defun pfLiteralString}
\getchunk{defun pfLiteral2Sex}
\getchunk{defun pfLocal}
\getchunk{defun pfLocal?}
\getchunk{defun pfLoop}
\getchunk{defun pfLoop1}
\getchunk{defun pfLoop?}
\getchunk{defun pfLp}
\getchunk{defun pfMacro}
\getchunk{defun pfMacro?}
\getchunk{defun pfMapParts}
\getchunk{defun pfMLambda}
\getchunk{defun pfMLambda?}
\getchunk{defun pfname}
\getchunk{defun pfNoPosition}
\getchunk{defun pfNoPosition?}
\getchunk{defun pfNot?}
\getchunk{defun pfNothing}
\getchunk{defun pfNothing?}
\getchunk{defun pfNovalue}
\getchunk{defun pfNovalue?}
\getchunk{defun pfOp2Sex}
\getchunk{defun pfOr}
\getchunk{defun pfOr?}
\getchunk{defun pfParen}
\getchunk{defun pfPretend}
\getchunk{defun pfPretend?}
\getchunk{defun pfPushBody}
\getchunk{defun pfPushMacroBody}
\getchunk{defun pfQualType}
\getchunk{defun pfRestrict}
\getchunk{defun pfRestrict?}
\getchunk{defun pfRetractTo}
\getchunk{defun pfReturn}
\getchunk{defun pfReturn?}

```

```

\getchunk{defun pfReturnNoName}
\getchunk{defun pfReturnTyped}
\getchunk{defun pfRhsRule2Sex}
\getchunk{defun pfRule}
\getchunk{defun pfRule?}
\getchunk{defun pfRule2Sex}
\getchunk{defun pfSequence}
\getchunk{defun pfSequence?}
\getchunk{defun pfSequenceToList}
\getchunk{defun pfSequence2Sex}
\getchunk{defun pfSequence2Sex0}
\getchunk{defun pfSexpr}
\getchunk{defun pfSexpr,strip}
\getchunk{defun pfSourcePosition}
\getchunk{defun pfSourceStok}
\getchunk{defun pfSpread}
\getchunk{defun pfSuch}
\getchunk{defun pfSuchthat}
\getchunk{defun pfSuchthat?}
\getchunk{defun pfSuchThat2Sex}
\getchunk{defun pfSymb}
\getchunk{defun pfSymbol}
\getchunk{defun pfSymbol?}
\getchunk{defun pfSymbolSymbol}
\getchunk{defun pfTagged}
\getchunk{defun pfTagged?}
\getchunk{defun pfTaggedToTyped}
\getchunk{defun pfTaggedToTyped1}
\getchunk{defun pfTransformArg}
\getchunk{defun pfTuple}
\getchunk{defun pfTupleListOf}
\getchunk{defun pfTweakIf}
\getchunk{defun pfTyped}
\getchunk{defun pfTyped?}
\getchunk{defun pfTyping}
\getchunk{defun pfTuple?}
\getchunk{defun pfUnSequence}
\getchunk{defun pfWDec}
\getchunk{defun pfWDeclare}
\getchunk{defun pfWhere}
\getchunk{defun pfWhere?}
\getchunk{defun pfWhile}
\getchunk{defun pfWhile?}
\getchunk{defun pfWith}
\getchunk{defun pfWrong}
\getchunk{defun pfWrong?}
\getchunk{defun pf0ApplicationArgs}
\getchunk{defun pf0DefinitionLhsItems}
\getchunk{defun pf0FlattenSyntacticTuple}
\getchunk{defun pf0ForinLhs}

```

```

\getchunk{defun pf0FreeItems}
\getchunk{defun pf0LambdaArgs}
\getchunk{defun pf0LocalItems}
\getchunk{defun pf0LoopIterators}
\getchunk{defun pf0MLambdaArgs}
\getchunk{defun pf0SequenceArgs}
\getchunk{defun pf0TupleParts}
\getchunk{defun pf0WhereContext}
\getchunk{defun pf2Sex}
\getchunk{defun pf2Sex1}
\getchunk{defun phMacro}
\getchunk{defun phParse}
\getchunk{defun phInterpret}
\getchunk{defun phIntReportMsgs}
\getchunk{defun pileCforest}
\getchunk{defun pileColumn}
\getchunk{defun pileCtree}
\getchunk{defun pileForest}
\getchunk{defun pileForest1}
\getchunk{defun pileForests}
\getchunk{defun pilePlusComment}
\getchunk{defun pilePlusComments}
\getchunk{defun pileTree}
\getchunk{defun poFileName}
\getchunk{defun poGlobalLinePosn}
\getchunk{defun poLinePosn}
\getchunk{defun poPosImmediate?}
\getchunk{defun porigin}
\getchunk{defun posend}
\getchunk{defun posPointers}
\getchunk{defun ppos}
\getchunk{defun pquit}
\getchunk{defun pquitSpad2Cmd}
\getchunk{defun previousInterpreterFrame}
\getchunk{defun printLabelledList}
\getchunk{defun printStatisticsSummary}
\getchunk{defun printStorage}
\getchunk{defun printSynonyms}
\getchunk{defun printTypeAndTime}
\getchunk{defun printTypeAndTimeNormal}
\getchunk{defun printTypeAndTimeSaturn}
\getchunk{defun probeName}
\getchunk{defun processChPosesForOneLine}
\getchunk{defun processInteractive}
\getchunk{defun processInteractive1}
\getchunk{defun processKeyedError}
\getchunk{defun processMsgList}
\getchunk{defun protectedEVAL}
\getchunk{defun processSynonymLine}
\getchunk{defun processSynonymLine,removeKeyFromLine}

```

```

\getchunk{defun processSynonyms}
\getchunk{defun prTraceNames}
\getchunk{defun prTraceNames,fn}
\getchunk{defun pspacers}
\getchunk{defun ptimers}
\getchunk{defun put}
\getchunk{defun putFTText}
\getchunk{defun punctuation?}
\getchunk{defun putDatabaseStuff}
\getchunk{defun putHist}
\getchunk{defun pvarPredTran}

\getchunk{defun queryClients}
\getchunk{defun queueUpErrors}
\getchunk{defun quit}
\getchunk{defun quitSpad2Cmd}

\getchunk{defun rassocSub}
\getchunk{defun rdefinstream}
\getchunk{defun rdefoutstream}
\getchunk{defun read}
\getchunk{defun /read}
\getchunk{defun readHiFi}
\getchunk{defun readSpadProfileIfThere}
\getchunk{defun readSpad2Cmd}
\getchunk{defun recordAndPrint}
\getchunk{defun recordFrame}
\getchunk{defun recordNewValue}
\getchunk{defun recordNewValue0}
\getchunk{defun recordOldValue}
\getchunk{defun recordOldValue0}
\getchunk{defun redundant}
\getchunk{defun regress}
\getchunk{defun remFile}
\getchunk{defun removeOption}
\getchunk{defun remover}
\getchunk{defun removeTracedMapSigs}
\getchunk{defun removeUndoLines}
\getchunk{defun replaceFile}
\getchunk{defun replaceSharps}
\getchunk{defun reportOperations}
\getchunk{defun reportOpsFromLisplib}
\getchunk{defun reportOpsFromLisplib0}
\getchunk{defun reportOpsFromLisplib1}
\getchunk{defun reportOpsFromUnitDirectly}
\getchunk{defun reportOpsFromUnitDirectly0}
\getchunk{defun reportOpsFromUnitDirectly1}
\getchunk{defun reportSpadTrace}
\getchunk{defun reportUndo}
\getchunk{defun reportWhatOptions}

```

```

\getchunk{defun reroot}
\getchunk{defun resetCounters}
\getchunk{defun resethashtables}
\getchunk{defun resetInCoreHist}
\getchunk{defun resetSpacers}
\getchunk{defun resetTimers}
\getchunk{defun resetWorkspaceVariables}
\getchunk{defun restart}
\getchunk{defun restart0}
\getchunk{defun restoreHistory}
\getchunk{defun retract}
\getchunk{defun rread}
\getchunk{defun ruleLhsTran}
\getchunk{defun rulePredicateTran}
\getchunk{defun runspad}
\getchunk{defun rwrite}

\getchunk{defun safeWritify}
\getchunk{defun sameMsg?}
\getchunk{defun satisfiesRegularExpressions}
\getchunk{defun saveHistory}
\getchunk{defun saveMapSig}
\getchunk{defun savesystem}
\getchunk{defun saveDependentsHashTable}
\getchunk{defun saveUsersHashTable}
\getchunk{defun sayAllCacheCounts}
\getchunk{defun sayBrightly1}
\getchunk{defun sayCacheCount}
\getchunk{defun sayExample}
\getchunk{defun sayKeyedMsg}
\getchunk{defun sayKeyedMsgLocal}
\getchunk{defun sayMSG}
\getchunk{defun sayMSG2File}
\getchunk{defun sayShowWarning}
\getchunk{defun scanCheckRadix}
\getchunk{defun scanComment}
\getchunk{defun scanDictCons}
\getchunk{defun scanError}
\getchunk{defun scanEsc}
\getchunk{defun scanEscape}
\getchunk{defun scanExponent}
\getchunk{defun scanIgnoreLine}
\getchunk{defun scanInsert}
\getchunk{defun scanKeyTr}
\getchunk{defun scanNegComment}
\getchunk{defun scanNumber}
\getchunk{defun ScanOrPairVec}
\getchunk{defun ScanOrPairVec,ScanOrInner}
\getchunk{defun scanPossFloat}
\getchunk{defun scanPunct}

```

```

\getchunk{defun scanPunCons}
\getchunk{defun scanS}
\getchunk{defun scanSpace}
\getchunk{defun scanString}
\getchunk{defun scanKeyTableCons}
\getchunk{defun scanToken}
\getchunk{defun scanTransform}
\getchunk{defun scanW}
\getchunk{defun scanWord}
\getchunk{defun search}
\getchunk{defun searchCurrentEnv}
\getchunk{defun searchTailEnv}
\getchunk{defun segmentKeyedMsg}
\getchunk{defun selectOption}
\getchunk{defun selectOptionLC}
\getchunk{defun separatePiles}
\getchunk{defun serverReadLine}
\getchunk{defun set}
\getchunk{defun set1}
\getchunk{defun setdatabase}
\getchunk{defun setExpose}
\getchunk{defun setExposeAdd}
\getchunk{defun setExposeAddConstr}
\getchunk{defun setExposeAddGroup}
\getchunk{defun setExposeDrop}
\getchunk{defun setExposeDropConstr}
\getchunk{defun setExposeDropGroup}
\getchunk{defun setFortDir}
\getchunk{defun setFortPers}
\getchunk{defun setFortTmpDir}
\getchunk{defun setFunctionsCache}
\getchunk{defun setHistoryCore}
\getchunk{defun setInputLibrary}
\getchunk{defun setIOindex}
\getchunk{defun setLinkerArgs}
\getchunk{defun setMsgCatlessAttr}
\getchunk{defun setMsgForcedAttr}
\getchunk{defun setMsgForcedAttrList}
\getchunk{defun setMsgUnforcedAttr}
\getchunk{defun setMsgUnforcedAttrList}
\getchunk{defun setNagHost}
\getchunk{defun setOutputAlgebra}
\getchunk{defun setOutputCharacters}
\getchunk{defun setOutputFormula}
\getchunk{defun setOutputFortran}
\getchunk{defun setOutputLibrary}
\getchunk{defun setOutputHtml}
\getchunk{defun setOutputMathml}
\getchunk{defun setOutputOpenMath}
\getchunk{defun setOutputTex}

```

```
\getchunk{defun setStreamsCalculate}  
\getchunk{defun shortenForPrinting}  
\getchunk{defun show}  
\getchunk{defun showdatabase}  
\getchunk{defun showInOut}  
\getchunk{defun showInput}  
\getchunk{defun showSpad2Cmd}  
\getchunk{defun shut}  
\getchunk{defun size}  
\getchunk{defun SkipEnd?}  
\getchunk{defun SkipPart?}  
\getchunk{defun Skipping?}  
\getchunk{defun spad}  
\getchunk{defun spadClosure?}  
\getchunk{defun spad-error-loc}  
\getchunk{defun SpadInterpretStream}  
\getchunk{defun spad-long-error}  
\getchunk{defun spadReply}  
\getchunk{defun spadReply,printName}  
\getchunk{defun spadrread}  
\getchunk{defun spadrwrite}  
\getchunk{defun spadrwrite0}  
\getchunk{defun spad-save}  
\getchunk{defun spad-short-error}  
\getchunk{defun spadStartUpMsgs}  
\getchunk{defun spad-syntax-error}  
\getchunk{defun spadTrace}  
\getchunk{defun spadTraceAlias}  
\getchunk{defun spadTrace,g}  
\getchunk{defun spadTrace,isTraceable}  
\getchunk{defun spadUntrace}  
\getchunk{defun spad2BootCoerce}  
\getchunk{defun specialChar}  
\getchunk{defun spleI}  
\getchunk{defun spleI1}  
\getchunk{defun splitIntoOptionBlocks}  
\getchunk{defun squeeze}  
\getchunk{defun stackTraceOptionError}  
\getchunk{defun startsComment?}  
\getchunk{defun startsNegComment?}  
\getchunk{defun statisticsInitialization}  
\getchunk{defun streamChop}  
\getchunk{defun stringMatches?}  
\getchunk{defun StringToDir}  
\getchunk{defun strpos}  
\getchunk{defun strpos1}  
\getchunk{defun stupidIsSpadFunction}  
\getchunk{defun subMatch}  
\getchunk{defun substringMatch}  
\getchunk{defun subTypes}
```



```

\getchunk{defun summary}
\getchunk{defun syGeneralErrorHere}
\getchunk{defun syIgnoredFromTo}
\getchunk{defun synonym}
\getchunk{defun synonymsForUserLevel}
\getchunk{defun synonymSpad2Cmd}
\getchunk{defun sySpecificErrorAtToken}
\getchunk{defun sySpecificErrorHere}
\getchunk{defun systemCommand}

\getchunk{defun ?t}
\getchunk{defun tabbing}
\getchunk{defun tangle}
\getchunk{defun terminateSystemCommand}
\getchunk{defun tersyscommand}
\getchunk{defun thisPosIsEqual}
\getchunk{defun thisPosIsLess}
\getchunk{defun throwEvalTypeMsg}
\getchunk{defun toFile?}
\getchunk{defun tokConstruct}
\getchunk{defun token-stack-show}
\getchunk{defun tokPosn}
\getchunk{defun tokTran}
\getchunk{defun tokType}
\getchunk{defun toScreen?}
\getchunk{defun trace}
\getchunk{defun trace1}
\getchunk{defun traceDomainConstructor}
\getchunk{defun traceDomainLocalOps}
\getchunk{defun tracelet}
\getchunk{defun traceOptionError}
\getchunk{defun /tracereply}
\getchunk{defun traceReply}
\getchunk{defun traceSpad2Cmd}
\getchunk{defun translateTrueFalse2YesNo}
\getchunk{defun translateYesNo2TrueFalse}
\getchunk{defun transOnlyOption}
\getchunk{defun transTraceItem}

\getchunk{defun unAbbreviateKeyword}
\getchunk{defun undo}
\getchunk{defun undoChanges}
\getchunk{defun undoCount}
\getchunk{defun undoFromFile}
\getchunk{defun undoInCore}
\getchunk{defun undoLocalModemapHack}
\getchunk{defun undoSingleStep}
\getchunk{defun undoSteps}
\getchunk{defun unescapeStringsInForm}
\getchunk{defun unifyStruct}

```

```

\getchunk{defun unifyStructVar}
\getchunk{defun unparseInputForm}
\getchunk{defun unsqueeze}
\getchunk{defun untrace}
\getchunk{defun untraceDomainConstructor}
\getchunk{defun untraceDomainConstructor,keepTraced?}
\getchunk{defun untraceDomainLocalOps}
\getchunk{defun untraceMapSubNames}
\getchunk{defun unwritable?}
\getchunk{defun updateCurrentInterpreterFrame}
\getchunk{defun updateDatabase}
\getchunk{defun updateFromCurrentInterpreterFrame}
\getchunk{defun updateHist}
\getchunk{defun updateInCoreHist}
\getchunk{defun updateSourceFiles}
\getchunk{defun userLevelErrorMessage}

\getchunk{defun validateOutputDirectory}
\getchunk{defun vec2list}
\getchunk{defun voidValue}

\getchunk{defun what}
\getchunk{defun whatCommands}
\getchunk{defun whatConstructors}
\getchunk{defun whatSpad2Cmd}
\getchunk{defun whatSpad2Cmd,fixpat}
\getchunk{defun whichCat}
\getchunk{defun with}
\getchunk{defun workfiles}
\getchunk{defun workfilesSpad2Cmd}
\getchunk{defun wrap}
\getchunk{defun write-browsedb}
\getchunk{defun write-categorydb}
\getchunk{defun write-compress}
\getchunk{defun writeHiFi}
\getchunk{defun writeHistModesAndValues}
\getchunk{defun writeInputLines}
\getchunk{defun write-interpdb}
\getchunk{defun write-operationdb}
\getchunk{defun write-warndata}
\getchunk{defun writify}
\getchunk{defun writifyComplain}
\getchunk{defun writify,writifyInner}

\getchunk{defun xlCannotRead}
\getchunk{defun xlCmdBug}
\getchunk{defun xlConActive}
\getchunk{defun xlConsole}
\getchunk{defun xlConStill}
\getchunk{defun xlFileCycle}

```

```
\getchunk{defun x1IfBug}  
\getchunk{defun x1IfSyntax}  
\getchunk{defun x1Msg}  
\getchunk{defun x1NoSuchFile}  
\getchunk{defun x1OK}  
\getchunk{defun x1OK1}  
\getchunk{defun x1PrematureEOF}  
\getchunk{defun x1PrematureFin}  
\getchunk{defun x1Say}  
\getchunk{defun x1Skip}  
\getchunk{defun x1SkippingFin}  
  
\getchunk{defun yesanswer}  
  
\getchunk{defun zsystemdevelopment}  
\getchunk{defun zsystemdevelopment1}  
\getchunk{defun zsystemDevelopmentSpad2Cmd}  
  
\getchunk{postvars}
```

Chapter 76

The Global Variables

76.1 Star Global Variables

NAME	SET	USE
<code>eof*</code>	<code>ncTopLevel</code>	
<code>features*</code>		restart
<code>package*</code>		restart
<code>standard-input*</code>		<code>ncIntLoop</code>
<code>standard-output*</code>		<code>ncIntLoop</code>
<code>top-level-hook*</code>	<code>set-restart-hook</code>	

76.1.1 `*eof*`

The `*eof*` variable is set to `NIL` in `ncTopLevel`.

76.1.2 `*features*`

The `*features*` variable from common lisp is tested for the presence of the `:unix` keyword. Apparently this controls the use of Saturn, a previous Axiom frontend. The Saturn frontend was never released as open source and so this test and the associated variables are probably not used.

76.1.3 `*package*`

The `*package*` variable, from common lisp, is set in restart to the `BOOT` package where the interpreter lives.

76.1.4 ***standard-input***

The ***standard-input*** common lisp variable is used to set the `curinstream` variable in `ncIntLoop`.

This variable is an argument to `serverReadLine` in the `intloopReadConsole` function.

76.1.5 ***standard-output***

The ***standard-output*** common lisp variable is used to set the `curoutstream` variable in `ncIntLoop`.

76.1.6 ***top-level-hook***

The ***top-level-hook*** common lisp variable contains the name of a function to invoke when an image is started. In our case it is called `restart`. This is the entry point to the Axiom interpreter.

76.2 Dollar Global Variables

NAME	SET	USE
\$boot	ncTopLevel	
coerceFailure		runspad
curinstream	ncIntLoop	
curoutstream	ncIntLoop	
\$currentLine	restart	removeUndoLines
\$dalymode		intloopReadConsole
\$displayStartMsgs		restart
\$e	ncTopLevel	
\$erMsgToss	SpadInterpretStream	
\$fn	SpadInterpretStream	
\$frameRecord	initvars	
	clearFrame	
	undoSteps	undoSteps
	recordFrame	recordFrame
\$HiFiAccess	initHist	historySpad2Cmd
	historySpad2Cmd	
		setHistoryCore
\$HistList	initHist	
\$HistListAct	initHist	
\$HistListLen	initHistList	
\$HistRecord	initHistList	
\$historyDirectory		makeHistFileName
		makeHistFileName
\$historyFileType	initvars	histInputFileName
\$InteractiveFrame	restart	ncTopLevel
	undo	recordFrame
	undoSteps	undoSteps
		reportUndo
\$internalHistoryTable	initvars	
\$interpreterFrameName	initializeInterpreterFrameRing	
\$interpreterFrameRing	initializeInterpreterFrameRing	
\$intRestart		intloop
\$intTopLevel	intloop	
\$IOindex	restart	historySpad2Cmd
	removeUndoLines	undoCount
\$genValue	bookvol5	i-toplev
		i-analy
		i-syscmd
		i-spec1
		i-spec2
		i-map
\$lastPos	SpadInterpretStream	
\$libQuiet	SpadInterpretStream	
\$msgDatabaseName	reroot *	
\$ncMsgList	SpadInterpretStream	
\$newcompErrorCount	SpadInterpretStream	
\$newspad	ncTopLevel	
\$nopus		SpadInterpretStream
\$okToExecuteMachineCode	SpadInterpretStream	
\$oldHistoryFileName	initvars	oldHistFileName
\$options		history
	historySpad2Cmd	historySpad2Cmd
		undo

76.2.1 \$boot

The `$boot` variable is set to `NIL` in `ncTopLevel`.

76.2.2 coerceFailure

The `coerceFailure` symbol is a catch tag used in `runspad` to catch an exit from `ncTopLevel`.

76.2.3 \$currentLine

The `$currentLine` line is set to `NIL` in restart. It is used in `removeUndoLines` in the undo mechanism.

76.2.4 \$displayStartMsgs

The `$displayStartMsgs` variable is used in restart but is not set so this is likely a bug.

76.2.5 \$e

The `$e` variable is set to the value of `$InteractiveFrame` which is set in restart to the value of the call to the `makeInitialModemapFrame` function. This function simply returns a copy of the variable `$InitialModemapFrame`.

Thus `$e` is a copy of the variable `$InitialModemapFrame`.

This variable is used in the undo mechanism.

76.2.6 \$erMsgToss

The `$erMsgToss` variable is set to `NIL` in `SpadInterpretStream`.

76.2.7 \$fn

The `$fn` variable is set in `SpadInterpretStream`. It is set to the second argument which is a list. It appears that this list has the same structure as an argument to the `LispVM rdefiostream` function.

76.2.8 \$frameRecord

`$frameRecord = [delta1, delta2, ...]` where `delta(i)` contains changes in the “backwards” direction. Each `delta(i)` has the form `((var . proplist)...)` where `proplist` denotes an ordinary `proplist`. For example, an entry of the form `((x (value) (mode (Integer))))` indicates that to undo 1 step, `x`’s value is cleared and its mode should be set to `(Integer)`.

A `delta(i)` of the form `(systemCommand . delta)` is a special delta indicating changes due to system commands executed between the last command and the current command. By recording these deltas separately, it is possible to undo to either BEFORE or AFTER the command. These special `delta(i)`s are given ONLY when a system command is given which alters the environment.

Note: `recordFrame('system)` is called before a command is executed, and `recordFrame('normal)` is called after (see `processInteractive1`). If no changes are found for former, no special entry is given.

This is part of the undo mechanism.

76.2.9 \$HiFiAccess

The `$HiFiAccess` is set by `initHist` to T. It is a flag used by the history mechanism to record whether the history function is currently on. It can be reset by using the axiom command

```
)history off
```

It appears that the name means “History File Access”.

The `$HiFiAccess` variable is used by `historySpad2Cmd` to check whether history is turned on. T means it is, NIL means it is not.

76.2.10 \$HistList

This `$HistList` variable is set by `initHistList` to an initial value of NIL elements. The last element of the list is smashed to point to the first element to make the list circular. This is a circular list of length `$HistListLen`.

76.2.11 \$HistListAct

The `$HistListAct` variable is set by `initHistList` to 0. This variable holds the actual number of elements in the history list. This is the number of “undoable” steps.

76.2.12 \$HistListLen

The `$HistListLen` variable is set by `initHistList` to 20. This is the length of a circular list maintained in the variable `$HistList`.

76.2.13 \$HistRecord

The `$HistRecord` variable is set by `initHistList` to NIL. `$HistRecord` collects the input line, all variable bindings and the output of a step, before it is written to the file named by the function `histFileName`.

76.2.14 `$historyFileType`

The `$historyFileType` is set at load time by a call to `initvars` to a value of “axh”. It appears that this is intended to be used as a filetype extension. It is part of the history mechanism. It is used in `makeHistFileName` as part of the history file name.

76.2.15 `$internalHistoryTable`

The `$internalHistoryTable` variable is set at load time by a call to `initvars` to a value of `NIL`. It is part of the history mechanism.

76.2.16 `$interpreterFrameName`

The `$interpreterFrameName` variable, set in `initializeInterpreterFrameRing` to the constant `initial` to indicate that this is the initial (default) frame.

Frames are structures that capture all of the variables defined in a session. There can be multiple frames and the user can freely switch between them. Frames are kept in a ring data structure so you can move around the ring.

76.2.17 `$interpreterFrameRing`

The `$interpreterFrameRing` is set to a pair whose `car` is set to the result of `emptyInterpreterFrame`

76.2.18 `$InteractiveFrame`

The `$InteractiveFrame` is set in `restart` to the value of the call to the `makeInitialModemapFrame` function. This function simply returns a copy of the variable `$InitialModemapFrame`

76.2.19 `$intRestart`

The `$intRestart` variable is used in `intloop` but has no value. This is probably a bug. While the variable’s value is unchanged the system will continually reenter the `SpadInterpretStream` function.

76.2.20 `$intTopLevel`

The `$intTopLevel` is a catch tag. Throwing to this tags which is caught in the `intloop` will restart the `SpadInterpretStream` function.

76.2.21 `$IOindex`

The `$IOindex` index variable is set to 1 in restart. This variable is used in the `historySpad2Cmd` function in the history mechanism. It is set in the `removeUndoLines` function in the undo mechanism.

This is used in the undo mechanism in function `undoCount` to compute the number of undos. You can't undo more actions than have already happened.

76.2.22 `$lastPos`

The `$lastPos` variable is set in `SpadInterpretStream` to the value of the `$nopus` variable. Since `$nopus` appears to have no value this is likely a bug.

76.2.23 `$libQuiet`

The `$libQuiet` variable is set to the third argument of the `SpadInterpretStream` function. This is passed from `intloop` with the value of T. This variable appears to be intended to control the printing of library loading messages which would need to be suppressed if input was coming from a file.

76.2.24 `$msgDatabaseName`

The `$msgDatabaseName` is set to NIL in `reroot`.

76.2.25 `$ncMsgList`

The `$ncMsgList` is set to NIL in `SpadInterpretStream`.

76.2.26 `$newcompErrorCount`

The `$newcompErrorCount` is set to 0 in `SpadInterpretStream`.

76.2.27 `$newspad`

The `$newspad` is set to T in `ncTopLevel`.

76.2.28 `$nopus`

The `$nopus` variable is used in `SpadInterpretStream` but does not appear to have a value and is likely a bug.

76.2.29 \$oldHistoryFileName

The `$oldHistoryFileName` is set at load time by a call to `initvars` to a value of “last”. It is part of the history mechanism. It is used in the function `oldHistFileName` and `restoreHistory`.

76.2.30 \$okToExecuteMachineCode

The `$okToExecuteMachineCode` is set to T in `SpadInterpretStream`.

76.2.31 \$options

The `$options` variable is tested by the history function. If it is NIL then output the message

```
You have not used the correct syntax for the history command.  
Issue )help history for more information.
```

The `$options` variable is tested in the `historySpad2Cmd` function. It appears to record the options that were given to a `spad` command on the input line. The function `selectOptionLC` appears to take a list off options to scan.

This variable is not yet set and is probably a bug.

76.2.32 \$previousBindings

The `$previousBindings` is a copy of the `CAAR $InteractiveFrame`. This is used to compute the `delta(i)s` stored in `$frameRecord`. This is part of the undo mechanism.

76.2.33 \$PrintCompilerMessageIfTrue

The `$PrintCompilerMessageIfTrue` variable is set to NIL in `spad`.

76.2.34 \$reportUndo

The `$reportUndo` variable is used in `diffAlist`. It was not normally bound but has been set to T in `initvars`. If the variable is set to T then we call `reportUndo`.

It is part of the undo mechanism.

76.2.35 \$spad

The `$spad` variable is set to T in `ncTopLevel`.

76.2.36 `$SpadServer`

If an open server is not requested then this variable is T. It has no value before this time (and is thus a bug).

76.2.37 `$SpadServerName`

The `$SpadServerName` is passed to the `openServer` function, if the function exists.

76.2.38 `$systemCommandFunction`

The `$systemCommandFunction` is set in `SpadInterpretStream` to point to the function `InterpExecuteSpadSystemCommand`.

76.2.39 `top_level`

The `top_level` symbol is a catch tag used in `runspad` to catch an exit from `ncTopLevel`.

76.2.40 `$quitTag`

The `$quitTag` is used as a variable in a catch block. It appears that it can be thrown somewhere below `ncTopLevel`.

76.2.41 `$useInternalHistoryTable`

The `$useInternalHistoryTable` variable is set at load time by a call to `initvars` to a value of `NIL`. It is part of the history mechanism.

76.2.42 `$undoFlag`

The `$undoFlag` is used in `recordFrame` to decide whether to do undo recording. It is initially set to T in `initvars`. This is part of the undo mechanism.

Bibliography

- [1] Daly, Timothy, "The Axiom Literate Documentation"
<http://axiom.axiom-developer.org/axiom-website/documentation.html>
- [2] Daly, Timothy, "The Axiom Wiki Website"
<http://axiom.axiom-developer.org>
- [3] Stephane Dalmas and Olivier Arsac "OpenMath" Project SAFIR, INRIA Sophia Antipolis
- [4] OpenMath Technical Overview www.openmath.org/overview/technical.html

Chapter 77

Index

Index

- *allOperations*, 999
 - usedby allOperations, 1035
 - usedby localnrlib, 1015
 - defvar, 999
- *allconstructors*, 999
 - usedby allConstructors, 1035
 - usedby browseOpen, 1004
 - usedby interpOpen, 1003
 - usedby localnrlib, 1015
 - usedby make-databases, 1018
 - usedby resethashtables, 1000
 - defvar, 999
- *ancestors-hash*
 - usedby write-interpdb, 1030
- *attributes*, 1024
 - usedby write-compress, 1024
 - defvar, 1024
- *browse-stream*, 998
 - usedby browseOpen, 1004
 - usedby getdatabase, 1009
 - usedby resethashtables, 999
 - defvar, 998
- *browse-stream-stamp*, 998
 - usedby browseOpen, 1004
 - defvar, 998
- *build-version*
 - usedby axiomVersion, 474
 - usedby spadStartUpMsgs, 19
- *category-stream*, 998
 - usedby categoryOpen, 1005
 - usedby getdatabase, 1009
 - usedby resethashtables, 999
 - defvar, 998
- *category-stream-stamp*, 999
 - usedby categoryOpen, 1005
 - usedby resethashtables, 999
 - defvar, 999
- *compress-stream*, 997
 - usedby compressOpen, 1023
 - usedby write-compress, 1024
 - defvar, 997
- *compress-stream-stamp*, 997
 - usedby compressOpen, 1023
 - usedby resethashtables, 1000
 - defvar, 997
- *compressVectorLength*, 996
 - usedby compressOpen, 1023
 - usedby write-compress, 1024
 - defvar, 996
- *compressvector*, 996
 - usedby compressOpen, 1023
 - usedby make-databases, 1018
 - usedby resethashtables, 1000
 - usedby squeeze, 1025
 - usedby unsqueeze, 1026
 - defvar, 996
- *defaultdomain-list*, 995
 - usedby getdatabase, 1009
 - defvar, 995
- *eof*, 24
 - usedby ncTopLevel, 25
 - usedby serverReadLine, 45
 - defvar, 24
- *hasCategory-hash*, 995
 - usedby categoryOpen, 1005
 - usedby getdatabase, 1009
 - usedby write-categorydb, 1033
 - defvar, 995
- *hascategory-hash*
 - usedby getdatabase, 1009
 - usedby resethashtables, 1000
- *index-filename*
 - usedby localdatabase, 1013
- *interp-stream*, 997

- usedby getdatabase, 1009
- usedby interpOpen, 1003
- usedby resethashtables, 999
- defvar, 997
- *interp-stream-stamp*, 997
 - usedby interpOpen, 1003
 - usedby resethashtables, 1000
 - defvar, 997
- *miss*, 996
 - usedby getdatabase, 1009
 - defvar, 996
- *monitor-domains*, 1157
 - usedby monitor-readinterp, 1170
 - usedby monitor-report, 1171
 - usedby monitor-spadfile, 1172
 - defvar, 1157
- *monitor-nrlibs*, 1157
 - usedby monitor-dirname, 1168
 - defvar, 1157
- *monitor-table*, 1158
 - usedby monitor-add, 1160
 - usedby monitor-apropos, 1173
 - usedby monitor-checkpoint, 1165
 - usedby monitor-decr, 1162
 - usedby monitor-delete, 1160
 - usedby monitor-disable, 1161
 - usedby monitor-enable, 1160
 - usedby monitor-end, 1159
 - usedby monitor-incr, 1162
 - usedby monitor-info, 1163
 - usedby monitor-inittable, 1158
 - usedby monitor-nrlib, 1169
 - usedby monitor-percent, 1173
 - usedby monitor-reset, 1161
 - usedby monitor-results, 1159
 - usedby monitor-untested, 1163
 - defvar, 1158
- *monitor-table*)
 - usedby monitor-tested, 1164
- *msghash*, 327
 - usedby cacheKeyedMsg, 329
 - usedby fetchKeyedMsg, 328
 - defvar, 327
- *operation-hash*, 995
 - usedby addoperations, 1007
 - usedby allOperations, 1036
 - usedby getdatabase, 1009
 - usedby make-databases, 1018
 - usedby operationOpen, 1006
 - usedby resethashtables, 1000
 - usedby write-operationdb, 1034
 - defvar, 995
- *operation-stream*, 997
 - usedby getdatabase, 1009
 - usedby operationOpen, 1006
 - usedby resethashtables, 999
 - defvar, 997
- *operation-stream-stamp*, 998
 - usedby operationOpen, 1006
 - usedby resethashtables, 1000
 - defvar, 998
- *print-package*
 - usedby monitor-checkpoint, 1165
- *print-pretty*
 - usedby write-browsedb, 1032
 - usedby write-categorydb, 1033
 - usedby write-interpdb, 1030
- *sourcefiles*
 - usedby make-databases, 1018
 - usedby resethashtables, 999
 - usedby write-browsedb, 1032
- *standard-output*
 - usedby init-boot/spad-reader, 966
- *whitespace*, 24
 - usedby assertCond, 96
 - defvar, 24
- *yearweek*
 - usedby axiomVersion, 474
 - usedby spadStartUpMsgs, 19
- /D,1
 - calledby compileBoot, 905
 - calledby zsystemdevelopment1, 952
- /breakcondition
 - usedby break, 904
- /comp
 - calledby zsystemdevelopment1, 952
- /countlist
 - usedby pcounters, 858
 - usedby resetCounters, 856
 - usedby resetWorkspaceVariables, 652
- /editfile, 513
 - usedby /read, 642

- usedby editSpad2Cmd, 543
- usedby readSpad2Cmd, 641
- usedby readSpadProfileIfThere, 959
- usedby resetWorkspaceVariables, 652
- defvar, 513
- /pretty
 - usedby resetWorkspaceVariables, 652
- /read, 642
 - calledby readSpad2Cmd, 640
 - calls /rf[9], 642
 - calls /rq[9], 642
 - uses /editfile, 642
 - defun, 642
- /rf[9]
 - called by /read, 642
- /rq[9]
 - called by /read, 642
- /sourcefiles
 - usedby resetWorkspaceVariables, 652
- /spacelist
 - usedby pspacers, 857
 - usedby resetSpacers, 856
 - usedby resetWorkspaceVariables, 652
- /timerlist
 - usedby ptimers, 857
 - usedby resetTimers, 856
 - usedby resetWorkspaceVariables, 652
- /trace,0
 - calledby trace1, 846
- /tracenames
 - usedby /tracereply, 892
 - usedby ?t, 901
 - usedby getBpiNameIfTracedMap, 888
 - usedby getMapSubNames, 867
 - usedby prTraceNames, 896
 - usedby spadReply, 893
 - usedby spadTrace, 875
 - usedby spadUntrace, 894
 - usedby traceReply, 898
 - usedby untraceDomainConstructor, 881
 - usedby untrace, 860
- /tracereply, 892
 - calls devaluate, 892
 - calls exit, 892
 - calls isDomainOrPackage, 892
 - calls qcar, 892
 - calls seq, 892
 - uses /tracenames, 892
 - defun, 892
- /untrace,0
 - calledby untraceDomainConstructor,keepTraced?, 880
 - calledby untrace, 860
- /untrace,2
 - calledby untraceMapSubNames, 871
- /version
 - usedby zsystemdevelopment1, 952
- /wsname
 - usedby zsystemdevelopment1, 952
- ?t, 900
 - calledby trace1, 846
 - calls bright, 901
 - calls devaluate, 901
 - calls get, 900
 - calls isDomainOrPackage, 901
 - calls isDomain, 901
 - calls isgenvar, 900
 - calls qcar, 901
 - calls qcdr, 901
 - calls rassocSub, 901
 - calls reportSpadTrace, 901
 - calls sayBrightly, 901
 - calls sayMSG, 901
 - calls take, 901
 - uses /tracenames, 901
 - uses \$InteractiveFrame, 901
 - uses \$mapSubNameAlist, 901
 - defun, 900
- \$FINDFILE
 - calledby \$editSpad2Cmd, 542
- \$erase
 - calledby \$addNewInterpreterFrame, 559
 - calledby \$closeInterpreterFrame, 560
- \$fcopy
 - calledby \$restoreHistory, 595
- \$filep
 - calledby \$setOutputAlgebra, 760
 - calledby \$setOutputFormula, 788
 - calledby \$setOutputFortran, 767
 - calledby \$setOutputHtml, 778
 - calledby \$setOutputMathml, 774
 - calledby \$setOutputOpenMath, 783

- calledby \$setOutputTex, 794
- \$nagMessages, 755
 - defvar, 755
- \$replace
 - calledby \$initHist, 579
- \$reportBottomUpFlag, 744
 - defvar, 744
- \$systemCommandFunction
 - calledby \$intloopProcess, 64
 - calledby \$ncloopCommand, 476
- \$BreakMode, 659
 - usedby letPrint2, 885
 - usedby letPrint3, 886
 - defvar, 659
- \$CallInterp
 - usedby serverReadLine, 45
- \$CatOfCatDatabase
 - usedby clearCmdCompletely, 500
- \$CategoryFrame
 - local def loadLibNoUpdate, 1039
 - local def loadLib, 1038
 - usedby getPropList, 962
 - usedby reportOpsFromUnitDirectly, 820
 - usedby systemCommand, 446
- \$CloseClient
 - usedby close, 509
- \$Coerce
 - local ref unifyStructVar, 429
 - usedby processInteractive, 50
- \$CommandSynonymAlist, 476
 - usedby npProcessSynonym, 471
 - usedby printSynonyms, 472
 - usedby processSynonyms, 34
 - usedby resetWorkspaceVariables, 652
 - usedby synonymSpad2Cmd, 830
 - defvar, 476
- \$ComplexInteger
 - local ref hasCateSpecialNew, 435
- \$ConstructorCache
 - usedby clearCmdSortedCaches, 499
 - usedby localdatabase, 1013
 - usedby traceDomainConstructor, 879
- \$CreateFrameAnswer
 - usedby serverReadLine, 45
- \$CreateFrame
 - usedby serverReadLine, 45
- \$DomOfCatDatabase
 - usedby clearCmdCompletely, 500
- \$EchoLines
 - usedby intloopEchoParse, 69
- \$EmptyEnvironment
 - usedby describeSpad2Cmd, 527
 - usedby displaySpad2Cmd, 534
- \$EmptyMode
 - local ref evaluateType1, 916
 - local ref evaluateType, 914
 - local ref hasCate, 433
 - local ref isPartialMode, 420
 - local ref mkEvalable, 911
 - local ref retract, 1058
 - usedby displayValue, 457
 - usedby interpret2, 55
 - usedby recordAndPrint, 56
- \$EndOfOutput
 - usedby serverReadLine, 45
- \$EndServerSession, 43
 - usedby serverReadLine, 45
 - defvar, 43
- \$EndSession
 - usedby serverReadLine, 45
- \$FormalMapVariableList
 - local ref domArg, 422
 - local ref mkDomPvar, 433
 - local ref replaceSharps, 956
 - usedby displayOperationsFromLisplib, 819
 - usedby localnrLib, 1015
 - usedby reportOpsFromLisplib, 816
- \$FunctionalExpression
 - local ref defaultTargetFE, 437
- \$HTCompanionWindowID, 52
 - usedby recordAndPrint, 56
 - defvar, 52
- \$HiFiAccess, 730
 - usedby createCurrentInterpreterFrame, 555
 - usedby disableHist, 601
 - usedby emptyInterpreterFrame, 554
 - usedby historySpad2Cmd, 581
 - usedby initHist, 579
 - usedby putHist, 589
 - usedby restoreHistory, 595
 - usedby saveHistory, 594
 - usedby setHistoryCore, 583

- usedby undoFromFile, 592
- usedby undoInCore, 591
- usedby updateFromCurrentInterpreterFrame, 556
- usedby updateHist, 588
- usedby writeInputLines, 585
- defvar, 730
- \$HistListAct**
 - usedby changeHistListLen, 587
 - usedby createCurrentInterpreterFrame, 555
 - usedby emptyInterpreterFrame, 554
 - usedby initHistList, 579
 - usedby resetInCoreHist, 586
 - usedby updateFromCurrentInterpreterFrame, 556
 - usedby updateInCoreHist, 588
- \$HistListLen**
 - usedby changeHistListLen, 587
 - usedby createCurrentInterpreterFrame, 555
 - usedby emptyInterpreterFrame, 554
 - usedby initHistList, 579
 - usedby resetInCoreHist, 586
 - usedby undoInCore, 591
 - usedby updateFromCurrentInterpreterFrame, 556
 - usedby updateInCoreHist, 588
- \$HistList**
 - usedby changeHistListLen, 587
 - usedby createCurrentInterpreterFrame, 555
 - usedby emptyInterpreterFrame, 554
 - usedby initHistList, 579
 - usedby recordOldValue0, 590
 - usedby resetInCoreHist, 586
 - usedby undoChanges, 591
 - usedby undoInCore, 591
 - usedby updateFromCurrentInterpreterFrame, 556
 - usedby updateInCoreHist, 588
- \$HistRecord**
 - usedby createCurrentInterpreterFrame, 555
 - usedby emptyInterpreterFrame, 554
 - usedby initHistList, 579
 - usedby recordNewValue0, 589
 - usedby updateFromCurrentInterpreterFrame, 556
 - usedby updateHist, 588
- usedby writeHiFi, 600
- \$IOindex**
 - usedby createCurrentInterpreterFrame, 555
 - usedby historySpad2Cmd, 581
 - usedby mkprompt, 42
 - usedby removeUndoLines, 932
 - usedby resetWorkspaceVariables, 652
 - usedby restart, 18
 - usedby setHistoryCore, 583
 - usedby setIOindex, 597
 - usedby undoCount, 927
 - usedby undoInCore, 591
 - usedby undoSteps, 928
 - usedby updateFromCurrentInterpreterFrame, 556
 - usedby updateHist, 587
 - usedby writeHiFi, 600
 - usedby writeInputLines, 585
- \$InitialCommandSynonymAlist**, 474
- usedby resetWorkspaceVariables, 652
- defvar, 474
- \$InitialModemapFrame**, 9
- usedby makeInitialModemapFrame, 37
- defvar, 9
- \$Integer**
 - local ref defaultTargetFE, 437
 - local ref hasCateSpecialNew, 435
 - local ref hasCateSpecial, 434
 - local ref mkEvaluable, 911
- \$InteractiveFrame**
 - local ref isDomainValuedVariable, 957
 - usedby ?t, 901
 - usedby augmentTraceNames, 870
 - usedby clearCmdAll, 501
 - usedby clearCmdParts, 503
 - usedby createCurrentInterpreterFrame, 555
 - usedby getAliasIfTracedMapParameter, 888
 - usedby getBpiNameIfTracedMap, 888
 - usedby getMapSig, 851
 - usedby getMapSubNames, 867
 - usedby getWorkspaceNames, 453
 - usedby interpFunctionDepAlists, 463
 - usedby isInterpOnlyMap, 870
 - usedby isUncompiledMap, 869
 - usedby ncTopLevel, 25

- usedby parseAndInterpret, 48
- usedby processInteractive1, 52
- usedby recordFrame, 921
- usedby reportUndo, 926
- usedby restart, 18
- usedby restoreHistory, 595
- usedby showSpad2Cmd, 813
- usedby undoChanges, 592
- usedby undoFromFile, 592
- usedby undoInCore, 591
- usedby undoSteps, 928
- usedby undo, 920
- usedby updateFromCurrentInterpreterFrame, 556
- usedby writeHistModesAndValues, 601
- \$InteractiveMode**, 24
 - local def unparsedInputForm, 1055
 - local ref loadLibNoUpdate, 1039
 - local ref loadLib, 1038
 - usedby addBinding, 961
 - usedby ncTopLevel, 25
 - usedby parseAndInterpret, 48
 - usedby readSpad2Cmd, 640
 - usedby zsystemDevelopmentSpad2Cmd, 951
 - usedby zsystemdevelopment1, 952
 - defvar, 24
- \$JoinOfCatDatabase**
 - usedby clearCmdCompletely, 500
- \$JoinOfDomDatabase**
 - usedby clearCmdCompletely, 500
- \$KillLispSystem**
 - usedby serverReadLine, 45
- \$LispCommand**
 - usedby serverReadLine, 45
- \$MenuServer**
 - usedby executeQuietCommand, 47
 - usedby serverReadLine, 45
- \$NeedToSignalSessionManager**, 44
 - usedby intloopSpadProcess, 65
 - usedby serverReadLine, 45
 - defvar, 44
- \$NonNullStream**, 609
 - usedby dewritify,dewritifyInner, 610
 - usedby writify,writifyInner, 605
 - defvar, 609
- \$NonSmanSession**
 - usedby serverReadLine, 45
- \$NullStream**, 609
 - usedby dewritify,dewritifyInner, 610
 - usedby writify,writifyInner, 605
 - defvar, 609
- \$OutputForm**
 - usedby coerceSpadArgs2E, 863
 - usedby coerceSpadFunValue2E, 866
 - usedby coerceTraceArgs2E, 862
 - usedby coerceTraceFunValue2E, 865
- \$PrintCompilerMessageIfTrue**
 - usedby spad, 20
- \$ProcessInteractiveValue**, 52
 - usedby processInteractive1, 52
 - usedby processInteractive, 50
 - defvar, 52
- \$QueryClients**
 - usedby queryClients, 508
- \$QuickLet**
 - usedby breaklet, 903
 - usedby tracelet, 902
- \$QuietCommand**, 47
 - usedby executeQuietCommand, 47
 - usedby pf2Sex1, 302
 - usedby pf2Sex, 299
 - usedby recordAndPrint, 56
 - defvar, 47
- \$QuietSpadCommand**
 - usedby serverReadLine, 45
- \$QuotientField**
 - local ref hasCateSpecial, 434
- \$RTspecialCharacters**, 976
 - usedby setOutputCharacters, 764
 - defvar, 976
- \$RationalNumber**
 - local ref defaultTargetFE, 437
 - local ref hasCateSpecialNew, 435
- \$SessionManager**
 - usedby close, 509
 - usedby queryClients, 508
 - usedby serverReadLine, 45
- \$SpadCommand**
 - usedby serverReadLine, 45
- \$SpadServerName**, 12, 13
 - defvar, 12, 13

- \$SpadServername
 - usedby restart, 18
- \$SpadServer, 12
 - usedby close, 509
 - usedby restart, 18
 - usedby serverReadLine, 45
 - usedby spad-save, 988
 - defvar, 12
- \$StreamFrame
 - usedby processInteractive, 50
- \$Subst
 - local def ofCategory, 419
 - local ref hasCate, 433
 - local ref unifyStructVar, 429
- \$SwitchFrames
 - usedby serverReadLine, 45
- \$Symbol
 - local ref defaultTargetFE, 437
- \$ThrowAwayMode
 - usedby interpret2, 55
- \$TriangleVariableList
 - local ref replaceSharps, 956
- \$UserAbbreviationsAlist
 - usedby resetWorkspaceVariables, 652
- \$UserLevel, 804
 - usedby getDirectoryList, 982
 - usedby readSpad2Cmd, 640
 - usedby satisfiesUserLevel, 449
 - usedby set1, 807
 - usedby synonymsForUserLevel, 831
 - usedby userLevelErrorMessage, 449
 - usedby whatCommands, 940
 - defvar, 804
- \$Void
 - usedby clearCmdSortedCaches, 499
 - usedby recordAndPrint, 56
- \$abbreviateTypes, 758
 - defvar, 758
- \$algebraFormat, 759
 - usedby setOutputAlgebra, 760
 - defvar, 759
- \$algebraOutputFile, 759
 - usedby setOutputAlgebra, 760
 - defvar, 759
- \$algebraOutputStream, 760
 - usedby recordAndPrint, 56
- usedby sayMSG, 331
- usedby setOutputAlgebra, 760
- defvar, 760
- \$analyzingMapList
 - usedby processInteractive, 50
- \$ans
 - usedby nplisp, 470
- \$attrCats, 364
 - usedby whichCat, 365
 - defvar, 364
- \$attributeDb
 - usedby clearCmdCompletely, 500
- \$boot, 25
 - usedby ioclear, 970
 - usedby iostat, 968
 - usedby ncTopLevel, 25
 - usedby parseAndInterpret, 48
 - usedby resetWorkspaceVariables, 652
 - defvar, 25
- \$cacheAlist, 705
 - defvar, 705
- \$cacheMessages, 326
 - defvar, 326
- \$clearExcept, 497
 - usedby clearSpad2Cmd, 498
 - defvar, 497
- \$clearOptions, 497
 - usedby clearCmdExcept, 503
 - usedby clearCmdParts, 503
 - usedby clearSpad2Cmd, 498
 - defvar, 497
- \$coerceIntByMapCounter
 - usedby resetWorkspaceVariables, 652
- \$collectOutput
 - usedby printStatisticsSummary, 57
 - usedby printStorage, 58
 - usedby printTypeAndTimeNormal, 59
 - usedby recordAndPrint, 56
- \$commentedOps
 - usedby reportOpsFromUnitDirectly, 820
- \$compErrorMessageStack
 - usedby processInteractive, 50
- \$compileDontDefineFunctions, 709
 - defvar, 709
- \$compileMapFlag
 - usedby resetWorkspaceVariables, 652

- \$compileRecurrence, 710
 - defvar, 710
- \$compilingLoop
 - usedby processInteractive, 50
- \$compilingMap
 - usedby processInteractive, 50
- \$constructorList
 - usedby make-databases, 1018
- \$constructors, 897
 - usedby addTraceItem, 900
 - usedby traceReply, 897
 - defvar, 897
- \$current-directory, 7
 - usedby getDirectoryList, 982
 - usedby reroot, 41
 - usedby restart, 18
 - defvar, 7
- \$current-line
 - usedby iostat, 968
 - usedby spad-short-error, 968
- \$currentCarrier
 - usedby intloopSpadProcess, 65
- \$currentFrameNum, 43
 - usedby close, 509
 - usedby serverReadLine, 45
 - defvar, 43
- \$currentLine
 - usedby ExecuteInterpSystemCommand, 33
 - usedby clearCmdAll, 502
 - usedby getSystemCommandLine, 832
 - usedby intnplisp, 36
 - usedby removeUndoLines, 932
 - usedby restart, 18
 - usedby setCurrentLine, 42
 - usedby unAbbreviateKeyword, 467
 - usedby updateHist, 588
 - usedby writeHiFi, 600
- \$dalymode, 661
 - usedby intloopReadConsole, 31
 - defvar, 661
- \$declaredMode
 - usedby processInteractive, 50
- \$defaultFortVar
 - usedby processInteractive, 50
- \$defaultFortranType, 715
 - defvar, 715
- \$defaultMsgDatabaseName, 8
 - usedby fetchKeyedMsg, 328
 - usedby reroot, 41
 - defvar, 8
- \$defaultSpecialCharacters, 973
 - defvar, 973
- \$depTb
 - local ref saveDependentsHashTable, 1021
- \$dependeeAlist
 - usedby displayProperties,sayFunctionDeps, 456
 - usedby displayProperties, 460
 - usedby interpFunctionDepAlists, 463
- \$dependeeClosureAlist
 - usedby resetWorkspaceVariables, 652
- \$dependentAlist
 - usedby displayProperties,sayFunctionDeps, 456
 - usedby displayProperties, 460
 - usedby interpFunctionDepAlists, 463
- \$describeOptions, 526
 - usedby describeSpad2Cmd, 527
 - defvar, 526
- \$directory-list, 8
 - usedby getDirectoryList, 982
 - usedby reroot, 41
 - defvar, 8
- \$displayDroppedMap, 736
 - defvar, 736
- \$displayMsgNumber, 743
 - usedby sayKeyedMsgLocal, 330
 - defvar, 743
- \$displayOptions, 533
 - usedby displaySpad2Cmd, 534
 - defvar, 533
- \$displaySetValue, 745
 - usedby set1, 807
 - defvar, 745
- \$displayStartMsgs, 746
 - usedby restart, 18
 - defvar, 746
- \$doNotAddEmptyModeIfTrue
 - usedby domainToGenvar, 859
 - usedby reportOperations, 814
 - usedby transTraceItem, 861

- \$domPvar, 49
 - local def hasAtt, 424
 - local def hasCate1, 427
 - local def hasCaty1, 431
 - local def hasSig, 423
 - local ref domArg2, 422
 - local ref hasCaty, 421
 - local ref unifyStructVar, 429
 - usedby processInteractive, 50
 - defvar, 49
- \$domainTraceNameAssoc
 - usedby genDomainTraceName, 860
- \$domains
 - usedby addTraceItem, 900
 - usedby traceReply, 897
- \$dotdot
 - usedby opTran, 323
- \$echoLineStack
 - usedby resetWorkspaceVariables, 652
- \$envHashTable, 961
 - usedby addBinding, 961
 - defvar, 961
- \$env
 - local ref isDomainValuedVariable, 957
 - usedby interpret, 54
 - usedby reportOperations, 814
 - usedby resetWorkspaceVariables, 652
 - usedby showSpad2Cmd, 813
- \$erMsgToss
 - usedby SpadInterpretStream, 29
 - usedby initImPr, 367
 - usedby phIntReportMsgs, 66
 - usedby showMsgPos?, 358
- \$erase
 - local ref saveDependentsHashTable, 1021
 - local ref saveUsersHashTable, 1022
 - usedby deleteFile, 1045
 - usedby reportOpsFromLisplib1, 815
 - usedby reportOpsFromUnitDirectly1, 824
- \$evalDomain
 - local ref evalDomain, 911
- \$eval
 - usedby interpret1, 54
 - usedby interpret, 54
 - usedby reportOperations, 814
- \$existingFiles
 - usedby clearCmdCompletely, 501
 - usedby resetWorkspaceVariables, 652
- \$expandSegments
 - local def evaluateType, 914
- \$e
 - local ref isDomainValuedVariable, 957
 - usedby clearCmdParts, 503
 - usedby describeSpad2Cmd, 527
 - usedby displaySpad2Cmd, 534
 - usedby interpFunctionDepAlists, 463
 - usedby ncTopLevel, 25
 - usedby parseAndInterpret, 48
 - usedby processInteractive1, 52
 - usedby recordAndPrint, 56
 - usedby resetWorkspaceVariables, 652
 - usedby restoreHistory, 595
 - usedby showSpad2Cmd, 813
 - usedby systemCommand, 446
 - usedby whatSpad2Cmd, 938
- \$filep
 - usedby setOutputAlgebra, 760
 - usedby setOutputFormula, 788
 - usedby setOutputFortran, 767
 - usedby setOutputHtml, 779
 - usedby setOutputMathml, 774
 - usedby setOutputOpenMath, 783
 - usedby setOutputTex, 794
- \$findfile
 - usedby readSpad2Cmd, 640
- \$floatok
 - usedby lineoftoks, 111
 - usedby scanKeyTr, 120
 - usedby scanNumber, 132
 - usedby scanSpace, 129
 - usedby scanString, 130
 - usedby scanWord, 126
- \$fn
 - usedby SpadInterpretStream, 29
 - usedby toFile?, 363
- \$forceDatabaseUpdate
 - local ref loadLib, 1038
 - local ref updateDatabase, 1017
 - usedby localdatabase, 1013
- \$formatSigAsTex
 - local def unparseInputForm, 1055
- \$formulaFormat, 787

- usedby setOutputFormula, 788
 - defvar, 787
- \$formulaOutputFile, 787
 - usedby setOutputFormula, 788
 - defvar, 787
- \$formulaOutputStream
 - usedby setOutputFormula, 788
- \$fortIndent, 712
 - defvar, 712
- \$fortInts2Floats, 712
 - defvar, 712
- \$fortLength, 713
 - defvar, 713
- \$fortPersistence, 753
 - usedby describeFortPersistence, 754
 - usedby setFortPers, 754
 - defvar, 753
- \$fortVar
 - usedby processInteractive, 50
- \$fortranArrayStartingIndex, 719
 - defvar, 719
- \$fortranDirectory, 723
 - usedby describeSetFortDir, 724
 - usedby setFortDir, 724
 - defvar, 723
- \$fortranFormat, 766
 - usedby setOutputFortran, 767
 - defvar, 766
- \$fortranLibraries, 725
 - usedby describeSetLinkerArgs, 726
 - usedby setLinkerArgs, 726
 - defvar, 725
- \$fortranOptimizationLevel, 718
 - defvar, 718
- \$fortranOutputFile, 766
 - usedby setOutputFortran, 767
 - defvar, 766
- \$fortranOutputStream
 - usedby setOutputFortran, 767
- \$fortranPrecision, 715
 - defvar, 715
- \$fortranSegment, 718
 - defvar, 718
- \$fortranTmpDir, 720
 - usedby describeSetFortTmpDir, 722
 - usedby setFortTmpDir, 721
 - defvar, 720
- defvar, 720
- \$fractionDisplayType, 771
 - defvar, 771
- \$frameAlist, 43
 - usedby serverReadLine, 45
 - defvar, 43
- \$frameMessages, 738
 - usedby clearCmdAll, 502
 - usedby displayProperties, 460
 - usedby updateFromCurrentInterpreterFrame, 556
 - defvar, 738
- \$frameNumber, 43
 - usedby serverReadLine, 45
 - defvar, 43
- \$frameRecord, 919
 - usedby clearCmdAll, 501
 - usedby clearFrame, 927
 - usedby recordFrame, 921
 - usedby undoSteps, 928
 - defvar, 919
- \$freeVars
 - usedby processInteractive, 50
- \$fromSpadTrace
 - usedby spadTrace, 875
- \$fullScreenSysVars, 727
 - defvar, 727
- \$functionTable, 500
 - usedby clearCmdCompletely, 501
 - usedby resetWorkspaceVariables, 652
 - defvar, 500
- \$funnyBacks
 - usedby unescapeStringsInForm, 62
- \$funnyQuote
 - usedby unescapeStringsInForm, 62
- \$f
 - usedby lineoftoks, 111
 - usedby nextline, 113
- \$genValue, 53
 - usedby interpret1, 54
 - usedby interpret, 54
 - usedby reportOperations, 814
 - defvar, 53
- \$giveExposureWarning, 736
 - defvar, 736
- \$globalExposureGroupAlist, 668

- local ref isExposedConstructor, 818
 - usedby setExposeAddGroup, 697
 - usedby setExposeDropGroup, 700
 - defvar, 668
- \$hashOp0
 - local ref basicLookup, 1070
- \$hashOp1
 - local ref basicLookup, 1070
- \$hashOpApply
 - local ref basicLookup, 1070
- \$hashOpSet
 - local ref basicLookup, 1070
- \$hashSeg
 - local ref basicLookup, 1070
- \$highlightAllowed, 739
 - defvar, 739
- \$historyDirectory, 577
 - usedby histInputFileName, 578
 - defvar, 577
- \$historyDisplayWidth, 728
 - defvar, 728
- \$historyFileType, 577
 - defvar, 577
- \$hope
 - local def hasCate, 433
 - local def ofCategory, 419
 - local def unifyStructVar, 429
- \$htmlFormat, 777
 - usedby setOutputHtml, 779
 - defvar, 777
- \$htmlOutputFile, 777
 - usedby setOutputHtml, 779
 - defvar, 777
- \$htmlOutputStream
 - usedby setOutputHtml, 778
- \$imPrGuys, 358
 - defvar, 358
- \$imPrTagGuys, 367
 - usedby initImPr, 367
 - defvar, 367
- \$inRetract
 - usedby processInteractive, 50
- \$inclAssertions
 - usedby SpadInterpretStream, 29
 - usedby assertCond, 96
 - usedby ifCond, 89
- \$includeUnexposed?
 - usedby getBrowseDatabase, 1083
- \$inputPromptType, 744
 - usedby mkprompt, 42
 - defvar, 744
- \$inputStream
 - usedby npFirstTok, 143
 - usedby npListAndRecover, 189
 - usedby npMoveTo, 191
 - usedby npNext, 145
 - usedby npParse, 141
 - usedby npRestore, 152
 - usedby npState, 212
- \$insideApplication
 - usedby pf2Sex, 299
 - usedby pfApplication2Sex, 306
 - usedby pfDefinition2Sex, 315
- \$insideRule
 - usedby pf2Sex1, 302
 - usedby pf2Sex, 299
 - usedby pfApplication2Sex, 306
 - usedby pfLhsRule2Sex, 318
 - usedby pfLiteral2Sex, 304
 - usedby pfOp2Sex, 308
 - usedby pfRhsRule2Sex, 319
- \$insideSEQ
 - usedby pf2Sex1, 302
 - usedby pf2Sex, 299
 - usedby pfSequence2Sex, 310
- \$instantCanCoerceCount
 - usedby processInteractive, 50
- \$instantCoerceCount
 - usedby processInteractive, 50
- \$instantMmCondCount
 - usedby processInteractive, 50
- \$instantRecord
 - usedby processInteractive, 50
- \$intCoerceFailure, 32
 - usedby InterpExecuteSpadSystemCommand, 32
 - usedby intloopSpadProcess, 65
 - defvar, 32
- \$intRestart, 26
 - usedby intloop, 26
 - defvar, 26
- \$intSpadReader, 32

- usedby InterpExecuteSpadSystemCommand, 32
 - usedby intloopSpadProcess, 65
 - defvar, 32
- \$intTopLevel, 26
 - usedby intloop, 26
 - defvar, 26
- \$internalHistoryTable
 - usedby clearCmdAll, 501
 - usedby createCurrentInterpreterFrame, 555
 - usedby readHiFi, 599
 - usedby restoreHistory, 595
 - usedby saveHistory, 594
 - usedby setHistoryCore, 583
 - usedby updateFromCurrentInterpreterFrame, 556
 - usedby writeHiFi, 600
- \$interpOnly, 49
 - usedby processInteractive, 50
 - defvar, 49
- \$interpreterFrameName
 - usedby clearCmdAll, 502
 - usedby closeInterpreterFrame, 560
 - usedby createCurrentInterpreterFrame, 555
 - usedby displayExposedGroups, 702
 - usedby displayProperties, 460
 - usedby histFileName, 578
 - usedby histInputFileName, 578
 - usedby initializeInterpreterFrameRing, 553
 - usedby mkprompt, 42
 - usedby setExposeAddConstr, 698
 - usedby setExposeAddGroup, 697
 - usedby setExposeDropConstr, 701
 - usedby setExposeDropGroup, 700
 - usedby updateFromCurrentInterpreterFrame, 556
- \$interpreterFrameRing
 - usedby addNewInterpreterFrame, 559
 - usedby changeToNamedInterpreterFrame, 558
 - usedby closeInterpreterFrame, 560
 - usedby displayFrameNames, 561
 - usedby findFrameInRing, 557
 - usedby frameNames, 554
 - usedby importFromFrame, 561
 - usedby initializeInterpreterFrameRing, 553
- usedby nextInterpreterFrame, 558
 - usedby previousInterpreterFrame, 559
 - usedby updateCurrentInterpreterFrame, 557
 - usedby updateFromCurrentInterpreterFrame, 556
- \$interpreterTimedClasses
 - usedby printStorage, 58
 - usedby printTypeAndTimeNormal, 59
 - usedby printTypeAndTimeSaturn, 60
 - usedby processInteractive, 50
- \$interpreterTimedNames
 - usedby printStorage, 58
 - usedby printTypeAndTimeNormal, 59
 - usedby printTypeAndTimeSaturn, 60
 - usedby processInteractive, 50
- \$lambdatype, 660
 - defvar, 660
- \$lastLineInSEQ
 - usedby processInteractive, 50
- \$lastPos
 - usedby SpadInterpretStream, 29
 - usedby getPosStL, 356
- \$lastUntraced
 - usedby getMapSubNames, 867
 - usedby trace1, 846
 - usedby untraceMapSubNames, 871
 - usedby untrace, 860
- \$letAssoc
 - usedby breaklet, 903
 - usedby letPrint2, 885
 - usedby letPrint3, 886
 - usedby letPrint, 883
 - usedby spadTrace, 875
 - usedby spadUntrace, 894
 - usedby tracelet, 902
- \$libQuiet
 - usedby SpadInterpretStream, 29
- \$library-directory-list, 9
 - usedby getDirectoryList, 982
 - usedby reroot, 41
 - defvar, 9
- \$linearFormatScripts, 791
 - defvar, 791
- \$linelength, 771
 - usedby displayOperationsFromLisplib, 819

- usedby displaySetOptionInformation, 653
- usedby displaySetVariableSettings, 655
- usedby filterAndFormatConstructors, 942
- usedby justifyMyType, 62
- usedby msgOutputter, 353
- usedby msgText, 62
- usedby printSynonyms, 472
- usedby reportOpsFromLisplib, 816
- usedby reportOpsFromUnitDirectly, 820
- usedby sayKeyedMsgLocal, 330
- usedby setExposeAddConstr, 698
- usedby setExposeAddGroup, 697
- usedby setExposeAdd, 696
- usedby setExposeDropConstr, 701
- usedby setExposeDropGroup, 700
- usedby setExposeDrop, 699
- usedby spadStartUpMsgs, 19
- usedby traceReply, 897
- usedby whatCommands, 940
- usedby workfilesSpad2Cmd, 948
- defvar, 771
- \$linepos**
 - usedby lineoftoks, 112
 - usedby nextline, 113
 - usedby scanCheckRadix, 134
 - usedby scanError, 135
 - usedby scanS, 131
 - usedby scanToken, 114
- \$lines**
 - usedby intloopEchoParse, 69
 - usedby intloopInclude0, 63
 - usedby nclloopInclude0, 73
- \$ln**
 - usedby lineoftoks, 112
 - usedby nextline, 113
 - usedby scanComment, 116
 - usedby scanError, 135
 - usedby scanEsc, 124
 - usedby scanExponent, 126
 - usedby scanNegComment, 117
 - usedby scanNumber, 132
 - usedby scanPossFloat, 121
 - usedby scanPunct, 118
 - usedby scanSpace, 129
 - usedby scanS, 131
 - usedby scanToken, 114
- usedby scanW, 128
- usedby spleI1, 122
- usedby startsComment?, 115
- usedby startsNegComment?, 117
- \$localExposureDataDefault**, 694
 - usedby clearCmdCompletely, 501
 - usedby emptyInterpreterFrame, 554
 - defvar, 694
- \$localExposureData**, 694
 - local ref isExposedConstructor, 818
 - usedby clearCmdCompletely, 500
 - usedby createCurrentInterpreterFrame, 555
 - usedby displayExposedConstructors, 702
 - usedby displayExposedGroups, 702
 - usedby displayHiddenConstructors, 703
 - usedby setExposeAddConstr, 698
 - usedby setExposeAddGroup, 697
 - usedby setExposeDropConstr, 701
 - usedby setExposeDropGroup, 700
 - usedby updateFromCurrentInterpreterFrame, 556
 - defvar, 694
- \$localVars**
 - usedby processInteractive, 50
- \$lookupDefaults**
 - local def oldCompLookup, 1072
 - local ref basicLookupCheckDefaults, 1072
 - usedby clearCmdSortedCaches, 499
- \$macActive**
 - usedby mac0ExpandBody, 225
 - usedby mac0MLambdaApply, 224
 - usedby macId, 227
 - usedby macroExpanded, 222
- \$mapList**
 - usedby processInteractive, 50
- \$mapSubNameAlist**
 - usedby ?t, 901
 - usedby isSubForRedundantMapName, 871
 - usedby saveMapSig, 851
 - usedby traceSpad2Cmd, 845
 - usedby untraceMapSubNames, 871
 - usedby untrace, 860
- \$margin**, 771
 - usedby msgText, 62
 - usedby sayKeyedMsgLocal, 330
 - defvar, 771

- `$mathTraceList`
 - usedby `coerceTraceArgs2E`, 862
 - usedby `coerceTraceFunValue2E`, 865
- `$mathmlFormat`, 773
 - usedby `setOutputMathml`, 774
 - defvar, 773
- `$mathmlOutputFile`, 773
 - usedby `setOutputMathml`, 774
 - defvar, 773
- `$mathmlOutputStream`
 - usedby `setOutputMathml`, 774
- `$maximumFortranExpressionLength`, 717
 - defvar, 717
- `$minivectorCode`
 - usedby `processInteractive`, 50
- `$minivectorNames`, 49
 - usedby `processInteractive`, 50
 - defvar, 49
- `$minivector`
 - usedby `processInteractive`, 50
- `$mkTestFlag`
 - usedby `recordAndPrint`, 56
- `$mkTestInputStack`
 - usedby `updateHist`, 588
- `$mkTestOutputType`
 - usedby `recordAndPrint`, 56
- `$msgAlist`, 326
 - usedby `resetWorkspaceVariables`, 652
 - usedby `spadStartUpMsgs`, 19
 - defvar, 326
- `$msgDatabaseName`, 9, 10, 326
 - usedby `getMsgInfoFromKey`, 366
 - usedby `reroot`, 41
 - usedby `resetWorkspaceVariables`, 652
 - defvar, 9, 10, 326
- `$msgDatabase`
 - usedby `resetWorkspaceVariables`, 652
- `$msgdbNoBlanksAfterGroup`, 328
 - defvar, 328
- `$msgdbNoBlanksBeforeGroup`, 328
 - defvar, 328
- `$msgdbPrims`, 327
 - usedby `fixObjectForPrinting`, 454
 - defvar, 327
- `$msgdbPunct`, 327
 - defvar, 327
- `$multiVarPredicateList`
 - usedby `pfRule2Sex`, 318
 - usedby `ruleLhsTran`, 322
 - usedby `rulePredicateTran`, 319
- `$nagEnforceDouble`, 756
 - defvar, 756
- `$nagHost`, 751
 - usedby `describeSetNagHost`, 752
 - usedby `setNagHost`, 752
 - defvar, 751
- `$nagMessages`, 742
 - defvar, 742
- `$ncMsgList`, 27
 - usedby `SpadInterpretStream`, 29
 - usedby `intloopSpadProcess`, 65
 - usedby `ncConversationPhase,wrapup`, 68
 - usedby `ncConversationPhase`, 68
 - usedby `processKeyedError`, 353
 - defvar, 27
- `$newConlist`
 - usedby `library`, 1013
- `$newcompErrorCount`, 28
 - usedby `SpadInterpretStream`, 29
 - usedby `ncBug`, 368
 - usedby `ncHardError`, 352
 - usedby `ncSoftError`, 351
 - defvar, 28
- `$newspad`
 - usedby `ncTopLevel`, 25
- `$noEvalTypeMsg`, 917
 - local ref `throwEvalTypeMsg`, 917
 - defvar, 917
- `$noParseCommands`, 442
 - usedby `doSystemCommand`, 444
 - defvar, 442
- `$noRepList`
 - usedby `processMsgList`, 369
 - usedby `redundant`, 374
- `$noSubsumption`, 960
 - defvar, 960
- `$nopos`, 28
 - usedby `SpadInterpretStream`, 29
 - usedby `makeLeaderMsg`, 377
 - usedby `ncBug`, 368
 - usedby `pfSourcePosition`, 238
 - usedby `poNoPosition`, 414

- defvar, 28
- \$npPParg
 - usedby npPPff, 210
- \$npTokToNames
 - usedby npId, 205
- \$numericFailure, 1073
 - defvar, 1073
- \$n
 - usedby lineoftoks, 112
 - usedby nextline, 113
 - usedby scanCheckRadix, 134
 - usedby scanComment, 116
 - usedby scanError, 135
 - usedby scanEscape, 135
 - usedby scanEsc, 124
 - usedby scanExponent, 126
 - usedby scanNegComment, 117
 - usedby scanNumber, 132
 - usedby scanPossFloat, 121
 - usedby scanPunct, 118
 - usedby scanSpace, 129
 - usedby scanString, 130
 - usedby scanS, 131
 - usedby scanToken, 114
 - usedby scanW, 128
 - usedby splel1, 123
 - usedby startsComment?, 115
 - usedby startsNegComment?, 117
- \$okToExecuteMachineCode
 - usedby SpadInterpretStream, 29
- \$oldBreakMode, 1074
 - defvar, 1074
- \$oldHistoryFileName, 576
 - usedby oldHistFileName, 578
 - usedby restoreHistory, 595
 - defvar, 576
- \$oldline, 447
 - usedby commandErrorIfAmbiguous, 468
 - usedby commandErrorMessage, 448
 - defvar, 447
- \$opSysName
 - usedby spadStartUpMsgs, 19
- \$openMathFormat, 782
 - usedby setOutputOpenMath, 783
 - defvar, 782
- \$openMathOutputFile, 782
 - usedby setOutputOpenMath, 783
 - defvar, 782
- \$openMathOutputStream
 - usedby setOutputOpenMath, 783
- \$openServerIfTrue, 10
 - usedby restart, 18
 - usedby spad-save, 988
 - defvar, 10
- \$operationNameList
 - usedby resetWorkspaceVariables, 652
- \$optionAlist, 844
 - usedby trace1, 847
 - defvar, 844
- \$options
 - usedby abbreviationsSpad2Cmd, 481
 - usedby clearSpad2Cmd, 498
 - usedby close, 509
 - usedby frameSpad2Cmd, 564
 - usedby historySpad2Cmd, 581
 - usedby history, 580
 - usedby library, 1013
 - usedby readSpad2Cmd, 640
 - usedby reportOpsFromLisplib, 816
 - usedby reportOpsFromUnitDirectly, 820
 - usedby restoreHistory, 595
 - usedby showSpad2Cmd, 813
 - usedby systemCommand, 446
 - usedby trace1, 846
 - usedby undo, 920
 - usedby workfilesSpad2Cmd, 948
 - usedby zsystemdevelopment1, 952
- \$op
 - usedby displayMacro, 452
 - usedby displayType, 458
 - usedby displayValue, 457
 - usedby processInteractive, 50
- \$outputLibraryName
 - usedby setOutputLibrary, 662
- \$outputLines
 - usedby printTypeAndTimeNormal, 59
- \$outputList
 - usedby processMsgList, 369
 - usedby queueUpErrors, 372
- \$outputMode
 - usedby recordAndPrint, 56, 57
- \$packages

- usedby addTraceItem, 900
- usedby traceReply, 897
- \$pfMacros, 98
 - usedby clearMacroTable, 502
 - usedby clearParserMacro, 451
 - usedby displayParserMacro, 462
 - usedby getParserMacroNames, 451
 - usedby mac0Define, 230
 - usedby mac0GetName, 226
 - usedby mac0Get, 228
 - usedby mac0MLambdaApply, 224
 - usedby macApplication, 223
 - usedby macLambda,mac, 229
 - usedby macLambda, 229
 - usedby macWhere,mac, 228
 - usedby macWhere, 228
 - defvar, 98
- \$plainRTspecialCharacters, 976
 - usedby setOutputCharacters, 764
 - defvar, 976
- \$plainSpecialCharacters0, 974
 - defvar, 974
- \$plainSpecialCharacters1, 974
 - defvar, 974
- \$plainSpecialCharacters2, 975
 - defvar, 975
- \$plainSpecialCharacters3, 975
 - defvar, 975
- \$posActive
 - usedby mac0ExpandBody, 225
 - usedby mac0MLambdaApply, 224
 - usedby macId, 227
 - usedby macroExpanded, 222
- \$preLength, 355
 - usedby getPreStL, 355
 - usedby makeLeaderMsg, 377
 - usedby makeMsgFromLine, 371
 - usedby processChPosesForOneLine, 376
 - usedby tabbing, 362
 - defvar, 355
- \$predicateList
 - usedby pfRule2Sex, 318
 - usedby pfSuchThat2Sex, 307
 - usedby ruleLhsTran, 322
- \$prettyprint, 803
 - defvar, 803
- \$prevCarrier
 - usedby intloopSpadProcess, 65
- \$previousBindings, 919
 - usedby clearCmdAll, 501
 - usedby clearFrame, 927
 - usedby recordFrame, 921
 - defvar, 919
- \$printAnyIfTrue, 732
 - usedby recordAndPrint, 57
 - defvar, 732
- \$printFortranDecs, 714
 - defvar, 714
- \$printLoadMsgs, 733
 - local ref loadLibNoUpdate, 1039
 - local ref loadLib, 1038
 - usedby restart, 18
 - defvar, 733
- \$printMsgsToFile, 737
 - usedby sayKeyedMsgLocal, 330
 - defvar, 737
- \$printStatisticsSummaryIfTrue, 747
 - usedby recordAndPrint, 56
 - defvar, 747
- \$printStorageIfTrue
 - usedby recordAndPrint, 56
- \$printTimeIfTrue, 748
 - usedby printTypeAndTimeNormal, 59
 - usedby printTypeAndTimeSaturn, 60
 - usedby recordAndPrint, 56
 - defvar, 748
- \$printTypeIfTrue, 749
 - usedby printTypeAndTimeNormal, 59
 - usedby printTypeAndTimeSaturn, 60
 - usedby recordAndPrint, 56
 - defvar, 749
- \$printVoidIfTrue, 750
 - usedby recordAndPrint, 56
 - defvar, 750
- \$promptMsg, 28
 - usedby SpadInterpretStream, 29
 - defvar, 28
- \$quadSymbol
 - local ref evaluateType1, 916
 - usedby reportOperations, 814
- \$quitCommandType, 797
 - usedby pquitSpad2Cmd, 632

- usedby quitSpad2Cmd, 636
 - defvar, 797
- \$quitTag, 20
 - usedby runspad, 21
 - defvar, 20
- \$quotedOpList
 - usedby pfOp2Sex, 308
 - usedby pfRule2Sex, 318
- \$relative-directory-list, 10, 11
 - usedby reroot, 41
 - defvar, 10, 11
- \$relative-library-directory-list, 11
 - usedby reroot, 41
 - defvar, 11
- \$repGuys, 375
 - defvar, 375
- \$reportBottomUpFlag, 734
 - defvar, 734
- \$reportCoerceIfTrue, 735
 - defvar, 735
- \$reportCompilation, 801
 - defvar, 801
- \$reportInstantiations, 740
 - usedby processInteractive, 50
 - defvar, 740
- \$reportInterpOnly, 741
 - defvar, 741
- \$reportOptimization, 802
 - defvar, 802
- \$reportSpadTrace, 844
 - usedby spadTrace, 875
 - defvar, 844
- \$reportUndo, 920
 - defvar, 920
- \$runTestFlag
 - usedby recordAndPrint, 56
- \$r
 - usedby lineoftoks, 112
 - usedby nextline, 113
 - usedby scanEsc, 124
- \$saturn
 - usedby printTypeAndTime, 58
- \$sayBrightlyStream
 - usedby reportOpsFromLisplib1, 815
 - usedby reportOpsFromUnitDirectly1, 823
- \$seen
 - usedby ScanOrPairVec, ScanOrInner, 613
 - usedby ScanOrPairVec, 614
 - usedby dewritify, dewritifyInner, 610
 - usedby dewritify, 613
 - usedby saveHistory, 594
 - usedby writify, writifyInner, 605
 - usedby writify, 608
- \$setOptionNames, 805
 - usedby set1, 807
 - defvar, 805
- \$setOptions
 - usedby resetWorkspaceVariables, 652
 - usedby set, 805
- \$showOptions
 - usedby reportOpsFromLisplib, 816
 - usedby reportOpsFromUnitDirectly, 820
 - usedby showSpad2Cmd, 813
- \$slamFlag
 - usedby resetWorkspaceVariables, 652
- \$sockBufferLength, 44
 - usedby serverReadLine, 45
 - defvar, 44
- \$sourceFiles
 - usedby resetWorkspaceVariables, 652
 - usedby updateSourceFiles, 544
 - usedby workfilesSpad2Cmd, 948
- \$spad-errors, 965
 - usedby init-boot/spad-reader, 966
 - defvar, 965
- \$spadroot, 11, 12
 - local ref isSystemDirectory, 1038
 - usedby DaaseName, 1022
 - usedby browseOpen, 1004
 - usedby categoryOpen, 1005
 - usedby compressOpen, 1023
 - usedby getdatabase, 1009
 - usedby initroot, 35
 - usedby interpOpen, 1003
 - usedby make-absolute-filename, 36
 - usedby operationOpen, 1006
 - usedby reroot, 41
 - usedby write-browsedb, 1032
 - usedby write-interpdb, 1030
 - defvar, 11, 12
- \$spad
 - usedby ioclear, 970

- usedby iostat, 968
- usedby ncTopLevel, 25
- usedby parseAndInterpret, 48
- \$specialCharacterAlist, 977
 - usedby setOutputCharacters, 764
 - usedby specialChar, 978
 - defvar, 977
- \$specialCharacters, 977
 - usedby setOutputCharacters, 764
 - usedby specialChar, 978
 - defvar, 977
- \$stack
 - usedby npListAndRecover, 189
 - usedby npListofFun, 221
 - usedby npList, 155
 - usedby npParse, 141
 - usedby npPop1, 144
 - usedby npPop2, 144
 - usedby npPop3, 144
 - usedby npPushId, 209
 - usedby npPush, 143
 - usedby npRestore, 152
 - usedby npState, 212
 - usedby npZeroOrMore, 177
- \$stepNo
 - usedby intloopSpadProcess, 65
- \$stok
 - usedby npConstTok, 184
 - usedby npDDInfKey, 208
 - usedby npDollar, 184
 - usedby npEnclosed, 211
 - usedby npEqKey, 145
 - usedby npEqPeek, 152
 - usedby npFirstTok, 143
 - usedby npId, 205
 - usedby npInfKey, 208
 - usedby npInfixOperator, 160
 - usedby npInfixOp, 161
 - usedby npMissing, 151
 - usedby npParenthesize, 215
 - usedby npParse, 141
 - usedby npPrefixColon, 161
 - usedby npPushId, 209
 - usedby npRecoverTrap, 190
 - usedby npTrap, 212
 - usedby sySpecificErrorHere, 192
- \$streamCount, 798
 - usedby coerceSpadArgs2E, 863
 - usedby coerceSpadFunValue2E, 866
 - usedby describeSetStreamsCalculate, 800
 - usedby setStreamsCalculate, 799
 - defvar, 798
- \$streamsShowAll, 800
 - defvar, 800
- \$syscommands, 442
 - usedby newHelpSpad2Cmd, 571
 - usedby systemCommand, 446
 - usedby unAbbreviateKeyword, 467
 - defvar, 442
- \$systemCommandFunction
 - usedby SpadInterpretStream, 29
 - usedby intloopProcess, 64
 - usedby ncloopCommand, 476
- \$systemCommands, 441
 - usedby synonymsForUserLevel, 831
 - usedby systemCommand, 446
 - usedby unAbbreviateKeyword, 467
 - usedby whatCommands, 940
 - defvar, 441
- \$sz
 - usedby lineoftoks, 112
 - usedby nextline, 112
 - usedby scanComment, 116
 - usedby scanEsc, 124
 - usedby scanExponent, 126
 - usedby scanNegComment, 117
 - usedby scanNumber, 132
 - usedby scanPossFloat, 121
 - usedby scanS, 131
 - usedby scanW, 128
 - usedby sple11, 123
 - usedby startsComment?, 115
 - usedby startsNegComment?, 117
- \$testingErrorPrefix, 327
 - defvar, 327
- \$testingSystem, 748
 - defvar, 748
- \$texFormatting, 327
 - usedby sayKeyedMsg, 330
 - defvar, 327
- \$texFormat, 793
 - usedby setOutputTex, 794

- defvar, 793
- \$texOutputFile, 793
 - usedby setOutputTex, 794
- defvar, 793
- \$texOutputStream
 - usedby printAsTeX, 61
 - usedby setOutputTex, 794
- \$timeGlobalName
 - usedby processInteractive, 50
- \$timedNameStack
 - usedby interpretTopLevel, 53
- \$toWhereGuys, 363
 - defvar, 363
- \$tokenCommands, 473
 - usedby doSystemCommand, 444
- defvar, 473
- \$topicHash
 - usedby write-warndata, 1035
- \$traceErrorStack
 - usedby getTraceOptions, 850
 - usedby stackTraceOptionError, 859
- \$traceNoisely, 844
 - usedby reportSpadTrace, 890
 - usedby spadTrace, 875
 - usedby trace1, 846
 - defvar, 844
- \$traceOptionList, 844
 - usedby getTraceOption, 852
 - defvar, 844
- \$tracedMapSignatures, 844
 - usedby coerceTraceArgs2E, 862
 - usedby coerceTraceFunValue2E, 865
 - usedby removeTracedMapSigs, 862
 - usedby saveMapSig, 851
 - defvar, 844
- \$tracedModemap
 - usedby spadTrace, 875
- \$tracedSpadModemap
 - usedby coerceSpadArgs2E, 863
 - usedby coerceSpadFunValue2E, 866
- \$traceletFunctions
 - usedby breaklet, 903
 - usedby tracelet, 902
- \$traceletflag
 - usedby tracelet, 902
- \$ttok
 - usedby npEqKey, 145
 - usedby npEqPeek, 152
 - usedby npFirstTok, 143
 - usedby npId, 205
 - usedby npInfKey, 208
 - usedby npInfixOp, 161
 - usedby npParse, 141
 - usedby npPushId, 209
- \$underbar, 584
 - defvar, 584
- \$undoFlag, 919
 - usedby recordFrame, 921
 - defvar, 919
- \$useBFasDefault
 - usedby float2Sex, 305
- \$useEditorForShowOutput, 792
 - usedby reportOpsFromLisplib0, 815
 - usedby reportOpsFromUnitDirectly0, 819
 - defvar, 792
- \$useFullScreenHelp, 729
 - usedby newHelpSpad2Cmd, 571
 - defvar, 729
- \$useInternalHistoryTable, 577
 - usedby clearCmdAll, 501
 - usedby initHist, 579
 - usedby readHiFi, 599
 - usedby restoreHistory, 595
 - usedby saveHistory, 594
 - usedby setHistoryCore, 583
 - usedby writeHiFi, 600
 - defvar, 577
- \$useIntrinsicFunctions, 716
 - defvar, 716
- \$usersTb
 - local ref saveUsersHashTable, 1022
- \$variableNumberAlist
 - usedby clearCmdAll, 501
- \$whatOptions, 937
 - usedby reportWhatOptions, 939
 - usedby whatSpad2Cmd, 938
 - defvar, 937
- \$whereCacheList
 - usedby processInteractive, 50
- \$writifyComplained
 - usedby writifyComplain, 604
 - usedby writify, 608

- \$xdatabase
 - usedby clearCmdCompletely, 500
- abbQuery, 534
 - calledby abbreviationsSpad2Cmd, 481
 - calledby displaySpad2Cmd, 533
 - calls getdatabase, 534
 - calls sayKeyedMsg, 534
 - defun, 534
- abbreviate
 - calledby traceReply, 897
- abbreviation?
 - calledby abbreviationsSpad2Cmd, 481
- abbreviations, 481
 - calls abbreviationsSpad2Cmd, 481
 - defun, 481
- abbreviations help page, 479
 - manpage, 479
- abbreviationsSpad2Cmd, 481
 - calledby abbreviations, 481
 - calls abbQuery, 481
 - calls abbreviation?, 481
 - calls deldatabase, 481
 - calls exit, 481
 - calls helpSpad2Cmd, 481
 - calls listConstructorAbbreviations, 481
 - calls mkUserConstructorAbbreviation, 481
 - calls opOf, 481
 - calls qcar, 481
 - calls qcdr, 481
 - calls sayKeyedMsg, 481
 - calls selectOptionLC, 481
 - calls seq, 481
 - calls setdatabase, 481
 - calls size, 481
 - uses \$options, 481
 - defun, 481
- acot, 1098
 - defun, 1098
- acoth, 1100
 - defun, 1100
- acsc, 1099
 - defun, 1099
- acsch, 1100
 - defun, 1100
- addassoc
 - calledby saveMapSig, 851
 - calledby trace1, 846
- addBinding, 961
 - calls addBindingInteractive, 961
 - calls getProplist, 961
 - calls hput, 961
 - uses \$InteractiveMode, 961
 - uses \$envHashTable, 961
 - defun, 961
- addBindingInteractive, 965
 - calledby addBinding, 961
 - calls assq, 965
 - defun, 965
- addInputLibrary, 666
 - calledby setInputLibrary, 665
 - calls dropInputLibrary, 666
 - uses input-libraries, 666
 - defun, 666
- addNewInterpreterFrame, 559
 - calledby frameSpad2Cmd, 564
 - calledby serverReadLine, 44
 - calls \$erase, 559
 - calls boot-equal, 559
 - calls emptyInterpreterFrame, 559
 - calls framename, 559
 - calls histFileName, 559
 - calls initHistList, 559
 - calls throwKeyedMsg, 559
 - calls updateCurrentInterpreterFrame, 559
 - calls updateFromCurrentInterpreterFrame, 559
 - uses \$interpreterFrameRing, 559
 - defun, 559
- addoperations, 1006
 - calledby localnrlib, 1015
 - calls getdatabase, 1006
 - uses *operation-hash*, 1007
 - defun, 1006
- addTraceItem, 900
 - calledby traceReply, 897
 - calls constructor?, 900
 - calls devaluate, 900
 - calls isDomainOrPackage, 900
 - calls isDomain, 900
 - uses \$constructors, 900
 - uses \$domains, 900

- uses \$packages, 900
 - defun, 900
- aldorTrace
 - calledby spadTrace, 874
- algCoerceInteractive, 1059
 - defun, 1059
- allConstructors, 1035
 - calledby make-databases, 1018
 - calledby write-browsedb, 1032
 - calledby write-compress, 1024
 - uses *allconstructors*, 1035
 - defun, 1035
- allocate
 - calledby init-memory-config, 34
- allocate-contiguous-pages
 - calledby init-memory-config, 34
- allocate-relocatable-pages
 - calledby init-memory-config, 34
- allOperations, 1035
 - calledby apropos, 943
 - calledby write-compress, 1024
 - uses *allOperations*, 1035
 - uses *operation-hash*, 1036
 - defun, 1035
- alqlGetKindString, 1082
 - calls dbPart, 1082
 - calls substring, 1083
 - defun, 1082
- alqlGetOrigin, 1082
 - calls charPosition, 1082
 - calls dbPart, 1082
 - calls substring, 1082
 - defun, 1082
- alqlGetParams, 1082
 - calls charPosition, 1082
 - calls dbPart, 1082
 - calls substring, 1082
 - defun, 1082
- alreadyOpened?, 363
 - calledby msgOutputter, 353
 - calls msgImPr?, 363
 - defun, 363
- apropos, 943
 - calledby whatSpad2Cmd, 938
 - calls allOperations, 943
 - calls downcase, 943
 - calls exit, 943
 - calls filterListOfStrings, 943
 - calls msort, 943
 - calls sayAsManyPerLineAsPossible, 943
 - calls sayKeyedMsg, 943
 - calls sayMessage, 943
 - calls seq, 943
 - defun, 943
- as-insert
 - calledby spadTrace, 874
- asec, 1098
 - defun, 1098
- asech, 1101
 - defun, 1101
- assertCond, 96
 - calledby incLude1, 82
 - calls MakeSymbol, 96
 - calls incCommandTail, 96
 - uses *whitespace*, 96
 - uses \$inclAssertions, 96
 - defun, 96
- assignment, 383
 - syntax, 383
- assoc
 - calledby breaklet, 903
 - calledby clearCmdParts, 503
 - calledby clearParserMacro, 451
 - calledby diffAlist, 923
 - calledby getOption, 890
 - calledby readHiFi, 599
 - calledby spadTrace, 874
 - calledby spadUntrace, 893
- assocleft
 - calledby clearCmdParts, 503
 - calledby isSubForRedundantMapName, 871
- assocright
 - calledby orderBySlotNumber, 891
 - calledby untraceMapSubNames, 871
- assq, 1052
 - calledby addBindingInteractive, 965
 - calledby diffAlist, 923
 - calledby fetchOutput, 598
 - calledby hasSig, 423
 - calledby recordNewValue0, 589
 - calledby recordOldValue0, 590
 - calledby searchCurrentEnv, 962

- calledby searchTailEnv, 963
- calledby showInOut, 598
- calledby specialChar, 978
- calledby undoFromFile, 592
- calledby undoInCore, 591
- calledby undoSingleStep, 929
- defmacro, 1052
- augmentSub
 - calledby hasCateSpecialNew, 435
 - calledby hasCateSpecial, 434
 - calledby hasCaty, 420
 - calledby unifyStructVar, 429
- augmentTraceNames, 870
 - calledby traceSpad2Cmd, 845
 - calls get, 870
 - uses \$InteractiveFrame, 870
 - defun, 870
- AxiomServer
 - calledby browse, 491
- axiomVersion, 474
 - uses *build-version*, 474
 - uses *yearweek*, 474
 - defun, 474
- AXSERV;axServer;IMV;2
 - calledby browse, 491
- basicLookup, 1069
 - calls HasCategory, 1070
 - calls error, 1070
 - calls hashCode?, 1069
 - calls hashString, 1070
 - calls hashType, 1070
 - calls isNewWorldDomain, 1070
 - calls lookupInDomainVector, 1070
 - calls oldCompLookup, 1070
 - calls opIsHasCat, 1069
 - calls spadcall, 1069
 - calls vecp, 1070
 - local ref \$hashOp0, 1070
 - local ref \$hashOp1, 1070
 - local ref \$hashOpApply, 1070
 - local ref \$hashOpSet, 1070
 - local ref \$hashSeg, 1070
 - defun, 1069
- basicLookupCheckDefaults, 1072
 - calledby lookupInDomainVector, 1071
- calls error, 1072
- calls hashCode?, 1072
- calls hashString, 1072
- calls hashType, 1072
- calls spadcall, 1072
- calls vecp, 1072
- local ref \$lookupDefaults, 1072
- defun, 1072
- basicMatch?
 - calledby stringMatches?, 1084
- bit-to-truth, 1065
 - defmacro, 1065
- blankList
 - calledby filterAndFormatConstructors, 942
 - calledby printLabelledList, 472
 - calledby whatCommands, 940
- blocks, 386
 - syntax, 386
- Boolean
 - calledby hashable, 1069
- BooleanEquality, 1064
 - defun, 1064
- boot help page, 485
 - manpage, 485
- boot-equal
 - calledby addNewInterpreterFrame, 559
 - calledby clearCmdParts, 503
 - calledby displaySetOptionInformation, 653
 - calledby fetchOutput, 598
 - calledby findFrameInRing, 557
 - calledby getMapSig, 851
 - calledby importFromFrame, 561
 - calledby setHistoryCore, 583
 - calledby undoChanges, 591
 - calledby untraceDomainConstructor,keepTraced?, 880
 - calledby whatConstructors, 943
 - calledby writify,writifyInner, 605
- boot-line-stack, 959
 - usedby init-boot/spad-reader, 966
 - usedby next-lines-clear, 970
 - usedby next-lines-show, 969
 - defvar, 959
- bottomUp
 - calledby evaluateType, 914
 - calledby interpret1, 54

- bottumUp
 - calledby evaluateType1, 916
- bpiname
 - calledby breaklet, 903
 - calledby hashable, 1069
 - calledby mkEvalable, 911
 - calledby spadClosure?, 609
 - calledby spadTrace,isTraceable, 874
 - calledby spadTrace, 875
 - calledby spadUntrace, 894
 - calledby tracelet, 902
- bpitrace
 - calledby spadTrace, 875
- bpiuntrace
 - calledby spadUntrace, 894
- break, 904
 - calledby letPrint2, 885
 - calledby letPrint3, 886
 - calledby letPrint, 883
 - calls MONITOR,EVALTRAN, 904
 - calls enable-backtrace, 904
 - calls interrupt, 904
 - calls sayBrightly, 904
 - uses /breakcondition, 904
 - defun, 904
- breaklet, 903
 - calls assoc, 903
 - calls bpiname, 903
 - calls compileBoot, 903
 - calls delete, 903
 - calls gensymp, 903
 - calls lassoc, 903
 - calls setletprintflag, 903
 - calls stupidIsSpadFunction, 903
 - calls union, 903
 - uses \$QuickLet, 903
 - uses \$letAssoc, 903
 - uses \$traceletFunctions, 903
 - defun, 903
- bright
 - calledby ?t, 901
 - calledby commandAmbiguityError, 450
 - calledby displayCondition, 463
 - calledby displayFrameNames, 561
 - calledby displayMacro, 452
 - calledby displayModemap, 464
 - calledby displayMode, 464
 - calledby displayProperties,sayFunctionDeps, 456
 - calledby displayProperties, 460
 - calledby displaySetOptionInformation, 653
 - calledby displaySetVariableSettings, 655
 - calledby letPrint2, 885
 - calledby letPrint3, 886
 - calledby letPrint, 883
 - calledby pcounters, 858
 - calledby pspacers, 857
 - calledby ptimers, 857
 - calledby reportOperations, 813
 - calledby reportOpsFromLisplib, 816
 - calledby reportOpsFromUnitDirectly, 820
 - calledby set1, 806
 - calledby setFortDir, 724
 - calledby setFortPers, 754
 - calledby setFortTmpDir, 721
 - calledby setOutputCharacters, 764
 - calledby setStreamsCalculate, 799
 - calledby spadUntrace, 894
 - calledby zsystemdevelopment1, 952
- brightprint, 1049
 - calledby saybrightly1, 1051
 - calls messageprint, 1049
 - defun, 1049
- brightprint-0, 1050
 - calledby saybrightly1, 1051
 - calls messageprint-1, 1050
 - defun, 1050
- browse
 - calls AXSERV;axServer;IMV;2, 491
 - calls AxiomServer, 491
 - calls loadLib, 491
 - calls set, 491
- browse help page, 487
 - manpage, 487
- browseOpen, 1004
 - calls unsqueeze, 1004
 - uses *allconstructors*, 1004
 - uses *browse-stream*, 1004
 - uses *browse-stream-stamp*, 1004
 - uses \$spadroot, 1004
 - defun, 1004
- browseopen

- calledby resethashables, 999
- calledby restart0, 19
- browserAutoloadOnceTrigger
 - calledby make-databases, 1018
- buildLibdb
 - calledby make-databases, 1018
- bumperrorcount
 - calledby spad-syntax-error, 967
- bvec-and, 1066
 - defun, 1066
- bvec-concat, 1065
 - defun, 1065
- bvec-copy, 1066
 - defun, 1066
- bvec-elt, 1065
 - defmacro, 1065
- bvec-equal, 1066
 - defun, 1066
- bvec-greater, 1066
 - defun, 1066
- bvec-make-full, 1064
 - defun, 1064
- bvec-nand, 1067
 - defun, 1067
- bvec-nor, 1067
 - defun, 1067
- bvec-not, 1068
 - defun, 1068
- bvec-or, 1067
 - defun, 1067
- bvec-setelt, 1065
 - defmacro, 1065
- bvec-size, 1065
 - defmacro, 1065
- bvec-xor, 1067
 - defun, 1067
- cacheKeyedMsg, 329
 - calledby fetchKeyedMsg, 328
 - uses *msghash*, 329
 - catches, 329
 - defun, 329
 - throws, 329
- CallerName
 - calledby processKeyedError, 353
- canCoerce
 - calledby unifyStructVar, 429
- canCoerceFrom
 - calledby hasCateSpecial, 434
- Catch
 - calledby intloopSpadProcess, 65
- CatchAsCan
 - calledby intloopSpadProcess, 65
- catches
 - cacheKeyedMsg, 329
 - executeQuietCommand, 47
 - InterpExecuteSpadSystemCommand, 32
 - interpretTopLevel, 53
 - intloop, 26
 - intloopSpadProcess, 64, 65
 - letPrint2, 885
 - letPrint3, 886
 - monitor-file, 1163
 - monitor-readinterp, 1170
 - monitor-spadfile, 1172
 - npListAndRecover, 189
 - npParse, 141
 - runspad, 21
 - safeWritify, 604
 - ScanOrPairVec, 614
 - serverReadLine, 44
 - zsystemdevelopment1, 952
- categoryForm?
 - calledby evaluateType1, 915
 - calledby loadLib, 1037
 - calledby localnrlib, 1015
 - calledby make-databases, 1018
- categoryOpen, 1005
 - calls unsqueeze, 1005
 - uses *category-stream*, 1005
 - uses *category-stream-stamp*, 1005
 - uses *hasCategory-hash*, 1005
 - uses \$spadroot, 1005
 - defun, 1005
- categoryopen
 - calledby resethashables, 999
 - calledby restart0, 19
- cd help page, 493
 - manpage, 493
- cdancols, 1080
 - defmacro, 1080
- cdanrows, 1080

- defmacro, 1080
- cdaref2, 1079
 - defmacro, 1079
- cdelt, 1076
 - defmacro, 1076
- cdlen, 1077
 - defmacro, 1077
- cdsetaref2, 1079
 - defmacro, 1079
- cdsetelt, 1076
 - defmacro, 1076
- centerAndHighlight
 - calledby displayExposedConstructors, 702
 - calledby displayExposedGroups, 702
 - calledby displayHiddenConstructors, 703
 - calledby displayOperationsFromLisplib, 818
 - calledby displaySetOptionInformation, 653
 - calledby displaySetVariableSettings, 655
 - calledby filterAndFormatConstructors, 942
 - calledby printSynonyms, 472
 - calledby reportOpsFromLisplib, 816
 - calledby reportOpsFromUnitDirectly, 820
 - calledby setExposeAddConstr, 698
 - calledby setExposeAddGroup, 697
 - calledby setExposeAdd, 695
 - calledby setExposeDropConstr, 701
 - calledby setExposeDropGroup, 700
 - calledby setExposeDrop, 699
 - calledby trace1, 846
 - calledby whatCommands, 939
 - calledby workfilesSpad2Cmd, 947
- changeHistListLen, 587
 - calledby historySpad2Cmd, 580
 - calls sayKeyedMsg, 587
 - calls spaddifference, 587
 - uses \$HistListAct, 587
 - uses \$HistListLen, 587
 - uses \$HistList, 587
 - defun, 587
- changeToNamedInterpreterFrame, 558
 - calledby serverReadLine, 44
 - calls findFrameInRing, 558
 - calls nremove, 558
 - calls updateCurrentInterpreterFrame, 558
 - calls updateFromCurrentInterpreterFrame, 558
 - uses \$interpreterFrameRing, 558
 - defun, 558
- char
 - calledby incCommand?, 100
 - calledby makeMsgFromLine, 371
- charDigitVal, 615
 - calledby gensymInt, 614
 - calls error, 615
 - calls spaddifference, 615
 - defun, 615
- charPosition
 - calledby alqlGetOrigin, 1082
 - calledby alqlGetParams, 1082
 - calledby removeUndoLines, 931
- cleanline, 527
 - calledby describeSpad2Cmd, 527
 - defun, 527
- cleanupLine, 538
 - defun, 538
- cleanupline
 - calledby sayexample, 538
- clear, 497
 - calls clearSpad2Cmd, 497
 - defun, 497
- clear help page, 495
- manpage, 495
- clearAllSlams
 - calledby updateDatabase, 1017
- clearClams
 - calledby clearCmdCompletely, 500
 - calledby setExposeAddConstr, 698
 - calledby setExposeAddGroup, 696
 - calledby setExposeDropConstr, 701
 - calledby setExposeDropGroup, 700
 - calledby updateDatabase, 1017
- clearCmdAll, 501
 - calledby clearCmdCompletely, 500
 - calledby clearFrame, 927
 - calledby clearSpad2Cmd, 498
 - calls clearCmdSortedCaches, 501
 - calls clearMacroTable, 501
 - calls deleteFile, 501
 - calls histFileName, 501
 - calls resetInCoreHist, 501

- calls sayKeyedMsg, 501
- calls untraceMapSubNames, 501
- calls updateCurrentInterpreterFrame, 501
- uses \$InteractiveFrame, 501
- uses \$currentLine, 502
- uses \$frameMessages, 502
- uses \$frameRecord, 501
- uses \$internalHistoryTable, 501
- uses \$interpreterFrameName, 502
- uses \$previousBindings, 501
- uses \$useInternalHistoryTable, 501
- uses \$variableNumberAlist, 501
- defun, 501
- clearCmdCompletely, 500
 - calledby clearSpad2Cmd, 498
 - calls clearClams, 500
 - calls clearCmdAll, 500
 - calls clearConstructorCaches, 500
 - calls reclaim, 500
 - calls sayKeyedMsg, 500
 - uses \$CatOfCatDatabase, 500
 - uses \$DomOfCatDatabase, 500
 - uses \$JoinOfCatDatabase, 500
 - uses \$JoinOfDomDatabase, 500
 - uses \$attributeDb, 500
 - uses \$existingFiles, 501
 - uses \$functionTable, 501
 - uses \$localExposureDataDefault, 501
 - uses \$localExposureData, 500
 - uses \$xdatabase, 500
 - defun, 500
- clearCmdExcept, 502
 - calledby clearSpad2Cmd, 498
 - calls clearCmdParts, 503
 - calls object2String, 503
 - calls stringPrefix?, 502
 - uses \$clearOptions, 503
 - defun, 502
- clearCmdParts, 503
 - calledby clearCmdExcept, 503
 - calledby clearSpad2Cmd, 498
 - calledby importFromFrame, 561
 - calls assocleft, 503
 - calls assoc, 503
 - calls boot-equal, 503
 - calls clearDependencies, 503
 - calls clearParserMacro, 503
 - calls deleteAssoc, 503
 - calls exit, 503
 - calls fixObjectForPrinting, 503
 - calls getInterpMacroNames, 503
 - calls getParserMacroNames, 503
 - calls get, 503
 - calls isMap, 503
 - calls member, 503
 - calls modes, 503
 - calls pname, 503
 - calls recordNewValue, 503
 - calls recordOldValue, 503
 - calls remdup, 503
 - calls sayKeyedMsg, 503
 - calls sayMessage, 503
 - calls selectOptionLC, 503
 - calls seq, 503
 - calls types, 503
 - calls untraceMapSubNames, 503
 - calls values, 503
 - uses \$InteractiveFrame, 503
 - uses \$clearOptions, 503
 - uses \$e, 503
 - defun, 503
- clearCmdSortedCaches, 499
 - calledby clearCmdAll, 501
 - calledby clearSpad2Cmd, 498
 - calledby restoreHistory, 595
 - calls compiledLookupCheck, 499
 - calls spadcall, 499
 - uses \$ConstructorCache, 499
 - uses \$Void, 499
 - uses \$lookupDefaults, 499
 - defun, 499
- clearConstructorCache
 - calledby loadLibNoUpdate, 1039
 - calledby loadLib, 1037
- clearConstructorCaches
 - calledby clearCmdCompletely, 500
- clearDependencies
 - calledby clearCmdParts, 503
- clearFrame, 927
 - calls clearCmdAll, 927
 - uses \$frameRecord, 927
 - uses \$previousBindings, 927

- defun, 927
- clearMacroTable, 502
 - calledby clearCmdAll, 501
 - uses \$pfMacros, 502
 - defun, 502
- clearParserMacro, 451
 - calledby clearCmdParts, 503
 - calls assoc, 451
 - calls ifcdr, 451
 - calls remalist, 451
 - uses \$pfMacros, 451
 - defun, 451
- clearSpad2Cmd, 498
 - calledby clear, 497
 - calledby historySpad2Cmd, 580
 - calledby restoreHistory, 595
 - calls clearCmdAll, 498
 - calls clearCmdCompletely, 498
 - calls clearCmdExcept, 498
 - calls clearCmdParts, 498
 - calls clearCmdSortedCaches, 498
 - calls sayKeyedMsg, 498
 - calls selectOptionLC, 498
 - calls updateCurrentInterpreterFrame, 498
 - uses \$clearExcept, 498
 - uses \$clearOptions, 498
 - uses \$options, 498
 - defun, 498
- clef, 388
 - syntax, 388
- close, 508
 - calls closeInterpreterFrame, 508
 - calls queryClients, 509
 - calls queryUserKeyedMsg, 508
 - calls selectOptionLC, 508
 - calls sockSendInt, 508
 - calls string2id-n, 509
 - calls throwKeyedMsg, 508
 - calls upcase, 508
 - uses \$CloseClient, 509
 - uses \$SessionManager, 509
 - uses \$SpadServer, 509
 - uses \$currentFrameNum, 509
 - uses \$options, 509
 - defun, 508
- close help page, 507
 - manpage, 507
- closeInterpreterFrame, 560
 - calledby close, 508
 - calledby frameSpad2Cmd, 564
 - calls \$erase, 560
 - calls framename, 560
 - calls makeHistFileName, 560
 - calls throwKeyedMsg, 560
 - calls updateFromCurrentInterpreterFrame, 560
 - uses \$interpreterFrameName, 560
 - uses \$interpreterFrameRing, 560
 - defun, 560
- CLOSEPAREN, 107
 - defvar, 107
- clrhash
 - calledby processInteractive, 50
- cmpnote, 28
 - defun, 28
- cnstructSubst
 - calledby hasSig, 423
- coerceInteractive
 - calledby coerceSpadArgs2E, 863
 - calledby coerceSpadFunValue2E, 866
 - calledby coerceTraceArgs2E, 862
 - calledby coerceTraceFunValue2E, 865
 - calledby interpret2, 55
- coerceOrRetract
 - calledby evaluateType1, 916
- coerceSpadArgs2E, 863
 - calledby coerceTraceArgs2E, 862
 - calls coerceInteractive, 863
 - calls exit, 863
 - calls objNewWrap, 863
 - calls objValUnwrap, 863
 - calls seq, 863
 - uses \$OutputForm, 863
 - uses \$streamCount, 863
 - uses \$tracedSpadModemap, 863
 - defun, 863
- coerceSpadFunValue2E, 866
 - calledby coerceTraceFunValue2E, 865
 - calls coerceInteractive, 866
 - calls objNewWrap, 866
 - calls objValUnwrap, 866
 - uses \$OutputForm, 866

- uses \$streamCount, 866
 - uses \$tracedSpadModemap, 866
 - defun, 866
- coerceTraceArgs2E, 862
 - calls coerceInteractive, 862
 - calls coerceSpadArgs2E, 862
 - calls objNewWrap, 862
 - calls objValUnwrap, 862
 - calls pname, 862
 - calls spadsysnamep, 862
 - uses \$OutputForm, 862
 - uses \$mathTraceList, 862
 - uses \$tracedMapSignatures, 862
 - defun, 862
- coerceTraceFunValue2E, 865
 - calls coerceInteractive, 865
 - calls coerceSpadFunValue2E, 865
 - calls lassoc, 865
 - calls objNewWrap, 865
 - calls objValUnwrap, 865
 - calls pname, 865
 - calls spadsysnamep, 865
 - uses \$OutputForm, 865
 - uses \$mathTraceList, 865
 - uses \$tracedMapSignatures, 865
 - defun, 865
- collection, 389
 - syntax, 389
- commandAmbiguityError, 450
 - calledby commandErrorIfAmbiguous, 468
 - calledby commandErrorMessage, 447
 - calledby traceOptionError, 855
 - calledby userLevelErrorMessage, 448
 - calls bright, 450
 - calls sayKeyedMsg, 450
 - calls sayMSG, 450
 - calls terminateSystemCommand, 450
 - defun, 450
- commandError, 447
 - calls commandErrorMessage, 447
 - defun, 447
- commandErrorIfAmbiguous, 468
 - calls commandAmbiguityError, 468
 - uses \$oldline, 468
 - uses line, 468
 - defun, 468
- commandErrorMessage, 447
 - calledby commandError, 447
 - calledby optionError, 447
 - calls commandAmbiguityError, 447
 - calls sayKeyedMsg, 448
 - calls terminateSystemCommand, 448
 - uses \$oldline, 448
 - uses line, 448
 - defun, 447
- commandsForUserLevel, 446
 - calledby synonymsForUserLevel, 831
 - calledby systemCommand, 446
 - calledby unAbbreviateKeyword, 467
 - calledby whatCommands, 940
 - calls satisfiesUserLevel, 446
 - defun, 446
- commandUserLevelError, 448
 - calls userLevelErrorMessage, 448
 - defun, 448
- compareposns, 370
 - calledby erMsgCompare, 370
 - calls poCharPosn, 370
 - calls poGlobalLinePosn, 370
 - defun, 370
- compFailure
 - calledby getAndEvalConstructorArgument, 956
- compile help page, 511
 - manpage, 511
- compileBoot, 905
 - calledby breaklet, 903
 - calledby tracelet, 902
 - calls /D,1, 905
 - defun, 905
- compiledLookup, 1069
 - calledby compiledLookupCheck, 499
 - calledby hashable, 1069
 - calls NRTevalDomain, 1069
 - calls isDomain, 1069
 - defun, 1069
- compiledLookupCheck, 499
 - calledby clearCmdSortedCaches, 499
 - calls compiledLookup, 499
 - calls formatSignature, 500
 - calls keyedSystemError, 499
 - defun, 499

- compressOpen, 1023
 - calls DaaseName, 1023
 - uses *compress-stream*, 1023
 - uses *compress-stream-stamp*, 1023
 - uses *compressVectorLength*, 1023
 - uses *compressvector*, 1023
 - uses \$spadroot, 1023
 - defun, 1023
- compressopen
 - calledby resethashtables, 999
 - calledby restart0, 18
- CONCAT
 - calledby xlSkip, 89
- concat, 1049
 - calledby copyright, 520
 - calledby dewritify,dewritifyInner, 610
 - calledby displayCondition, 463
 - calledby displayModemap, 464
 - calledby displayMode, 464
 - calledby displaySetOptionInformation, 653
 - calledby displaySetVariableSettings, 655
 - calledby displayType, 458
 - calledby displayValue, 457
 - calledby doSystemCommand, 444
 - calledby evalDomain, 911
 - calledby getTraceOption, 852
 - calledby handleNoParseCommands, 468
 - calledby incLude1, 81
 - calledby inclmsgIfSyntax, 97
 - calledby intloopReadConsole, 30
 - calledby lffloat, 127
 - calledby lfrinteger, 134
 - calledby mkprompt, 42
 - calledby ncloopIncFileName, 620
 - calledby newHelpSpad2Cmd, 570
 - calledby pcounters, 858
 - calledby printLabelledList, 472
 - calledby processSynonyms, 33
 - calledby pspacers, 857
 - calledby ptimers, 857
 - calledby removeUndoLines, 932
 - calledby reportOpsFromLisplib, 816
 - calledby reportOpsFromUnitDirectly, 820
 - calledby reportUndo, 926
 - calledby resetCounters, 856
 - calledby resetSpacers, 856
 - calledby resetTimers, 856
 - calledby scanExponent, 126
 - calledby scanNumber, 132
 - calledby scanS, 131
 - calledby scanW, 128
 - calledby setOutputAlgebra, 760
 - calledby setOutputCharacters, 764
 - calledby setOutputFormula, 788
 - calledby setOutputFortran, 767
 - calledby setOutputHtml, 778
 - calledby setOutputMathml, 774
 - calledby setOutputOpenMath, 783
 - calledby setOutputTex, 794
 - calledby spleI1, 122
 - calledby summary, 828
 - calledby traceDomainConstructor, 879
 - calledby traceReply, 897
 - calledby undoCount, 927
 - calledby untraceDomainConstructor, 881
 - calledby writeInputLines, 585
 - calls string-concatenate, 1049
 - defun, 1049
- consoleinputp
 - calledby spad-syntax-error, 967
- constoken, 113
 - calledby lineoftoks, 111
 - calledby scanToken, 114
 - calls ncPutQ, 113
 - defun, 113
- constructor?
 - calledby addTraceItem, 900
 - calledby evaluateType1, 915
 - calledby evaluateType, 914
 - calledby hasSig, 423
 - calledby mkEvalable, 911
 - calledby reportOpsFromLisplib, 816
 - calledby transTraceItem, 861
 - calledby unifyStructVar, 429
 - calledby updateDatabase, 1017
 - calledby writify,writifyInner, 605
- constructSubst, 434
 - calledby hasAtt, 424
 - calledby hasCaty, 420
 - calledby spadTrace, 875
 - calls internl, 434
 - calls stringimage, 434

- defun, 434
- contained
 - calledby isPartialMode, 420
 - calledby unifyStructVar, 429
- containsVariables
 - calledby hasCate, 433
- containsVars, 430
 - calledby hasCateSpecial, 434
 - calledby unifyStructVar, 429
- calls containsVars1, 431
- calls isPatternVar, 430
- defun, 430
- containsVars1, 431
 - calledby containsVars1, 431
 - calledby containsVars, 431
 - calls containsVars1, 431
 - calls isPatternVar, 431
 - defun, 431
- copy
 - calledby makeInitialModemapFrame, 37
 - calledby resetWorkspaceVariables, 652
 - calledby undoSteps, 928
 - calledby untrace, 860
- copyright, 520
 - calls concat, 520
 - calls getenviron, 520
 - calls obey, 520
 - defun, 520
- copyright help page, 515
 - manpage, 515
- cot, 1097
 - defun, 1097
- coth, 1100
 - defun, 1100
- createCurrentInterpreterFrame, 555
 - calledby updateCurrentInterpreterFrame, 557
 - uses \$HiFiAccess, 555
 - uses \$HistListAct, 555
 - uses \$HistListLen, 555
 - uses \$HistList, 555
 - uses \$HistRecord, 555
 - uses \$IOindex, 555
 - uses \$InteractiveFrame, 555
 - uses \$internalHistoryTable, 555
 - uses \$interpreterFrameName, 555
 - uses \$localExposureData, 555
 - defun, 555
- credits, 1, 523
 - usedby credits, 523
 - uses credits, 523
 - defun, 523
 - defvar, 1
- credits help page, 523
 - manpage, 523
- csc, 1099
 - defun, 1099
- csch, 1099
 - defun, 1099
- curinstream, 23
 - usedby ncIntLoop, 25
 - defvar, 23
- curoutstream, 23
 - usedby ncIntLoop, 26
 - defvar, 23
- current-fragment
 - usedby ioclear, 970
- current-line
 - usedby ioclear, 970
- current-token
 - usedby token-stack-show, 969
- currenttime
 - calledby mkprompt, 42
- DaaseName, 1022
 - calledby compressOpen, 1023
 - calledby interpOpen, 1003
 - calls getEnv, 1022
 - uses \$spadroot, 1022
 - defun, 1022
- dancols, 1078
 - defmacro, 1078
- danrows, 1078
 - defmacro, 1078
- daref2, 1078
 - defmacro, 1078
- database, 994
 - defstruct, 994
- dbPart
 - calledby alqlGetKindString, 1082
 - calledby alqlGetOrigin, 1082
 - calledby alqlGetParams, 1082

- dbSplitLibdb
 - calledby make-databases, 1018
- dc1
 - calledby reportOpsFromLisplib, 816
- debugmode
 - usedby spad-syntax-error, 967
- decideHowMuch, 359
 - calledby getPosStL, 356
 - calls poFileName, 359
 - calls poLinePosn, 359
 - calls poNopos?, 359
 - calls poPosImmediate?, 359
 - defun, 359
- defaultTargetFE, 437
 - calledby defaultTargetFE, 437
 - calledby hasCateSpecialNew, 435
 - calls defaultTargetFE, 437
 - calls ifcar, 437
 - calls isEqualOrSubDomain, 437
 - calls typeIsASmallInteger, 437
 - local ref \$FunctionalExpression, 437
 - local ref \$Integer, 437
 - local ref \$RationalNumber, 437
 - local ref \$Symbol, 437
 - defun, 437
- defiostream, 980
 - calledby reportOpsFromLisplib1, 815
 - calledby reportOpsFromUnitDirectly1, 823
 - calledby sayMSG2File, 331
 - calledby setOutputAlgebra, 760
 - calledby setOutputFormula, 787
 - calledby setOutputFortran, 767
 - calledby setOutputHtml, 778
 - calledby setOutputMathml, 774
 - calledby setOutputOpenMath, 783
 - calledby setOutputTex, 794
 - calledby writeInputLines, 585
 - calledby zsystemdevelopment1, 952
 - defun, 980
- defmacro
 - assq, 1052
 - bit-to-truth, 1065
 - bvec-elt, 1065
 - bvec-setelt, 1065
 - bvec-size, 1065
 - cdancols, 1080
 - cdanrows, 1080
 - cdaref2, 1079
 - cdelt, 1076
 - cdlen, 1077
 - cdsetaref2, 1079
 - cdsetelt, 1076
 - dancols, 1078
 - danrows, 1078
 - daref2, 1078
 - delt, 1075
 - DFAcos, 1093
 - DFAcosh, 1095
 - DFAdd, 1088
 - DFAsin, 1093
 - DFAsinh, 1095
 - DFAtan, 1093
 - DFAtan2, 1094
 - DFAtanh, 1096
 - DFCos, 1092
 - DFCosh, 1094
 - DFDivide, 1090
 - DFEq, 1090
 - DFExp, 1092
 - DFExpt, 1092
 - DFIntegerDivide, 1090
 - DFIntegerExpt, 1091
 - DFIntegerMultiply, 1089
 - DFLessThan, 1087
 - DFLog, 1091
 - DFLogE, 1091
 - DFMax, 1089
 - DFMin, 1090
 - DFMinusp, 1088
 - DFMultiply, 1089
 - DFSin, 1092
 - DFSinh, 1094
 - DFSqrt, 1091
 - DFSubtract, 1089
 - DFTan, 1093
 - DFTanh, 1095
 - DFUnaryMinus, 1088
 - DFZerop, 1088
 - dlen, 1074
 - dsetaref2, 1078
 - dsetelt, 1075
 - elt32, 1057

- funfind, 872
- hget, 1046
- idChar?, 128
- identp, 1048
- make-cdouble-matrix, 1079
- make-cdouble-vector, 1076
- make-double-matrix, 1077
- make-double-matrix1, 1077
- make-double-vector, 1075
- make-double-vector1, 1075
- qsabsval, 1062
- qsadd1, 1061
- qsdifference, 1061
- qslessp, 1061
- qsmax, 1063
- qsmin, 1063
- qsminus, 1062
- qsoddp, 1063
- qsplus, 1062
- qssub1, 1061
- qstimes, 1062
- qszerop, 1063
- qv32len, 1056
- Rest, 77
- setelt32, 1057
- spadConstant, 1149
- startsId?, 1046
- trapNumericErrors, 1074
- truth-to-bit, 1064
- while, 1041
- whileWithResult, 1042
- defstruct
 - database, 994
 - libstream, 1158
 - monitor-data, 1158
- defun
 - /read, 642
 - /tracereply, 892
 - ?t, 900
 - abbQuery, 534
 - abbreviations, 481
 - abbreviationsSpad2Cmd, 481
 - acot, 1098
 - acoth, 1100
 - acsc, 1099
 - acsch, 1100
 - addBinding, 961
 - addBindingInteractive, 965
 - addInputLibrary, 666
 - addNewInterpreterFrame, 559
 - addoperations, 1006
 - addTraceItem, 900
 - algCoerceInteractive, 1059
 - allConstructors, 1035
 - allOperations, 1035
 - alqlGetKindString, 1082
 - alqlGetOrigin, 1082
 - alqlGetParams, 1082
 - alreadyOpened?, 363
 - apropos, 943
 - asec, 1098
 - asech, 1101
 - assertCond, 96
 - augmentTraceNames, 870
 - axiomVersion, 474
 - basicLookup, 1069
 - basicLookupCheckDefaults, 1072
 - BooleanEquality, 1064
 - break, 904
 - breaklet, 903
 - brightprint, 1049
 - brightprint-0, 1050
 - browseOpen, 1004
 - bvec-and, 1066
 - bvec-concat, 1065
 - bvec-copy, 1066
 - bvec-equal, 1066
 - bvec-greater, 1066
 - bvec-make-full, 1064
 - bvec-nand, 1067
 - bvec-nor, 1067
 - bvec-not, 1068
 - bvec-or, 1067
 - bvec-xor, 1067
 - cacheKeyedMsg, 329
 - categoryOpen, 1005
 - changeHistListLen, 587
 - changeToNamedInterpreterFrame, 558
 - charDigitVal, 615
 - cleanline, 527
 - cleanupLine, 538
 - clear, 497

- clearCmdAll, 501
- clearCmdCompletely, 500
- clearCmdExcept, 502
- clearCmdParts, 503
- clearCmdSortedCaches, 499
- clearFrame, 927
- clearMacroTable, 502
- clearParserMacro, 451
- clearSpad2Cmd, 498
- close, 508
- closeInterpreterFrame, 560
- cmpnote, 28
- coerceSpadArgs2E, 863
- coerceSpadFunValue2E, 866
- coerceTraceArgs2E, 862
- coerceTraceFunValue2E, 865
- commandAmbiguityError, 450
- commandError, 447
- commandErrorIfAmbiguous, 468
- commandErrorMessage, 447
- commandsForUserLevel, 446
- commandUserLevelError, 448
- compareposns, 370
- compileBoot, 905
- compiledLookup, 1069
- compiledLookupCheck, 499
- compressOpen, 1023
- concat, 1049
- constoken, 113
- constructSubst, 434
- containsVars, 430
- containsVars1, 431
- copyright, 520
- cot, 1097
- coth, 1100
- createCurrentInterpreterFrame, 555
- credits, 523
- csc, 1099
- csch, 1099
- DaaseName, 1022
- decideHowMuch, 359
- defaultTargetFE, 437
- defiostream, 980
- Delay, 103
- deldatabase, 1009
- deleteFile, 1044
- describe, 526
- describeFortPersistence, 754
- describeInputLibraryArgs, 666
- describeOutputLibraryArgs, 663
- describeSetFortDir, 724
- describeSetFortTmpDir, 722
- describeSetLinkerArgs, 726
- describeSetNagHost, 752
- describeSetOutputAlgebra, 762
- describeSetOutputFormula, 790
- describeSetOutputFortran, 769
- describeSetOutputHtml, 780
- describeSetOutputMathml, 776
- describeSetOutputOpenMath, 785
- describeSetOutputTex, 796
- describeSetStreamsCalculate, 799
- describeSpad2Cmd, 526
- desiredMsg, 352
- dewritify, 613
- dewritify,dewritifyInner, 610
- diffAlist, 922
- digit?, 122
- digitp, 1047
- DirToString, 1085
- disableHist, 601
- display, 533
- displayCondition, 463
- displayExposedConstructors, 702
- displayExposedGroups, 702
- displayFrameNames, 561
- displayHiddenConstructors, 703
- displayMacro, 451
- displayMacros, 536
- displayMode, 464
- displayModemap, 464
- displayOperations, 535
- displayOperationsFromLisplib, 818
- displayParserMacro, 462
- displayProperties, 459
- displayProperties,sayFunctionDeps, 454
- displaySetOptionInformation, 653
- displaySetVariableSettings, 655
- displayType, 458
- displayValue, 457
- displayWorkspaceNames, 452
- divide2, 1080

- domainToGenvar, 859
- domArg, 422
- domArg2, 422
- doSystemCommand, 444
- dqAppend, 344
- dqConcat, 343
- dqToList, 344
- dqUnit, 343
- dropInputLibrary, 667
- dumbTokenize, 465
- edit, 542
- editFile, 543
- editSpad2Cmd, 542
- emptyInterpreterFrame, 554
- enPile, 340
- eofp, 981
- eqpileTree, 339
- erMsgCompare, 370
- erMsgSep, 370
- erMsgSort, 369
- evalCategory, 957
- evalDomain, 911
- evaluateSignature, 918
- evaluateType, 914
- evaluateType1, 915
- ExecuteInterpSystemCommand, 33
- executeQuietCommand, 47
- fetchKeyedMsg, 328
- fetchOutput, 598
- fillerSpaces, 20
- filterAndFormatConstructors, 942
- filterListOfStrings, 940
- filterListOfStringsWithFn, 941
- fin, 546
- findFrameInRing, 557
- firstTokPosn, 341
- fixObjectForPrinting, 454
- flatten, 529
- flattenOperationAlist, 881
- float2Sex, 305
- fnameDirectory, 1085
- fnameExists?, 1086
- fnameMake, 1084
- fnameName, 1085
- fnameNew, 1087
- fnameReadable?, 1086
- fnameType, 1085
- fnameWritable?, 1086
- frame, 563
- frameEnvironment, 554
- frameName, 550
- frameNames, 554
- frameSpad2Cmd, 564
- From, 380
- FromTo, 380
- functionp, 1049
- funfind,LAM, 872
- genDomainTraceName, 860
- gensymInt, 614
- get-current-directory, 36
- getAliasIfTracedMapParameter, 887
- getAndEvalConstructorArgument, 956
- getAndSay, 459
- getBpiNameIfTracedMap, 888
- getBrowseDatabase, 1083
- getdatabase, 1009
- getDirectoryList, 982
- getenviron, 31
- getFirstWord, 467
- getKeyedMsg, 329
- getLinePos, 372
- getLineText, 372
- getMapSig, 851
- getMapSubNames, 867
- getMsgArgL, 349
- getMsgCatAttr, 358
- getMsgFTTag?, 359
- getMsgInfoFromKey, 366
- getMsgKey, 348
- getMsgKey?, 362
- getMsgLitSym, 362
- getMsgPos, 359
- getMsgPos2, 378
- getMsgPosTagOb, 348
- getMsgPrefix, 349
- getMsgPrefix?, 350
- getMsgTag, 350
- getMsgTag?, 350
- getMsgText, 349
- getMsgToWhere, 363
- getOplistForConstructorForm, 822
- getOplistWithUniqueSignatures, 823

- getOption, 890
- getParserMacroNames, 451
- getPosStL, 356
- getPreStL, 355
- getPreviousMapSubNames, 868
- getProplist, 962
- getrefv32, 1056
- getStFromMsg, 354
- getSystemCommandLine, 831
- getTraceOption, 852
- getTraceOption,hn, 851
- getTraceOptions, 850
- getWorkspaceNames, 453
- handleNoParseCommands, 443
- handleParsedSystemCommands, 466
- handleTokenSizeSystemCommands, 445
- hasAtt, 424
- hasAttSig, 426
- hasCate, 433
- hasCate1, 427
- hasCateSpecial, 434
- hasCateSpecialNew, 435
- hasCatExpression, 427
- hasCaty, 420
- hasCaty1, 431
- hashable, 1069
- hasOptArgs?, 309
- hasOption, 449
- hasPair, 889
- hasSig, 423
- hasSigAnd, 425
- hasSigOr, 426
- help, 570
- helpSpad2Cmd, 570
- histFileErase, 615
- histFileName, 578
- histInputFileName, 578
- history, 580
- historySpad2Cmd, 580
- hkeys, 1046
- hput, 1046
- ifCond, 89
- importFromFrame, 561
- incActive?, 103
- incAppend, 87
- incAppend1, 87
- incBiteOff, 621
- incClassify, 99
- incCommand?, 100
- incCommandTail, 101
- incConsoleInput, 102
- incDrop, 101
- incFileInput, 102
- incFileName, 620
- incHandleMessage, 76
- incIgen, 75
- incIgen1, 75
- inclFname, 102
- incLine, 87
- incLine1, 88
- inclmsgCannotRead, 92
- inclmsgCmdBug, 98
- inclmsgConActive, 93
- inclmsgConsole, 94
- inclmsgConStill, 94
- inclmsgFileCycle, 92
- inclmsgFinSkipped, 95
- inclmsgIfBug, 97
- inclmsgIfSyntax, 97
- inclmsgNoSuchFile, 91
- inclmsgPrematureEOF, 88
- inclmsgPrematureFin, 95
- inclmsgSay, 90
- incLude, 76
- incLude1, 81
- incNConsoles, 103
- incPrefix?, 100
- incRenumbr, 74
- incRenumbrItem, 76
- incRenumbrLine, 75
- incRgen, 103
- incRgen1, 104
- incStream, 73
- incString, 39
- incZip, 74
- incZip1, 74
- init-boot/spad-reader, 966
- init-memory-config, 34
- initHist, 579
- initHistList, 579
- initial-getdatabase, 1000
- initializeInterpreterFrameRing, 553

- initializeSetVariables, 651
- initImPr, 367
- initroot, 35
- initToWhere, 368
- insertpile, 335
- insertPos, 379
- integer-decode-float-denominator, 1096
- integer-decode-float-exponent, 1097
- integer-decode-float-numerator, 1096
- integer-decode-float-sign, 1097
- InterpExecuteSpadSystemCommand, 32
- interpFunctionDepAlists, 463
- interpOpen, 1002
- interpret, 54
- interpret1, 54
- interpret2, 55
- interpretTopLevel, 53
- intInterpretPform, 67
- intloop, 26
- intloopEchoParse, 69
- intloopInclude, 63
- intloopInclude0, 63
- intloopPrefix?, 36
- intloopProcess, 64
- intloopProcessString, 37
- intloopReadConsole, 30
- intloopSpadProcess, 64
- intloopSpadProcess,interp, 65
- intnplisp, 36
- intProcessSynonyms, 33
- ioclear, 970
- iostat, 968
- isDomainOrPackage, 873
- isDomainValuedVariable, 957
- isEqualOrSubDomain, 438
- isExposedConstructor, 818
- isgenvar, 884
- isIntegerString, 466
- isInterpOnlyMap, 870
- isListOfIdentifiers, 866
- isListOfIdentifiersOrStrings, 867
- isPartialMode, 420
- isSharpVar, 884
- isSharpVarWithNum, 884
- isSubForRedundantMapName, 871
- isSystemDirectory, 1038
- isTraceGensym, 873
- isUncompiledMap, 869
- justifyMyType, 62
- keyword, 121
- keyword?, 121
- lassocSub, 869
- lastTokPosn, 341
- leader?, 351
- leaveScratchpad, 637
- letPrint, 883
- letPrint2, 885
- letPrint3, 886
- lfcomment, 116
- lferror, 135
- lffloat, 127
- lfid, 115
- lfinteger, 133
- lfkey, 122
- lfnegcomment, 118
- lfrinteger, 134
- lfspaces, 130
- lfstring, 130
- library, 1013
- line?, 351
- lineoftoks, 111
- listConstructorAbbreviations, 482
- listDecideHowMuch, 361
- listOutputter, 354
- lnCreate, 345
- lnExtraBlanks, 345
- lnFileName, 347
- lnFileName?, 347
- lnGlobalNum, 346
- lnImmediate?, 347
- lnLocalNum, 346
- lnPlaceOfOrigin, 346
- lnSetGlobalNum, 346
- lnString, 345
- load, 627
- loadFunctor, 1040
- loadLib, 1037
- loadLibNoUpdate, 1039
- localdatabase, 1013
- localnrlib, 1015
- lookupInDomainVector, 1071
- loopIters2Sex, 311

- lotsof, 1045
- ltrace, 630
- mac0Define, 230
- mac0ExpandBody, 224
- mac0Get, 228
- mac0GetName, 226
- mac0InfiniteExpansion, 225
- mac0InfiniteExpansion,name, 226
- mac0MLambdaApply, 223
- mac0SubstituteOuter, 231
- macApplication, 223
- macExpand, 222
- macId, 227
- macLambda, 228
- macLambda,mac, 229
- macLambdaParameterHandling, 231
- macMacro, 229
- macroExpanded, 222
- macSubstituteId, 232
- macSubstituteOuter, 230
- macWhere, 228
- macWhere,mac, 228
- make-absolute-filename, 36
- make-appendstream, 980
- make-databases, 1017
- make-instream, 979
- make-outstream, 979
- makeByteWordVec2, 1149
- makeFullNamestring, 983
- makeHistFileName, 577
- makeInitialModemapFrame, 37
- makeInputFilename, 981
- makeLeaderMsg, 377
- makeMsgFromLine, 371
- makeOrdinal, 918
- makePathname, 1044
- makeStream, 981
- manexp, 1097
- mapLetPrint, 882
- member, 1050
- mergePathnames, 1043
- messageprint, 1050
- messageprint-1, 1051
- messageprint-2, 1051
- mkDomPvar, 432
- mkEvalable, 911
- mkEvalableMapping, 913
- mkEvalableRecord, 913
- mkEvalableUnion, 913
- mkLineList, 70
- mkprompt, 42
- monitor-add, 1160
- monitor-apropos, 1173
- monitor-autoload, 1168
- monitor-checkpoint, 1165
- monitor-decr, 1162
- monitor-delete, 1160
- monitor-dirname, 1168
- monitor-disable, 1161
- monitor-enable, 1160
- monitor-end, 1159
- monitor-exposedp, 1170
- monitor-file, 1163
- monitor-help, 1166
- monitor-incr, 1162
- monitor-info, 1163
- monitor-inittable, 1158
- monitor-libname, 1169
- monitor-nrlib, 1169
- monitor-parse, 1172
- monitor-percent, 1173
- monitor-readinterp, 1170
- monitor-report, 1171
- monitor-reset, 1161
- monitor-restore, 1165
- monitor-results, 1159
- monitor-spadfile, 1172
- monitor-tested, 1164
- monitor-untested, 1163
- monitor-write, 1164
- msgCreate, 347
- msgImPr?, 358
- msgNoRep?, 375
- msgOutputter, 353
- msgText, 61
- myWritable?, 1086
- namestring, 1042
- ncAlist, 415
- ncBug, 368
- ncConversationPhase, 68
- ncConversationPhase,wrapup, 68
- ncEltQ, 416

ncError, 69
ncHardError, 352
ncIntLoop, 25
ncloopCommand, 476
ncloopDQlines, 71
ncloopEscaped, 37
ncloopIncFileName, 620
ncloopInclude, 620
ncloopInclude0, 73
ncloopInclude1, 619
ncloopParse, 38
ncloopPrefix?, 477
ncloopPrintLines, 70
ncParseFromString, 1060
ncPutQ, 416
ncSoftError, 351
ncTag, 415
ncTopLevel, 25
newHelpSpad2Cmd, 570
next, 38
next-lines-clear, 970
next-lines-show, 969
next1, 38
nextInterpreterFrame, 558
nextline, 112
nonBlank, 71
npADD, 158
npAdd, 159
npAmpersand, 204
npAmpersandFrom, 202
npAndOr, 181
npAngleBared, 186
npAnyNo, 162
npApplication, 162
npApplication2, 163
npArith, 200
npAssign, 216
npAssignment, 217
npAssignVariable, 217
npAtom1, 183
npAtom2, 159
npBacksetElse, 197
npBackTrack, 148
npBDefinition, 185
npboot, 470
npBPILEDefinition, 188
npBraced, 186
npBracked, 186
npBracketed, 185
npBreak, 174
npBy, 199
npCategory, 153
npCategoryL, 152
npCoerceTo, 220
npColon, 217
npColonQuery, 219
npComma, 146
npCommaBackSet, 146
npCompMissing, 151
npConditional, 195
npConditionalStatement, 180
npConstTok, 184
npDDInfKey, 208
npDecl, 214
npDef, 187
npDefaultDecl, 170
npDefaultItem, 169
npDefaultItemList, 168
npDefaultValue, 194
npDefinition, 167
npDefinitionItem, 167
npDefinitionlist, 193
npDefinitionOrStatement, 147
npDefn, 187
npDefTail, 194
npDiscrim, 197
npDisjand, 197
npDollar, 183
npDotted, 162
npElse, 196
npEncAp, 182
npEncl, 182
npEnclosed, 211
npEqKey, 145
npEqPeek, 152
npExit, 215
npExport, 171
npExpress, 179
npExpress1, 179
npFirstTok, 143
npFix, 166
npForIn, 177

- npFree, 173
- npFromdom, 202
- npFromdom1, 203
- npGives, 148
- npId, 204
- npImport, 180
- npInfGeneric, 207
- npInfixOp, 161
- npInfixOperator, 160
- npInfKey, 208
- npInline, 174
- npInterval, 199
- npItem, 142
- npItem1, 142
- npIterate, 174
- npIterator, 176
- npIterators, 175
- npLambda, 148
- npLeftAssoc, 206
- npLet, 166
- npLetQualified, 166
- npLisp, 470
- npList, 155
- npListAndRecover, 189
- npListing, 155
- npListofFun, 221
- npLocal, 173
- npLocalDecl, 172
- npLocalItem, 172
- npLocalItemlist, 171
- npLogical, 197
- npLoop, 175
- npMacro, 164
- npMatch, 150
- npMDEF, 165
- npMdef, 164
- npMDEFinition, 165
- npMissing, 151
- npMissingMate, 215
- npMoveTo, 191
- npName, 204
- npNext, 145
- npNull, 333
- npParened, 185
- npParenthesize, 215
- npParenthesized, 214
- npParse, 141
- npPDefinition, 183
- npPileBracketed, 188
- npPileDefinitionlist, 189
- npPileExit, 216
- npPop1, 144
- npPop2, 144
- npPop3, 144
- npPower, 202
- npPP, 209
- npPPf, 211
- npPPff, 210
- npPPg, 210
- npPrefixColon, 161
- npPretend, 219
- npPrimary, 157
- npPrimary1, 164
- npPrimary2, 158
- npProcessSynonym, 471
- npProduct, 202
- npPush, 143
- npPushId, 209
- npQualDef, 145
- npQualified, 147
- npQualifiedDefinition, 147
- npQualType, 181
- npQualTypelist, 180
- npQuiver, 198
- npRecoverTrap, 190
- npRelation, 198
- npRemainder, 201
- npRestore, 152
- npRestrict, 220
- npReturn, 178
- npRightAssoc, 206
- npRule, 193
- npSCategory, 153
- npSDefaultItem, 169
- npSegment, 200
- npSelector, 163
- npSemiBackSet, 193
- npSemiListing, 193
- npSigDecl, 157
- npSigItem, 156
- npSigItemlist, 154
- npSignature, 154

- npSignatureDefinee, 156
- npSingleRule, 194
- npSLocalItem, 172
- npSQualTypelist, 181
- npState, 212
- npStatement, 170
- npSuch, 150
- npSuchThat, 176
- npSum, 201
- npSymbolVariable, 205
- npsynonym, 471
- npSynthetic, 198
- npsystem, 470
- npTagged, 218
- npTerm, 201
- npTrap, 212
- npTrapForm, 212
- npTuple, 146
- npType, 149
- npTypedForm, 220
- npTypedForm1, 218
- npTypeStyle, 219
- npTypeVariable, 156
- npTypeVariablelist, 157
- npTypified, 218
- npTyping, 168
- npVariable, 213
- npVariablelist, 213
- npVariableName, 213
- npVoid, 179
- npWConditional, 195
- npWhile, 177
- npWith, 150
- npZeroOrMore, 177
- NRTevalDomain, 1073
- ofCategory, 419
- oldCompLookup, 1072
- oldHistFileName, 578
- om-bindTCP, 1135
- om-closeConn, 1134
- om-closeDev, 1134
- om-connectTCP, 1136
- om-getApp, 1137
- om-getAtp, 1138
- om-getAttr, 1138
- om-getBind, 1138
- om-getBVar, 1138
- om-getByteArray, 1139
- om-getConnInDev, 1135
- om-getConnOutDev, 1135
- om-getEndApp, 1139
- om-getEndAtp, 1139
- om-getEndAttr, 1139
- om-getEndBind, 1140
- om-getEndBVar, 1140
- om-getEndError, 1140
- om-getEndObject, 1140
- om-getError, 1141
- om-getFloat, 1141
- om-getInt, 1141
- om-getObject, 1141
- om-getString, 1142
- om-getSymbol, 1142
- om-getType, 1142
- om-getVar, 1142
- om-listCDs, 1132
- om-listSymbols, 1132
- om-makeConn, 1134
- om-openFileDev, 1133
- om-openStringDev, 1134
- om-putApp, 1143
- om-putAtp, 1143
- om-putAttr, 1143
- om-putBind, 1143
- om-putBVar, 1144
- om-putByteArray, 1144
- om-putEndApp, 1144
- om-putEndAtp, 1144
- om-putEndAttr, 1145
- om-putEndBind, 1145
- om-putEndBVar, 1145
- om-putEndError, 1145
- om-putEndObject, 1146
- om-putError, 1146
- om-putFloat, 1146
- om-putInt, 1146
- om-putObject, 1147
- om-putString, 1147
- om-putSymbol, 1147
- om-putVar, 1147
- om-Read, 1131
- om-setDevEncoding, 1133

- om-stringPtrToString, 1148
- om-stringToStringPtr, 1148
- om-supportsCD, 1132
- om-supportsSymbol, 1132
- openOutputLibrary, 664
- openserver, 985
- operationOpen, 1006
- optionError, 447
- optionUserLevelError, 448
- opTran, 323
- orderBySlotNumber, 891
- parseAndInterpret, 48
- parseFromString, 48
- parseSystemCmd, 467
- pathname, 1044
- pathnameDirectory, 1043
- pathnameName, 1042
- pathnameType, 1042
- pathnameTypeId, 1043
- patternVarsOf, 321
- patternVarsOf1, 321
- pcounters, 858
- pf0ApplicationArgs, 237
- pf0AssignLhsItems, 256
- pf0DefinitionLhsItems, 262
- pf0FlattenSyntacticTuple, 237
- pf0ForinLhs, 267
- pf0FreeItems, 266
- pf0LambdaArgs, 274
- pf0LocalItems, 275
- pf0LoopIterators, 276
- pf0MLambdaArgs, 278
- pf0SequenceArgs, 287
- pf0TupleParts, 293
- pf0WhereContext, 295
- pf2Sex, 299
- pf2Sex1, 300
- pfAbSynOp, 412
- pfAbSynOp?, 412
- pfAdd, 252
- pfAnd, 253
- pfAnd?, 254
- pfAndLeft, 254
- pfAndRight, 255
- pfAppend, 255
- pfApplication, 253
- pfApplication2Sex, 305
- pfApplication?, 255
- pfApplicationArg, 254
- pfApplicationOp, 254
- pfAssign, 255
- pfAssign?, 256
- pfAssignLhsItems, 256
- pfAssignRhs, 256
- pfAttribute, 253
- pfBrace, 257
- pfBraceBar, 257
- pfBracket, 257
- pfBracketBar, 257
- pfBreak, 258
- pfBreak?, 258
- pfBreakFrom, 258
- pfCharPosn, 235
- pfCheckArg, 241
- pfCheckId, 241
- pfCheckItOut, 239
- pfCheckMacroOut, 240
- pfCoerceto, 259
- pfCoerceto?, 259
- pfCoercetoExpr, 259
- pfCoercetoType, 259
- pfCollect, 260
- pfCollect1?, 242
- pfCollect2Sex, 314
- pfCollect?, 260
- pfCollectArgTran, 317
- pfCollectBody, 260
- pfCollectIterators, 260
- pfCollectVariable1, 242
- pfCopyWithPos, 236
- pfDefinition, 261
- pfDefinition2Sex, 315
- pfDefinition?, 261
- pfDefinitionLhsItems, 261
- pfDefinitionRhs, 261
- pfDo, 262
- pfDo?, 262
- pfDoBody, 262
- pfDocument, 246
- pfEnSequence, 263
- pfExit, 263
- pfExit?, 263

- pfExitCond, 263
- pfExitExpr, 264
- pfExport, 264
- pfExpression, 264
- pfFileName, 236
- pfFirst, 264
- pfFix, 265
- pfFlattenApp, 241
- pfForin, 266
- pfForin?, 266
- pfForinLhs, 267
- pfForinWhole, 267
- pfFree, 265
- pfFree?, 265
- pfFreeItems, 266
- pfFromDom, 267
- pfFromdom, 268
- pfFromdom?, 268
- pfFromdomDomain, 269
- pfFromdomWhat, 268
- pfGlobalLinePosn, 235
- pfHide, 269
- pfId, 246
- pfId?, 246
- pfIdPos, 246
- pfIdSymbol, 247
- pfIf, 269
- pfIf?, 269
- pfIfCond, 270
- pfIfElse, 270
- pfIfThen, 270
- pfIfThenOnly, 270
- pfImport, 271
- pfInfApplication, 271
- pfInline, 272
- pfIterate, 271
- pfIterate?, 271
- pfLam, 272
- pfLambda, 273
- pfLambda2Sex, 317
- pfLambda?, 273
- pfLambdaArgs, 274
- pfLambdaBody, 273
- pfLambdaRets, 273
- pfLambdaTran, 316
- pfLeaf, 247
- pfLeaf?, 247
- pfLeafPosition, 248
- pfLeafToken, 248
- pfLhsRule2Sex, 318
- pfLinePosn, 235
- pfListOf, 245
- pfLiteral2Sex, 304
- pfLiteral?, 248
- pfLiteralClass, 248
- pfLiteralString, 249
- pfLocal, 274
- pfLocal?, 274
- pfLocalItems, 275
- pfLoop, 275
- pfLoop1, 275
- pfLoop?, 276
- pfLoopIterators, 276
- pfLp, 276
- pfMacro, 277
- pfMacro?, 277
- pfMacroLhs, 277
- pfMacroRhs, 277
- pfMapParts, 236
- pfMLambda, 278
- pfMLambda?, 278
- pfMLambdaArgs, 278
- pfMLambdaBody, 279
- pfname, 91
- pfNoPosition, 414
- pfNoPosition?, 412
- pfNot?, 279
- pfNotArg, 279
- pfNothing, 245
- pfNothing?, 245
- pfNovalue, 279
- pfNovalue?, 280
- pfNovalueExpr, 280
- pfOp2Sex, 308
- pfOr, 280
- pfOr?, 280
- pfOrLeft, 281
- pfOrRight, 281
- pfParen, 281
- pfParts, 249
- pfPile, 249
- pfPretend, 281

- pfPretend?, 282
- pfPretendExpr, 282
- pfPretendType, 282
- pfPushBody, 249
- pfPushMacroBody, 243
- pfQualType, 282
- pfRestrict, 283
- pfRestrict?, 283
- pfRestrictExpr, 283
- pfRestrictType, 283
- pfRetractTo, 284
- pfReturn, 284
- pfReturn?, 284
- pfReturnExpr, 284
- pfReturnNoName, 285
- pfReturnTyped, 285
- pfRhsRule2Sex, 319
- pfRule, 285
- pfRule2Sex, 318
- pfRule?, 286
- pfRuleLhsItems, 286
- pfRuleRhs, 286
- pfSecond, 286
- pfSequence, 287
- pfSequence2Sex, 310
- pfSequence2Sex0, 310
- pfSequence?, 287
- pfSequenceArgs, 287
- pfSequenceToList, 238
- pfSexpr, 250
- pfSexpr,strip, 250
- pfSourcePosition, 238
- pfSourceStok, 243
- pfSpread, 239
- pfSuch, 244
- pfSuchthat, 288
- pfSuchThat2Sex, 307
- pfSuchthat?, 288
- pfSuchthatCond, 288
- pfSymb, 251
- pfSymbol, 251
- pfSymbol?, 252
- pfSymbolSymbol, 252
- pfTagged, 288
- pfTagged?, 289
- pfTaggedExpr, 289
- pfTaggedTag, 289
- pfTaggedToTyped, 289
- pfTaggedToTyped1, 244
- pfTransformArg, 244
- pfTree, 252
- pfTuple, 292
- pfTuple?, 292
- pfTupleListOf, 292
- pfTupleParts, 293
- pfTweakIf, 290
- pfTyped, 290
- pfTyped?, 291
- pfTypedId, 291
- pfTypedType, 291
- pfTyping, 291
- pfUnSequence, 293
- pfWDec, 293
- pfWDeclare, 294
- pfWhere, 294
- pfWhere?, 294
- pfWhereContext, 295
- pfWhereExpr, 295
- pfWhile, 295
- pfWhile?, 296
- pfWhileCond, 296
- pfWith, 296
- pfWrong, 296
- pfWrong?, 297
- phInterpret, 67
- phIntReportMsgs, 66
- phMacro, 221
- phParse, 66
- pileCforest, 340
- pileColumn, 337
- pileCtree, 340
- pileForest, 338
- pileForest1, 338
- pileForests, 337
- pilePlusComment, 336
- pilePlusComments, 336
- pileTree, 337
- pmDontQuote?, 309
- pname, 1047
- poCharPosn, 377
- poFileName, 360
- poGetLineObject, 361

- poGlobalLinePosn, 72
- poLinePosn, 361
- poNopos?, 360
- poNoPosition, 414
- poNoPosition?, 413
- poPosImmediate?, 360
- porigin, 88
- posend, 129
- posPointers, 378
- ppos, 357
- pquit, 632
- pquitSpad2Cmd, 632
- previousInterpreterFrame, 559
- printAsTeX, 61
- printLabelledList, 472
- printStatisticsSummary, 57
- printStorage, 58
- printSynonyms, 472
- printTypeAndTime, 58
- printTypeAndTimeNormal, 59
- printTypeAndTimeSaturn, 60
- probeName, 982
- processChPosesForOneLine, 376
- processInteractive, 49
- processInteractive1, 52
- processKeyedError, 353
- processMsgList, 369
- processSynonymLine, 833
- processSynonymLine,removeKeyFromLine, 832
- processSynonyms, 33
- protectedEVAL, 47
- prTraceNames, 896
- prTraceNames,fn, 896
- pspacers, 857
- ptimers, 857
- punctuation?, 118
- put, 1041
- putDatabaseStuff, 365
- putFTText, 379
- putHist, 588
- pvarPredTran, 322
- qenum, 1048
- qsquotient, 1060
- qsremainder, 1060
- queryClients, 508
- queueUpErrors, 372
- quit, 636
- quitSpad2Cmd, 636
- quotient2, 1081
- random, 1081
- rassocSub, 869
- rdefinstream, 1068
- rdefoutstream, 1068
- rdigit?, 133
- read, 640
- readHiFi, 599
- readSpad2Cmd, 640
- readSpadProfileIfThere, 959
- reclaim, 39
- recordAndPrint, 56
- recordFrame, 921
- recordNewValue, 589
- recordNewValue0, 589
- recordOldValue, 590
- recordOldValue0, 590
- redundant, 374
- remainder2, 1081
- remFile, 357
- remLine, 362
- removeOption, 859
- remover, 895
- removeTracedMapSigs, 862
- removeUndoLines, 931
- rep, 371
- replaceFile, 983
- replaceSharps, 956
- reportOperations, 813
- reportOpsFromLisplib, 816
- reportOpsFromLisplib0, 815
- reportOpsFromLisplib1, 815
- reportOpsFromUnitDirectly, 819
- reportOpsFromUnitDirectly0, 819
- reportOpsFromUnitDirectly1, 823
- reportSpadTrace, 890
- reportUndo, 925
- reportWhatOptions, 939
- reroot, 40
- resetCounters, 856
- resethashtables, 999
- resetInCoreHist, 586
- resetSpacers, 856

- resetStackLimits, 21
- resetTimers, 856
- resetWorkspaceVariables, 652
- restart0, 18
- restoreHistory, 595
- retract, 1057
- rread, 603
- ruleLhsTran, 322
- rulePredicateTran, 319
- runspad, 21
- rwrite, 602
- safeWritify, 604
- sameMsg?, 376
- sameUnionBranch, 61
- satisfiesRegularExpressions, 941
- satisfiesUserLevel, 449
- saveDependentsHashTable, 1021
- saveHistory, 593
- saveMapSig, 851
- savesystem, 648
- saveUsersHashTable, 1022
- sayBrightly1, 1051
- sayExample, 537
- sayKeyedMsg, 329
- sayKeyedMsgLocal, 330
- sayMSG, 331
- sayMSG2File, 331
- sayShowWarning, 824
- scanCheckRadix, 134
- scanCloser?, 125
- scanComment, 116
- scanDictCons, 137
- scanError, 135
- scanEsc, 123
- scanEscape, 135
- scanExponent, 126
- scanIgnoreLine, 113
- scanInsert, 138
- scanKeyTableCons, 136
- scanKeyTr, 120
- scanNegComment, 117
- scanNumber, 132
- ScanOrPairVec, 614
- ScanOrPairVec,ScanOrInner, 613
- scanPossFloat, 121
- scanPunCons, 139
- scanPunct, 118
- scanS, 131
- scanSpace, 129
- scanString, 130
- scanToken, 114
- scanTransform, 132
- scanW, 128
- scanWord, 126
- search, 962
- searchCurrentEnv, 962
- searchTailEnv, 963
- sec, 1098
- sech, 1100
- segmentKeyedMsg, 330
- selectOption, 477
- selectOptionLC, 477
- separateFiles, 341
- serverReadLine, 44
- set, 805
- set-restart-hook, 15
- set1, 806
- setCurrentLine, 41
- setdatabase, 1008
- setExpose, 694
- setExposeAdd, 695
- setExposeAddConstr, 698
- setExposeAddGroup, 696
- setExposeDrop, 699
- setExposeDropConstr, 701
- setExposeDropGroup, 700
- setFortDir, 723
- setFortPers, 754
- setFortTmpDir, 721
- setFunctionsCache, 705
- setHistoryCore, 582
- setInputLibrary, 665
- setIOindex, 597
- setLinkerArgs, 726
- setMsgCatlessAttr, 365
- setMsgForcedAttr, 364
- setMsgForcedAttrList, 364
- setMsgPrefix, 349
- setMsgText, 349
- setMsgUnforcedAttr, 367
- setMsgUnforcedAttrList, 366
- setNagHost, 752

- setOutputAlgebra, 760
- setOutputCharacters, 764
- setOutputFormula, 787
- setOutputFortran, 767
- setOutputHtml, 778
- setOutputLibrary, 662
- setOutputMathml, 774
- setOutputOpenMath, 783
- setOutputTex, 794
- setStreamsCalculate, 799
- shortenForPrinting, 889
- show, 812
- showdatabase, 1007
- showInOut, 598
- showInput, 597
- showMsgPos?, 357
- showSpad2Cmd, 812
- shut, 980
- size, 1047
- spad, 20
- spad-error-loc, 968
- spad-long-error, 967
- spad-save, 987
- spad-short-error, 968
- spad-syntax-error, 967
- spad2BootCoerce, 1059
- spadClosure?, 609
- SpadInterpretStream, 27
- spadReply, 893
- spadReply,printName, 892
- spadrread, 603
- spadrwrite, 603
- spadrwrite0, 602
- spadStartUpMsgs, 19
- spadTrace, 874
- spadTrace,g, 873
- spadTrace,isTraceable, 873
- spadTraceAlias, 889
- spadUntrace, 893
- specialChar, 978
- spleI, 122
- spleI1, 122
- splitIntoOptionBlocks, 445
- squeeze, 1025
- stackTraceOptionError, 859
- startsComment?, 115
- startsNegComment?, 117
- streamChop, 72
- StreamNull, 333
- stringMatches?, 1084
- StringToDir, 1084
- stripLisp, 469
- stripSpaces, 469
- strpos, 1047
- strposl, 1048
- stupidIsSpadFunction, 904
- subMatch, 119
- substringMatch, 119
- subTypes, 864
- summary, 828
- syGeneralErrorHere, 192
- syIgnoredFromTo, 191
- synonym, 830
- synonymsForUserLevel, 831
- synonymSpad2Cmd, 830
- sySpecificErrorAtToken, 192
- sySpecificErrorHere, 192
- systemCommand, 446
- tabbing, 362
- terminateSystemCommand, 450
- tersyscommand, 450
- thefname, 91
- theid, 90
- theorigin, 88
- thisPosIsEqual, 374
- thisPosIsLess, 374
- throwEvalTypeMsg, 917
- To, 380
- toFile?, 363
- tokConstruct, 411
- token-stack-show, 969
- tokPart, 413
- tokPosn, 413
- tokTran, 465
- tokType, 413
- toScreen?, 351
- trace, 845
- trace1, 846
- traceDomainConstructor, 878
- traceDomainLocalOps, 878
- tracelet, 902
- traceOptionError, 855

- traceReply, 897
- traceSpad2Cmd, 845
- trademark, 521
- translateTrueFalse2YesNo, 657
- translateYesNo2TrueFalse, 656
- transOnlyOption, 858
- transTraceItem, 861
- unAbbreviateKeyword, 467
- undo, 920
- undoChanges, 591
- undoCount, 927
- undoFromFile, 592
- undoInCore, 590
- undoLocalModemapHack, 931
- undoSingleStep, 929
- undoSteps, 928
- unescapeStringsInForm, 62
- unifyStruct, 428
- unifyStructVar, 429
- unparseInputForm, 1055
- unsqueeze, 1026
- untrace, 860
- untraceDomainConstructor, 881
- untraceDomainConstructor,keepTraced?, 880
- untraceDomainLocalOps, 878
- untraceMapSubNames, 871
- unwritable?, 604
- updateCurrentInterpreterFrame, 557
- updateDatabase, 1017
- updateFromCurrentInterpreterFrame, 556
- updateHist, 587
- updateInCoreHist, 588
- updateSourceFiles, 544
- userLevelErrorMessage, 448
- validateOutputDirectory, 722
- vec2list, 1057
- voidValue, 1056
- what, 937
- whatCommands, 939
- whatConstructors, 943
- whatSpad2Cmd, 938
- whatSpad2Cmd,fixpat, 937
- whichCat, 365
- with, 945
- workfiles, 947
- workfilesSpad2Cmd, 947
- wrap, 1045
- write-browsedb, 1032
- write-categorydb, 1033
- write-compress, 1024
- write-interpdb, 1030
- write-operationdb, 1034
- write-warmdata, 1035
- writeHiFi, 600
- writeHistModesAndValues, 601
- writeInputLines, 585
- writify, 608
- writify,writifyInner, 605
- writifyComplain, 604
- xlCannotRead, 91
- xlCmdBug, 98
- xlConActive, 93
- xlConsole, 94
- xlConStill, 94
- xlFileCycle, 92
- xlIfBug, 97
- xlIfSyntax, 96
- xlMsg, 86
- xlNoSuchFile, 90
- xlOK, 86
- xlOK1, 86
- xlPrematureEOF, 86
- xlPrematureFin, 95
- xlSay, 89
- xlSkip, 89
- xlSkippingFin, 95
- yesanswer, 535
- zeroOneTran, 68
- zsystemdevelopment, 951
- zsystemdevelopment1, 952
- zsystemDevelopmentSpad2Cmd, 951
- defvar
 - *allOperations*, 999
 - *allconstructors*, 999
 - *attributes*, 1024
 - *browse-stream*, 998
 - *browse-stream-stamp*, 998
 - *category-stream*, 998
 - *category-stream-stamp*, 999
 - *compress-stream*, 997
 - *compress-stream-stamp*, 997

- *compressVectorLength*, 996
- *compressvector*, 996
- *defaultdomain-list*, 995
- *eof*, 24
- *hasCategory-hash*, 995
- *interp-stream*, 997
- *interp-stream-stamp*, 997
- *miss*, 996
- *monitor-domains*, 1157
- *monitor-nrlibs*, 1157
- *monitor-table*, 1158
- *msghash*, 327
- *operation-hash*, 995
- *operation-stream*, 997
- *operation-stream-stamp*, 998
- *whitespace*, 24
- /editfile, 513
- \$nagMessages, 755
- \$reportBottomUpFlag, 744
- \$BreakMode, 659
- \$CommandSynonymAlist, 476
- \$EndServerSession, 43
- \$HTCompanionWindowID, 52
- \$HiFiAccess, 730
- \$InitialCommandSynonymAlist, 474
- \$InitialModemapFrame, 9
- \$InteractiveMode, 24
- \$NeedToSignalSessionManager, 44
- \$NonNullStream, 609
- \$NullStream, 609
- \$ProcessInteractiveValue, 52
- \$QuietCommand, 47
- \$RTspecialCharacters, 976
- \$SpadServerName, 12, 13
- \$SpadServer, 12
- \$UserLevel, 804
- \$abbreviateTypes, 758
- \$algebraFormat, 759
- \$algebraOutputFile, 759
- \$algebraOutputStream, 760
- \$attrCats, 364
- \$boot, 25
- \$cacheAlist, 705
- \$cacheMessages, 326
- \$clearExcept, 497
- \$clearOptions, 497
- \$compileDontDefineFunctions, 709
- \$compileRecurrence, 710
- \$constructors, 897
- \$current-directory, 7
- \$currentFrameNum, 43
- \$dalymode, 661
- \$defaultFortranType, 715
- \$defaultMsgDatabaseName, 8
- \$defaultSpecialCharacters, 973
- \$describeOptions, 526
- \$directory-list, 8
- \$displayDroppedMap, 736
- \$displayMsgNumber, 743
- \$displayOptions, 533
- \$displaySetValue, 745
- \$displayStartMsgs, 746
- \$domPvar, 49
- \$envHashTable, 961
- \$formulaFormat, 787
- \$formulaOutputFile, 787
- \$fortIndent, 712
- \$fortInts2Floats, 712
- \$fortLength, 713
- \$fortPersistence, 753
- \$fortranArrayStartingIndex, 719
- \$fortranDirectory, 723
- \$fortranFormat, 766
- \$fortranLibraries, 725
- \$fortranOptimizationLevel, 718
- \$fortranOutputFile, 766
- \$fortranPrecision, 715
- \$fortranSegment, 718
- \$fortranTmpDir, 720
- \$fractionDisplayType, 771
- \$frameAlist, 43
- \$frameMessages, 738
- \$frameNumber, 43
- \$frameRecord, 919
- \$fullScreenSysVars, 727
- \$functionTable, 500
- \$genValue, 53
- \$giveExposureWarning, 736
- \$globalExposureGroupAlist, 668
- \$highlightAllowed, 739
- \$historyDirectory, 577
- \$historyDisplayWidth, 728

- \$historyFileType, 577
- \$htmlFormat, 777
- \$htmlOutputFile, 777
- \$imPrGuys, 358
- \$imPrTagGuys, 367
- \$inputPromptType, 744
- \$intCoerceFailure, 32
- \$intRestart, 26
- \$intSpadReader, 32
- \$intTopLevel, 26
- \$interpOnly, 49
- \$lambdtype, 660
- \$library-directory-list, 9
- \$linearFormatScripts, 791
- \$linelength, 771
- \$localExposureDataDefault, 694
- \$localExposureData, 694
- \$margin, 771
- \$mathmlFormat, 773
- \$mathmlOutputFile, 773
- \$maximumFortranExpressionLength, 717
- \$minivectorNames, 49
- \$msgAlist, 326
- \$msgDatabaseName, 9, 10, 326
- \$msgdbNoBlanksAfterGroup, 328
- \$msgdbNoBlanksBeforeGroup, 328
- \$msgdbPrims, 327
- \$msgdbPunct, 327
- \$nagEnforceDouble, 756
- \$nagHost, 751
- \$nagMessages, 742
- \$ncMsgList, 27
- \$newcompErrorCount, 28
- \$noEvalTypeMsg, 917
- \$noParseCommands, 442
- \$noSubsumption, 960
- \$n opos, 28
- \$numericFailure, 1073
- \$oldBreakMode, 1074
- \$oldHistoryFileName, 576
- \$oldline, 447
- \$openMathFormat, 782
- \$openMathOutputFile, 782
- \$openServerIfTrue, 10
- \$optionAlist, 844
- \$pfMacros, 98
- \$plainRTspecialCharacters, 976
- \$plainSpecialCharacters0, 974
- \$plainSpecialCharacters1, 974
- \$plainSpecialCharacters2, 975
- \$plainSpecialCharacters3, 975
- \$preLength, 355
- \$prettyprint, 803
- \$previousBindings, 919
- \$printAnyIfTrue, 732
- \$printFortranDecs, 714
- \$printLoadMsgs, 733
- \$printStatsToFile, 737
- \$printStatisticsSummaryIfTrue, 747
- \$printTimeIfTrue, 748
- \$printTypeIfTrue, 749
- \$printVoidIfTrue, 750
- \$promptMsg, 28
- \$quitCommandType, 797
- \$quitTag, 20
- \$relative-directory-list, 10, 11
- \$relative-library-directory-list, 11
- \$repGuys, 375
- \$reportBottomUpFlag, 734
- \$reportCoerceIfTrue, 735
- \$reportCompilation, 801
- \$reportInstantiations, 740
- \$reportInterpOnly, 741
- \$reportOptimization, 802
- \$reportSpadTrace, 844
- \$reportUndo, 920
- \$setOptionNames, 805
- \$sockBufferLength, 44
- \$spad-errors, 965
- \$spadroot, 11, 12
- \$specialCharacterAlist, 977
- \$specialCharacters, 977
- \$streamCount, 798
- \$streamsShowAll, 800
- \$syscommands, 442
- \$systemCommands, 441
- \$testingErrorPrefix, 327
- \$testingSystem, 748
- \$texFormatting, 327
- \$texFormat, 793
- \$texOutputFile, 793
- \$toWhereGuys, 363

- \$tokenCommands, 473
- \$traceNoisely, 844
- \$traceOptionList, 844
- \$tracedMapSignatures, 844
- \$underbar, 584
- \$undoFlag, 919
- \$useEditorForShowOutput, 792
- \$useFullScreenHelp, 729
- \$useInternalHistoryTable, 577
- \$useIntrinsicFunctions, 716
- \$whatOptions, 937
- boot-line-stack, 959
- CLOSEPAREN, 107
- credits, 1
- curinstream, 23
- curoutstream, 23
- DOT, 106
- dotdot, 323
- echo-meta, 960
- Else?, 80
- Elseif?, 79
- ElseifKeepPart, 78
- ElseifSkipPart, 78
- ElseifSkipToEnd, 78
- ElseKeepPart, 79
- ElseSkipToEnd, 78
- errorinstream, 23
- erroroutstream, 24
- ESCAPE, 105
- EXPONENT1, 107
- EXPONENT2, 107
- file-closed, 960
- If?, 79
- IfKeepPart, 77
- IfSkipPart, 78
- IfSkipToEnd, 77
- in-stream, 959
- incCommands, 98
- infgeneric, 110
- input-libraries, 666
- KeepPart?, 80
- line-handler, 965
- MINUSCOMMENT, 106
- npPParg, 204, 209
- out-stream, 960
- output-library, 663
- PLUSCOMMENT, 106
- QUESTION, 107
- RADIXCHAR, 106
- scanCloser, 125
- scanDict, 137
- scanKeyTable, 136
- scanKeyWords, 108
- scanPun, 139
- SkipEnd?, 80
- SkipPart?, 81
- Skipping?, 81
- SPACE, 105
- StreamNil, 104
- STRINGCHAR, 105
- Top, 77
- Top?, 79
- xtokenreader, 966
- delasc
 - calledby spadUntrace, 894
- Delay, 103
 - calledby incAppend, 87
 - calledby incIgen, 75
 - calledby incLude, 76
 - calledby incRgen, 103
 - calledby incZip, 74
 - calledby next, 38
 - defun, 103
- deldatabase, 1009
 - calledby abbreviationsSpad2Cmd, 481
 - defun, 1009
- delete
 - calledby breaklet, 903
 - calledby setExposeAddConstr, 698
 - calledby setExposeDropConstr, 701
 - calledby setExposeDropGroup, 700
 - calledby trace1, 846
 - calledby tracelet, 902
 - calledby untraceDomainConstructor, 881
 - calledby workfilesSpad2Cmd, 947
- deleteAssoc
 - calledby clearCmdParts, 503
- deleteFile, 1044
 - calledby clearCmdAll, 501
 - calls erase, 1044
 - calls pathname, 1045
 - uses \$erase, 1045

- defun, 1044
- delt, 1075
 - defmacro, 1075
- describe, 526
 - calls describespad2cmd, 526
 - defun, 526
- describe help page, 525
 - manpage, 525
- describeFortPersistence, 754
 - calledby setFortPers, 754
 - calls sayBrightly, 754
 - uses \$fortPersistence, 754
 - defun, 754
- describeInputLibraryArgs, 666
 - calledby setInputLibrary, 665
 - calls sayBrightly, 666
 - defun, 666
- describeOutputLibraryArgs, 663
 - calledby setOutputLibrary, 662
 - calls sayBrightly, 663
 - defun, 663
- describeSetFortDir, 724
 - calledby setFortDir, 723
 - calls sayBrightly, 724
 - uses \$fortranDirectory, 724
 - defun, 724
- describeSetFortTmpDir, 722
 - calledby setFortTmpDir, 721
 - calls sayBrightly, 722
 - uses \$fortranTmpDir, 722
 - defun, 722
- describeSetLinkerArgs, 726
 - calledby setLinkerArgs, 726
 - calls sayBrightly, 726
 - uses \$fortranLibraries, 726
 - defun, 726
- describeSetNagHost, 752
 - calledby setNagHost, 752
 - calls sayBrightly, 752
 - uses \$nagHost, 752
 - defun, 752
- describeSetOutputAlgebra, 762
 - calledby setOutputAlgebra, 760
 - calls sayBrightly, 762
 - calls setOutputAlgebra, 762
 - defun, 762
- describeSetOutputFormula, 790
 - calledby setOutputFormula, 788
 - calls sayBrightly, 790
 - calls setOutputFormula, 790
 - defun, 790
- describeSetOutputFortran, 769
 - calledby setOutputFortran, 767
 - calls sayBrightly, 769
 - calls setOutputFortran, 769
 - defun, 769
- describeSetOutputHtml, 780
 - calledby setOutputHtml, 778
 - calls sayBrightly, 780
 - calls setOutputHtml, 780
 - defun, 780
- describeSetOutputMathml, 776
 - calledby setOutputMathml, 774
 - calls sayBrightly, 776
 - calls setOutputMathml, 776
 - defun, 776
- describeSetOutputOpenMath, 785
 - calledby setOutputOpenMath, 783
 - calls sayBrightly, 785
 - calls setOutputOpenMath, 785
 - defun, 785
- describeSetOutputTex, 796
 - calledby setOutputTex, 794
 - calls sayBrightly, 796
 - calls setOutputTex, 796
 - defun, 796
- describeSetStreamsCalculate, 799
 - calledby setStreamsCalculate, 799
 - calls sayKeyedMsg, 799
 - uses \$streamCount, 800
 - defun, 799
- describeSpad2Cmd, 526
 - calls cleanline, 527
 - calls flatten, 527
 - calls getdatabase, 527
 - calls sayMessage, 527
 - calls selectOptionLC, 527
 - uses \$EmptyEnvironment, 527
 - uses \$describeOptions, 527
 - uses \$e, 527
 - defun, 526
- describespad2cmd

- calledby describe, 526
- desiredMsg, 352
 - calledby ncHardError, 352
 - calledby ncSoftError, 351
 - defun, 352
- devaluate
 - calledby /tracereply, 892
 - calledby ?t, 901
 - calledby addTraceItem, 900
 - calledby mkEvalable, 911
 - calledby prTraceNames,fn, 896
 - calledby printTypeAndTimeSaturn, 60
 - calledby shortenForPrinting, 889
 - calledby spadReply,printName, 892
 - calledby spadUntrace, 893
 - calledby trace1, 846
 - calledby transTraceItem, 861
 - calledby untraceDomainConstructor,keepTDEAsyn, 880
 - calledby writify,writifyInner, 605
- dewritify, 613
 - calledby SPADRREAD, 603
 - calls ScanOrPairVec, 613
 - calls dewritify,dewritifyInner, 613
 - calls function, 613
 - uses \$seen, 613
 - defun, 613
- dewritify,dewritifyInner, 610
 - calledby dewritify,dewritifyInner, 610
 - calledby dewritify, 613
 - calls concat, 610
 - calls dewritify,dewritifyInner, 610
 - calls error, 610
 - calls exit, 610
 - calls gensymmer, 610
 - calls hget, 610
 - calls hput, 610
 - calls intp, 610
 - calls make-instream, 610
 - calls poundsign, 610
 - calls qcar, 610
 - calls qcdr, 610
 - calls qrplaca, 610
 - calls qrplacd, 610
 - calls qsetvelt, 610
 - calls qvelt, 610
 - calls qvmaxindex, 610
 - calls seq, 610
 - calls spaddifference, 610
 - calls vecp, 610
 - calls vmread, 610
 - uses \$NonNullStream, 610
 - uses \$NullStream, 610
 - uses \$seen, 610
 - defun, 610
- DFAcos, 1093
 - defmacro, 1093
- DFAcosh, 1095
 - defmacro, 1095
- DFAAdd, 1088
 - defmacro, 1088
- DFAasin, 1093
 - defmacro, 1093
- DFAatanh, 1095
 - defmacro, 1095
- DFAatan, 1093
 - defmacro, 1093
- DFAatan2, 1094
 - defmacro, 1094
- DFAtanh, 1096
 - defmacro, 1096
- DFCos, 1092
 - defmacro, 1092
- DFCosh, 1094
 - defmacro, 1094
- DFDivide, 1090
 - defmacro, 1090
- DFEql, 1090
 - defmacro, 1090
- DFExp, 1092
 - defmacro, 1092
- DFExpt, 1092
 - defmacro, 1092
- DFIntegerDivide, 1090
 - defmacro, 1090
- DFIntegerExpt, 1091
 - defmacro, 1091
- DFIntegerMultiply, 1089
 - defmacro, 1089
- DFLessThan, 1087
 - defmacro, 1087
- DFLog, 1091

- defmacro, 1091
- DFLogE, 1091
 - defmacro, 1091
- DFMax, 1089
 - defmacro, 1089
- DFMin, 1090
 - defmacro, 1090
- DFMinusp, 1088
 - defmacro, 1088
- DFMultiply, 1089
 - defmacro, 1089
- DFSin, 1092
 - defmacro, 1092
- DFSinh, 1094
 - defmacro, 1094
- DFSqrt, 1091
 - defmacro, 1091
- DFSubtract, 1089
 - defmacro, 1089
- DFTan, 1093
 - defmacro, 1093
- DFTanh, 1095
 - defmacro, 1095
- DFUnaryMinus, 1088
 - defmacro, 1088
- DFZerop, 1088
 - defmacro, 1088
- diffAlist, 922
 - calledby recordFrame, 921
 - calls assoc, 923
 - calls assq, 923
 - calls exit, 923
 - calls lassq, 923
 - calls reportUndo, 923
 - calls seq, 923
 - calls tmp1, 923
 - defun, 922
- dig2fix
 - calledby isSharpVarWithNum, 884
- digit?, 122
 - calledby scanExponent, 126
 - calledby scanPossFloat, 121
 - calledby scanToken, 114
 - calls digitp, 122
 - defun, 122
- digitp, 1047
 - calledby digit?, 122
 - calledby digitp, 1047
 - calledby isSharpVarWithNum, 884
 - calledby isgenvar, 885
 - calls digitp, 1047
 - defun, 1047
- DirToString, 1085
 - calledby fNameDirectory, 1085
 - defun, 1085
- disableHist, 601
 - calledby fetchOutput, 598
 - calledby historySpad2Cmd, 580
 - calledby restoreHistory, 595
 - calledby setHistoryCore, 583
 - calledby showInOut, 598
 - calledby showInput, 597
 - calledby undoFromFile, 592
 - calledby undoInCore, 591
 - calledby updateHist, 587
 - calls histFileErase, 601
 - calls histFileName, 601
 - uses \$HiFiAccess, 601
 - defun, 601
- display, 533
 - calls displayspad2cmd, 533
 - defun, 533
- display help page, 531
 - manpage, 531
- displayCondition, 463
 - calledby displayProperties, 459
 - calls bright, 463
 - calls concat, 463
 - calls pred2English, 463
 - calls sayBrightly, 463
 - defun, 463
- displayExposedConstructors, 702
 - calledby setExposeAddConstr, 698
 - calledby setExposeAddGroup, 696
 - calledby setExposeAdd, 695
 - calledby setExposeDropConstr, 701
 - calledby setExposeDropGroup, 700
 - calledby setExpose, 695
 - calls centerAndHighlight, 702
 - calls sayKeyedMsg, 702
 - uses \$localExposureData, 702
 - defun, 702

- displayExposedGroups, 702
 - calledby setExposeAddGroup, 696
 - calledby setExposeAdd, 695
 - calledby setExposeDropGroup, 700
 - calledby setExpose, 694
 - calls centerAndHighlight, 702
 - calls sayKeyedMsg, 702
 - uses \$interpreterFrameName, 702
 - uses \$localExposureData, 702
 - defun, 702
- displayFrameNames, 561
 - calledby frameSpad2Cmd, 564
 - calls bright, 561
 - calls framename, 561
 - calls sayKeyedMsg, 561
 - uses \$interpreterFrameRing, 561
 - defun, 561
- displayHiddenConstructors, 703
 - calledby setExposeAddGroup, 696
 - calledby setExposeDropConstr, 701
 - calledby setExposeDropGroup, 700
 - calledby setExposeDrop, 699
 - calledby setExpose, 695
 - calls centerAndHighlight, 703
 - calls sayKeyedMsg, 703
 - uses \$localExposureData, 703
 - defun, 703
- displayMacro, 451
 - calledby displayMacros, 536
 - calledby displayProperties, 460
 - calls bright, 452
 - calls isInterpMacro, 451
 - calls mathprint, 452
 - calls object2String, 452
 - calls sayBrightly, 452
 - calls strconc, 452
 - uses \$op, 452
 - defun, 451
- displayMacros, 536
 - calledby displaySpad2Cmd, 533
 - calls displayMacro, 536
 - calls displayParserMacro, 536
 - calls exit, 536
 - calls getInterpMacroNames, 536
 - calls getParserMacroNames, 536
 - calls member, 536
 - calls remdup, 536
 - calls sayBrightly, 536
 - calls seq, 536
 - defun, 536
- displayMode, 464
 - calledby displayProperties, 459
 - calls bright, 464
 - calls concat, 464
 - calls fixObjectForPrinting, 464
 - calls prefix2String, 465
 - calls sayBrightly, 464
 - defun, 464
- displayModemap, 464
 - calledby displayProperties, 460
 - calls bright, 464
 - calls concat, 464
 - calls formatSignature, 464
 - calls sayBrightly, 464
 - defun, 464
- displayOperations, 535
 - calledby displaySpad2Cmd, 533
 - calls reportOpSymbol, 535
 - calls sayKeyedMsg, 535
 - calls yesanswer, 535
 - defun, 535
- displayOperationsFromLisplib, 818
 - calledby reportOpsFromLisplib, 816
 - calls centerAndHighlight, 818
 - calls eqsubstlist, 818
 - calls formatOperationAlistEntry, 819
 - calls getdatabase, 818
 - calls msort, 818
 - calls remdup, 818
 - calls reportOpsFromUnitDirectly, 818
 - calls say2PerLine, 819
 - calls specialChar, 818
 - uses \$FormalMapVariableList, 819
 - uses \$linelength, 819
 - defun, 818
- displayParserMacro, 462
 - calledby displayMacros, 536
 - calledby displayProperties, 460
 - calls pfPrintSrcLines, 462
 - uses \$pfMacros, 462
 - defun, 462
- displayProperties, 459

- calledby displaySpad2Cmd, 533
- calls bright, 460
- calls displayCondition, 459
- calls displayMacro, 460
- calls displayModemap, 460
- calls displayMode, 459
- calls displayParserMacro, 460
- calls displayProperties,sayFunctionDeps, 460
- calls displayType, 459
- calls displayValue, 459
- calls exit, 460
- calls fixObjectForPrinting, 460
- calls getAndSay, 459
- calls getIProplist, 459
- calls getInterpMacroNames, 459
- calls getI, 459
- calls getParserMacroNames, 459
- calls getWorkspaceNames, 459
- calls interpFunctionDepAlists, 459
- calls isInternalMapName, 459
- calls isInterpMacro, 460
- calls member, 460
- calls msort, 459
- calls prefix2String, 460
- calls qcar, 459
- calls qcdr, 459
- calls remdup, 459
- calls sayKeyedMsg, 459
- calls sayMSG, 460
- calls seq, 460
- calls terminateSystemCommand, 460
- uses \$dependeeAlist, 460
- uses \$dependentAlist, 460
- uses \$frameMessages, 460
- uses \$interpreterFrameName, 460
- defun, 459
- displayProperties,sayFunctionDeps, 454
 - calledby displayProperties, 460
 - calls bright, 456
 - calls exit, 456
 - calls getalist, 456
 - calls sayMSG, 456
 - calls seq, 456
 - uses \$dependeeAlist, 456
 - uses \$dependentAlist, 456
- defun, 454
- displayRule
 - calledby displayValue, 457
- displaySetOptionInformation, 653
 - calledby set1, 806
 - calls boot-equal, 653
 - calls bright, 653
 - calls centerAndHighlight, 653
 - calls concat, 653
 - calls displaySetVariableSettings, 653
 - calls eval, 653
 - calls literals, 653
 - calls object2String, 653
 - calls sayBrightly, 653
 - calls sayMSG, 653
 - calls sayMessage, 653
 - calls specialChar, 653
 - calls translateTrueFalse2YesNo, 653
 - uses \$linelength, 653
 - defun, 653
- displaySetVariableSettings, 655
 - calledby displaySetOptionInformation, 653
 - calledby set1, 806
 - calls bright, 655
 - calls centerAndHighlight, 655
 - calls concat, 655
 - calls eval, 655
 - calls fillerSpaces, 655
 - calls literals, 655
 - calls object2String, 655
 - calls poundsign, 655
 - calls satisfiesUserLevel, 655
 - calls sayBrightly, 655
 - calls say, 655
 - calls spaddifference, 655
 - calls specialChar, 655
 - calls translateTrueFalse2YesNo, 655
 - calls tree, 655
 - uses \$linelength, 655
 - defun, 655
- displaySpad2Cmd
 - calls abbQuery, 533
 - calls displayMacros, 533
 - calls displayOperations, 533
 - calls displayProperties, 533
 - calls displayWorkspaceNames, 533

- calls listConstructorAbbreviations, 533
- calls opOf, 533
- calls sayMessage, 534
- calls selectOptionLC, 534
- uses \$EmptyEnvironment, 534
- uses \$displayOptions, 534
- uses \$e, 534
- displayspad2cmd
 - calledby display, 533
- displayType, 458
 - calledby displayProperties, 459
 - calls concat, 458
 - calls fixObjectForPrinting, 458
 - calls objMode, 458
 - calls pname, 458
 - calls prefix2String, 458
 - calls sayMSG, 458
 - uses \$op, 458
 - defun, 458
- displayValue, 457
 - calledby displayProperties, 459
 - calls concat, 457
 - calls displayRule, 457
 - calls fixObjectForPrinting, 457
 - calls form2String, 457
 - calls getdatabase, 457
 - calls mathprint, 457
 - calls objMode, 457
 - calls objValUnwrap, 457
 - calls outputFormat, 457
 - calls pname, 457
 - calls prefix2String, 457
 - calls sayMSG, 457
 - calls strconc, 457
 - uses \$EmptyMode, 457
 - uses \$op, 457
 - defun, 457
- displayWorkspaceNames, 452
 - calledby displaySpad2Cmd, 533
 - calls getInterpMacroNames, 452
 - calls getParserMacroNames, 452
 - calls getWorkspaceNames, 452
 - calls msort, 452
 - calls sayAsManyPerLineAsPossible, 452
 - calls sayBrightly, 452
 - calls sayMessage, 452
 - calls setdifference, 452
 - defun, 452
- divide2, 1080
 - defun, 1080
- dlen, 1074
 - defmacro, 1074
- domainsOf
 - calledby make-databases, 1018
- domainToGenvar, 859
 - calledby getTraceOption,hn, 852
 - calledby transTraceItem, 861
 - calls evalDomain, 859
 - calls genDomainTraceName, 859
 - calls getdatabase, 859
 - calls opOf, 859
 - calls unabbrevAndLoad, 859
 - uses \$doNotAddEmptyModeIfTrue, 859
 - defun, 859
- domArg, 422
 - calledby hasCaty, 420
 - calledby mkDomPvar, 432
 - local ref \$FormalMapVariableList, 422
 - defun, 422
- domArg2, 422
 - calledby hasCaty, 420
 - calls isSharpVar, 422
 - calls subCopy, 422
 - local ref \$domPvar, 422
 - defun, 422
- done
 - calledby insertPos, 379
- doSystemCommand, 444
 - calledby ExecuteInterpSystemCommand, 33
 - calls concat, 444
 - calls expand-tabs, 444
 - calls getFirstWord, 444
 - calls handleNoParseCommands, 444
 - calls handleParsedSystemCommands, 444
 - calls handleTokenSizeSystemCommands, 444
 - calls member, 444
 - calls processSynonyms, 444
 - calls splitIntoOptionBlocks, 444
 - calls substring, 444
 - calls unAbbreviateKeyword, 444

- uses \$noParseCommands, 444
 - uses \$tokenCommands, 444
 - uses line, 444
 - defun, 444
- DOT, 106
 - defvar, 106
- dotdot, 323
 - defvar, 323
- downcase
 - calledby apropos, 943
 - calledby selectOptionLC, 477
 - calledby set1, 806
 - calledby setOutputCharacters, 764
 - calledby whatSpad2Cmd,fixpat, 937
- dqAppend, 344
 - calledby dqConcat, 343
 - calledby pileCtree, 340
 - defun, 344
- dqConcat, 343
 - calledby dqConcat, 343
 - calledby enPile, 340
 - calledby separatePiles, 341
 - calls dqAppend, 343
 - calls dqConcat, 343
 - defun, 343
- dqToList, 344
 - calledby intloopEchoParse, 69
 - calledby ncloopParse, 38
 - defun, 344
- dqUnit, 343
 - calledby enPile, 340
 - calledby lineoftoks, 111
 - calledby scanToken, 114
 - calledby separatePiles, 341
 - defun, 343
- drop[9]
 - called by frameSpad2Cmd, 564
- dropInputLibrary, 667
 - calledby addInputLibrary, 666
 - calledby openOutputLibrary, 664
 - calledby setInputLibrary, 665
 - uses input-libraries, 667
 - defun, 667
- dropLeadingBlanks
 - calledby processSynonymLine,removeKeyFromLine, 832
- dsetaref2, 1078
 - defmacro, 1078
- dsetelt, 1075
 - defmacro, 1075
- dumbTokenize, 465
 - calledby handleParsedSystemCommands, 466
 - calledby handleTokenizeSystemCommands, 445
 - calledby parseSystemCmd, 467
 - calls stripSpaces, 465
 - defun, 465
- echo-meta, 960
 - defvar, 960
- edit, 542
 - calls editSpad2Cmd, 542
 - defun, 542
- edit help page, 541
 - manpage, 541
- editFile, 543
 - calledby editSpad2Cmd, 542
 - calledby reportOpsFromLisplib1, 815
 - calledby reportOpsFromUnitDirectly1, 823
 - calls namestring, 543
 - calls obey, 543
 - calls pathname, 543
 - calls strconc, 543
 - defun, 543
- editSpad2Cmd, 542
 - calledby edit, 542
 - calls \$FINDFILE, 542
 - calls editFile, 542
 - calls pathnameDirectory, 542
 - calls pathnameName, 542
 - calls pathnameType, 542
 - calls pathname, 542
 - calls updateSourceFiles, 542
 - uses /editfile, 543
 - defun, 542
- Else?, 80
 - calledby xIfSyntax, 96
 - calls QUOTIENT, 80
 - defvar, 80
- Elseif?, 79
 - calledby incLude1, 82

- calls QUOTIENT, 79
- defvar, 79
- ElseifKeepPart, 78
 - defvar, 78
- ElseifSkipPart, 78
 - defvar, 78
- ElseifSkipToEnd, 78
 - defvar, 78
- ElseKeepPart, 79
 - defvar, 79
- ElseSkipToEnd, 78
 - defvar, 78
- elt32, 1057
 - defmacro, 1057
- embed
 - calledby traceDomainConstructor, 879
- emptyInterpreterFrame, 554
 - calledby addNewInterpreterFrame, 559
 - calledby initializeInterpreterFrameRing, 553
 - uses \$HiFiAccess, 554
 - uses \$HistListAct, 554
 - uses \$HistListLen, 554
 - uses \$HistList, 554
 - uses \$HistRecord, 554
 - uses \$localExposureDataDefault, 554
 - defun, 554
- enable-backtrace
 - calledby break, 904
 - calledby ncBug, 368
- enPile, 340
 - calledby pileCforest, 340
 - calls dqConcat, 340
 - calls dqUnit, 340
 - calls firstTokPosn, 340
 - calls lastTokPosn, 340
 - calls tokConstruct, 340
 - defun, 340
- entryWidth
 - calledby printLabelledList, 472
- eof
 - usedby fin, 546
- eofp, 981
 - defun, 981
- eqcar
 - calledby StreamNull, 333
- calledby hasCateSpecialNew, 435
- calledby hasCateSpecial, 434
- calledby pfAbSynOp?, 412
- calledby poNoPosition?, 413
- eqpileTree, 339
 - calledby pileForest1, 338
 - calls npNull, 339
 - calls pileColumn, 339
 - calls pileForests, 339
 - defun, 339
- eqsubstlist
 - calledby displayOperationsFromLisplib, 818
 - calledby reportOpsFromLisplib, 816
- erase
 - calledby deleteFile, 1044
 - calledby reportOpsFromLisplib1, 815
 - calledby reportOpsFromUnitDirectly1, 823
 - calledby saveDependentsHashTable, 1021
 - calledby saveUsersHashTable, 1022
- erMsgCompare, 370
 - calls compareposns, 370
 - calls getMsgPos, 370
 - defun, 370
- erMsgSep, 370
 - calledby erMsgSort, 369
 - calls getMsgPos, 370
 - calls poNopos?, 370
 - defun, 370
- erMsgSort, 369
 - calledby processMsgList, 369
 - calls erMsgSep, 369
 - calls listSort, 369
 - defun, 369
- error
 - calledby basicLookupCheckDefaults, 1072
 - calledby basicLookup, 1070
 - calledby charDigitVal, 615
 - calledby dewritify, dewritifyInner, 610
 - calledby gensymInt, 614
 - calledby myWritable?, 1086
- errorinstream, 23
 - defvar, 23
- erroroutstream, 24
 - defvar, 24
- ESCAPE, 105

- defvar, 105
- eval
 - calledby NRTEvalDomain, 1073
 - calledby displaySetOptionInformation, 653
 - calledby displaySetVariableSettings, 655
 - calledby evalDomain, 911
- evalCategory, 957
 - calledby evaluateType1, 916
 - calls isPartialMode, 957
 - calls ofCategory, 957
 - defun, 957
- evalDomain, 911
 - calledby NRTEvalDomain, 1073
 - calledby domainToGenvar, 859
 - calledby reportOpsFromUnitDirectly, 820
 - calls concat, 911
 - calls eval, 911
 - calls mkEvaluable, 911
 - calls prefix2String, 911
 - calls sayMSG, 911
 - calls startTimingProcess, 911
 - calls stopTimingProcess, 911
 - local ref \$evalDomain, 911
 - defun, 911
- evaluateSignature, 918
 - calledby evaluateType, 914
 - calls evaluateType, 918
 - defun, 918
- evaluateType, 914
 - calledby evaluateSignature, 918
 - calledby evaluateType1, 916
 - calledby evaluateType, 914
 - calledby reportOperations, 814
 - calls bottomUp, 914
 - calls constructor?, 914
 - calls evaluateSignature, 914
 - calls evaluateType, 914
 - calls getValue, 914
 - calls isDomainValuedVariable, 914
 - calls member, 914
 - calls mkAtree, 914
 - calls objVal, 914
 - calls qcar, 914
 - calls qcdr, 914
 - calls throwEvalTypeMsg, 914
 - local def \$expandSegments, 914
 - local ref \$EmptyMode, 914
 - defun, 914
- evaluateType1, 915
 - calls bottumUp, 916
 - calls categoryForm?, 915
 - calls coerceOrRetract, 916
 - calls constructor?, 915
 - calls evalCategory, 916
 - calls evaluateType, 916
 - calls getAndEvalConstructorArgument, 916
 - calls getConstructorSignature, 915
 - calls getdatabase, 916
 - calls makeOrdinal, 916
 - calls mkAtree, 916
 - calls objValUnwrap, 916
 - calls putTarget, 916
 - calls qcar, 916
 - calls qcdr, 916
 - calls replaceSharps, 915
 - calls throwEvalTypeMsg, 915
 - calls throwKeyedMsgCannotCoerceWithValue, 916
 - local ref \$EmptyMode, 916
 - local ref \$quadSymbol, 916
 - defun, 915
- ExecuteInterpSystemCommand, 33
 - calledby InterpExecuteSpadSystemCommand, 32
 - calls doSystemCommand, 33
 - calls intProcessSynonyms, 33
 - calls substring, 33
 - uses \$currentLine, 33
 - defun, 33
- executeQuietCommand, 47
 - calledby serverReadLine, 44
 - calls make-string, 47
 - calls parseAndInterpret, 47
 - calls sockGetString, 47
 - uses \$MenuServer, 47
 - uses \$QuietCommand, 47
 - catches, 47
 - defun, 47
- exit
 - calledby /tracereply, 892
 - calledby abbreviationsSpad2Cmd, 481
 - calledby apropos, 943

- calledby clearCmdParts, 503
- calledby coerceSpadArgs2E, 863
- calledby dewritify,dewritifyInner, 610
- calledby diffAlist, 923
- calledby displayMacros, 536
- calledby displayProperties,sayFunctionDepEND, 456
- calledby displayProperties, 460
- calledby flattenOperationAlist, 881
- calledby funfind,LAM, 872
- calledby getAliasIfTracedMapParameter, 887
- calledby getBpiNameIfTracedMap, 888
- calledby getPreviousMapSubNames, 868
- calledby getTraceOption,hn, 851
- calledby getTraceOptions, 850
- calledby getTraceOption, 852
- calledby getWorkspaceNames, 453
- calledby historySpad2Cmd, 581
- calledby importFromFrame, 561
- calledby isListOfIdentifiersOrStrings, 867
- calledby isListOfIdentifiers, 866
- calledby orderBySlotNumber, 891
- calledby prTraceNames,fn, 896
- calledby prTraceNames, 896
- calledby recordFrame, 921
- calledby removeUndoLines, 931
- calledby reportUndo, 926
- calledby runspad, 21
- calledby set1, 806
- calledby spadReply,printName, 892
- calledby spadReply, 893
- calledby spadTrace,isTraceable, 874
- calledby spadTrace, 874
- calledby spadUntrace, 894
- calledby subTypes, 864
- calledby trace1, 846
- calledby traceDomainConstructor, 879
- calledby traceReply, 897
- calledby undoFromFile, 592
- calledby undoLocalModemapHack, 931
- calledby undoSingleStep, 929
- calledby untraceDomainConstructor,keepTraced, 880
- calledby untraceDomainConstructor, 881
- calledby whatConstructors, 943
- calledby whatSpad2Cmd, 938
- calledby writify,writifyInner, 605
- expand-tabs
 - calledby doSystemCommand, 444
 - calledby include1, 82
- EXPONENT1, 107
 - defvar, 107
- EXPONENT2, 107
 - defvar, 107
- extendLocalLibdb
 - calledby library, 1013
- fbpip
 - calledby mkEvalable, 911
- fetchKeyedMsg, 328
 - calledby getKeyedMsg, 329
 - calls cacheKeyedMsg, 328
 - calls object2Identifier, 328
 - uses *msghash*, 328
 - uses \$defaultMsgDatabaseName, 328
 - defun, 328
- fetchOutput, 598
 - calls assq, 598
 - calls boot-equal, 598
 - calls disableHist, 598
 - calls getI, 598
 - calls readHiFi, 598
 - calls spaddifference, 598
 - calls throwKeyedMsg, 598
 - defun, 598
- file-closed, 960
 - usedby init-boot/spad-reader, 966
 - defvar, 960
- filep
 - calledby setOutputLibrary, 662
- fillerSpaces, 20
 - calledby displaySetVariableSettings, 655
 - calledby justifyMyType, 62
 - calledby printLabelledList, 472
 - calledby spadStartUpMsgs, 19
 - calls ifcar, 20
 - defun, 20
- filterAndFormatConstructors, 942
 - calledby whatSpad2Cmd, 938
 - calls blankList, 942
 - calls centerAndHighlight, 942

- calls filterListOfStringsWithFn, 942
- calls function, 942
- calls pp2Cols, 942
- calls sayMessage, 942
- calls specialChar, 942
- calls whatConstructors, 942
- uses \$linelength, 942
- defun, 942
- filterListOfStrings, 940
 - calledby apropos, 943
 - calledby whatCommands, 940
 - calls satisfiesRegularExpressions, 940
 - defun, 940
- filterListOfStringsWithFn, 941
 - calledby filterAndFormatConstructors, 942
 - calledby printSynonyms, 472
 - calls satisfiesRegularExpressions, 941
 - defun, 941
- fin, 546
 - uses eof, 546
 - defun, 546
 - throws, 546
- fin help page, 545
 - manpage, 545
- findfile
 - calledby readSpad2Cmd, 640
- findFrameInRing, 557
 - calledby changeToNamedInterpreterFrame, 558
 - calls boot-equal, 557
 - calls frameName, 557
 - uses \$interpreterFrameRing, 557
 - defun, 557
- firstTokPosn, 341
 - calledby enPile, 340
 - calls tokPosn, 341
 - defun, 341
- fixObjectForPrinting, 454
 - calledby clearCmdParts, 503
 - calledby displayMode, 464
 - calledby displayProperties, 460
 - calledby displayType, 458
 - calledby displayValue, 457
 - calls member, 454
 - calls object2Identifier, 454
 - calls pname, 454
 - calls strconc, 454
 - uses \$msgdbPrims, 454
 - defun, 454
- flatten, 529
 - calledby describeSpad2Cmd, 527
 - defun, 529
- flattenOperationAlist, 881
 - calledby spadTrace, 874
 - calls exit, 881
 - calls seq, 881
 - defun, 881
- float
 - calledby ptimers, 857
- float2Sex, 305
 - calledby pLiteral2Sex, 304
 - uses \$useBFasDefault, 305
 - defun, 305
- flowSegmentedMsg
 - calledby msgOutputter, 353
 - calledby msgText, 62
 - calledby sayKeyedMsgLocal, 330
 - calledby traceReply, 897
- flung
 - usedby intloopSpadProcess, 65
- fnameDirectory, 1085
 - calledby myWritable?, 1086
 - calls DirToString, 1085
 - defun, 1085
- fnameExists?, 1086
 - calledby myWritable?, 1086
 - defun, 1086
- fnameMake, 1084
 - calledby fnameNew, 1087
 - calls StringToDir, 1084
 - defun, 1084
- fnameName, 1085
 - defun, 1085
- fnameNew, 1087
 - calls fnameMake, 1087
 - defun, 1087
- fnameReadable?, 1086
 - defun, 1086
- fnameType, 1085
 - defun, 1085
- fnameWritable?, 1086
 - calls myWriteable?, 1086

- defun, 1086
- for, 391
 - syntax, 391
- form2String
 - calledby displayValue, 457
 - calledby reportOpsFromLisplib, 816
- form2StringAsTeX
 - calledby printTypeAndTimeSaturn, 60
- form2StringWithWhere
 - calledby reportOpsFromLisplib, 816
- formatAttribute
 - calledby reportOpsFromLisplib, 816
 - calledby reportOpsFromUnitDirectly, 820
- formatOperation
 - calledby reportOpsFromUnitDirectly, 820
- formatOperationAlistEntry
 - calledby displayOperationsFromLisplib, 819
- formatOpType
 - calledby reportOpsFromUnitDirectly, 820
- formatSignature
 - calledby compiledLookupCheck, 500
 - calledby displayModemap, 464
- frame, 563
 - calls frameSpad2Cmd, 563
 - defun, 563
- frame help page, 547
 - manpage, 547
- frameEnvironment, 554
 - calledby importFromFrame, 561
 - calls frameInteractive, 554
 - defun, 554
- frameInteractive
 - calledby frameEnvironment, 554
- frameName, 550
 - calledby findFrameInRing, 557
 - defun, 550
- framename
 - calledby addNewInterpreterFrame, 559
 - calledby closeInterpreterFrame, 560
 - calledby displayFrameNames, 561
 - calledby importFromFrame, 561
- frameNames, 554
 - calledby importFromFrame, 561
 - uses \$interpreterFrameRing, 554
 - defun, 554
- frameSpad2Cmd, 564
 - calledby frame, 563
 - calls addNewInterpreterFrame, 564
 - calls closeInterpreterFrame, 564
 - calls displayFrameNames, 564
 - calls drop[9], 564
 - calls helpSpad2Cmd, 564
 - calls importFromFrame, 564
 - calls import, 564
 - calls last, 564
 - calls names, 564
 - calls new, 564
 - calls nextInterpreterFrame, 564
 - calls next, 564
 - calls object2Identifier, 564
 - calls previousInterpreterFrame, 564
 - calls qcar, 564
 - calls qcdr, 564
 - calls selectOptionLC, 564
 - calls throwKeyedMsg, 564
 - uses \$options, 564
 - defun, 564
- From, 380
 - calledby syIgnoredFromTo, 191
 - defun, 380
- FromTo, 380
 - calledby syIgnoredFromTo, 191
 - defun, 380
- function
 - calledby dewritify, 613
 - calledby filterAndFormatConstructors, 942
 - calledby isSystemDirectory, 1038
 - calledby writify, 608
- functionp, 1049
 - calls identp, 1049
 - defun, 1049
- funfind, 872
 - defmacro, 872
- funfind,LAM, 872
 - calls SEQ, 872
 - calls exit, 872
 - calls isFunctor, 872
 - calls qcar, 872
 - defun, 872
- gbc-time

- calledby statisticsInitialization, 1037
- genCategoryTable
 - calledby write-categorydb, 1033
- genDomainTraceName, 860
 - calledby domainToGenvar, 859
 - calls genvar, 860
 - calls lassoc, 860
 - uses \$domainTraceNameAssoc, 860
 - defun, 860
- gensymInt, 614
 - calls charDigitVal, 614
 - calls error, 614
 - calls gensymp, 614
 - calls pname, 614
 - defun, 614
- gensymmer
 - calledby dewritify,dewritifyInner, 610
- gensymp
 - calledby breaklet, 903
 - calledby gensymInt, 614
 - calledby isTraceGensym, 873
 - calledby letPrint2, 885
 - calledby letPrint3, 886
 - calledby letPrint, 883
 - calledby spadTrace,isTraceable, 874
 - calledby tracelet, 902
- genvar
 - calledby genDomainTraceName, 860
- get
 - calledby ?t, 900
 - calledby augmentTraceNames, 870
 - calledby clearCmdParts, 503
 - calledby getAliasIfTracedMapParameter, 887
 - calledby getBpiNameIfTracedMap, 888
 - calledby getMapSig, 851
 - calledby getMapSubNames, 867
 - calledby getPreviousMapSubNames, 868
 - calledby importFromFrame, 561
 - calledby isDomainValuedVariable, 957
 - calledby isInterpOnlyMap, 870
 - calledby isUncompiledMap, 869
 - calledby putHist, 588
 - calledby restoreHistory, 595
 - calledby transTraceItem, 861
 - calledby writeHistModesAndValues, 601
- get-current-directory, 36
 - calledby restart, 17
 - defun, 36
- getAliasIfTracedMapParameter, 887
 - calledby mapLetPrint, 882
 - calls exit, 887
 - calls get, 887
 - calls isSharpVarWithNum, 887
 - calls pname, 888
 - calls seq, 888
 - calls spaddifference, 887
 - calls string2pint-n, 887
 - calls substring, 887
 - uses \$InteractiveFrame, 888
 - defun, 887
- getalist
 - calledby displayProperties,sayFunctionDeps, 456
 - calledby importFromFrame, 561
 - calledby interpFunctionDepAlists, 463
 - calledby isExposedConstructor, 818
 - calledby setExposeAddGroup, 697
 - calledby setExposeDropGroup, 700
- getAndEvalConstructorArgument, 956
 - calledby evaluateType1, 916
 - calls compFailure, 956
 - calls getValue, 956
 - calls isLocalVar, 956
 - calls isWrapped, 956
 - calls objMode, 956
 - calls objNewWrap, 956
 - calls objVal, 956
 - calls timedEVALFUN, 956
 - defun, 956
- getAndSay, 459
 - calledby displayProperties, 459
 - calls getI, 459
 - calls sayMSG, 459
 - defun, 459
- getArgValue
 - calledby interpret1, 54
- getBpiNameIfTracedMap, 888
 - calledby mapLetPrint, 882
 - calls exit, 888
 - calls get, 888
 - calls seq, 888

- uses /tracenames, 888
 - uses \$InteractiveFrame, 888
 - defun, 888
- getBrowseDatabase, 1083
 - calls grepConstruct, 1083
 - calls member, 1083
 - uses \$includeUnexposed?, 1083
 - defun, 1083
- getConstructorForm
 - calledby make-databases, 1018
- getConstructorSignature
 - calledby evaluateType1, 915
 - calledby reportOpsFromLisplib, 816
- getdatabase, 1009
 - calledby abbQuery, 534
 - calledby addoperations, 1006
 - calledby describeSpad2Cmd, 527
 - calledby displayOperationsFromLisplib, 818
 - calledby displayValue, 457
 - calledby domainToGenvar, 859
 - calledby evaluateType1, 916
 - calledby hasAtt, 424
 - calledby initial-getdatabase, 1000
 - calledby loadLibNoUpdate, 1039
 - calledby loadLib, 1037
 - calledby localnrlib, 1015
 - calledby mkEvalable, 911
 - calledby reportOpsFromLisplib, 816
 - calledby reportOpsFromUnitDirectly, 820
 - calledby setExposeAddConstr, 698
 - calledby setExposeDropConstr, 701
 - calledby showdatabase, 1007
 - calledby whatConstructors, 943
 - calls unsqueeze, 1009
 - calls warn, 1009
 - uses *browse-stream*, 1009
 - uses *category-stream*, 1009
 - uses *defaultdomain-list*, 1009
 - uses *hasCategory-hash*, 1009
 - uses *hascategory-hash*, 1009
 - uses *interp-stream*, 1009
 - uses *miss*, 1009
 - uses *operation-hash*, 1009
 - uses *operation-stream*, 1009
 - uses \$spadroot, 1009
 - defun, 1009
- getDirectoryList, 982
 - uses \$UserLevel, 982
 - uses \$current-directory, 982
 - uses \$directory-list, 982
 - uses \$library-directory-list, 982
 - defun, 982
- getEnv
 - calledby DaaseName, 1022
 - calledby initial-getdatabase, 1000
 - calledby make-databases, 1018
 - calledby restart0, 19
- getenv
 - calledby getenviron, 31
- getenviron, 31
 - calledby copyright, 520
 - calledby initroot, 35
 - calledby summary, 828
 - calls getenv, 31
 - defun, 31
- getErFromDbL
 - calledby getMsgInfoFromKey, 366
- getFirstWord, 467
 - calledby doSystemCommand, 444
 - calls stringLibSpaces, 467
 - calls subseq, 467
 - defun, 467
- getFlag
 - calledby interpFunctionDepAlists, 463
- getI
 - calledby displayProperties, 459
 - calledby fetchOutput, 598
 - calledby getAndSay, 459
- getInfovec
 - calledby hasAtt, 424
- getInterpMacroNames
 - calledby clearCmdParts, 503
 - calledby displayMacros, 536
 - calledby displayProperties, 459
 - calledby displayWorkspaceNames, 452
- getIProplist
 - calledby displayProperties, 459
- getKeyedMsg, 329
 - calledby msgText, 62
 - calledby sayKeyedMsgLocal, 330
 - calls fetchKeyedMsg, 329

- defun, 329
- getl
 - calledby reportOpsFromUnitDirectly, 820
- getLinePos, 372
 - calledby makeMsgFromLine, 371
 - defun, 372
- getLineText, 372
 - calledby makeMsgFromLine, 371
 - defun, 372
- getMapSig, 851
 - calledby saveMapSig, 851
 - calls boot-equal, 851
 - calls get, 851
 - uses \$InteractiveFrame, 851
 - defun, 851
- getMapSubNames, 867
 - calledby traceSpad2Cmd, 845
 - calls getPreviousMapSubNames, 867
 - calls get, 867
 - calls unionq, 867
 - calls union, 867
 - uses /tracenames, 867
 - uses \$InteractiveFrame, 867
 - uses \$lastUntraced, 867
 - defun, 867
- getMsgArgL, 349
 - calledby getMsgInfoFromKey, 366
 - calledby sameMsg?, 376
 - defun, 349
- getMsgCatAttr, 358
 - calledby getMsgToWhere, 363
 - calledby initToWhere, 368
 - calledby msgImPr?, 358
 - calledby msgNoRep?, 375
 - calls ifcdr, 358
 - calls ncAlist, 358
 - calls qassq, 358
 - defun, 358
- getMsgFTTag
 - usedby posPointers, 378
- getMsgFTTag?, 359
 - calledby getMsgPos2, 378
 - calledby getMsgPos, 359
 - calledby processChPosesForOneLine, 376
 - calledby putFTText, 379
 - calls getMsgPosTagOb, 359
- calls ifcar, 359
- defun, 359
- getMsgInfoFromKey, 366
 - calledby putDatabaseStuff, 365
 - calls getErFromDbL, 366
 - calls getMsgArgL, 366
 - calls getMsgKey?, 366
 - calls getMsgKey, 366
 - calls removeAttributes, 366
 - calls segmentKeyedMsg, 366
 - calls substituteSegmentedMsg, 366
 - uses \$msgDatabaseName, 366
 - defun, 366
- getMsgKey, 348
 - calledby getMsgInfoFromKey, 366
 - calledby processKeyedError, 353
 - calledby sameMsg?, 376
 - defun, 348
- getMsgKey?, 362
 - calledby getMsgInfoFromKey, 366
 - calledby getMsgLitSym, 362
 - calledby getStFromMsg, 354
 - calls identp, 362
 - defun, 362
- getMsgLitSym, 362
 - calledby getStFromMsg, 354
 - calls getMsgKey?, 362
 - defun, 362
- getMsgPos, 359
 - calledby erMsgCompare, 370
 - calledby erMsgSep, 370
 - calledby getPosStL, 356
 - calledby posPointers, 378
 - calledby processChPosesForOneLine, 376
 - calledby processMsgList, 369
 - calledby putFTText, 379
 - calls getMsgFTTag?, 359
 - calls getMsgPosTagOb, 359
 - defun, 359
- getMsgPos2, 378
 - calledby posPointers, 378
 - calledby putFTText, 379
 - calls getMsgFTTag?, 378
 - calls getMsgPosTagOb, 378
 - calls ncBug, 379
 - defun, 378

- getMsgPosTagOb, 348
 - calledby getMsgFTTag?, 359
 - calledby getMsgPos2, 378
 - calledby getMsgPos, 359
 - defun, 348
- getMsgPrefix, 349
 - calledby processChPosesForOneLine, 376
 - defun, 349
- getMsgPrefix?, 350
 - calledby getStFromMsg, 354
 - calledby processKeyedError, 353
 - calledby tabbing, 362
 - defun, 350
- getMsgTag, 350
 - calledby getMsgTag?, 350
 - calledby getStFromMsg, 354
 - calledby initImPr, 367
 - calledby leader?, 351
 - calledby line?, 351
 - calls ncTag, 350
 - defun, 350
- getMsgTag?, 350
 - calledby processKeyedError, 353
 - calls IFCAR, 350
 - calls getMsgTag, 350
 - defun, 350
- getMsgText, 349
 - calledby getStFromMsg, 354
 - calledby putFTText, 379
 - defun, 349
- getMsgToWhere, 363
 - calledby toFile?, 363
 - calledby toScreen?, 351
 - calls getMsgCatAttr, 363
 - defun, 363
- getOperationAlistFromLisplib
 - calledby hasSig, 423
 - calledby spadTrace, 874
- getOplistForConstructorForm, 822
 - calledby reportOpsFromUnitDirectly, 820
 - defun, 822
- getOplistWithUniqueSignatures, 823
 - defun, 823
- getOption, 890
 - calledby spadTrace, 874
 - calledby spadUntrace, 893
 - calledby traceDomainConstructor, 878
 - calls assoc, 890
 - defun, 890
- getParserMacroNames, 451
 - calledby clearCmdParts, 503
 - calledby displayMacros, 536
 - calledby displayProperties, 459
 - calledby displayWorkspaceNames, 452
 - uses \$pfMacros, 451
 - defun, 451
- getPosStL, 356
 - calledby getStFromMsg, 354
 - calls decideHowMuch, 356
 - calls getMsgPos, 356
 - calls listDecideHowMuch, 356
 - calls msgImPr?, 356
 - calls ppos, 356
 - calls remFile, 356
 - calls remLine, 356
 - calls showMsgPos?, 356
 - uses \$lastPos, 356
 - defun, 356
- getPreStL, 355
 - calledby getStFromMsg, 354
 - calls size, 355
 - uses \$preLength, 355
 - defun, 355
- getPreviousMapSubNames, 868
 - calledby getMapSubNames, 867
 - calledby untraceMapSubNames, 871
 - calls exit, 868
 - calls get, 868
 - calls seq, 868
 - defun, 868
- getProplist, 962
 - calledby addBinding, 961
 - calledby getProplist, 962
 - calls getProplist, 962
 - calls search, 962
 - uses \$CategoryFrame, 962
 - defun, 962
- getrefv32, 1056
 - defun, 1056
- getStFromMsg, 354
 - calledby msgOutputter, 353
 - calls getMsgKey?, 354

- calls getMsgLitSym, 354
- calls getMsgPrefix?, 354
- calls getMsgTag, 354
- calls getMsgText, 354
- calls getPosStL, 354
- calls getPreStL, 354
- calls pname, 354
- calls tabbing, 354
- defun, 354
- getSystemCommandLine, 831
 - calledby synonymSpad2Cmd, 830
 - calls strpos, 831
 - calls substring, 831
 - uses \$currentLine, 832
 - defun, 831
- getTraceOption, 852
 - calledby getTraceOptions, 850
 - calledby trace1, 846
 - calls concat, 852
 - calls exit, 852
 - calls getTraceOption,hn, 852
 - calls identp, 852
 - calls isListOfIdentifiersOrStrings, 852
 - calls isListOfIdentifiers, 852
 - calls object2String, 852
 - calls qcar, 852
 - calls qcdr, 852
 - calls selectOptionLC, 852
 - calls seq, 852
 - calls stackTraceOptionError, 852
 - calls throwKeyedMsg, 852
 - calls transOnlyOption, 852
 - uses \$traceOptionList, 852
 - defun, 852
- getTraceOption,hn, 851
 - calledby getTraceOption, 852
 - calls domainToGenvar, 852
 - calls exit, 851
 - calls isDomainOrPackage, 852
 - calls seq, 851
 - calls stackTraceOptionError, 852
 - defun, 851
- getTraceOptions, 850
 - calledby trace1, 846
 - calls exit, 850
 - calls getTraceOption, 850
 - calls poundsign, 850
 - calls seq, 850
 - calls throwKeyedMsg, 850
 - calls throwListOfKeyedMsgs, 850
 - uses \$traceErrorStack, 850
 - defun, 850
- getValue
 - calledby evaluateType, 914
 - calledby getAndEvalConstructorArgument, 956
 - calledby interpret1, 54
- getWorkspaceNames, 453
 - calledby displayProperties, 459
 - calledby displayWorkspaceNames, 452
 - calls exit, 453
 - calls nmsort, 453
 - calls seq, 453
 - uses \$InteractiveFrame, 453
 - defun, 453
- grepConstruct
 - calledby getBrowseDatabase, 1083
- handleNoParseCommands, 443
 - calledby doSystemCommand, 444
 - calls concat, 468
 - calls member, 468
 - calls npboot, 468
 - calls nplisp, 468
 - calls npsynonym, 468
 - calls npsystem, 468
 - calls sayKeyedMsg, 468
 - calls stripLisp, 468
 - calls stripSpaces, 468
 - defun, 443
- handleParsedSystemCommands, 466
 - calledby doSystemCommand, 444
 - calls dumbTokenize, 466
 - calls parseSystemCmd, 466
 - calls systemCommand, 466
 - calls tokTran, 466
 - defun, 466
- handleTokenizeSystemCommands, 445
 - calledby doSystemCommand, 444
 - calls dumbTokenize, 445
 - calls systemCommand, 445
 - calls tokTran, 445

- defun, 445
- hasAtt, 424
 - calledby hasAttSig, 426
 - calledby hasCaty, 420
 - calls constructSubst, 424
 - calls getInfovec, 424
 - calls getdatabase, 424
 - calls hasCatExpression, 424
 - calls subCopy, 424
 - calls unifyStruct, 424
 - local def \$domPvar, 424
 - defun, 424
- hasAttSig, 426
 - calledby hasCaty, 420
 - calls hasAtt, 426
 - calls hasSig, 426
 - calls keyedSystemError, 426
 - defun, 426
- hasCat
 - calledby hasCaty, 420
- hasCate, 433
 - calledby hasCatExpression, 427
 - calledby hasCate1, 427
 - calledby hasCateSpecial, 434
 - calledby hasCaty1, 431
 - calledby hasSigAnd, 425
 - calledby hasSigOr, 426
 - calledby hasSig, 423
 - calls containsVariables, 433
 - calls hasCate1, 433
 - calls hasCateSpecial, 433
 - calls hasCaty, 433
 - calls isPatternVar, 433
 - calls subCopy, 433
 - local def \$hope, 433
 - local ref \$EmptyMode, 433
 - local ref \$Subst, 433
 - defun, 433
- hasCate1, 427
 - calledby hasCate, 433
 - calls hasCate, 427
 - local def \$domPvar, 427
 - defun, 427
- HasCategory
 - calledby basicLookup, 1070
- hasCateSpecial, 434
 - calledby hasCate, 433
 - calls augmentSub, 434
 - calls canCoerceFrom, 434
 - calls containsVars, 434
 - calls eqcar, 434
 - calls hasCateSpecialNew, 434
 - calls hasCate, 434
 - calls hasCaty, 434
 - calls isSubDomain, 434
 - local ref \$Integer, 434
 - local ref \$QuotientField, 434
 - defun, 434
- hasCateSpecialNew, 435
 - calledby hasCateSpecial, 434
 - calls augmentSub, 435
 - calls defaultTargetFE, 435
 - calls eqcar, 435
 - calls hasCaty, 435
 - calls isEqualOrSubDomain, 435
 - calls member, 435
 - calls underDomainOf, 435
 - local ref \$ComplexInteger, 435
 - local ref \$Integer, 435
 - local ref \$RationalNumber, 435
 - defun, 435
- hasCatExpression, 427
 - calledby hasAtt, 424
 - calledby hasCatExpression, 427
 - calls hasCatExpression, 427
 - calls hasCate, 427
 - calls keyedSystemError, 427
 - defun, 427
- hasCaty, 420
 - calledby hasCateSpecialNew, 435
 - calledby hasCateSpecial, 434
 - calledby hasCate, 433
 - calledby ofCategory, 419
 - calls augmentSub, 420
 - calls constructSubst, 420
 - calls domArg2, 420
 - calls domArg, 420
 - calls hasAttSig, 420
 - calls hasAtt, 420
 - calls hasCaty1, 421
 - calls hasCat, 420
 - calls hasSig, 420

- calls kdr, 420
- calls mkDomPvar, 420
- calls opOf, 420
- calls subCopy, 420
- calls unifyStruct, 420
- local ref \$domPvar, 421
- defun, 420
- hasCaty1, 431
 - calledby hasCaty1, 431
 - calledby hasCaty, 421
 - calls hasCate, 431
 - calls hasCaty1, 431
 - calls keyedSystemError, 431
 - local def \$domPvar, 431
 - defun, 431
- hashable, 1069
 - calls Boolean, 1069
 - calls bpiname, 1069
 - calls compiledLookup, 1069
 - calls knownEqualPred, 1069
 - defun, 1069
- hashCode?
 - calledby basicLookupCheckDefaults, 1072
 - calledby basicLookup, 1069
- hashString
 - calledby basicLookupCheckDefaults, 1072
 - calledby basicLookup, 1070
- hashtable-class
 - calledby writify, writifyInner, 605
- hashType
 - calledby basicLookupCheckDefaults, 1072
 - calledby basicLookup, 1070
- hasOptArgs?, 309
 - calledby pfApplication2Sex, 306
 - defun, 309
- hasOption, 449
 - calledby trace1, 846
 - calls pname, 449
 - calls stringPrefix?, 449
 - defun, 449
- hasPair, 889
 - calledby hasPair, 889
 - calledby letPrint2, 885
 - calledby letPrint3, 886
 - calledby letPrint, 883
 - calls hasPair, 889
 - calls qcar, 889
 - calls qcdr, 889
 - defun, 889
- hasSig, 423
 - calledby hasAttSig, 426
 - calledby hasCaty, 420
 - calls assq, 423
 - calls cnstructSubst, 423
 - calls constructor?, 423
 - calls getOperationAlistFromLisplib, 423
 - calls hasCate, 423
 - calls hasSigAnd, 423
 - calls hasSigOr, 423
 - calls keyedSystemError, 423
 - calls subCopy, 423
 - calls unifyStruct, 423
 - local def \$domPvar, 423
 - defun, 423
- hasSigAnd, 425
 - calledby hasSigOr, 426
 - calledby hasSig, 423
 - calls hasCate, 425
 - calls keyedSystemError, 425
 - calls subCopy, 425
 - defun, 425
- hasSigOr, 426
 - calledby hasSig, 423
 - calls hasCate, 426
 - calls hasSigAnd, 426
 - calls keyedSystemError, 426
 - defun, 426
- help, 570
 - calls helpSpad2Cmd, 570
 - defun, 570
- help help page, 567
 - manpage, 567
- helpSpad2Cmd, 570
 - calledby abbreviationsSpad2Cmd, 481
 - calledby frameSpad2Cmd, 564
 - calledby help, 570
 - calledby savesystem, 648
 - calledby showSpad2Cmd, 812
 - calledby systemCommand, 446
 - calls newHelpSpad2Cmd, 570
 - calls sayKeyedMsg, 570
 - defun, 570

- hget, 1046
 - calledby ScanOrPairVec,ScanOrInner, 613
 - calledby dewritify,dewritifyInner, 610
 - calledby keyword?, 121
 - calledby keyword, 121
 - calledby saveDependentsHashTable, 1021
 - calledby saveUsersHashTable, 1022
 - calledby writify,writifyInner, 605
 - defmacro, 1046
- histFileErase, 615
 - calledby disableHist, 601
 - calledby historySpad2Cmd, 580
 - calledby initHist, 579
 - calledby restoreHistory, 595
 - calledby saveHistory, 593
 - calledby setHistoryCore, 583
 - calledby writeInputLines, 585
 - defun, 615
- histFileName, 578
 - calledby addNewInterpreterFrame, 559
 - calledby clearCmdAll, 501
 - calledby disableHist, 601
 - calledby historySpad2Cmd, 580
 - calledby initHist, 579
 - calledby readHiFi, 599
 - calledby restoreHistory, 595
 - calledby saveHistory, 593
 - calledby setHistoryCore, 583
 - calledby writeHiFi, 600
 - calls makeHistFileName, 578
 - uses \$interpreterFrameName, 578
 - defun, 578
- histInputFileName, 578
 - calledby saveHistory, 593
 - calledby writeInputLines, 585
 - calls makePathname, 578
 - uses \$historyDirectory, 578
 - uses \$interpreterFrameName, 578
 - defun, 578
- history, 580
 - calls historySpad2Cmd, 580
 - calls sayKeyedMsg, 580
 - uses \$options, 580
 - defun, 580
- history help page, 573
 - manpage, 573
- historySpad2Cmd, 580
 - calledby history, 580
 - calls changeHistListLen, 580
 - calls clearSpad2Cmd, 580
 - calls disableHist, 580
 - calls exit, 581
 - calls histFileErase, 580
 - calls histFileName, 580
 - calls initHistList, 580
 - calls member, 580
 - calls queryUserKeyedMsg, 580
 - calls resetInCoreHist, 580
 - calls restoreHistory, 580
 - calls saveHistory, 580
 - calls sayKeyedMsg, 580
 - calls selectOptionLC, 580
 - calls seq, 581
 - calls setHistoryCore, 580
 - calls showHistory, 580
 - calls string2id-n, 580
 - calls upcase, 580
 - calls writeInputLines, 580
 - uses \$HiFiAccess, 581
 - uses \$IOindex, 581
 - uses \$options, 581
 - defun, 580
- hkeys, 1046
 - calledby saveDependentsHashTable, 1021
 - calledby saveUsersHashTable, 1022
 - calledby scanDictCons, 137
 - calledby scanPunCons, 139
 - calledby writify,writifyInner, 605
 - defun, 1046
- hput, 1046
 - calledby ScanOrPairVec,ScanOrInner, 613
 - calledby addBinding, 961
 - calledby dewritify,dewritifyInner, 610
 - calledby writify,writifyInner, 605
 - defun, 1046
- id
 - calledby inclmsgConActive, 93
 - calledby inclmsgConStill, 94
 - calledby inclmsgFileCycle, 92
 - calledby inclmsgIfSyntax, 97
 - calledby inclmsgSay, 90

- idChar?, 128
 - calledby scanW, 128
 - defmacro, 128
- identp, 1048
 - calledby functionp, 1049
 - calledby getMsgKey?, 362
 - calledby getTraceOption, 852
 - calledby isDomainValuedVariable, 957
 - calledby isListOfIdentifiersOrStrings, 867
 - calledby isListOfIdentifiers, 866
 - calledby isSharpVar, 884
 - calledby isgenvar, 885
 - calledby messageprint-1, 1051
 - calledby ncAlist, 415
 - calledby ncTag, 415
 - calledby ofCategory, 419
 - calledby restoreHistory, 595
 - calledby rwrite, 603
 - calledby selectOption, 477
 - calledby undo, 920
 - defmacro, 1048
- if, 395
 - syntax, 395
- If?, 79
 - calledby incLude1, 82
 - calls quotient, 79
 - defvar, 79
- IFCAR
 - calledby getMsgTag?, 350
 - calledby posPointers, 378
 - calledby remLine, 357
- ifcar
 - calledby defaultTargetFE, 437
 - calledby fillerSpaces, 20
 - calledby getMsgFTTag?, 359
 - calledby pfAbSynOp, 412
 - calledby pfExpression, 264
 - calledby pfLeaf, 247
 - calledby pfSymbol, 251
 - calledby pfSymb, 251
 - calledby tokConstruct, 411
- IFCDR
 - calledby remFile, 357
- ifcdr
 - calledby clearParserMacro, 451
 - calledby getMsgCatAttr, 358
 - calledby mac0Get, 228
 - calledby setMsgCatlessAttr, 365
 - calledby specialChar, 978
- ifCond, 89
 - calledby incLude1, 82
 - calls MakeSymbol, 89
 - calls incCommandTail, 89
 - uses \$inclAssertions, 89
 - defun, 89
- IfKeepPart, 77
 - defvar, 77
- IfSkipPart, 78
 - defvar, 78
- IfSkipToEnd, 77
 - defvar, 77
- images
 - Restart, 16
- import
 - calledby frameSpad2Cmd, 564
- importFromFrame, 561
 - calledby frameSpad2Cmd, 564
 - calledby importFromFrame, 561
 - calls boot-equal, 561
 - calls clearCmdParts, 561
 - calls exit, 561
 - calls frameEnvironment, 561
 - calls frameNames, 561
 - calls framename, 561
 - calls getalist, 561
 - calls get, 561
 - calls importFromFrame, 561
 - calls member, 561
 - calls putHist, 561
 - calls queryUserKeyedMsg, 561
 - calls sayKeyedMsg, 561
 - calls seq, 561
 - calls string2id-n, 561
 - calls throwKeyedMsg, 561
 - calls upcase, 561
 - uses \$interpreterFrameRing, 561
 - defun, 561
- in-stream, 959
 - usedby ncTopLevel, 25
 - usedby serverReadLine, 45
 - defvar, 959
- incActive?, 103

- calledby incLude1, 81
 - defun, 103
- incAppend, 87
 - calledby incAppend1, 87
 - calledby incLude1, 82
 - calledby next1, 39
 - calls Delay, 87
 - calls incAppend1, 87
 - defun, 87
- incAppend1, 87
 - calledby incAppend, 87
 - calls StreamNull, 87
 - calls incAppend, 87
 - defun, 87
- incBiteOff, 621
 - calledby incFileName, 620
 - defun, 621
- incClassify, 99
 - calledby incLude1, 82
 - calls incCommand?, 99
 - uses incCommands, 99
 - defun, 99
- incCommand?, 100
 - calledby incClassify, 99
 - calls char, 100
 - defun, 100
- incCommands, 98
 - usedby incClassify, 99
 - defvar, 98
- incCommandTail, 101
 - calledby assertCond, 96
 - calledby ifCond, 89
 - calledby incLude1, 81
 - calledby inclFname, 102
 - calls incDrop, 101
 - defun, 101
- incConsoleInput, 102
 - calledby incLude1, 82
 - calls incRgen, 102
 - calls make-instream, 102
 - defun, 102
- incDrop, 101
 - calledby incCommandTail, 101
 - calls substring, 101
 - defun, 101
- incFileInput, 102
 - calledby incLude1, 82
 - calls incRgen, 102
 - calls make-instream, 102
 - defun, 102
- incFileName, 620
 - calledby inclFname, 102
 - calledby ncloopIncFileName, 620
 - calls incBiteOff, 620
 - defun, 620
- incHandleMessage, 76
 - calledby incRenumberLine, 75
 - calls ncBug, 76
 - calls ncSoftError, 76
 - defun, 76
- incIgen, 75
 - calledby incIgen1, 75
 - calledby incRenumber, 74
 - calls Delay, 75
 - calls incIgen1, 75
 - defun, 75
- incIgen1, 75
 - calledby incIgen, 75
 - calls incIgen, 75
 - defun, 75
- inclFname, 102
 - calledby incLude1, 82
 - calls incCommandTail, 102
 - calls incFileName, 102
 - defun, 102
- incLine, 87
 - calledby xlMsg, 86
 - calledby xlSkip, 89
 - calls incLine1, 87
 - defun, 87
- incLine1, 88
 - calledby incLine, 87
 - calledby xlOK1, 86
 - calls lnCreate, 88
 - defun, 88
- inclmsgCannotRead, 92
 - calledby xlCannotRead, 91
 - calls thefname, 92
 - defun, 92
- inclmsgCmdBug, 98
 - calledby xlCmdBug, 98
 - defun, 98

- inclmsgConActive, 93
 - calledby xlConActive, 93
 - calls id, 93
 - defun, 93
- inclmsgConsole, 94
 - calledby xlConsole, 94
 - defun, 94
- inclmsgConStill, 94
 - calledby xlConStill, 94
 - calls id, 94
 - defun, 94
- inclmsgFileCycle, 92
 - calledby xlFileCycle, 92
 - calls id, 92
 - calls porigin, 92
 - defun, 92
- inclmsgFinSkipped, 95
 - calledby xlSkippingFin, 95
 - defun, 95
- inclmsgIfBug, 97
 - calledby xlIfBug, 97
 - defun, 97
- inclmsgIfSyntax, 97
 - calledby xlIfSyntax, 96
 - calls concat, 97
 - calls id, 97
 - calls origin, 97
 - defun, 97
- inclmsgNoSuchFile, 91
 - calledby xlNoSuchFile, 90
 - calls thefname, 91
 - defun, 91
- inclmsgPrematureEOF, 88
 - calledby xlPrematureEOF, 86
 - calls origin, 88
 - defun, 88
- inclmsgPrematureFin, 95
 - calledby xlPrematureFin, 95
 - calls origin, 95
 - defun, 95
- inclmsgSay, 90
 - calledby xlSay, 90
 - calls id, 90
 - defun, 90
- incLude, 76
 - calledby incLude1, 81
- calledby incStream, 73
- calledby incString, 39
- calls Delay, 76
- defun, 76
- include
 - calls incLude1, 76
- include help page, 619
- manpage, 619
- incLude1, 81
 - calledby include, 76
 - calls Elseif?, 82
 - calls If?, 82
 - calls KeepPart?, 82
 - calls Rest, 81
 - calls SkipEnd?, 82
 - calls SkipPart?, 82
 - calls Skipping?, 81
 - calls StreamNull, 81
 - calls Top?, 81
 - calls assertCond, 82
 - calls concat, 81
 - calls expand-tabs, 82
 - calls ifCond, 82
 - calls incActive?, 81
 - calls incAppend, 82
 - calls incClassify, 82
 - calls incCommandTail, 81
 - calls incConsoleInput, 82
 - calls incFileInput, 82
 - calls incLude, 81
 - calls incNConsoles, 82
 - calls inclFname, 82
 - calls xlCannotRead, 81
 - calls xlCmdBug, 82
 - calls xlConActive, 82
 - calls xlConStill, 82
 - calls xlConsole, 82
 - calls xlFileCycle, 81
 - calls xlIfBug, 82
 - calls xlIfSyntax, 82
 - calls xlNoSuchFile, 81
 - calls xLOK1, 81
 - calls xLOK, 81
 - calls xlPrematureEOF, 81
 - calls xlPrematureFin, 82
 - calls xlSay, 81

- calls xlSkippingFin, 82
 - calls xlSkip, 81
 - defun, 81
- incNConsoles, 103
 - calledby incLude1, 82
 - calledby incNConsoles, 103
 - calls incNConsoles, 103
 - defun, 103
- incPrefix?, 100
 - calledby lineoftoks, 111
 - calledby scanIgnoreLine, 113
 - defun, 100
- incRenumber, 74
 - calledby incStream, 73
 - calledby incString, 39
 - calls incIgen, 74
 - calls incZip, 74
 - defun, 74
- incRenumberItem, 76
 - calledby incRenumberLine, 75
 - calls lnSetGlobalNum, 76
 - defun, 76
- incRenumberLine, 75
 - calls incHandleMessage, 75
 - calls incRenumberItem, 75
 - defun, 75
- incRgen, 103
 - calledby incConsoleInput, 102
 - calledby incFileInput, 102
 - calledby incRgen1, 104
 - calledby incStream, 73
 - calls Delay, 103
 - calls incRgen1, 103
 - defun, 103
- incRgen1, 104
 - calledby incRgen, 103
 - calls incRgen, 104
 - uses StreamNil, 104
 - defun, 104
- incStream, 73
 - calledby intloopInclude0, 63
 - calledby ncloopInclude0, 73
 - calls incLude, 73
 - calls incRenumber, 73
 - calls incRgen, 73
 - uses Top, 73
 - defun, 73
- incString, 39
 - calledby intloopProcessString, 37
 - calledby parseFromString, 48
 - calls incLude, 39
 - calls incRenumber, 39
 - uses Top, 39
 - defun, 39
- incZip, 74
 - calledby incRenumber, 74
 - calledby incZip1, 74
 - calls Delay, 74
 - calls incZip1, 74
 - defun, 74
- incZip1, 74
 - calledby incZip, 74
 - calls StreamNull, 74
 - calls incZip, 74
 - defun, 74
- infgeneric, 110
 - defvar, 110
- init-boot/spad-reader, 966
 - calls ioclear, 966
 - calls next-lines-clear, 966
 - uses *standard-output* , 966
 - uses \$spad-errors, 966
 - uses boot-line-stack, 966
 - uses file-closed, 966
 - uses line-handler, 966
 - uses meta-error-handler, 966
 - uses spaderrorstream, 966
 - uses xtokenreader, 966
 - defun, 966
- init-memory-config, 34
 - calledby restart, 17
 - calls allocate-contiguous-pages, 34
 - calls allocate-relocatable-pages, 34
 - calls allocate, 34
 - calls set-hole-size, 34
 - defun, 34
- initHist, 579
 - calledby restart, 17
 - calls \$replace, 579
 - calls histFileErase, 579
 - calls histFileName, 579
 - calls initHistList, 579

- calls makeInputFilename, 579
- calls oldHistFileName, 579
- uses \$HiFiAccess, 579
- uses \$useInternalHistoryTable, 579
- defun, 579
- initHistList, 579
 - calledby addNewInterpreterFrame, 559
 - calledby historySpad2Cmd, 580
 - calledby initHist, 579
 - uses \$HistListAct, 579
 - uses \$HistListLen, 579
 - uses \$HistList, 579
 - uses \$HistRecord, 579
 - defun, 579
- initial-getdatabase, 1000
 - calledby resethashtables, 999
 - calls getEnv, 1000
 - calls getdatabase, 1000
 - defun, 1000
- initializeInterpreterFrameRing, 553
 - calledby restart, 17
 - calls emptyInterpreterFrame, 553
 - calls updateFromCurrentInterpreterFrame, 553
 - uses \$interpreterFrameName, 553
 - uses \$interpreterFrameRing, 553
 - defun, 553
- initializeSetVariables, 651
 - calledby initializeSetVariables, 651
 - calledby resetWorkspaceVariables, 652
 - calls initializeSetVariables, 651
 - calls literals, 651
 - calls sayMSG, 651
 - calls translateYesNo2TrueFalse, 651
 - calls tree, 651
 - defun, 651
- initializeTimedNames
 - calledby processInteractive, 49
- initImPr, 367
 - calledby msgCreate, 348
 - calls getMsgTag, 367
 - calls setMsgUnforcedAttr, 367
 - uses \$erMsgToss, 367
 - uses \$imPrTagGuys, 367
 - defun, 367
- initroot, 35
 - calledby restart, 17
 - calls getenviron, 35
 - calls reroot, 35
 - uses \$spadroot, 35
 - defun, 35
- initToWhere, 368
 - calledby msgCreate, 348
 - calls getMsgCatAttr, 368
 - calls setMsgUnforcedAttr, 368
 - defun, 368
- input-libraries, 666
 - usedby addInputLibrary, 666
 - usedby dropInputLibrary, 667
 - usedby openOutputLibrary, 664
 - usedby setInputLibrary, 665
 - defvar, 666
- insert
 - calledby updateSourceFiles, 544
- insertpile, 335
 - calledby intloopInclude0, 63
 - calledby nclloopInclude0, 73
 - calls npNull, 335
 - calls pileCforest, 335
 - calls pilePlusComments, 335
 - calls pilePlusComment, 335
 - calls pileTree, 335
 - defun, 335
- insertPos, 379
 - calledby posPointers, 378
 - calls done, 379
 - defun, 379
- installConstructor
 - calledby loadLibNoUpdate, 1039
 - calledby loadLib, 1037
 - calledby localnrlib, 1015
- integer-decode-float-denominator, 1096
 - defun, 1096
- integer-decode-float-exponent, 1097
 - defun, 1097
- integer-decode-float-numerator, 1096
 - defun, 1096
- integer-decode-float-sign, 1097
 - defun, 1097
- internl
 - calledby constructSubst, 434
 - calledby spadTraceAlias, 889

- InterpExecuteSpadSystemCommand, 32
 - calls ExecuteInterpSystemCommand, 32
 - uses \$intCoerceFailure, 32
 - uses \$intSpadReader, 32
 - catches, 32
 - defun, 32
- interpFunctionDepAlists, 463
 - calledby displayProperties, 459
 - calls getFlag, 463
 - calls getalist, 463
 - calls putalist, 463
 - uses \$InteractiveFrame, 463
 - uses \$dependeeAlist, 463
 - uses \$dependentAlist, 463
 - uses \$e, 463
 - defun, 463
- interpOpen, 1002
 - calls DaaseName, 1003
 - calls make-database, 1003
 - calls unsqueeze, 1003
 - uses *allconstructors*, 1003
 - uses *interp-stream*, 1003
 - uses *interp-stream-stamp*, 1003
 - uses \$spadroot, 1003
 - defun, 1002
- interpopen
 - calledby resethashables, 999
 - calledby restart0, 19
- interpret, 54
 - calledby interpretTopLevel, 53
 - calls interpret1, 54
 - uses \$env, 54
 - uses \$eval, 54
 - uses \$genValue, 54
 - defun, 54
- interpret1, 54
 - calledby interpret, 54
 - calls bottomUp, 54
 - calls getArgValue, 54
 - calls getValue, 54
 - calls interpret2, 54
 - calls keyedSystemError, 54
 - calls mkAtreeWithSrcPos, 54
 - calls objNew, 54
 - calls putTarget, 54
 - uses \$eval, 54
 - uses \$genValue, 54
 - defun, 54
- interpret2, 55
 - calledby interpret1, 54
 - calls coerceInteractive, 55
 - calls member, 55
 - calls objMode, 55
 - calls objNew, 55
 - calls objVal, 55
 - calls systemErrorHere, 55
 - calls throwKeyedMsgCannotCoerceWith-Value, 55
 - uses \$EmptyMode, 55
 - uses \$ThrowAwayMode, 55
 - defun, 55
- interpretTopLevel, 53
 - calledby interpretTopLevel, 53
 - calledby processInteractive1, 52
 - calls interpretTopLevel, 53
 - calls interpret, 53
 - calls peekTimedName, 53
 - calls stopTimingProcess, 53
 - uses \$timedNameStack, 53
 - catches, 53
 - defun, 53
- interrupt
 - calledby break, 904
- intInterpretPform, 67
 - calledby phInterpret, 67
 - calls pf2Sex, 67
 - calls processInteractive, 67
 - calls zeroOneTran, 67
 - defun, 67
- intloop, 26
 - calledby ncIntLoop, 25
 - calls SpadInterpretStream, 26
 - calls resetStackLimits, 26
 - uses \$intRestart, 26
 - uses \$intTopLevel, 26
 - catches, 26
 - defun, 26
- intloopEchoParse, 69
 - calledby intloopInclude0, 63
 - calls dqToLis, 69
 - calls mkLineList, 69
 - calls ncloopDQlines, 69

- calls ncloopPrintLines, 69
 - calls npParse, 69
 - calls setCurrentLine, 69
 - uses \$EchoLines, 69
 - uses \$lines, 69
 - defun, 69
- intloopInclude, 63
 - calledby SpadInterpretStream, 29
 - calls ST, 63
 - calls intloopInclude0, 63
 - defun, 63
- intloopInclude0, 63
 - calledby intloopInclude, 63
 - calls incStream, 63
 - calls insertpile, 63
 - calls intloopEchoParse, 63
 - calls intloopProcess, 63
 - calls lineoftoks, 63
 - calls next, 63
 - uses \$lines, 63
 - defun, 63
- intloopPrefix?, 36
 - calledby intloopReadConsole, 30
 - defun, 36
- intloopProcess, 64
 - calledby intloopInclude0, 63
 - calledby intloopProcessString, 37
 - calledby intloopProcess, 64
 - calls StreamNull, 64
 - calls \$systemCommandFunction, 64
 - calls intloopProcess, 64
 - calls intloopSpadProcess, 64
 - calls pfAbSynOp?, 64
 - calls setCurrentLine, 64
 - calls tokPart, 64
 - uses \$systemCommandFunction, 64
 - defun, 64
- intloopProcessString, 37
 - calledby intloopReadConsole, 30
 - calls incString, 37
 - calls intloopProcess, 37
 - calls next, 37
 - calls setCurrentLine, 37
 - defun, 37
- intloopReadConsole, 30
 - calledby SpadInterpretStream, 29
 - calledby intloopReadConsole, 30
 - calls concat, 30
 - calls intloopPrefix?, 30
 - calls intloopProcessString, 30
 - calls intloopReadConsole, 30
 - calls intnplisp, 30
 - calls leaveScratchpad, 30
 - calls mkprompt, 30
 - calls ncloopCommand, 30
 - calls ncloopEscaped, 30
 - calls serverReadLine, 30
 - calls setCurrentLine, 30
 - uses \$dalymode, 31
 - defun, 30
 - throws, 30
- intloopSpadProcess, 64
 - calledby intloopProcess, 64
 - calls CatchAsCan, 65
 - calls Catch, 65
 - calls intloopSpadProcess,interp, 65
 - calls ncPutQ, 65
 - uses \$NeedToSignalSessionManager, 65
 - uses \$currentCarrier, 65
 - uses \$intCoerceFailure, 65
 - uses \$intSpadReader, 65
 - uses \$ncMsgList, 65
 - uses \$prevCarrier, 65
 - uses \$stepNo, 65
 - uses flung, 65
 - catches, 64, 65
 - defun, 64
- intloopSpadProcess,interp, 65
 - calledby intloopSpadProcess, 65
 - calls ncConversationPhase, 65
 - calls ncEltQ, 66
 - calls ncError, 66
 - defun, 65
- intnplisp, 36
 - calledby intloopReadConsole, 30
 - calls nplisp, 36
 - uses \$currentLine, 36
 - defun, 36
- intp
 - calledby dewritify,dewritifyInner, 610
- intProcessSynonyms, 33

- calledby ExecuteInterpSystemCommand, 33
 - calls processSynonyms, 33
 - uses line, 33
 - defun, 33
- ioclear, 970
 - calledby init-boot/spad-reader, 966
 - calledby spad-syntax-error, 967
 - calls line-clear, 970
 - calls reduce-stack-clear, 970
 - uses \$boot, 970
 - uses \$spad, 970
 - uses current-fragment, 970
 - uses current-line, 970
 - defun, 970
- iostat, 968
 - calledby spad-long-error, 967
 - calls line-past-end-p, 968
 - calls line-print, 968
 - calls next-lines-show, 968
 - calls token-stack-show, 968
 - uses \$boot, 968
 - uses \$current-line, 968
 - uses \$spad, 968
 - defun, 968
- is-console[9]
 - called by serverReadLine, 45
 - called by shut, 980
- isDomain
 - calledby ?t, 901
 - calledby addTraceItem, 900
 - calledby compiledLookup, 1069
- isDomainOrPackage, 873
 - calledby /tracereply, 892
 - calledby ?t, 901
 - calledby addTraceItem, 900
 - calledby getTraceOption,hn, 852
 - calledby prTraceNames,fn, 896
 - calledby shortenForPrinting, 889
 - calledby spadReply,printName, 892
 - calledby spadTrace, 874
 - calledby spadUntrace, 893
 - calledby traceReply, 897
 - calledby untraceDomainConstructor,keepTraced, 880
 - calledby writify,writifyInner, 605
- calls isFunctor, 873
 - calls opOf, 873
 - calls poundsign, 873
 - calls refvecp, 873
 - defun, 873
- isDomainValuedVariable, 957
 - calledby evaluateType, 914
 - calledby reportOperations, 813
 - calls get, 957
 - calls identp, 957
 - calls member, 957
 - calls objMode, 957
 - calls objValUnwrap, 957
 - local ref \$InteractiveFrame, 957
 - local ref \$env, 957
 - local ref \$e, 957
 - defun, 957
- isEqualOrSubDomain, 438
 - calledby defaultTargetFE, 437
 - calledby hasCateSpecialNew, 435
 - calls isSubDomain, 438
 - defun, 438
- isExposedConstructor, 818
 - calledby reportOpsFromLisplib, 816
 - calledby reportOpsFromUnitDirectly, 820
 - calls getalist, 818
 - local ref \$globalExposureGroupAlist, 818
 - local ref \$localExposureData, 818
 - defun, 818
- isFunctor
 - calledby funfind,LAM, 872
 - calledby isDomainOrPackage, 873
 - calledby trace1, 846
 - calledby traceReply, 897
- isgenvar, 884
 - calledby ?t, 900
 - calledby letPrint2, 885
 - calledby letPrint3, 886
 - calledby letPrint, 883
 - calledby traceReply, 897
 - calledby tracelet, 902
 - calls digitp, 885
 - calls identp, 885
 - calls size, 884
 - defun, 884
- isIntegerString, 466

- calledby tokTran, 465
 - defun, 466
- isInternalMapName
 - calledby displayProperties, 459
- isInterpMacro
 - calledby displayMacro, 451
 - calledby displayProperties, 460
- isInterpOnlyMap, 870
 - calls get, 870
 - uses \$InteractiveFrame, 870
 - defun, 870
- isListOfIdentifiers, 866
 - calledby getTraceOption, 852
 - calls exit, 866
 - calls identp, 866
 - calls seq, 866
 - defun, 866
- isListOfIdentifiersOrStrings, 867
 - calledby getTraceOption, 852
 - calls exit, 867
 - calls identp, 867
 - calls seq, 867
 - defun, 867
- isLocalVar
 - calledby getAndEvalConstructorArgumentisSystemDirectory, 1038
 - 956
- isMap
 - calledby clearCmdParts, 503
- isNameOfType
 - calledby reportOperations, 813
- isNewWorldDomain
 - calledby basicLookup, 1070
- isPartialMode, 420
 - calledby evalCategory, 957
 - calls contained, 420
 - local ref \$EmptyMode, 420
 - defun, 420
- isPatternVar
 - calledby containsVars1, 431
 - calledby containsVars, 430
 - calledby hasCate, 433
 - calledby unifyStructVar, 429
 - calledby unifyStruct, 428
- isSharpVar, 884
 - calledby domArg2, 422
 - calledby isSharpVarWithNum, 884
- calls identp, 884
 - defun, 884
- isSharpVarWithNum, 884
 - calledby getAliasIfTracedMapParameter, 887
 - calledby letPrint2, 885
 - calledby letPrint3, 886
 - calledby letPrint, 883
 - calls dig2fix, 884
 - calls digitp, 884
 - calls isSharpVar, 884
 - calls pname, 884
 - calls qcsiz, 884
 - defun, 884
- isSubDomain
 - calledby hasCateSpecial, 434
 - calledby isEqualOrSubDomain, 438
- isSubForRedundantMapName, 871
 - calledby traceReply, 897
 - calls assocleft, 871
 - calls member, 871
 - calls rassocSub, 871
 - uses \$mapSubNameAlist, 871
 - defun, 871
- calledby loadLib, 1037
 - calls function, 1038
 - local ref \$spadroot, 1038
 - defun, 1038
- isTraceGensym, 873
 - calls gensymp, 873
 - defun, 873
- isType
 - calledby reportOperations, 814
- isUncompiledMap, 869
 - calls get, 869
 - uses \$InteractiveFrame, 869
 - defun, 869
- isWrapped
 - calledby getAndEvalConstructorArgument, 956
 - calledby retract, 1057
- iterate, 397
 - syntax, 397
- justifyMyType, 62

- calledby printTypeAndTimeNormal, 59
- calls fillerSpaces, 62
- uses \$linelength, 62
- defun, 62
- kaddr
 - calledby zsystemdevelopment1, 952
- kadr
 - calledby zsystemdevelopment1, 952
- kar
 - calledby recordFrame, 921
 - calledby untraceDomainConstructor, keepTraced, 880
 - calledby zsystemdevelopment1, 952
- kdr
 - calledby hasCaty, 420
 - calledby reportOpsFromLisplib, 816
 - calledby searchCurrentEnv, 962
 - calledby searchTailEnv, 963
 - calledby set1, 806
 - calledby spadTrace, 874
- KeepPart?, 80
 - calledby Skipping?, 81
 - calledby incLude1, 82
 - calls remainder, 80
 - defvar, 80
- keyedSystemError
 - calledby compiledLookupCheck, 499
 - calledby hasAttSig, 426
 - calledby hasCatExpression, 427
 - calledby hasCaty1, 431
 - calledby hasSigAnd, 425
 - calledby hasSigOr, 426
 - calledby hasSig, 423
 - calledby interpret1, 54
 - calledby pf2Sex1, 301
 - calledby pfLiteral2Sex, 304
 - calledby readHiFi, 599
- keyword, 121
 - calledby lfkey, 122
 - calledby scanCloser?, 125
 - calledby scanKeyTr, 120
 - calls hget, 121
 - defun, 121
- keyword?, 121
 - calledby scanWord, 126
- calls hget, 121
- defun, 121
- knownEqualPred
 - calledby hashable, 1069
- lassoc
 - calledby breaklet, 903
 - calledby coerceTraceFunValue2E, 865
 - calledby genDomainTraceName, 860
 - calledby letPrint2, 885
 - calledby letPrint3, 886
 - calledby letPrint, 883
 - calledby processSynonyms, 33
 - calledby reportUndo, 926
 - calledby serverReadLine, 44
 - calledby set1, 806
 - calledby subTypes, 864
 - calledby trace1, 846
 - calledby tracelet, 902
 - calledby undoSingleStep, 929
 - calledby unifyStructVar, 429
- lassocSub, 869
 - calledby untrace, 860
 - calls lassq, 869
 - defun, 869
- lassq
 - calledby diffAlist, 923
 - calledby lassocSub, 869
- last
 - calledby frameSpad2Cmd, 564
- lastc
 - calledby StringToDir, 1084
- lastTokPosn, 341
 - calledby enPile, 340
 - calledby separatePiles, 341
 - calls tokPosn, 341
 - defun, 341
- leader?, 351
 - calledby msgOutputter, 353
 - calledby showMsgPos?, 358
 - calls getMsgTag, 351
 - defun, 351
- leave, 398
 - syntax, 398
- leaveScratchpad, 637
 - calledby intloopReadConsole, 30

- calledby quitSpad2Cmd, 636
 - defun, 637
- length
 - calledby mkDomPvar, 432
- letPrint, 883
 - calledby mapLetPrint, 882
 - calls break, 883
 - calls bright, 883
 - calls gensymp, 883
 - calls hasPair, 883
 - calls isSharpVarWithNum, 883
 - calls isgenvar, 883
 - calls lassoc, 883
 - calls pname, 883
 - calls sayBrightlyNT, 883
 - calls shortenForPrinting, 883
 - uses \$letAssoc, 883
 - defun, 883
- letPrint2, 885
 - calls break, 885
 - calls bright, 885
 - calls gensymp, 885
 - calls hasPair, 885
 - calls isSharpVarWithNum, 885
 - calls isgenvar, 885
 - calls lassoc, 885
 - calls mathprint, 885
 - calls pname, 885
 - calls print, 885
 - uses \$BreakMode, 885
 - uses \$letAssoc, 885
 - catches, 885
 - defun, 885
- letPrint3, 886
 - calls break, 886
 - calls bright, 886
 - calls gensymp, 886
 - calls hasPair, 886
 - calls isSharpVarWithNum, 886
 - calls isgenvar, 886
 - calls lassoc, 886
 - calls mathprint, 886
 - calls pname, 886
 - calls print, 886
 - calls spadcall, 886
 - uses \$BreakMode, 886
 - uses \$letAssoc, 886
 - catches, 886
 - defun, 886
- lfcomment, 116
 - calledby scanComment, 116
 - defun, 116
- lferror, 135
 - calledby scanError, 135
 - defun, 135
- lffloat, 127
 - calledby scanExponent, 126
 - calls concat, 127
 - defun, 127
- lfid, 115
 - calledby scanToken, 114
 - calledby scanWord, 126
 - defun, 115
- lfinteger, 133
 - calledby scanNumber, 132
 - defun, 133
- lfkey, 122
 - calledby scanKeyTr, 120
 - calledby scanPossFloat, 121
 - calledby scanWord, 126
 - calls keyword, 122
 - defun, 122
- lfnegcomment, 118
 - calledby scanNegComment, 117
 - defun, 118
- lfrinteger, 134
 - calledby scanNumber, 132
 - calls concat, 134
 - defun, 134
- lfspace, 130
 - calledby scanSpace, 129
 - defun, 130
- lfstring, 130
 - calledby scanString, 130
 - defun, 130
- library, 1013
 - calledby with, 945
 - calls extendLocalLibdb, 1013
 - calls localdatabase, 1013
 - calls tersyscommand, 1013
 - uses \$newConlist, 1013
 - uses \$options, 1013

- defun, 1013
- library help page, 623
 - manpage, 623
- libstream, 1158
 - defstruct, 1158
- line
 - usedby commandErrorIfAmbiguous, 468
 - usedby commandErrorMessage, 448
 - usedby doSystemCommand, 444
 - usedby intProcessSynonyms, 33
 - usedby processSynonyms, 34
 - usedby unAbbreviateKeyword, 468
- line-clear
 - calledby ioclear, 970
- line-handler, 965
 - usedby init-boot/spad-reader, 966
 - defvar, 965
- line-past-end-p
 - calledby iostat, 968
 - calledby spad-short-error, 968
- line-print
 - calledby iostat, 968
 - calledby spad-short-error, 968
- line?, 351
 - calledby msgOutputter, 353
 - calls getMsgTag, 351
 - defun, 351
- lineoftoks, 111
 - calledby intloopInclude0, 63
 - calledby ncloopInclude0, 73
 - calledby parseFromString, 48
 - calls constoken, 111
 - calls dqUnit, 111
 - calls incPrefix?, 111
 - calls nextline, 111
 - calls scanIgnoreLine, 111
 - calls substring, 111
 - uses \$floatok, 111
 - uses \$f, 111
 - uses \$linepos, 112
 - uses \$ln, 112
 - uses \$n, 112
 - uses \$r, 112
 - uses \$sz, 112
 - defun, 111
- lisp help page, 625
 - manpage, 625
- listConstructorAbbreviations, 482
 - calledby abbreviationsSpad2Cmd, 481
 - calledby displaySpad2Cmd, 533
 - calls queryUserKeyedMsg, 482
 - calls sayKeyedMsg, 483
 - calls string2id-n, 482
 - calls upcase, 482
 - calls whatSpad2Cmd, 483
 - defun, 482
- listDecideHowMuch, 361
 - calledby getPosStL, 356
 - calls poGlobalLinePosn, 361
 - calls poNopos?, 361
 - calls poPosImmediate?, 361
 - defun, 361
- ListMember?
 - calledby whichCat, 365
- listOutputter, 354
 - calledby processMsgList, 369
 - calls msgOutputter, 354
 - defun, 354
- listSort
 - calledby erMsgSort, 369
- literals
 - calledby displaySetOptionInformation, 653
 - calledby displaySetVariableSettings, 655
 - calledby initializeSetVariables, 651
 - calledby set1, 807
- lnCreate, 345
 - calledby incLine1, 88
 - defun, 345
- lnExtraBlanks, 345
 - calledby scanError, 135
 - calledby scanS, 131
 - calledby scanToken, 114
 - defun, 345
- lnFileName, 347
 - calledby poFileName, 360
 - calls lnFileName?, 347
 - calls ncBug, 347
 - defun, 347
- lnFileName?, 347
 - calledby lnFileName, 347
 - calledby lnImmediate?, 347
 - defun, 347

- lnGlobalNum, 346
 - calledby poGlobalLinePosn, 72
 - defun, 346
- lnImmediate?, 347
 - calledby poPosImmediate?, 360
 - calls lnFileName?, 347
 - defun, 347
- lnLocalNum, 346
 - calledby poLinePosn, 361
 - defun, 346
- lnPlaceOfOrigin, 346
 - defun, 346
- lnSetGlobalNum, 346
 - calledby incRenumberItem, 76
 - defun, 346
- lnString, 345
 - defun, 345
- load, 627
 - calls sayKeyedMsg, 627
 - defun, 627
- load help page, 627
 - manpage, 627
- loadFunctor, 1040
 - calledby loadFunctor, 1040
 - calledby traceDomainConstructor, 879
 - calls loadFunctor, 1040
 - calls loadLibIfNotLoaded, 1040
 - defun, 1040
- loadIfNecessary
 - calledby mkEvalable, 911
- loadLib, 1037
 - calledby browse, 491
 - calls categoryForm?, 1037
 - calls clearConstructorCache, 1037
 - calls getdatabase, 1037
 - calls installConstructor, 1037
 - calls isSystemDirectory, 1037
 - calls loadLibNoUpdate, 1037
 - calls namestring, 1037
 - calls pathnameDirectory, 1037
 - calls remprop, 1038
 - calls sayKeyedMsg, 1037
 - calls startTimingProcess, 1037
 - calls stopTimingProcess, 1038
 - calls updateCategoryTable, 1037
 - calls updateDatabase, 1037
- local def \$CategoryFrame, 1038
- local ref \$InteractiveMode, 1038
- local ref \$forceDatabaseUpdate, 1038
- local ref \$printLoadMsgs, 1038
- defun, 1037
- loadLibIfNotLoaded
 - calledby loadFunctor, 1040
- loadLibNoUpdate, 1039
 - calledby loadLib, 1037
 - calledby localnrLib, 1015
 - calls clearConstructorCache, 1039
 - calls getdatabase, 1039
 - calls installConstructor, 1039
 - calls sayKeyedMsg, 1039
 - calls stopTimingProcess, 1039
 - calls toplevel, 1039
 - local def \$CategoryFrame, 1039
 - local ref \$InteractiveMode, 1039
 - local ref \$printLoadMsgs, 1039
 - defun, 1039
- localdatabase, 1013
 - calledby library, 1013
 - calledby make-databases, 1018
 - calls localnrLib, 1013
 - calls sayKeyedMsg, 1013
 - uses *index-filename*, 1013
 - uses \$ConstructorCache, 1013
 - uses \$forceDatabaseUpdate, 1013
 - defun, 1013
- localnrLib, 1015
 - calledby localdatabase, 1013
 - calls addoperations, 1015
 - calls categoryForm?, 1015
 - calls getdatabase, 1015
 - calls installConstructor, 1015
 - calls loadLibNoUpdate, 1015
 - calls make-database, 1015
 - calls sayKeyedMsg, 1015
 - calls setExposeAddConstr, 1015
 - calls startTimingProcess, 1015
 - calls sublis, 1015
 - calls updateCategoryTable, 1015
 - calls updateDatabase, 1015
 - uses *allOperations*, 1015
 - uses *allconstructors*, 1015
 - uses \$FormalMapVariableList, 1015

- defun, 1015
- lookupInDomainVector, 1071
 - calledby basicLookup, 1070
 - calledby oldCompLookup, 1072
 - calls basicLookupCheckDefaults, 1071
 - calls spadcall, 1071
 - defun, 1071
- loopIters2Sex, 311
 - calledby pf2Sex1, 300
 - calledby pfCollect2Sex, 314
 - calls pf2Sex1, 312
 - defun, 311
- lotsof, 1045
 - calledby wrap, 1045
 - defun, 1045
- ltrace, 630
 - calls trace, 630
 - defun, 630
- ltrace help page, 629
 - manpage, 629
- lxOK1
 - calledby xlOK, 86
- mac0Define, 230
 - calledby mac0MLambdaApply, 224
 - calledby macMacro, 229
 - uses \$pfMacros, 230
 - defun, 230
- mac0ExpandBody, 224
 - calledby mac0MLambdaApply, 224
 - calledby macId, 227
 - calls mac0InfiniteExpansion, 224
 - calls macExpand, 225
 - calls pfSourcePosition, 224
 - uses \$macActive, 225
 - uses \$posActive, 225
 - defun, 224
- mac0Get, 228
 - calledby macId, 227
 - calls ifcdr, 228
 - uses \$pfMacros, 228
 - defun, 228
- mac0GetName, 226
 - calledby mac0InfiniteExpansion,name, 226
 - calls pfMLambdaBody, 226
 - uses \$pfMacros, 226
- defun, 226
- mac0InfiniteExpansion, 225
 - calledby mac0ExpandBody, 224
 - calls mac0InfiniteExpansion,name, 225
 - calls ncSoftError, 225
 - calls pform, 225
 - defun, 225
- mac0InfiniteExpansion,name, 226
 - calledby mac0InfiniteExpansion, 225
 - calls mac0GetName, 226
 - calls pname, 226
 - defun, 226
- mac0MLambdaApply, 223
 - calledby macApplication, 223
 - calls mac0Define, 224
 - calls mac0ExpandBody, 224
 - calls ncHardError, 223
 - calls pf0MLambdaArgs, 223
 - calls pfId?, 224
 - calls pfMLambdaBody, 223
 - calls pfSourcePosition, 223
 - calls pform, 224
 - uses \$macActive, 224
 - uses \$pfMacros, 224
 - uses \$posActive, 224
 - defun, 223
- mac0SubstituteOuter, 231
 - calledby mac0SubstituteOuter, 231
 - calledby macSubstituteOuter, 230
 - calls mac0SubstituteOuter, 231
 - calls macLambdaParameterHandling, 231
 - calls macSubstituteId, 231
 - calls pfId?, 231
 - calls pfLambda?, 231
 - calls pfLeaf?, 231
 - calls pfParts, 231
 - defun, 231
- macApplication, 223
 - calledby macExpand, 222
 - calls mac0MLambdaApply, 223
 - calls macExpand, 223
 - calls pf0ApplicationArgs, 223
 - calls pfApplicationOp, 223
 - calls pfMLambda?, 223
 - calls pfMapParts, 223
 - uses \$pfMacros, 223

- defun, 223
- macExpand, 222
 - calledby mac0ExpandBody, 225
 - calledby macApplication, 223
 - calledby macExpand, 222
 - calledby macLambda,mac, 229
 - calledby macWhere,mac, 228
 - calledby macroExpanded, 222
 - calls macApplication, 222
 - calls macExpand, 222
 - calls macId, 222
 - calls macLambda, 222
 - calls macMacro, 222
 - calls macWhere, 222
 - calls pfApplication?, 222
 - calls pfId?, 222
 - calls pfLambda?, 222
 - calls pfMacro?, 222
 - calls pfMapParts, 222
 - calls pfWhere?, 222
 - defun, 222
- macId, 227
 - calledby macExpand, 222
 - calls mac0ExpandBody, 227
 - calls mac0Get, 227
 - calls pfCopyWithPos, 227
 - calls pfIdSymbol, 227
 - calls pfSourcePosition, 227
 - uses \$macActive, 227
 - uses \$posActive, 227
 - defun, 227
- macLambda, 228
 - calledby macExpand, 222
 - calls macLambda,mac, 228
 - uses \$pfMacros, 229
 - defun, 228
- macLambda,mac, 229
 - calledby macLambda, 228
 - calls macExpand, 229
 - calls pfMapParts, 229
 - uses \$pfMacros, 229
 - defun, 229
- macLambdaParameterHandling, 231
 - calledby mac0SubstituteOuter, 231
 - calledby macLambdaParameterHandling, 231
- calledby macSubstituteOuter, 230
- calls macLambdaParameterHandling, 231
- calls pf0LambdaArgs, 231
- calls pf0MLambdaArgs, 231
- calls pfAbSynOp, 231
- calls pfIdSymbol, 231
- calls pfLambda?, 231
- calls pfLeaf?, 231
- calls pfLeafPosition, 231
- calls pfLeaf, 231
- calls pfMLambda?, 231
- calls pfParts, 231
- calls pfTypedId, 231
- defun, 231
- macMacro, 229
 - calledby macExpand, 222
 - calls mac0Define, 229
 - calls macSubstituteOuter, 229
 - calls ncSoftError, 229
 - calls pfId?, 229
 - calls pfIdSymbol, 229
 - calls pfMLambda?, 229
 - calls pfMacroLhs, 229
 - calls pfMacroRhs, 229
 - calls pfMacro, 229
 - calls pfNothing?, 229
 - calls pfNothing, 229
 - calls pfSourcePosition, 229
 - calls pform, 229
 - defun, 229
- macroExpanded, 222
 - calledby parseFromString, 48
 - calledby phMacro, 221
 - calls macExpand, 222
 - uses \$macActive, 222
 - uses \$posActive, 222
 - defun, 222
- macSubstituteId, 232
 - calledby mac0SubstituteOuter, 231
 - calls pfIdSymbol, 232
 - defun, 232
- macSubstituteOuter, 230
 - calledby macMacro, 229
 - calls mac0SubstituteOuter, 230
 - calls macLambdaParameterHandling, 230
 - defun, 230

- macWhere, 228
 - calledby macExpand, 222
 - calls macWhere,mac, 228
 - uses \$pfMacros, 228
 - defun, 228
- macWhere,mac, 228
 - calledby macWhere, 228
 - calls macExpand, 228
 - calls pfMapParts, 228
 - uses \$pfMacros, 228
 - defun, 228
- make-absolute-filename, 36
 - calledby reroot, 41
 - uses \$spadroot, 36
 - defun, 36
- make-appendstream, 980
 - calledby makeStream, 981
 - calls make-filename, 980
 - defun, 980
- make-cdouble-matrix, 1079
 - defmacro, 1079
- make-cdouble-vector, 1076
 - defmacro, 1076
- make-database
 - calledby interpOpen, 1003
 - calledby localnrlib, 1015
 - calledby setdatabase, 1008
- make-databases, 1017
 - calls allConstructors, 1018
 - calls browserAutoloadOnceTrigger, 1018
 - calls buildLibdb, 1018
 - calls categoryForm?, 1018
 - calls dbSplitLibdb, 1018
 - calls domainsOf, 1018
 - calls getConstructorForm, 1018
 - calls getEnv, 1018
 - calls localdatabase, 1018
 - calls mkDependentsHashTable, 1018
 - calls mkTopicHashTable, 1018
 - calls mkUsersHashTable, 1018
 - calls saveDependentsHashTable, 1018
 - calls saveUsersHashTable, 1018
 - calls write-browsedb, 1018
 - calls write-categorydb, 1018
 - calls write-compress, 1018
 - calls write-interpdb, 1018
 - calls write-operationdb, 1018
 - calls write-warndata, 1018
 - uses *allconstructors*, 1018
 - uses *compressvector*, 1018
 - uses *operation-hash*, 1018
 - uses *sourcefiles*, 1018
 - uses \$constructorList, 1018
 - defun, 1017
- make-double-matrix, 1077
 - defmacro, 1077
- make-double-matrix1, 1077
 - defmacro, 1077
- make-double-vector, 1075
 - defmacro, 1075
- make-double-vector1, 1075
 - defmacro, 1075
- make-filename
 - calledby make-appendstream, 980
 - calledby make-outstream, 979
 - calledby pathname, 1044
- make-instream, 979
 - calledby dewritify,dewritifyInner, 610
 - calledby incConsoleInput, 102
 - calledby incFileInput, 102
 - calledby newHelpSpad2Cmd, 571
 - calls makeInputFilename, 979
 - defun, 979
- make-monitor-data
 - calledby monitor-add, 1160
- make-outstream, 979
 - calledby makeStream, 981
 - calledby setOutputAlgebra, 760
 - calledby setOutputFormula, 788
 - calledby setOutputHtml, 778
 - calledby setOutputMathml, 774
 - calledby setOutputOpenMath, 783
 - calledby setOutputTex, 794
 - calls make-filename, 979
 - defun, 979
- make-string
 - calledby executeQuietCommand, 47
- makeByteWordVec2, 1149
 - defun, 1149
- makeFullNamestring, 983
 - calledby makeStream, 983
 - defun, 983

- makeHistFileName, 577
 - calledby closeInterpreterFrame, 560
 - calledby histFileName, 578
 - calledby oldHistFileName, 578
 - calledby restoreHistory, 595
 - calledby saveHistory, 593
 - calls makePathname, 577
 - defun, 577
- makeInitialModemapFrame, 37
 - calledby restart, 17
 - calls copy, 37
 - uses \$InitialModemapFrame, 37
 - defun, 37
- makeInputFilename, 981
 - calledby initHist, 579
 - calledby make-instream, 979
 - calledby newHelpSpad2Cmd, 570
 - calledby restoreHistory, 595
 - calledby saveHistory, 593
 - calledby updateSourceFiles, 544
 - calledby workfilesSpad2Cmd, 947
 - defun, 981
- makeLeaderMsg, 377
 - calledby processChPosesForOneLine, 376
 - uses \$nopos, 377
 - uses \$preLength, 377
 - defun, 377
- makeLongSpaceString
 - calledby printStorage, 58
- makeLongTimeString
 - calledby printTypeAndTimeNormal, 59
 - calledby printTypeAndTimeSaturn, 60
- makeMsgFromLine, 371
 - calledby processMsgList, 369
 - calls char, 371
 - calls getLinePos, 371
 - calls getLineText, 371
 - calls poGlobalLinePosn, 371
 - calls poLinePosn, 371
 - calls rep, 371
 - calls size, 371
 - calls strconc, 371
 - uses \$preLength, 371
 - defun, 371
- makeOrdinal, 918
 - calledby evaluateType1, 916
- defun, 918
- makePathname, 1044
 - calledby histInputFileName, 578
 - calledby makeHistFileName, 577
 - calledby readSpad2Cmd, 640
 - calledby sayMSG2File, 331
 - calls object2String, 1044
 - calls pathname, 1044
 - defun, 1044
- makeStream, 981
 - calledby setOutputFortran, 767
 - calls make-appendstream, 981
 - calls make-outstream, 981
 - calls makeFullNamestring, 983
 - defun, 981
- MakeSymbol
 - calledby assertCond, 96
 - calledby ifCond, 89
- manexp, 1097
 - defun, 1097
- mapage
 - abbreviations help page, 479
 - boot help page, 485
 - browse help page, 487
 - cd help page, 493
 - clear help page, 495
 - close help page, 507
 - compile help page, 511
 - copyright help page, 515
 - credits help page, 523
 - describe help page, 525
 - display help page, 531
 - edit help page, 541
 - fin help page, 545
 - frame help page, 547
 - help help page, 567
 - history help page, 573
 - include help page, 619
 - library help page, 623
 - lisp help page, 625
 - load help page, 627
 - ltrace help page, 629
 - pquit help page, 631
 - quit help page, 635
 - read help page, 639
 - regress help page, 643

- savesystem help page, 647
- set help page, 649
- show help page, 811
- spool help page, 825
- summary help page, 827
- synonym help page, 829
- system help page, 835
- tangle help page, 837
- trace help page, 839
- undo help page, 907
- what help page, 935
- with help page, 945
- workfiles help page, 947
- zsystemdevelopment help page, 951
- mapLetPrint, 882
 - calls getAliasIfTracedMapParameter, 882
 - calls getBpiNameIfTracedMap, 882
 - calls letPrint, 882
 - defun, 882
- mathprint
 - calledby displayMacro, 452
 - calledby displayValue, 457
 - calledby letPrint2, 885
 - calledby letPrint3, 886
- maxindex
 - calledby processSynonymLine, removeKeyFromIndex, 832
 - calledby removeUndoLines, 932
- member, 1050
 - calledby clearCmdParts, 503
 - calledby displayMacros, 536
 - calledby displayProperties, 460
 - calledby doSystemCommand, 444
 - calledby evaluateType, 914
 - calledby fixObjectForPrinting, 454
 - calledby getBrowseDatabase, 1083
 - calledby handleNoParseCommands, 468
 - calledby hasCateSpecialNew, 435
 - calledby historySpad2Cmd, 580
 - calledby importFromFrame, 561
 - calledby interpret2, 55
 - calledby isDomainValuedVariable, 957
 - calledby isSubForRedundantMapName, 871
 - calledby readSpad2Cmd, 640
 - calledby reportOpsFromUnitDirectly, 819
 - calledby selectOption, 477
 - calledby setExposeAddConstr, 698
 - calledby setExposeAddGroup, 697
 - calledby setExposeDropConstr, 701
 - calledby setExposeDropGroup, 700
 - calledby setOutputAlgebra, 760
 - calledby setOutputFormula, 788
 - calledby setOutputFortran, 767
 - calledby setOutputHtml, 778
 - calledby setOutputMathml, 774
 - calledby setOutputOpenMath, 783
 - calledby setOutputTex, 794
 - calledby showSpad2Cmd, 812
 - calledby transTraceItem, 861
 - calledby translateYesNo2TrueFalse, 656
 - calledby updateSourceFiles, 544
 - defun, 1050
- mergePathnames, 1043
 - calledby readSpad2Cmd, 640
 - calls pathnameDirectory, 1043
 - calls pathnameName, 1043
 - calls pathnameType, 1043
 - defun, 1043
- messageprint, 1050
 - calledby brightprint, 1049
 - defun, 1050
- messageprint-1, 1051
 - calledby brightprint-0, 1050
 - calledby messageprint-1, 1051
 - calledby messageprint-2, 1051
 - calls identp, 1051
 - calls messageprint-1, 1051
 - calls messageprint-2, 1051
 - defun, 1051
- messageprint-2, 1051
 - calledby messageprint-1, 1051
 - calledby messageprint-2, 1051
 - calls messageprint-1, 1051
 - calls messageprint-2, 1051
 - defun, 1051
- meta-error-handler
 - usedby init-boot/spad-reader, 966
- MINUSCOMMENT, 106
 - defvar, 106
- mkAtree
 - calledby evaluateType1, 916
 - calledby evaluateType, 914

- calledby reportOperations, 814
- mkAtreeWithSrcPos
 - calledby interpret1, 54
- mkCompanionPage
 - calledby recordAndPrint, 56
- mkDependentsHashTable
 - calledby make-databases, 1018
- mkDomPvar, 432
 - calledby hasCaty, 420
 - calls domArg, 432
 - calls length, 432
 - local ref \$FormalMapVariableList, 433
 - defun, 432
- mkEvalable, 911
 - calledby evalDomain, 911
 - calledby mkEvalableMapping, 913
 - calledby mkEvalableRecord, 913
 - calledby mkEvalableUnion, 913
 - calledby mkEvalable, 911
 - calledby writify,writifyInner, 605
 - calls bpiname, 911
 - calls constructor?, 911
 - calls devaluate, 911
 - calls fbpip, 911
 - calls getdatabase, 911
 - calls loadIfNecessary, 911
 - calls mkEvalableMapping, 911
 - calls mkEvalableRecord, 911
 - calls mkEvalableUnion, 911
 - calls mkEvalable, 911
 - calls mkq, 911
 - calls qcar, 911
 - calls qcdr, 911
 - local ref \$EmptyMode, 911
 - local ref \$Integer, 911
 - defun, 911
- mkEvalableMapping, 913
 - calledby mkEvalable, 911
 - calls mkEvalable, 913
 - defun, 913
- mkEvalableRecord, 913
 - calledby mkEvalable, 911
 - calls mkEvalable, 913
 - defun, 913
- mkEvalableUnion, 913
 - calledby mkEvalable, 911
- calls mkEvalable, 913
 - defun, 913
- mkLineList, 70
 - calledby intloopEchoParse, 69
 - defun, 70
- mkprompt, 42
 - calledby SpadInterpretStream, 29
 - calledby intloopReadConsole, 30
 - calledby serverReadLine, 44
 - calls concat, 42
 - calls currenttime, 42
 - calls substring, 42
 - uses \$IOindex, 42
 - uses \$inputPromptType, 42
 - uses \$interpreterFrameName, 42
 - defun, 42
- mkq
 - calledby mkEvalable, 911
 - calledby traceDomainConstructor, 879
- mkTopicHashTable
 - calledby make-databases, 1018
- mkUserConstructorAbbreviation
 - calledby abbreviationsSpad2Cmd, 481
- mkUsersHashTable
 - calledby make-databases, 1018
- modes
 - calledby clearCmdParts, 503
- MONITOR,EVALTRAN
 - calledby break, 904
- monitor-add, 1160
 - calledby monitor-file, 1163
 - calls make-monitor-data, 1160
 - calls monitor-delete, 1160
 - uses *monitor-table*, 1160
 - defun, 1160
- monitor-apropos, 1173
 - uses *monitor-table*, 1173
 - defun, 1173
- monitor-autoload, 1168
 - defun, 1168
- monitor-checkpoint, 1165
 - uses *monitor-table*, 1165
 - uses *print-package*, 1165
 - defun, 1165
- monitor-data, 1158
 - defstruct, 1158

- monitor-decr, 1162
 - uses *monitor-table*, 1162
 - defun, 1162
- monitor-delete, 1160
 - calledby monitor-add, 1160
 - calledby monitor-tested, 1164
 - uses *monitor-table*, 1160
 - defun, 1160
- monitor-dirname, 1168
 - uses *monitor-nrlibs*, 1168
 - defun, 1168
- monitor-disable, 1161
 - uses *monitor-table*, 1161
 - defun, 1161
- monitor-enable, 1160
 - uses *monitor-table*, 1160
 - defun, 1160
- monitor-end, 1159
 - uses *monitor-table*, 1159
 - defun, 1159
- monitor-exposedp, 1170
 - defun, 1170
- monitor-file, 1163
 - calls monitor-add, 1163
 - catches, 1163
 - defun, 1163
 - throws, 1163
- monitor-help, 1166
 - defun, 1166
- monitor-incr, 1162
 - uses *monitor-table*, 1162
 - defun, 1162
- monitor-info, 1163
 - uses *monitor-table*, 1163
 - defun, 1163
- monitor-inittable, 1158
 - uses *monitor-table*, 1158
 - defun, 1158
- monitor-libname, 1169
 - defun, 1169
- monitor-nrlib, 1169
 - uses *monitor-table*, 1169
 - defun, 1169
- monitor-parse, 1172
 - calledby monitor-spadfile, 1172
 - defun, 1172
- monitor-percent, 1173
 - uses *monitor-table*, 1173
 - defun, 1173
- monitor-readinterp, 1170
 - calledby monitor-report, 1171
 - uses *monitor-domains*, 1170
 - catches, 1170
 - defun, 1170
 - throws, 1170
- monitor-report, 1171
 - calls monitor-readinterp, 1171
 - uses *monitor-domains*, 1171
 - defun, 1171
- monitor-reset, 1161
 - uses *monitor-table*, 1161
 - defun, 1161
- monitor-restore, 1165
 - defun, 1165
- monitor-results, 1159
 - uses *monitor-table*, 1159
 - defun, 1159
- monitor-spadfile, 1172
 - calls monitor-parse, 1172
 - uses *monitor-domains*, 1172
 - catches, 1172
 - defun, 1172
 - throws, 1172
- monitor-tested, 1164
 - calls monitor-delete, 1164
 - uses *monitor-table*, 1164
 - defun, 1164
- monitor-untested, 1163
 - uses *monitor-table*, 1163
 - defun, 1163
- monitor-write, 1164
 - defun, 1164
- msgCreate, 347
 - calledby ncBug, 368
 - calledby ncHardError, 352
 - calledby ncSoftError, 351
 - calls initImPr, 348
 - calls initToWhere, 348
 - calls putDatabaseStuff, 348
 - calls setMsgForcedAttrList, 348
 - defun, 347
- msgImPr?, 358

- calledby alreadyOpened?, 363
- calledby getPosStL, 356
- calledby processKeyedError, 353
- calledby showMsgPos?, 357
- calls getMsgCatAttr, 358
- defun, 358
- msgNoRep?, 375
 - calledby redundant, 374
 - calls getMsgCatAttr, 375
 - defun, 375
- msgOutputter, 353
 - calledby listOutputter, 354
 - calledby processKeyedError, 353
 - calls alreadyOpened?, 353
 - calls flowSegmentedMsg, 353
 - calls getStFromMsg, 353
 - calls leader?, 353
 - calls line?, 353
 - calls sayBrightly, 353
 - calls toFile?, 353
 - calls toScreen?, 353
 - uses \$linelength, 353
 - defun, 353
- msgText, 61
 - calledby printTypeAndTimeNormal, 59
 - calls flowSegmentedMsg, 62
 - calls getKeyedMsg, 62
 - calls segmentKeyedMsg, 61
 - calls substituteSegmentedMsg, 62
 - uses \$linelength, 62
 - uses \$margin, 62
 - defun, 61
- msort
 - calledby apropos, 943
 - calledby displayOperationsFromLisplib, 818
 - calledby displayProperties, 459
 - calledby displayWorkspaceNames, 452
 - calledby reportOpsFromLisplib, 816
 - calledby reportOpsFromUnitDirectly, 820
 - calledby saveDependentsHashTable, 1021
 - calledby saveUsersHashTable, 1022
 - calledby setExposeAddConstr, 698
 - calledby setExposeAddGroup, 697
 - calledby setExposeDropConstr, 701
 - calledby whatConstructors, 943
- myWritable?, 1086
 - calls error, 1086
 - calls fnameDirectory, 1086
 - calls fnameExists?, 1086
 - calls writeablep, 1086
 - defun, 1086
- myWriteable?
 - calledby fnameWritable?, 1086
- names
 - calledby frameSpad2Cmd, 564
- namestring, 1042
 - calledby editFile, 543
 - calledby loadLib, 1037
 - calledby newHelpSpad2Cmd, 571
 - calledby readSpad2Cmd, 640
 - calledby reportOpsFromLisplib, 816
 - calledby reportOpsFromUnitDirectly, 820
 - calledby restoreHistory, 595
 - calledby saveHistory, 594
 - calledby setExposeAddGroup, 697
 - calledby setExpose, 695
 - calledby workfilesSpad2Cmd, 947
 - calledby writeInputLines, 585
 - calls pathname, 1042
 - defun, 1042
- ncAbort
 - calledby ncBug, 368
- ncAlist, 415
 - calledby getMsgCatAttr, 358
 - calledby ncEltQ, 416
 - calledby ncPutQ, 417
 - calledby setMsgCatlessAttr, 365
 - calledby setMsgUnforcedAttr, 367
 - calledby tokPosn, 413
 - calls identp, 415
 - calls ncBug, 415
 - calls qcar, 415
 - calls qcdr, 416
 - defun, 415
- ncBug, 368
 - calledby getMsgPos2, 379
 - calledby incHandleMessage, 76
 - calledby lnFileName, 347
 - calledby ncAlist, 415
 - calledby ncEltQ, 416

- calledby ncTag, 415
- calledby poGlobalLinePosn, 72
- calls enable-backtrace, 368
- calls msgCreate, 368
- calls ncAbort, 368
- calls processKeyedError, 368
- uses \$newcompErrorCount, 368
- uses \$nopus, 368
- defun, 368
- ncConversationPhase, 68
 - calledby intloopSpadProcess,interp, 65
 - calls ncConversationPhase,wrapup, 68
 - uses \$ncMsgList, 68
 - defun, 68
- ncConversationPhase,wrapup, 68
 - calledby ncConversationPhase, 68
 - uses \$ncMsgList, 68
 - defun, 68
- ncEltQ, 416
 - calledby intloopSpadProcess,interp, 66
 - calledby phIntReportMsgs, 66
 - calledby phInterpret, 67
 - calledby phMacro, 221
 - calls ncAlist, 416
 - calls ncBug, 416
 - calls qassq, 416
 - defun, 416
- ncError, 69
 - calledby intloopSpadProcess,interp, 66
 - calledby ncHardError, 352
 - defun, 69
 - throws, 69
- ncHardError, 352
 - calledby mac0MLambdaApply, 223
 - calls desiredMsg, 352
 - calls msgCreate, 352
 - calls ncError, 352
 - calls processKeyedError, 352
 - uses \$newcompErrorCount, 352
 - defun, 352
- ncIntLoop, 25
 - calledby ncTopLevel, 25
 - calls intloop, 25
 - uses curinstream, 25
 - uses curoutstream, 26
 - defun, 25
- ncloopCommand, 476
 - calledby intloopReadConsole, 30
 - calls \$systemCommandFunction, 476
 - calls ncloopInclude1, 476
 - calls ncloopPrefix?, 476
 - uses \$systemCommandFunction, 476
 - defun, 476
- ncloopDQlines, 71
 - calledby intloopEchoParse, 69
 - calledby ncloopParse, 38
 - calls StreamNull, 71
 - calls poGlobalLinePosn, 71
 - calls streamChop, 71
 - calls tokPosn, 71
 - defun, 71
- ncloopEchoParse
 - calledby ncloopInclude0, 73
- ncloopEscaped, 37
 - calledby intloopReadConsole, 30
 - defun, 37
- ncloopIncFileName, 620
 - calledby ncloopInclude1, 619
 - calls concat, 620
 - calls incFileName, 620
 - defun, 620
- ncloopInclude, 620
 - calledby ncloopInclude1, 619
 - calls ncloopInclude0, 620
 - defun, 620
- ncloopInclude0, 73
 - calledby ncloopInclude, 620
 - calls incStream, 73
 - calls insertpile, 73
 - calls lineoftoks, 73
 - calls ncloopEchoParse, 73
 - calls ncloopProcess, 73
 - calls next, 73
 - uses \$lines, 73
 - defun, 73
- ncloopInclude1, 619
 - calledby ncloopCommand, 476
 - calls ncloopIncFileName, 619
 - calls ncloopInclude, 619
 - defun, 619
- ncloopParse, 38
 - calledby parseFromString, 48

- calls dqToList, 38
- calls nclloopDQlines, 38
- calls npParse, 38
- defun, 38
- ncloopPrefix?, 477
 - calledby nclloopCommand, 476
 - calledby streamChop, 72
 - defun, 477
- ncloopPrintLines, 70
 - calledby intloopEchoParse, 69
 - defun, 70
- ncloopProcess
 - calledby nclloopInclude0, 73
- ncParseFromString, 1060
 - defun, 1060
- ncPutQ, 416
 - calledby constoken, 113
 - calledby intloopSpadProcess, 65
 - calledby phIntReportMsgs, 66
 - calledby phInterpret, 67
 - calledby phMacro, 221
 - calledby phParse, 66
 - calledby setMsgCatlessAttr, 365
 - calledby setMsgForcedAttr, 364
 - calledby setMsgUnforcedAttr, 367
 - calledby tokConstruct, 411
 - calls ncAlist, 417
 - calls ncTag, 417
 - calls qassq, 417
 - defun, 416
- ncSoftError, 351
 - calledby incHandleMessage, 76
 - calledby mac0InfiniteExpansion, 225
 - calledby macMacro, 229
 - calledby npMissingMate, 215
 - calledby npMissing, 151
 - calledby npParse, 141
 - calledby npTrapForm, 212
 - calledby npTrap, 212
 - calledby scanError, 135
 - calledby scanS, 131
 - calledby syIgnoredFromTo, 191
 - calledby sySpecificErrorAtToken, 192
 - calls desiredMsg, 351
 - calls msgCreate, 351
 - calls processKeyedError, 351
 - uses \$newcompErrorCount, 351
 - defun, 351
- ncTag, 415
 - calledby getMsgTag, 350
 - calledby ncPutQ, 417
 - calledby tokType, 413
 - calls identp, 415
 - calls ncBug, 415
 - calls qcar, 415
 - defun, 415
- ncTopLevel, 25
 - calledby runspad, 21
 - calls ncIntLoop, 25
 - uses *eof*, 25
 - uses \$InteractiveFrame, 25
 - uses \$InteractiveMode, 25
 - uses \$boot, 25
 - uses \$e, 25
 - uses \$newspad, 25
 - uses \$spad, 25
 - uses in-stream, 25
 - defun, 25
- new
 - calledby frameSpad2Cmd, 564
- newHelpSpad2Cmd, 570
 - calledby helpSpad2Cmd, 570
 - calls concat, 570
 - calls make-instream, 571
 - calls makeInputFilename, 570
 - calls namestring, 571
 - calls obey, 570
 - calls pname, 571
 - calls poundsign, 571
 - calls sayKeyedMsg, 571
 - calls say, 571
 - calls selectOptionLC, 571
 - uses \$syscommands, 571
 - uses \$useFullScreenHelp, 571
 - defun, 570
- next, 38
 - calledby frameSpad2Cmd, 564
 - calledby intloopInclude0, 63
 - calledby intloopProcessString, 37
 - calledby nclloopInclude0, 73
 - calledby next1, 39
 - calledby parseFromString, 48

- calledby zsystemdevelopment1, 952
 - calls Delay, 38
 - calls next1, 38
 - defun, 38
- next-lines-clear, 970
 - calledby init-boot/spad-reader, 966
 - uses boot-line-stack, 970
 - defun, 970
- next-lines-show, 969
 - calledby iostat, 968
 - uses boot-line-stack, 969
 - defun, 969
- next-token
 - usedby token-stack-show, 969
- next1, 38
 - calledby next, 38
 - calls StreamNull, 38
 - calls incAppend, 39
 - calls next, 39
 - defun, 38
- nextInterpreterFrame, 558
 - calledby frameSpad2Cmd, 564
 - calls updateFromCurrentInterpreterFrame, 558
 - uses \$interpreterFrameRing, 558
 - defun, 558
- nextline, 112
 - calledby lineoftoks, 111
 - calledby scanEsc, 124
 - calls npNull, 112
 - calls strposl, 112
 - uses \$f, 113
 - uses \$linepos, 113
 - uses \$ln, 113
 - uses \$n, 113
 - uses \$r, 113
 - uses \$sz, 112
 - defun, 112
- nmsort
 - calledby getWorkspaceNames, 453
- nonBlank, 71
 - defun, 71
- npADD, 158
 - calledby npExpress1, 179
 - calls npAdd, 158
 - calls npPop1, 158
 - calls npPush, 158
 - calls npType, 158
 - defun, 158
- npAdd, 159
 - calledby npADD, 158
 - calledby npPrimary2, 158
 - calls npCompMissing, 159
 - calls npDefinitionOrStatement, 159
 - calls npEqKey, 159
 - calls npEqPeek, 159
 - calls npPop1, 159
 - calls npPop2, 159
 - calls npPush, 159
 - calls npRestore, 159
 - calls npState, 159
 - calls npTrap, 159
 - calls npVariable, 159
 - calls pfAdd, 159
 - calls pfNothing, 159
 - defun, 159
- npAmpersand, 204
 - calledby npAmpersandFrom, 202
 - calledby npAtom2, 160
 - calls npEqKey, 204
 - calls npName, 204
 - calls npTrap, 204
 - defun, 204
- npAmpersandFrom, 202
 - calledby npSynthetic, 198
 - calls npAmpersand, 202
 - calls npFromdom, 202
 - defun, 202
- npAndOr, 181
 - calledby npImport, 180
 - calledby npInline, 174
 - calledby npSuchThat, 176
 - calledby npVoid, 179
 - calledby npWhile, 177
 - calls npEqKey, 181
 - calls npPop1, 182
 - calls npPush, 182
 - calls npTrap, 182
 - defun, 181
- npAngleBared, 186
 - calledby npBracketed, 185
 - calls npEnclosed, 186

- calls pfHide, 186
- defun, 186
- npAnyNo, 162
 - calledby npColon, 217
 - calledby npEncAp, 182
 - calledby npTypified, 218
 - defun, 162
- npApplication, 162
 - calledby npFromdom1, 203
 - calledby npFromdom, 203
 - calledby npSCategory, 153
 - calledby npTypedForm, 220
 - calledby npTypified, 218
 - calls npApplication2, 162
 - calls npDotted, 162
 - calls npPop1, 162
 - calls npPop2, 162
 - calls npPrimary, 162
 - calls npPush, 162
 - calls pfApplication, 162
 - defun, 162
- npApplication2, 163
 - calledby npApplication2, 163
 - calledby npApplication, 162
 - calls npApplication2, 163
 - calls npDotted, 163
 - calls npPop1, 163
 - calls npPop2, 163
 - calls npPrimary1, 163
 - calls npPush, 163
 - calls pfApplication, 163
 - defun, 163
- npArith, 200
 - calledby npInterval, 199
 - calls npLeftAssoc, 200
 - calls npSum, 200
 - defun, 200
- npAssign, 216
 - calledby npExit, 216
 - calledby npLoop, 175
 - calledby npPileExit, 216
 - calls npAssignment, 216
 - calls npBackTrack, 216
 - calls npMDEF, 216
 - defun, 216
- npAssignment, 217
 - calledby npAssign, 216
 - calls npAssignVariable, 217
 - calls npEqKey, 217
 - calls npGives, 217
 - calls npPop1, 217
 - calls npPop2, 217
 - calls npPush, 217
 - calls npTrap, 217
 - calls pfAssign, 217
 - defun, 217
- npAssignVariable, 217
 - calledby npAssignment, 217
 - calls npColon, 217
 - calls npPop1, 217
 - calls npPush, 217
 - calls pfListOf, 217
 - defun, 217
- npAtom1, 183
 - calledby npPrimary1, 164
 - calls npBDefinition, 183
 - calls npConstTok, 183
 - calls npDollar, 183
 - calls npFromdom, 183
 - calls npName, 183
 - calls npPDefinition, 183
 - defun, 183
- npAtom2, 159
 - calledby npPrimary2, 158
 - calls npAmpersand, 160
 - calls npFromdom, 160
 - calls npInfixOperator, 159
 - calls npPrefixColon, 160
 - defun, 159
- npBacksetElse, 197
 - calledby npElse, 196
 - calls npEqKey, 197
 - defun, 197
- npBackTrack, 148
 - calledby npAssign, 216
 - calledby npDefinitionOrStatement, 147
 - calledby npExit, 215
 - calledby npGives, 148
 - calledby npMDEF, 165
 - calls npEqPeek, 148
 - calls npRestore, 148
 - calls npState, 148

- calls npTrap, 148
- defun, 148
- npBDefinition, 185
 - calledby npAtom1, 183
 - calledby npEncl, 182
 - calls npBracketed, 185
 - calls npDefinitionlist, 185
 - calls npPDefinition, 185
 - defun, 185
- npboot, 470
 - calledby handleNoParseCommands, 468
 - defun, 470
- npBPileDefinition, 188
 - calledby npPrimary1, 164
 - calls npPileBracketed, 188
 - calls npPileDefinitionlist, 188
 - calls npPop1, 188
 - calls npPush, 188
 - calls pfListOf, 188
 - calls pfSequence, 188
 - defun, 188
- npBraced, 186
 - calledby npBracketed, 185
 - calls npEnclosed, 186
 - calls pfBraceBar, 186
 - calls pfBrace, 186
 - defun, 186
- npBracketed, 186
 - calledby npBracketed, 185
 - calls npEnclosed, 186
 - calls pfBracketBar, 186
 - calls pfBracket, 186
 - defun, 186
- npBracketed, 185
 - calledby npBDefinition, 185
 - calls npAngleBared, 185
 - calls npBraced, 185
 - calls npBracked, 185
 - calls npParened, 185
 - defun, 185
- npBreak, 174
 - calledby npStatement, 170
 - calls npEqKey, 174
 - calls npPush, 174
 - calls pfBreak, 174
 - calls pfNothing, 174
- defun, 174
- npBy, 199
 - calledby npForIn, 177
 - calledby npSynthetic, 198
 - calls npInterval, 199
 - calls npLeftAssoc, 199
 - defun, 199
- npCategory, 153
 - calledby npCategoryL, 152
 - calls npPP, 153
 - calls npSCategory, 153
 - defun, 153
- npCategoryL, 152
 - calledby npSCategory, 153
 - calledby npWith, 150
 - calls npCategory, 152
 - calls npPop1, 152
 - calls npPush, 152
 - calls pfUnSequence, 152
 - defun, 152
- npCoerceTo, 220
 - calledby npTypeStyle, 219
 - calls npTypedForm, 220
 - calls pfCoerceto, 220
 - defun, 220
- npColon, 217
 - calledby npAssignVariable, 217
 - calledby npPower, 202
 - calls npAnyNo, 217
 - calls npTagged, 217
 - calls npTypified, 217
 - defun, 217
- npColonQuery, 219
 - calledby npTypeStyle, 219
 - calls npTypedForm, 219
 - calls pfRetractTo, 219
 - defun, 219
- npComma, 146
 - calledby npQualDef, 145
 - calls npQualifiedDefinition, 146
 - calls npTuple, 146
 - defun, 146
- npCommaBackSet, 146
 - calledby npTuple, 146
 - calls npEqKey, 146
 - defun, 146

- npCompMissing, 151
 - calledby npAdd, 159
 - calledby npForIn, 177
 - calledby npLetQualified, 166
 - calledby npLoop, 175
 - calledby npWith, 150
 - calls npEqKey, 151
 - calls npMissing, 151
 - defun, 151
- npConditional, 195
 - calledby npConditionalStatement, 180
 - calledby npWConditional, 195
 - calls npElse, 195
 - calls npEqKey, 195
 - calls npLogical, 195
 - calls npMissing, 195
 - calls npTrap, 195
 - defun, 195
- npConditionalStatement, 180
 - calledby npExpress1, 179
 - calls npConditional, 180
 - calls npQualifiedDefinition, 180
 - defun, 180
- npConstTok, 184
 - calledby npAtom1, 183
 - calls npEqPeek, 184
 - calls npNext, 184
 - calls npPop1, 184
 - calls npPrimary1, 184
 - calls npPush, 184
 - calls npRestore, 184
 - calls npState, 184
 - calls pfSymb, 184
 - calls tokPosn, 184
 - calls tokType, 184
 - uses \$stok, 184
 - defun, 184
- npDDInfKey, 208
 - calledby npInfGeneric, 207
 - calls npEqKey, 208
 - calls npInfKey, 208
 - calls npPop1, 208
 - calls npPush, 208
 - calls npRestore, 208
 - calls npState, 208
 - calls pfSymb, 208
 - calls tokConstruct, 208
 - calls tokPart, 208
 - calls tokPosn, 208
 - uses \$stok, 208
 - defun, 208
- npDecl, 214
 - calledby npVariableName, 214
 - calls npEqKey, 214
 - calls npPop1, 214
 - calls npPop2, 214
 - calls npPush, 214
 - calls npTrap, 214
 - calls npType, 214
 - calls pfTyped, 214
 - defun, 214
- npDef, 187
 - calledby npDefinitionItem, 167
 - calledby npDefinitionOrStatement, 147
 - calledby npDefn, 187
 - calledby npFix, 166
 - calls npDefTail, 187
 - calls npMatch, 187
 - calls npPop1, 187
 - calls npPush, 187
 - calls npTrap, 187
 - calls pfCheckItOut, 187
 - calls pfDefinition, 187
 - calls pfPushBody, 187
 - defun, 187
- npDefaultDecl, 170
 - calledby npDefaultItem, 169
 - calls npEqKey, 170
 - calls npPop1, 170
 - calls npPop2, 170
 - calls npPush, 170
 - calls npTrap, 170
 - calls npType, 170
 - calls pfParts, 170
 - calls pfSpread, 170
 - defun, 170
- npDefaultItem, 169
 - calledby npSDefaultItem, 169
 - calls npDefaultDecl, 169
 - calls npTrap, 169
 - calls npTypeVariable, 169
 - defun, 169

- npDefaultItemList, 168
 - calledby npTyping, 168
 - calls npPC, 168
 - calls npPop1, 169
 - calls npPush, 169
 - calls npSDefaultItem, 169
 - calls pfUnSequence, 169
 - defun, 168
- npDefaultValue, 194
 - calledby npSCategory, 153
 - calls npDefinitionOrStatement, 195
 - calls npEqKey, 194
 - calls npPop1, 195
 - calls npPush, 195
 - calls npTrap, 195
 - calls pfAdd, 195
 - calls pfNothing, 195
 - defun, 194
- npDefinition, 167
 - calledby npLetQualified, 166
 - calledby npQualified, 147
 - calls npDefinitionItem, 167
 - calls npPP, 167
 - calls npPop1, 167
 - calls npPush, 167
 - calls pfSequenceToList, 167
 - defun, 167
- npDefinitionItem, 167
 - calledby npDefinition, 167
 - calls npDefn, 168
 - calls npDef, 167
 - calls npEqPeek, 167
 - calls npImport, 167
 - calls npMacro, 167
 - calls npRestore, 167
 - calls npStatement, 167
 - calls npState, 167
 - calls npTrap, 168
 - calls npTyping, 167
 - defun, 167
- npDefinitionlist, 193
 - calledby npBDefinition, 185
 - calledby npPDefinition, 183
 - calledby npPileDefinitionlist, 189
 - calls npQualDef, 193
 - calls npSemiListing, 193
- defun, 193
- npDefinitionOrStatement, 147
 - calledby npAdd, 159
 - calledby npDefTail, 194
 - calledby npDefaultValue, 195
 - calledby npLambda, 149
 - calledby npLet, 166
 - calledby npQualifiedDefinition, 147
 - calls npBackTrack, 147
 - calls npDef, 147
 - calls npGives, 147
 - defun, 147
- npDefn, 187
 - calledby npDefinitionItem, 168
 - calledby npPrimary1, 164
 - calls npDef, 187
 - calls npEqKey, 187
 - calls npPP, 187
 - defun, 187
- npDefTail, 194
 - calledby npDef, 187
 - calledby npMdef, 165
 - calledby npSingleRule, 194
 - calls npDefinitionOrStatement, 194
 - calls npEqKey, 194
 - defun, 194
- npDiscrim, 197
 - calledby npDisjand, 197
 - calls npLeftAssoc, 197
 - calls npQuiver, 197
 - defun, 197
- npDisjand, 197
 - calledby npLogical, 197
 - calls npDiscrim, 197
 - calls npLeftAssoc, 197
 - defun, 197
- npDollar, 183
 - calledby npAtom1, 183
 - calls npEqPeek, 183
 - calls npNext, 184
 - calls npPush, 183
 - calls tokConstruct, 183
 - calls tokPosn, 183
 - uses \$stok, 184
 - defun, 183
- npDotted, 162

- calledby npApplication2, 163
- calledby npApplication, 162
- calls , 162
- defun, 162
- npElse, 196
 - calledby npConditional, 195
 - calls npBacksetElse, 196
 - calls npPop1, 196
 - calls npPop2, 196
 - calls npPop3, 196
 - calls npPush, 196
 - calls npRestore, 196
 - calls npState, 196
 - calls npTrap, 196
 - calls pflfThenOnly, 196
 - calls pflf, 196
 - defun, 196
- npEncAp, 182
 - calledby npPrimary1, 164
 - calledby npPrimary2, 158
 - calls npAnyNo, 182
 - calls npEncl, 182
 - calls npFromdom, 182
 - defun, 182
- npEncl, 182
 - calledby npEncAp, 182
 - calls npBDefinition, 182
 - calls npPop1, 182
 - calls npPop2, 182
 - calls npPush, 182
 - calls pfApplication, 182
 - defun, 182
- npEnclosed, 211
 - calledby npAngleBared, 186
 - calledby npBraced, 186
 - calledby npBracked, 186
 - calledby npParened, 185
 - calls npEqKey, 211
 - calls npMissingMate, 211
 - calls npPop1, 211
 - calls npPush, 211
 - calls pfEnSequence, 211
 - calls pfListOf, 211
 - calls pfTuple, 211
 - uses \$stok, 211
 - defun, 211
- npEqKey, 145
 - calledby npAdd, 159
 - calledby npAmpersand, 204
 - calledby npAndOr, 181
 - calledby npAssignment, 217
 - calledby npBacksetElse, 197
 - calledby npBreak, 174
 - calledby npCommaBackSet, 146
 - calledby npCompMissing, 151
 - calledby npConditional, 195
 - calledby npDDInfKey, 208
 - calledby npDecl, 214
 - calledby npDefTail, 194
 - calledby npDefaultDecl, 170
 - calledby npDefaultValue, 194
 - calledby npDefn, 187
 - calledby npEnclosed, 211
 - calledby npExport, 171
 - calledby npFix, 166
 - calledby npForIn, 177
 - calledby npFree, 173
 - calledby npFromdom1, 203
 - calledby npFromdom, 202
 - calledby npInfGeneric, 207
 - calledby npInfixOperator, 160
 - calledby npItem1, 142
 - calledby npItem, 142
 - calledby npIterate, 174
 - calledby npLambda, 149
 - calledby npLetQualified, 166
 - calledby npListAndRecover, 189
 - calledby npList, 155
 - calledby npLocalDecl, 172
 - calledby npLocal, 173
 - calledby npLoop, 175
 - calledby npMoveTo, 191
 - calledby npParenthesize, 215
 - calledby npPileBracketed, 188
 - calledby npPileExit, 216
 - calledby npQualified, 147
 - calledby npReturn, 178
 - calledby npRule, 193
 - calledby npSelector, 163
 - calledby npSemiBackSet, 193
 - calledby npSigDecl, 157
 - calledby npSymbolVariable, 205

- calledby npTypedForm1, 218
- calledby npTypedForm, 220
- calledby npTyping, 168
- calledby npWith, 150
- calls npNext, 145
- uses \$stok, 145
- uses \$ttok, 145
- defun, 145
- npEqPeek, 152
 - calledby npAdd, 159
 - calledby npBackTrack, 148
 - calledby npConstTok, 184
 - calledby npDefinitionItem, 167
 - calledby npDollar, 183
 - calledby npInterval, 199
 - calledby npListAndRecover, 189
 - calledby npMoveTo, 191
 - calledby npPrefixColon, 161
 - calledby npSCategory, 153
 - calledby npSegment, 200
 - calledby npWith, 150
 - uses \$stok, 152
 - uses \$ttok, 152
 - defun, 152
- npExit, 215
 - calledby npGives, 148
 - calls npAssign, 216
 - calls npBackTrack, 215
 - calls npPileExit, 216
 - defun, 215
- npExport, 171
 - calledby npStatement, 170
 - calls npEqKey, 171
 - calls npLocalItemlist, 171
 - calls npPop1, 171
 - calls npPush, 171
 - calls npTrap, 171
 - calls pfExport, 171
 - defun, 171
- npExpress, 179
 - calledby npReturn, 178
 - calledby npStatement, 170
 - calls npExpress1, 179
 - calls npIterators, 179
 - calls npPop1, 179
 - calls npPop2, 179
 - calls npPush, 179
 - calls pfCollect, 179
 - calls pfListOf, 179
 - defun, 179
- npExpress1, 179
 - calledby npExpress, 179
 - calls npADD, 179
 - calls npConditionalStatement, 179
 - defun, 179
- npFirstTok, 143
 - calledby npNext, 145
 - calledby npParse, 141
 - calledby npRecoverTrap, 190
 - calledby npRestore, 152
 - calls tokConstruct, 143
 - calls tokPart, 143
 - calls tokPosn, 143
 - uses \$inputStream, 143
 - uses \$stok, 143
 - uses \$ttok, 143
 - defun, 143
- npFix, 166
 - calledby npPrimary1, 164
 - calls npDef, 166
 - calls npEqKey, 166
 - calls npPop1, 166
 - calls npPush, 166
 - calls pfFix, 166
 - defun, 166
- npForIn, 177
 - calledby npIterators, 175
 - calledby npIterator, 176
 - calls npBy, 177
 - calls npCompMissing, 177
 - calls npEqKey, 177
 - calls npPop1, 178
 - calls npPop2, 178
 - calls npPush, 178
 - calls npTrap, 177
 - calls npVariable, 177
 - calls pfForin, 178
 - defun, 177
- npFree, 173
 - calledby npStatement, 170
 - calls npEqKey, 173
 - calls npLocalItemlist, 173

- calls npPop1, 173
- calls npPush, 173
- calls npTrap, 173
- calls pfFree, 173
- defun, 173
- npFromdom, 202
 - calledby npAmpersandFrom, 202
 - calledby npAtom1, 183
 - calledby npAtom2, 160
 - calledby npEncAp, 182
 - calledby npSegment, 200
 - calls npApplication, 203
 - calls npEqKey, 202
 - calls npFromdom1, 203
 - calls npPop1, 203
 - calls npPush, 203
 - calls npTrap, 203
 - calls pfFromDom, 203
 - defun, 202
- npFromdom1, 203
 - calledby npFromdom1, 203
 - calledby npFromdom, 203
 - calls npApplication, 203
 - calls npEqKey, 203
 - calls npFromdom1, 203
 - calls npPop1, 203
 - calls npPush, 203
 - calls npTrap, 203
 - calls pfFromDom, 203
 - defun, 203
- npGives, 148
 - calledby npAssignment, 217
 - calledby npDefinitionOrStatement, 147
 - calls npBackTrack, 148
 - calls npExit, 148
 - calls npLambda, 148
 - defun, 148
- npId, 204
 - calledby npName, 204
 - calledby npSymbolVariable, 205
 - calls npNext, 204
 - calls npPush, 204
 - calls tokConstruct, 204
 - calls tokPosn, 205
 - uses \$npTokToNames, 205
 - uses \$stok, 205
- uses \$ttok, 205
- defun, 204
- npImport, 180
 - calledby npDefinitionItem, 167
 - calledby npStatement, 170
 - calls npAndOr, 180
 - calls npQualTypelist, 180
 - calls pfImport, 180
 - defun, 180
- npInfGeneric, 207
 - calledby npLeftAssoc, 207
 - calledby npRightAssoc, 206
 - calledby npTerm, 201
 - calls npDDInfKey, 207
 - calls npEqKey, 207
 - defun, 207
- npInfixOp, 161
 - calledby npInfixOperator, 160
 - calls npPushId, 161
 - uses \$stok, 161
 - uses \$ttok, 161
 - defun, 161
- npInfixOperator, 160
 - calledby npAtom2, 159
 - calledby npSignatureDefinee, 156
 - calls npEqKey, 160
 - calls npInfixOp, 160
 - calls npPop1, 160
 - calls npPush, 160
 - calls npRestore, 160
 - calls npState, 160
 - calls pfSymb, 160
 - calls tokConstruct, 160
 - calls tokPart, 160
 - calls tokPosn, 160
 - uses \$stok, 160
 - defun, 160
- npInfKey, 208
 - calledby npDDInfKey, 208
 - calls npPushId, 208
 - uses \$stok, 208
 - uses \$ttok, 208
 - defun, 208
- npInline, 174
 - calledby npStatement, 170
 - calls npAndOr, 174

- calls npQualTypelist, 174
 - calls pfInline, 174
 - defun, 174
- npInterval, 199
 - calledby npBy, 199
 - calls npArith, 199
 - calls npEqPeek, 199
 - calls npPop1, 199
 - calls npPop2, 199
 - calls npPush, 199
 - calls npSegment, 199
 - calls pfApplication, 199
 - calls pfInfApplication, 199
 - defun, 199
- npItem, 142
 - calledby npParse, 141
 - calls npEqKey, 142
 - calls npItem1, 142
 - calls npPop1, 142
 - calls npPush, 142
 - calls npQualDef, 142
 - calls pfEnSequence, 142
 - calls pfNovalue, 142
 - defun, 142
- npItem1, 142
 - calledby npItem1, 142
 - calledby npItem, 142
 - calls npEqKey, 142
 - calls npItem1, 142
 - calls npPop1, 143
 - calls npQualDef, 142
 - defun, 142
- npIterate, 174
 - calledby npStatement, 170
 - calls npEqKey, 174
 - calls npPush, 174
 - calls pfIterate, 174
 - calls pfNothing, 174
 - defun, 174
- npIterator, 176
 - calledby npIterators, 175
 - calls npForIn, 176
 - calls npSuchThat, 176
 - calls npWhile, 176
 - defun, 176
- npIterators, 175
 - calledby npExpress, 179
 - calledby npIterators, 176
 - calledby npLoop, 175
 - calls npForIn, 175
 - calls npIterators, 176
 - calls npIterator, 175
 - calls npPop1, 175
 - calls npPop2, 175
 - calls npPush, 175
 - calls npWhile, 175
 - calls npZeroOrMore, 175
 - defun, 175
- npLambda, 148
 - calledby npGives, 148
 - calledby npLambda, 149
 - calls npDefinitionOrStatement, 149
 - calls npEqKey, 149
 - calls npLambda, 149
 - calls npPop1, 149
 - calls npPop2, 149
 - calls npPush, 149
 - calls npTrap, 149
 - calls npType, 149
 - calls npVariable, 148
 - calls pfLam, 149
 - calls pfReturnTyped, 149
 - defun, 148
- npLeftAssoc, 206
 - calledby npArith, 200
 - calledby npBy, 199
 - calledby npDiscrim, 197
 - calledby npDisjand, 197
 - calledby npLogical, 197
 - calledby npMatch, 150
 - calledby npProduct, 202
 - calledby npRelation, 198
 - calledby npRemainder, 201
 - calledby npSuch, 150
 - calledby npSum, 201
 - calls npInfGeneric, 207
 - calls npPop1, 207
 - calls npPop2, 207
 - calls npPush, 207
 - calls pfApplication, 207
 - calls pfInfApplication, 207
 - defun, 206

- npLet, 166
 - calledby npPrimary1, 164
 - calls npDefinitionOrStatement, 166
 - calls npLetQualified, 166
 - defun, 166
- npLetQualified, 166
 - calledby npLet, 166
 - calledby npQualified, 147
 - calls npCompMissing, 166
 - calls npDefinition, 166
 - calls npEqKey, 166
 - calls npPop1, 167
 - calls npPop2, 167
 - calls npPush, 167
 - calls npTrap, 166
 - calls pfWhere, 167
 - defun, 166
- nplisp, 470
 - calledby handleNoParseCommands, 468
 - calledby intnplisp, 36
 - uses \$ans, 470
 - defun, 470
- npList, 155
 - calledby npListing, 155
 - calls npEqKey, 155
 - calls npPop1, 155
 - calls npPop2, 155
 - calls npPop3, 155
 - calls npPush, 155
 - calls npTrap, 155
 - uses \$stack, 155
 - defun, 155
- npListAndRecover, 189
 - calledby npPPg, 210
 - calledby npPileDefinitionlist, 189
 - calls npEqKey, 189
 - calls npEqPeek, 189
 - calls npNext, 189
 - calls npPop1, 189
 - calls npPush, 189
 - calls npRecoverTrap, 189
 - calls syGeneralErrorHere, 189
 - uses \$inputStream, 189
 - uses \$stack, 189
 - catches, 189
 - defun, 189
- npListing, 155
 - calledby npSDefaultItem, 169
 - calledby npSLocalItem, 172
 - calledby npSQualTypelist, 181
 - calledby npSigItemList, 154
 - calledby npTypeVariablelist, 157
 - calledby npVariablelist, 213
 - calls npList, 155
 - calls pfListOf, 155
 - defun, 155
- npListofFun, 221
 - calledby npSemiListing, 193
 - calledby npTuple, 146
 - calls npPop1, 221
 - calls npPop2, 221
 - calls npPop3, 221
 - calls npPush, 221
 - calls npTrap, 221
 - uses \$stack, 221
 - defun, 221
- npLocal, 173
 - calledby npStatement, 170
 - calls npEqKey, 173
 - calls npLocalItemList, 173
 - calls npPop1, 173
 - calls npPush, 173
 - calls npTrap, 173
 - calls pfLocal, 173
 - defun, 173
- npLocalDecl, 172
 - calledby npLocalItem, 172
 - calls npEqKey, 172
 - calls npPop1, 172
 - calls npPop2, 172
 - calls npPush, 172
 - calls npTrap, 172
 - calls npType, 172
 - calls pfNothing, 173
 - calls pfParts, 172
 - calls pfSpread, 172
 - defun, 172
- npLocalItem, 172
 - calledby npSLocalItem, 172
 - calls npLocalDecl, 172
 - calls npTypeVariable, 172
 - defun, 172

- npLocalItemList, 171
 - calledby npExport, 171
 - calledby npFree, 173
 - calledby npLocal, 173
 - calls npPC, 171
 - calls npPop1, 171
 - calls npPush, 171
 - calls npSLocalItem, 171
 - calls pfUnSequence, 171
 - defun, 171
- npLogical, 197
 - calledby npConditional, 195
 - calledby npSuchThat, 176
 - calledby npSuch, 150
 - calledby npWhile, 177
 - calls npDisjand, 197
 - calls npLeftAssoc, 197
 - defun, 197
- npLoop, 175
 - calledby npStatement, 170
 - calls npAssign, 175
 - calls npCompMissing, 175
 - calls npEqKey, 175
 - calls npIterators, 175
 - calls npPop1, 175
 - calls npPop2, 175
 - calls npPush, 175
 - calls npTrap, 175
 - calls pfLoop1, 175
 - calls pfLp, 175
 - defun, 175
- npMacro, 164
 - calledby npDefinitionItem, 167
 - calledby npPrimary1, 164
 - calls npMdef, 164
 - calls npPP, 164
 - defun, 164
- npMatch, 150
 - calledby npDef, 187
 - calledby npType, 149
 - calls npLeftAssoc, 150
 - calls npSuch, 150
 - defun, 150
- npMDEF, 165
 - calledby npAssign, 216
 - calls npBackTrack, 165
 - calls npMDEFinition, 165
 - calls npStatement, 165
 - defun, 165
- npMdef, 164
 - calledby npMDEFinition, 165
 - calledby npMacro, 164
 - calls npDefTail, 165
 - calls npPop1, 165
 - calls npPush, 165
 - calls npQuiver, 164
 - calls npTrap, 165
 - calls pfCheckMacroOut, 164
 - calls pfMacro, 165
 - calls pfPushMacroBody, 165
 - defun, 164
- npMDEFinition, 165
 - calledby npMDEF, 165
 - calls npMdef, 165
 - calls npPP, 165
 - defun, 165
- npMissing, 151
 - calledby npCompMissing, 151
 - calledby npConditional, 195
 - calledby npMissingMate, 215
 - calledby npPileBracketed, 188
 - calls ncSoftError, 151
 - calls pname, 151
 - calls tokPosn, 151
 - uses \$stok, 151
 - defun, 151
 - throws, 151
- npMissingMate, 215
 - calledby npEnclosed, 211
 - calledby npParenthesize, 215
 - calls ncSoftError, 215
 - calls npMissing, 215
 - calls tokPosn, 215
 - defun, 215
- npMoveTo, 191
 - calledby npMoveTo, 191
 - calledby npRecoverTrap, 190
 - calls npEqKey, 191
 - calls npEqPeek, 191
 - calls npMoveTo, 191
 - calls npNext, 191
 - uses \$inputStream, 191

- defun, 191
- npName, 204
 - calledby npAmpersand, 204
 - calledby npAtom1, 183
 - calledby npReturn, 178
 - calledby npSignatureDefinee, 156
 - calledby npVariableName, 213
 - calls npId, 204
 - calls npSymbolVariable, 204
 - defun, 204
- npNext, 145
 - calledby npConstTok, 184
 - calledby npDollar, 184
 - calledby npEqKey, 145
 - calledby npId, 204
 - calledby npListAndRecover, 189
 - calledby npMoveTo, 191
 - calledby npPrefixColon, 161
 - calledby npPushId, 209
 - calls npFirstTok, 145
 - uses \$inputStream, 145
 - defun, 145
- npNull, 333
 - calledby eqpileTree, 339
 - calledby insertpile, 335
 - calledby nextline, 112
 - calledby pileForests, 338
 - calledby pilePlusComments, 336
 - calledby pileTree, 337
 - calls StreamNull, 333
 - defun, 333
- npParened, 185
 - calledby npBracketed, 185
 - calledby npPP, 209
 - calls npEnclosed, 185
 - calls pfParen, 185
 - defun, 185
- npParenthesize, 215
 - calledby npParenthesized, 214
 - calls npEqKey, 215
 - calls npMissingMate, 215
 - calls npPush, 215
 - uses \$stok, 215
 - defun, 215
- npParenthesized, 214
 - calledby npPDefinition, 183
 - calledby npTypeVariable, 156
 - calledby npVariable, 213
 - calls npParenthesize, 214
 - defun, 214
- npParse, 141
 - calledby intloopEchoParse, 69
 - calledby ncloopParse, 38
 - calls ncSoftError, 141
 - calls npFirstTok, 141
 - calls npItem, 141
 - calls pfDocument, 141
 - calls pfListOf, 141
 - calls pfWrong, 141
 - calls tokPosn, 141
 - uses \$inputStream, 141
 - uses \$stack, 141
 - uses \$stok, 141
 - uses \$ttok, 141
 - catches, 141
 - defun, 141
- npPC
 - calledby npDefaultItemList, 168
 - calledby npLocalItemList, 171
 - calledby npQualTypelist, 180
- npPDefinition, 183
 - calledby npAtom1, 183
 - calledby npBDefinition, 185
 - calls npDefinitionlist, 183
 - calls npParenthesized, 183
 - calls npPop1, 183
 - calls npPush, 183
 - calls pfEnSequence, 183
 - defun, 183
- npPileBracketed, 188
 - calledby npBPileDefinition, 188
 - calledby npPP, 210
 - calls npEqKey, 188
 - calls npMissing, 188
 - calls npPop1, 188
 - calls npPush, 188
 - calls pfNothing, 188
 - calls pfPile, 188
 - defun, 188
- npPileDefinitionlist, 189
 - calledby npBPileDefinition, 188
 - calls npDefinitionlist, 189

- calls npListAndRecover, 189
- calls npPop1, 189
- calls npPush, 189
- calls pfAppend, 189
- defun, 189
- npPileExit, 216
 - calledby npExit, 216
 - calls npAssign, 216
 - calls npEqKey, 216
 - calls npPop1, 216
 - calls npPop2, 216
 - calls npPush, 216
 - calls npStatement, 216
 - calls pfExit, 216
 - defun, 216
- npPop1, 144
 - calledby npADD, 158
 - calledby npAdd, 159
 - calledby npAndOr, 182
 - calledby npApplication2, 163
 - calledby npApplication, 162
 - calledby npAssignVariable, 217
 - calledby npAssignment, 217
 - calledby npBPileDefinition, 188
 - calledby npCategoryL, 152
 - calledby npConstTok, 184
 - calledby npDDInfKey, 208
 - calledby npDecl, 214
 - calledby npDefaultDecl, 170
 - calledby npDefaultItemlist, 169
 - calledby npDefaultValue, 195
 - calledby npDefinition, 167
 - calledby npDef, 187
 - calledby npElse, 196
 - calledby npEnclosed, 211
 - calledby npEncl, 182
 - calledby npExport, 171
 - calledby npExpress, 179
 - calledby npFix, 166
 - calledby npForIn, 178
 - calledby npFree, 173
 - calledby npFromdom1, 203
 - calledby npFromdom, 203
 - calledby npInfixOperator, 160
 - calledby npInterval, 199
 - calledby npItem1, 143
 - calledby npItem, 142
 - calledby npIterators, 175
 - calledby npLambda, 149
 - calledby npLeftAssoc, 207
 - calledby npLetQualified, 167
 - calledby npListAndRecover, 189
 - calledby npListofFun, 221
 - calledby npList, 155
 - calledby npLocalDecl, 172
 - calledby npLocalItemlist, 171
 - calledby npLocal, 173
 - calledby npLoop, 175
 - calledby npMdef, 165
 - calledby npPDefinition, 183
 - calledby npPPff, 210
 - calledby npPPg, 210
 - calledby npPP, 210
 - calledby npPileBracketed, 188
 - calledby npPileDefinitionlist, 189
 - calledby npPileExit, 216
 - calledby npQualDef, 145
 - calledby npQualTypelist, 180
 - calledby npQualType, 181
 - calledby npQualified, 147
 - calledby npReturn, 178
 - calledby npRightAssoc, 206
 - calledby npSCategory, 153
 - calledby npSDefaultItem, 169
 - calledby npSLocalItem, 172
 - calledby npSQualTypelist, 181
 - calledby npSelector, 163
 - calledby npSigDecl, 157
 - calledby npSigItemlist, 154
 - calledby npSignature, 154
 - calledby npSingleRule, 194
 - calledby npSymbolVariable, 205
 - calledby npSynthetic, 198
 - calledby npTerm, 201
 - calledby npTypeVariable, 156
 - calledby npTypedForm1, 218
 - calledby npTypedForm, 220
 - calledby npType, 149
 - calledby npTyping, 168
 - calledby npVariableName, 214
 - calledby npVariable, 213
 - calledby npWConditional, 195

- calledby npWith, 150
- calledby npZeroOrMore, 177
- uses \$stack, 144
- defun, 144
- npPop2, 144
 - calledby npAdd, 159
 - calledby npApplication2, 163
 - calledby npApplication, 162
 - calledby npAssignment, 217
 - calledby npDecl, 214
 - calledby npDefaultDecl, 170
 - calledby npElse, 196
 - calledby npEncl, 182
 - calledby npExpress, 179
 - calledby npForIn, 178
 - calledby npInterval, 199
 - calledby npIterators, 175
 - calledby npLambda, 149
 - calledby npLeftAssoc, 207
 - calledby npLetQualified, 167
 - calledby npListofFun, 221
 - calledby npList, 155
 - calledby npLocalDecl, 172
 - calledby npLoop, 175
 - calledby npPileExit, 216
 - calledby npReturn, 178
 - calledby npRightAssoc, 206
 - calledby npSelector, 163
 - calledby npSigDecl, 157
 - calledby npSingleRule, 194
 - calledby npSynthetic, 198
 - calledby npTerm, 201
 - calledby npTypedForm1, 218
 - calledby npTypedForm, 220
 - calledby npWith, 150
 - calledby npZeroOrMore, 177
 - uses \$stack, 144
 - defun, 144
- npPop3, 144
 - calledby npElse, 196
 - calledby npListofFun, 221
 - calledby npList, 155
 - uses \$stack, 144
 - defun, 144
- npPower, 202
 - calledby npProduct, 202
 - calls npColon, 202
 - calls npRightAssoc, 202
 - defun, 202
- npPP, 209
 - calledby npCategory, 153
 - calledby npDefinition, 167
 - calledby npDefn, 187
 - calledby npMDEFinition, 165
 - calledby npMacro, 164
 - calledby npRule, 193
 - calls npPPf, 209
 - calls npPPg, 210
 - calls npParened, 209
 - calls npPileBracketed, 210
 - calls npPop1, 210
 - calls npPush, 210
 - calls pfEnSequence, 210
 - uses npPParg, 210
 - defun, 209
- npPParg, 204, 209
 - usedby npPP, 210
 - defvar, 204, 209
- npPPf, 211
 - calledby npPPg, 210
 - calledby npPP, 209
 - calls npPPff, 211
 - calls npSemiListing, 211
 - defun, 211
- npPPff, 210
 - calledby npPPf, 211
 - calls npPop1, 210
 - calls npPush, 210
 - uses \$npPParg, 210
 - defun, 210
- npPPg, 210
 - calledby npPP, 210
 - calls npListAndRecover, 210
 - calls npPPf, 210
 - calls npPop1, 210
 - calls npPush, 210
 - calls pfAppend, 210
 - defun, 210
- npPrefixColon, 161
 - calledby npAtom2, 160
 - calledby npSignatureDefinee, 156
 - calls npEqPeek, 161

- calls npNext, 161
- calls npPush, 161
- calls tokConstruct, 161
- calls tokPosn, 161
- uses \$stok, 161
- defun, 161
- npPretend, 219
 - calledby npTypeStyle, 219
 - calls npTypedForm, 219
 - calls pfPretend, 219
 - defun, 219
- npPrimary, 157
 - calledby npApplication, 162
 - calledby npSCategory, 153
 - calledby npSelector, 163
 - calls npPrimary1, 157
 - calls npPrimary2, 158
 - defun, 157
- npPrimary1, 164
 - calledby npApplication2, 163
 - calledby npConstTok, 184
 - calledby npPrimary, 157
 - calls npAtom1, 164
 - calls npBPileDefinition, 164
 - calls npDefn, 164
 - calls npEncAp, 164
 - calls npFix, 164
 - calls npLet, 164
 - calls npMacro, 164
 - calls npRule, 164
 - defun, 164
- npPrimary2, 158
 - calledby npPrimary, 158
 - calls npAdd, 158
 - calls npAtom2, 158
 - calls npEncAp, 158
 - calls npWith, 158
 - calls pfNothing, 158
 - defun, 158
- npProcessSynonym, 471
 - calledby npsynonym, 471
 - calls printSynonyms, 471
 - calls processSynonymLine, 471
 - calls putalist, 471
 - calls terminateSystemCommand, 471
 - uses \$CommandSynonymAlist, 471
- defun, 471
- npProduct, 202
 - calledby npRemainder, 201
 - calls npLeftAssoc, 202
 - calls npPower, 202
 - defun, 202
- npPush, 143
 - calledby npADD, 158
 - calledby npAdd, 159
 - calledby npAndOr, 182
 - calledby npApplication2, 163
 - calledby npApplication, 162
 - calledby npAssignVariable, 217
 - calledby npAssignment, 217
 - calledby npBPileDefinition, 188
 - calledby npBreak, 174
 - calledby npCategoryL, 152
 - calledby npConstTok, 184
 - calledby npDDInfKey, 208
 - calledby npDecl, 214
 - calledby npDefaultDecl, 170
 - calledby npDefaultItemlist, 169
 - calledby npDefaultValue, 195
 - calledby npDefinition, 167
 - calledby npDef, 187
 - calledby npDollar, 183
 - calledby npElse, 196
 - calledby npEnclosed, 211
 - calledby npEncl, 182
 - calledby npExport, 171
 - calledby npExpress, 179
 - calledby npFix, 166
 - calledby npForIn, 178
 - calledby npFree, 173
 - calledby npFromdom1, 203
 - calledby npFromdom, 203
 - calledby npId, 204
 - calledby npInfixOperator, 160
 - calledby npInterval, 199
 - calledby npItem, 142
 - calledby npIterate, 174
 - calledby npIterators, 175
 - calledby npLambda, 149
 - calledby npLeftAssoc, 207
 - calledby npLetQualified, 167
 - calledby npListAndRecover, 189

- calledby npListofFun, 221
- calledby npList, 155
- calledby npLocalDecl, 172
- calledby npLocalItemlist, 171
- calledby npLocal, 173
- calledby npLoop, 175
- calledby npMdef, 165
- calledby npPDefinition, 183
- calledby npPPff, 210
- calledby npPPg, 210
- calledby npPP, 210
- calledby npParenthesize, 215
- calledby npPileBracketed, 188
- calledby npPileDefinitionlist, 189
- calledby npPileExit, 216
- calledby npPrefixColon, 161
- calledby npQualDef, 145
- calledby npQualTypelist, 180
- calledby npQualType, 181
- calledby npQualified, 147
- calledby npRecoverTrap, 190
- calledby npReturn, 178
- calledby npRightAssoc, 206
- calledby npSCategory, 153
- calledby npSDefaultItem, 169
- calledby npSLocalItem, 172
- calledby npSQualTypelist, 181
- calledby npSelector, 163
- calledby npSigDecl, 157
- calledby npSigItemlist, 154
- calledby npSignature, 154
- calledby npSingleRule, 194
- calledby npSymbolVariable, 205
- calledby npSynthetic, 198
- calledby npTerm, 201
- calledby npTypeVariable, 156
- calledby npTypedForm1, 218
- calledby npTypedForm, 220
- calledby npType, 149
- calledby npTyping, 168
- calledby npVariableName, 214
- calledby npVariable, 213
- calledby npWConditional, 195
- calledby npWith, 150
- calledby npZeroOrMore, 177
- uses \$stack, 143
- defun, 143
- npPushId, 209
 - calledby npInfKey, 208
 - calledby npInfixOp, 161
 - calledby npSegment, 200
 - calls npNext, 209
 - calls tokConstruct, 209
 - calls tokPosn, 209
 - uses \$stack, 209
 - uses \$stok, 209
 - uses \$ttok, 209
 - defun, 209
- npQualDef, 145
 - calledby npDefinitionlist, 193
 - calledby npItem1, 142
 - calledby npItem, 142
 - calls npComma, 145
 - calls npPop1, 145
 - calls npPush, 145
 - defun, 145
- npQualified, 147
 - calledby npQualifiedDefinition, 147
 - calls npDefinition, 147
 - calls npEqKey, 147
 - calls npLetQualified, 147
 - calls npPop1, 147
 - calls npPush, 147
 - calls npTrap, 147
 - calls pfWhere, 147
 - defun, 147
- npQualifiedDefinition, 147
 - calledby npComma, 146
 - calledby npConditionalStatement, 180
 - calls npDefinitionOrStatement, 147
 - calls npQualified, 147
 - defun, 147
- npQualType, 181
 - calledby npSQualTypelist, 181
 - calls npPop1, 181
 - calls npPush, 181
 - calls npType, 181
 - calls pfNothing, 181
 - calls pfQualType, 181
 - defun, 181
- npQualTypelist, 180
 - calledby npImport, 180

- calledby npInline, 174
- calls npPC, 180
- calls npPop1, 180
- calls npPush, 180
- calls npSQualTypelist, 180
- calls pfUnSequence, 180
- defun, 180
- npQuiver, 198
 - calledby npDiscrim, 197
 - calledby npMdef, 164
 - calledby npSingleRule, 194
 - calls npRelation, 198
 - calls npRightAssoc, 198
 - defun, 198
- npRecoverTrap, 190
 - calledby npListAndRecover, 189
 - calls npFirstTok, 190
 - calls npMoveTo, 190
 - calls npPush, 190
 - calls pfDocument, 190
 - calls pfListOf, 190
 - calls pfWrong, 190
 - calls syIgnoredFromTo, 190
 - calls tokPosn, 190
 - uses \$stok, 190
 - defun, 190
- npRelation, 198
 - calledby npQuiver, 198
 - calls npLeftAssoc, 198
 - calls npSynthetic, 198
 - defun, 198
- npRemainder, 201
 - calledby npTerm, 201
 - calls npLeftAssoc, 201
 - calls npProduct, 201
 - defun, 201
- npRestore, 152
 - calledby npAdd, 159
 - calledby npBackTrack, 148
 - calledby npConstTok, 184
 - calledby npDDInfKey, 208
 - calledby npDefinitionItem, 167
 - calledby npElse, 196
 - calledby npInfixOperator, 160
 - calledby npRightAssoc, 206
 - calledby npSCategory, 153
 - calledby npSymbolVariable, 205
 - calledby npWith, 150
 - calls npFirstTok, 152
 - uses \$inputStream, 152
 - uses \$stack, 152
 - defun, 152
- npRestrict, 220
 - calledby npTypeStyle, 219
 - calls npTypedForm, 220
 - calls pfRestrict, 220
 - defun, 220
- npReturn, 178
 - calledby npStatement, 170
 - calls npEqKey, 178
 - calls npExpress, 178
 - calls npName, 178
 - calls npPop1, 178
 - calls npPop2, 178
 - calls npPush, 178
 - calls npTrap, 178
 - calls pfNothing, 178
 - calls pfReturnNoName, 178
 - calls pfReturn, 178
 - defun, 178
- npRightAssoc, 206
 - calledby npPower, 202
 - calledby npQuiver, 198
 - calledby npRightAssoc, 206
 - calls npInfGeneric, 206
 - calls npPop1, 206
 - calls npPop2, 206
 - calls npPush, 206
 - calls npRestore, 206
 - calls npRightAssoc, 206
 - calls npState, 206
 - calls pfApplication, 206
 - calls pfInfApplication, 206
 - defun, 206
- npRule, 193
 - calledby npPrimary1, 164
 - calls npEqKey, 193
 - calls npPP, 193
 - calls npSingleRule, 193
 - defun, 193
- npSCategory, 153
 - calledby npCategory, 153

- calls npApplication, 153
- calls npCategoryL, 153
- calls npDefaultValue, 153
- calls npEqPeek, 153
- calls npPop1, 153
- calls npPrimary, 153
- calls npPush, 153
- calls npRestore, 153
- calls npSignature, 153
- calls npState, 153
- calls npTrap, 153
- calls npWConditional, 153
- calls pfAttribute, 153
- defun, 153
- npSDefaultItem, 169
 - calledby npDefaultItemList, 169
 - calls npDefaultItem, 169
 - calls npListing, 169
 - calls npPop1, 169
 - calls npPush, 169
 - calls pfAppend, 169
 - calls pfParts, 169
 - defun, 169
- npSegment, 200
 - calledby npInterval, 199
 - calls npEqPeek, 200
 - calls npFromdom, 200
 - calls npPushId, 200
 - defun, 200
- npSelector, 163
 - calls npEqKey, 163
 - calls npPop1, 163
 - calls npPop2, 163
 - calls npPrimary, 163
 - calls npPush, 163
 - calls npTrap, 163
 - calls pfApplication, 163
 - defun, 163
- npSemiBackSet, 193
 - calledby npSemiListing, 193
 - calls npEqKey, 193
 - defun, 193
- npSemiListing, 193
 - calledby npDefinitionlist, 193
 - calledby npPPf, 211
 - calls npListoffun, 193
 - calls npSemiBackSet, 193
 - calls pfAppend, 193
 - defun, 193
- npSigDecl, 157
 - calledby npSigItem, 156
 - calls npEqKey, 157
 - calls npPop1, 157
 - calls npPop2, 157
 - calls npPush, 157
 - calls npTrap, 157
 - calls npType, 157
 - calls pfParts, 157
 - calls pfSpread, 157
 - defun, 157
- npSigItem, 156
 - calledby npSigItemList, 154
 - calls npSigDecl, 156
 - calls npTrap, 156
 - calls npTypeVariable, 156
 - defun, 156
- npSigItemList, 154
 - calledby npSignature, 154
 - calls npListing, 154
 - calls npPop1, 154
 - calls npPush, 154
 - calls npSigItem, 154
 - calls pfAppend, 154
 - calls pfListof, 154
 - calls pfParts, 154
 - defun, 154
- npSignature, 154
 - calledby npSCategory, 153
 - calls npPop1, 154
 - calls npPush, 154
 - calls npSigItemList, 154
 - calls pfNothing, 154
 - calls pfWDec, 154
 - defun, 154
- npSignatureDefinee, 156
 - calledby npTypeVariablelist, 157
 - calledby npTypeVariable, 156
 - calls npInfixOperator, 156
 - calls npName, 156
 - calls npPrefixColon, 156
 - defun, 156
- npSingleRule, 194

- calledby npRule, 193
- calls npDefTail, 194
- calls npPop1, 194
- calls npPop2, 194
- calls npPush, 194
- calls npQuiver, 194
- calls npTrap, 194
- calls pfRule, 194
- defun, 194
- npSLocalItem, 172
 - calledby npLocalItemList, 171
 - calls npListing, 172
 - calls npLocalItem, 172
 - calls npPop1, 172
 - calls npPush, 172
 - calls pfAppend, 172
 - calls pfParts, 172
 - defun, 172
- npSQualTypelist, 181
 - calledby npQualTypelist, 180
 - calls npListing, 181
 - calls npPop1, 181
 - calls npPush, 181
 - calls npQualType, 181
 - calls pfParts, 181
 - defun, 181
- npState, 212
 - calledby npAdd, 159
 - calledby npBackTrack, 148
 - calledby npConstTok, 184
 - calledby npDDInfKey, 208
 - calledby npDefinitionItem, 167
 - calledby npElse, 196
 - calledby npInfixOperator, 160
 - calledby npRightAssoc, 206
 - calledby npSCategory, 153
 - calledby npSymbolVariable, 205
 - calledby npWith, 150
 - uses \$inputStream, 212
 - uses \$stack, 212
 - defun, 212
- npStatement, 170
 - calledby npDefinitionItem, 167
 - calledby npMDEF, 165
 - calledby npPileExit, 216
 - calledby npVoid, 179
 - calls npBreak, 170
 - calls npExport, 170
 - calls npExpress, 170
 - calls npFree, 170
 - calls npImport, 170
 - calls npInline, 170
 - calls npIterate, 170
 - calls npLocal, 170
 - calls npLoop, 170
 - calls npReturn, 170
 - calls npTyping, 170
 - calls npVoid, 170
 - defun, 170
- npSuch, 150
 - calledby npMatch, 150
 - calls npLeftAssoc, 150
 - calls npLogical, 150
 - defun, 150
- npSuchThat, 176
 - calledby npIterator, 176
 - calls npAndOr, 176
 - calls npLogical, 176
 - calls pfSuchthat, 176
 - defun, 176
- npSum, 201
 - calledby npArith, 200
 - calls npLeftAssoc, 201
 - calls npTerm, 201
 - defun, 201
- npSymbolVariable, 205
 - calledby npName, 204
 - calls npEqKey, 205
 - calls npId, 205
 - calls npPop1, 205
 - calls npPush, 205
 - calls npRestore, 205
 - calls npState, 205
 - calls tokConstruct, 205
 - calls tokPart, 205
 - calls tokPosn, 205
 - defun, 205
- npsynonym, 471
 - calledby handleNoParseCommands, 468
 - calls npProcessSynonym, 471
 - defun, 471
- npSynthetic, 198

- calledby npRelation, 198
- calls npAmpersandFrom, 198
- calls npBy, 198
- calls npPop1, 198
- calls npPop2, 198
- calls npPush, 198
- calls pfApplication, 198
- calls pfInfApplication, 198
- defun, 198
- npsystem, 470
 - calledby handleNoParseCommands, 468
 - calls sayKeyedMsg, 470
 - defun, 470
- npTagged, 218
 - calledby npColon, 217
 - calls npTypedForm1, 218
 - calls pfTagged, 218
 - defun, 218
- npTerm, 201
 - calledby npSum, 201
 - calls npInfGeneric, 201
 - calls npPop1, 201
 - calls npPop2, 201
 - calls npPush, 201
 - calls npRemainder, 201
 - calls pfApplication, 201
 - defun, 201
- npTrap, 212
 - calledby npAdd, 159
 - calledby npAmpersand, 204
 - calledby npAndOr, 182
 - calledby npAssignment, 217
 - calledby npBackTrack, 148
 - calledby npConditional, 195
 - calledby npDecl, 214
 - calledby npDefaultDecl, 170
 - calledby npDefaultItem, 169
 - calledby npDefaultValue, 195
 - calledby npDefinitionItem, 168
 - calledby npDef, 187
 - calledby npElse, 196
 - calledby npExport, 171
 - calledby npForIn, 177
 - calledby npFree, 173
 - calledby npFromdom1, 203
 - calledby npFromdom, 203
 - calledby npLambda, 149
 - calledby npLetQualified, 166
 - calledby npListofFun, 221
 - calledby npList, 155
 - calledby npLocalDecl, 172
 - calledby npLocal, 173
 - calledby npLoop, 175
 - calledby npMdef, 165
 - calledby npQualified, 147
 - calledby npReturn, 178
 - calledby npSCategory, 153
 - calledby npSelector, 163
 - calledby npSigDecl, 157
 - calledby npSigItem, 156
 - calledby npSingleRule, 194
 - calledby npTypedForm1, 218
 - calledby npTypedForm, 220
 - calledby npTyping, 168
 - calledby npWith, 150
 - calls ncSoftError, 212
 - calls tokPosn, 212
 - uses \$stok, 212
 - defun, 212
 - throws, 212
- npTrapForm, 212
 - calledby pfCheckId, 241
 - calledby pfCheckItOut, 239
 - calledby pfCheckMacroOut, 240
 - calls ncSoftError, 212
 - calls pfSourceStok, 212
 - calls syGeneralErrorHere, 212
 - calls tokPosn, 212
 - defun, 212
 - throws, 212
- npTuple, 146
 - calledby npComma, 146
 - calls npCommaBackSet, 146
 - calls npListofFun, 146
 - calls pfTupleListOf, 146
 - defun, 146
- npType, 149
 - calledby npADD, 158
 - calledby npDecl, 214
 - calledby npDefaultDecl, 170
 - calledby npLambda, 149
 - calledby npLocalDecl, 172

- calledby npQualType, 181
- calledby npSigDecl, 157
- calledby npTypedForm1, 218
- calls npMatch, 149
- calls npPop1, 149
- calls npPush, 149
- calls npWith, 149
- defun, 149
- npTypedForm, 220
 - calledby npCoerceTo, 220
 - calledby npColonQuery, 219
 - calledby npPretend, 219
 - calledby npRestrict, 220
 - calls npApplication, 220
 - calls npEqKey, 220
 - calls npPop1, 220
 - calls npPop2, 220
 - calls npPush, 220
 - calls npTrap, 220
 - defun, 220
- npTypedForm1, 218
 - calledby npTagged, 218
 - calls npEqKey, 218
 - calls npPop1, 218
 - calls npPop2, 218
 - calls npPush, 218
 - calls npTrap, 218
 - calls npType, 218
 - defun, 218
- npTypeStyle, 219
 - calledby npTypified, 218
 - calls npCoerceTo, 219
 - calls npColonQuery, 219
 - calls npPretend, 219
 - calls npRestrict, 219
 - defun, 219
- npTypeVariable, 156
 - calledby npDefaultItem, 169
 - calledby npLocalItem, 172
 - calledby npSigItem, 156
 - calls npParenthesized, 156
 - calls npPop1, 156
 - calls npPush, 156
 - calls npSignatureDefinee, 156
 - calls npTypeVariablelist, 156
 - calls pfListOf, 156
 - defun, 156
- npTypeVariablelist, 157
 - calledby npTypeVariable, 156
 - calls npListing, 157
 - calls npSignatureDefinee, 157
 - defun, 157
- npTypified, 218
 - calledby npColon, 217
 - calls npAnyNo, 218
 - calls npApplication, 218
 - calls npTypeStyle, 218
 - defun, 218
- npTyping, 168
 - calledby npDefinitionItem, 167
 - calledby npStatement, 170
 - calls npDefaultItemlist, 168
 - calls npEqKey, 168
 - calls npPop1, 168
 - calls npPush, 168
 - calls npTrap, 168
 - calls pfTyping, 168
 - defun, 168
- npVariable, 213
 - calledby npAdd, 159
 - calledby npForIn, 177
 - calledby npLambda, 148
 - calledby npWith, 150
 - calls npParenthesized, 213
 - calls npPop1, 213
 - calls npPush, 213
 - calls npVariableName, 213
 - calls npVariablelist, 213
 - calls pfListOf, 213
 - defun, 213
- npVariablelist, 213
 - calledby npVariable, 213
 - calls npListing, 213
 - calls npVariableName, 213
 - defun, 213
- npVariableName, 213
 - calledby npVariablelist, 213
 - calledby npVariable, 213
 - calls npDecl, 214
 - calls npName, 213
 - calls npPop1, 214
 - calls npPush, 214

- calls pfNothing, 214
- calls pfTyped, 214
- defun, 213
- npVoid, 179
 - calledby npStatement, 170
 - calls npAndOr, 179
 - calls npStatement, 179
 - calls pfNoValue, 179
 - defun, 179
- npWConditional, 195
 - calledby npSCategory, 153
 - calls npConditional, 195
 - calls npPop1, 195
 - calls npPush, 195
 - calls pfTweakIf, 195
 - defun, 195
- npWhile, 177
 - calledby npIterators, 175
 - calledby npIterator, 176
 - calls npAndOr, 177
 - calls npLogical, 177
 - calls pfWhile, 177
 - defun, 177
- npWith, 150
 - calledby npPrimary2, 158
 - calledby npType, 149
 - calls npCategoryL, 150
 - calls npCompMissing, 150
 - calls npEqKey, 150
 - calls npEqPeek, 150
 - calls npPop1, 150
 - calls npPop2, 150
 - calls npPush, 150
 - calls npRestore, 150
 - calls npState, 150
 - calls npTrap, 150
 - calls npVariable, 150
 - calls pfNothing, 150
 - calls pfWith, 150
 - defun, 150
- npZeroOrMore, 177
 - calledby npIterators, 175
 - calls npPop1, 177
 - calls npPop2, 177
 - calls npPush, 177
 - uses \$stack, 177
- defun, 177
- nremove
 - calledby changeToNamedInterpreterFrame, 558
- nreverse0
 - calledby reportOpsFromLisplib, 816
 - calledby reportOpsFromUnitDirectly, 820
- NRTevalDomain, 1073
 - calledby compiledLookup, 1069
 - calls evalDomain, 1073
 - calls eval, 1073
 - calls qcar, 1073
 - defun, 1073
- nsbst
 - calledby ruleLhsTran, 322
 - calledby zeroOneTran, 68
- obey
 - calledby copyright, 520
 - calledby editFile, 543
 - calledby newHelpSpad2Cmd, 570
 - calledby summary, 828
- object2Identifier
 - calledby fetchKeyedMsg, 328
 - calledby fixObjectForPrinting, 454
 - calledby frameSpad2Cmd, 564
 - calledby pathnameTypeId, 1043
 - calledby readHiFi, 599
 - calledby saveHistory, 594
 - calledby selectOptionLC, 477
 - calledby setHistoryCore, 583
 - calledby writeHiFi, 600
- object2String
 - calledby clearCmdExcept, 503
 - calledby displayMacro, 452
 - calledby displaySetOptionInformation, 653
 - calledby displaySetVariableSettings, 655
 - calledby getTraceOption, 852
 - calledby makePathname, 1044
 - calledby set1, 806
 - calledby setExposeAddGroup, 696
 - calledby setLinkerArgs, 726
 - calledby setNagHost, 752
 - calledby setOutputAlgebra, 760
 - calledby setOutputFormula, 788
 - calledby setOutputFortran, 767

- calledby setOutputHtml, 778
- calledby setOutputMathml, 774
- calledby setOutputOpenMath, 783
- calledby setOutputTex, 794
- calledby setStreamsCalculate, 799
- objMode
 - calledby displayType, 458
 - calledby displayValue, 457
 - calledby getAndEvalConstructorArgument, 956
 - calledby interpret2, 55
 - calledby isDomainValuedVariable, 957
 - calledby printTypeAndTimeNormal, 59
 - calledby processInteractive1, 52
 - calledby retract, 1057
 - calledby showInOut, 598
 - calledby transTraceItem, 861
- objNew
 - calledby interpret1, 54
 - calledby interpret2, 55
 - calledby retract, 1058
- objNewWrap
 - calledby coerceSpadArgs2E, 863
 - calledby coerceSpadFunValue2E, 866
 - calledby coerceTraceArgs2E, 862
 - calledby coerceTraceFunValue2E, 865
 - calledby getAndEvalConstructorArgument, 956
 - calledby printTypeAndTimeNormal, 59
 - calledby recordAndPrint, 56
- objVal
 - calledby evaluateType, 914
 - calledby getAndEvalConstructorArgument, 956
 - calledby interpret2, 55
 - calledby retract, 1057
 - calledby transTraceItem, 861
- objValUnwrap
 - calledby coerceSpadArgs2E, 863
 - calledby coerceSpadFunValue2E, 866
 - calledby coerceTraceArgs2E, 862
 - calledby coerceTraceFunValue2E, 865
 - calledby displayValue, 457
 - calledby evaluateType1, 916
 - calledby isDomainValuedVariable, 957
 - calledby processInteractive1, 52
 - calledby showInOut, 598
- ofCategory, 419
 - calledby evalCategory, 957
 - calledby ofCategory, 419
 - calls hasCaty, 419
 - calls identp, 419
 - calls ofCategory, 419
 - local def \$Subst, 419
 - local def \$hope, 419
 - defun, 419
- oldCompLookup, 1072
 - calledby basicLookup, 1070
 - calls lookupInDomainVector, 1072
 - local def \$lookupDefaults, 1072
 - defun, 1072
- oldHistFileName, 578
 - calledby initHist, 579
 - calls makeHistFileName, 578
 - uses \$oldHistoryFileName, 578
 - defun, 578
- om-bindTCP, 1135
 - defun, 1135
- om-closeConn, 1134
 - defun, 1134
- om-closeDev, 1134
 - defun, 1134
- om-connectTCP, 1136
 - defun, 1136
- om-getApp, 1137
 - defun, 1137
- om-getAtp, 1138
 - defun, 1138
- om-getAttr, 1138
 - defun, 1138
- om-getBind, 1138
 - defun, 1138
- om-getBVar, 1138
 - defun, 1138
- om-getByteArray, 1139
 - defun, 1139
- om-getConnInDev, 1135
 - defun, 1135
- om-getConnOutDev, 1135
 - defun, 1135
- om-getEndApp, 1139
 - defun, 1139

- om-getEndAtp, 1139
 - defun, 1139
- om-getEndAttr, 1139
 - defun, 1139
- om-getEndBind, 1140
 - defun, 1140
- om-getEndBVar, 1140
 - defun, 1140
- om-getEndError, 1140
 - defun, 1140
- om-getEndObject, 1140
 - defun, 1140
- om-getError, 1141
 - defun, 1141
- om-getFloat, 1141
 - defun, 1141
- om-getInt, 1141
 - defun, 1141
- om-getObject, 1141
 - defun, 1141
- om-getString, 1142
 - defun, 1142
- om-getSymbol, 1142
 - defun, 1142
- om-getType, 1142
 - defun, 1142
- om-getVar, 1142
 - defun, 1142
- om-listCDs, 1132
 - defun, 1132
- om-listSymbols, 1132
 - defun, 1132
- om-makeConn, 1134
 - defun, 1134
- om-openFileDev, 1133
 - defun, 1133
- om-openStringDev, 1134
 - defun, 1134
- om-putApp, 1143
 - defun, 1143
- om-putAtp, 1143
 - defun, 1143
- om-putAttr, 1143
 - defun, 1143
- om-putBind, 1143
 - defun, 1143
- om-putBVar, 1144
 - defun, 1144
- om-putByteArray, 1144
 - defun, 1144
- om-putEndApp, 1144
 - defun, 1144
- om-putEndAtp, 1144
 - defun, 1144
- om-putEndAttr, 1145
 - defun, 1145
- om-putEndBind, 1145
 - defun, 1145
- om-putEndBVar, 1145
 - defun, 1145
- om-putEndError, 1145
 - defun, 1145
- om-putEndObject, 1146
 - defun, 1146
- om-putError, 1146
 - defun, 1146
- om-putFloat, 1146
 - defun, 1146
- om-putInt, 1146
 - defun, 1146
- om-putObject, 1147
 - defun, 1147
- om-putString, 1147
 - defun, 1147
- om-putSymbol, 1147
 - defun, 1147
- om-putVar, 1147
 - defun, 1147
- om-Read, 1131
 - defun, 1131
- om-setDevEncoding, 1133
 - defun, 1133
- om-stringPtrToString, 1148
 - defun, 1148
- om-stringToStringPtr, 1148
 - defun, 1148
- om-supportsCD, 1132
 - defun, 1132
- om-supportsSymbol, 1132
 - defun, 1132
- openOutputLibrary, 664
 - calledby setOutputLibrary, 662

- calls dropInputLibrary, 664
 - uses input-libraries, 664
 - uses output-library, 664
 - defun, 664
- openserver, 985
 - calledby restart, 17
 - defun, 985
- operationOpen, 1006
 - calls unsqueeze, 1006
 - uses *operation-hash*, 1006
 - uses *operation-stream*, 1006
 - uses *operation-stream-stamp*, 1006
 - uses \$spadroot, 1006
 - defun, 1006
- operationopen
 - calledby resethashtables, 999
 - calledby restart0, 19
- opIsHasCat
 - calledby basicLookup, 1069
- opOf
 - calledby abbreviationsSpad2Cmd, 481
 - calledby displaySpad2Cmd, 533
 - calledby domainToGenvar, 859
 - calledby hasCaty, 420
 - calledby isDomainOrPackage, 873
 - calledby reportOperations, 814
 - calledby spadTrace, 874
- optionError, 447
 - calledby readSpad2Cmd, 640
 - calls commandErrorMessage, 447
 - defun, 447
- optionUserLevelError, 448
 - calls userLevelErrorMessage, 448
 - defun, 448
- opTran, 323
 - calledby pf2Sex1, 300
 - calledby pfApplication2Sex, 305
 - uses \$dotdot, 323
 - defun, 323
- orderBySlotNumber, 891
 - calls assocright, 891
 - calls exit, 891
 - calls orderList, 891
 - calls seq, 891
 - defun, 891
- orderList
 - calledby orderBySlotNumber, 891
- origin
 - calledby inclmsgIfSyntax, 97
 - calledby inclmsgPrematureEOF, 88
 - calledby inclmsgPrematureFin, 95
- out-stream, 960
 - usedby spad-long-error, 967
 - defvar, 960
- output
 - calledby recordAndPrint, 56
- output-library, 663
 - usedby openOutputLibrary, 664
 - defvar, 663
- outputFormat
 - calledby displayValue, 457
- parallel, 399
 - syntax, 399
- parseAndInterpret, 48
 - calledby executeQuietCommand, 47
 - calledby serverReadLine, 44
 - uses \$InteractiveFrame, 48
 - uses \$InteractiveMode, 48
 - uses \$boot, 48
 - uses \$e, 48
 - uses \$spad, 48
 - defun, 48
- parseFromString, 48
 - calledby parseSystemCmd, 467
 - calls StreamNull, 48
 - calls incString, 48
 - calls lineoftoks, 48
 - calls macroExpanded, 48
 - calls ncloopParse, 48
 - calls next, 48
 - calls pf2Sex, 48
 - defun, 48
- parseSystemCmd, 467
 - calledby handleParsedSystemCommands, 466
 - calls dumbTokenize, 467
 - calls parseFromString, 467
 - calls stripSpaces, 467
 - calls tokTran, 467
 - defun, 467
- pathname, 1044

- calledby deleteFile, 1045
- calledby editFile, 543
- calledby editSpad2Cmd, 542
- calledby makePathname, 1044
- calledby namestring, 1042
- calledby pathnameDirectory, 1043
- calledby pathnameName, 1042
- calledby pathnameType, 1042
- calledby pathname, 1044
- calledby readSpad2Cmd, 640
- calledby reportOpsFromLisplib1, 815
- calledby reportOpsFromUnitDirectly1, 823
- calledby setExposeAddGroup, 697
- calledby setExpose, 695
- calledby updateSourceFiles, 544
- calledby workfilesSpad2Cmd, 947
- calls make-filename, 1044
- calls pathname, 1044
- defun, 1044
- pathnameDirectory, 1043
 - calledby editSpad2Cmd, 542
 - calledby loadLib, 1037
 - calledby mergePathnames, 1043
 - calledby setOutputAlgebra, 760
 - calledby setOutputFormula, 788
 - calledby setOutputFortran, 767
 - calledby setOutputHtml, 778
 - calledby setOutputMathml, 774
 - calledby setOutputOpenMath, 783
 - calledby setOutputTex, 794
 - calls pathname, 1043
 - defun, 1043
- pathnameName, 1042
 - calledby editSpad2Cmd, 542
 - calledby mergePathnames, 1043
 - calledby readSpad2Cmd, 640
 - calledby setOutputAlgebra, 760
 - calledby setOutputFormula, 788
 - calledby setOutputFortran, 767
 - calledby setOutputHtml, 778
 - calledby setOutputMathml, 774
 - calledby setOutputOpenMath, 783
 - calledby setOutputTex, 794
 - calledby updateSourceFiles, 544
 - calls pathname, 1042
 - defun, 1042
- PathnameString
 - calledby pfname, 91
- pathnameType, 1042
 - calledby editSpad2Cmd, 542
 - calledby mergePathnames, 1043
 - calledby pathnameTypeId, 1043
 - calledby setOutputAlgebra, 760
 - calledby setOutputFormula, 788
 - calledby setOutputFortran, 767
 - calledby setOutputHtml, 778
 - calledby setOutputMathml, 774
 - calledby setOutputOpenMath, 783
 - calledby setOutputTex, 794
 - calledby updateSourceFiles, 544
 - calls pathname, 1042
 - defun, 1042
- pathnameTypeId, 1043
 - calledby readSpad2Cmd, 640
 - calledby updateSourceFiles, 544
 - calls object2Identifier, 1043
 - calls pathnameType, 1043
 - calls upcase, 1043
 - defun, 1043
- patternVarsOf, 321
 - calledby ruleLhsTran, 322
 - calledby rulePredicateTran, 319
 - calls patternVarsOf1, 321
 - defun, 321
- patternVarsOf1, 321
 - calledby patternVarsOf1, 321
 - calledby patternVarsOf, 321
 - calls patternVarsOf1, 321
 - defun, 321
- pcounters, 858
 - calledby trace1, 846
 - calls bright, 858
 - calls concat, 858
 - calls sayBrightly, 858
 - uses /countlist, 858
 - defun, 858
- peekTimedName
 - calledby interpretTopLevel, 53
- pf0ApplicationArgs, 237
 - calledby macApplication, 223
 - calls pf0FlattenSyntacticTuple, 237
 - calls pfApplicationArg, 237

- defun, 237
- pf0AssignLhsItems, 256
 - calledby pf2Sex1, 301
 - calls pfAssignLhsItems, 256
 - calls pfParts, 256
 - defun, 256
- pf0DefinitionLhsItems, 262
 - calledby pfDefinition2Sex, 315
 - calls pfDefinitionLhsItems, 262
 - calls pfParts, 262
 - defun, 262
- pf0FlattenSyntacticTuple, 237
 - calledby pf0ApplicationArgs, 237
 - calledby pf0FlattenSyntacticTuple, 237
 - calls pf0FlattenSyntacticTuple, 237
 - calls pf0TupleParts, 237
 - calls pfTuple?, 237
 - defun, 237
- pf0ForinLhs, 267
 - calledby pf2Sex1, 300
 - calls pfForinLhs, 267
 - calls pfParts, 267
 - defun, 267
- pf0FreeItems, 266
 - calledby pf2Sex1, 301
 - calls pfFreeItems, 266
 - calls pfParts, 266
 - defun, 266
- pf0LambdaArgs, 274
 - calledby macLambdaParameterHandling, 231
 - calledby pfLambdaTran, 316
 - calls pfLambdaArgs, 274
 - calls pfParts, 274
 - defun, 274
- pf0LocalItems, 275
 - calledby pf2Sex1, 301
 - calls pfLocalItems, 275
 - calls pfParts, 275
 - defun, 275
- pf0LoopIterators, 276
 - calledby pf0LoopIterators, 276
 - calledby pf2Sex1, 300
 - calls pf0LoopIterators, 276
 - calls pfParts, 276
 - defun, 276
- pf0MLambdaArgs, 278
 - calledby mac0MLambdaApply, 223
 - calledby macLambdaParameterHandling, 231
 - calls pfParts, 278
 - defun, 278
- pf0SequenceArgs, 287
 - calledby pfSequence2Sex, 310
 - calledby pfUnSequence, 293
 - calls pfParts, 287
 - calls pfSequenceArgs, 287
 - defun, 287
- pf0TupleParts, 293
 - calledby pf0FlattenSyntacticTuple, 237
 - calledby pf2Sex1, 300
 - calledby pfApplication2Sex, 306
 - calledby pfCheckArg, 241
 - calledby pfCheckItOut, 239
 - calledby pfCollectVariable1, 242
 - calledby pfSexpr,strip, 250
 - calledby pfSuchThat2Sex, 307
 - calledby pfTransformArg, 244
 - calls pfParts, 293
 - calls pfTupleParts, 293
 - defun, 293
- pf0WhereContext, 295
 - calledby pf2Sex1, 301
 - calls pfParts, 295
 - calls pfWhereContext, 295
 - defun, 295
- pf2Sex, 299
 - calledby intInterpretPform, 67
 - calledby parseFromString, 48
 - calledby pfApplication2Sex, 306
 - calledby pfSuchThat2Sex, 307
 - calls pf2Sex1, 299
 - uses \$QuietCommand, 299
 - uses \$insideApplication, 299
 - uses \$insideRule, 299
 - uses \$insideSEQ, 299
 - defun, 299
- pf2Sex1, 300
 - calledby loopIters2Sex, 312
 - calledby pf2Sex1, 300
 - calledby pf2Sex, 299
 - calledby pfApplication2Sex, 306

- calledby pfCollect2Sex, 314
- calledby pfDefinition2Sex, 315
- calledby pfLambdaTran, 316
- calledby pfLhsRule2Sex, 318
- calledby pfOp2Sex, 308
- calledby pfRhsRule2Sex, 319
- calledby pfSequence2Sex, 310
- calledby pfSuchThat2Sex, 307
- calls keyedSystemError, 301
- calls loopIters2Sex, 300
- calls opTran, 300
- calls pf0AssignLhsItems, 301
- calls pf0ForinLhs, 300
- calls pf0FreeItems, 301
- calls pf0LocalItems, 301
- calls pf0LoopIterators, 300
- calls pf0TupleParts, 300
- calls pf0WhereContext, 301
- calls pf2Sex1, 300
- calls pfAbSynOp, 302
- calls pfAnd?, 301
- calls pfAndLeft, 301
- calls pfAndRight, 301
- calls pfApplication2Sex, 300
- calls pfApplication?, 300
- calls pfAssign?, 301
- calls pfAssignRhs, 301
- calls pfBreak?, 301
- calls pfBreakFrom, 301
- calls pfCoerceto?, 300
- calls pfCoercetoExpr, 300
- calls pfCoercetoType, 300
- calls pfCollect2Sex, 300
- calls pfCollect?, 300
- calls pfDefinition2Sex, 301
- calls pfDefinition?, 301
- calls pfDo?, 301
- calls pfDoBody, 301
- calls pfExit?, 300
- calls pfExitCond, 300
- calls pfExitExpr, 300
- calls pfForin?, 300
- calls pfForinWhole, 300
- calls pfFree?, 301
- calls pfFromdom?, 300
- calls pfFromdomDomain, 300
- calls pfFromdomWhat, 300
- calls pfIdSymbol, 300
- calls pfIf?, 300
- calls pfIfCond, 300
- calls pfIfElse, 300
- calls pfIfThen, 300
- calls pfIterate?, 301
- calls pfLambda2Sex, 301
- calls pfLambda?, 301
- calls pfLiteral2Sex, 300
- calls pfLiteral?, 300
- calls pfLocal?, 301
- calls pfLoop?, 300
- calls pfMLambda?, 301
- calls pfMacro?, 301
- calls pfNot?, 301
- calls pfNotArg, 301
- calls pfNothing?, 300
- calls pfNovalue?, 301
- calls pfNovalueExpr, 301
- calls pfOr?, 301
- calls pfOrLeft, 301
- calls pfOrRight, 301
- calls pfPretend?, 300
- calls pfPretendExpr, 300
- calls pfPretendType, 300
- calls pfRestrict?, 301
- calls pfRestrictExpr, 301
- calls pfRestrictType, 301
- calls pfReturn?, 301
- calls pfReturnExpr, 301
- calls pfRule2Sex, 301
- calls pfRule?, 301
- calls pfSequence2Sex, 300
- calls pfSequence?, 300
- calls pfSuchthat?, 301
- calls pfSuchthatCond, 301
- calls pfSymbol?, 300
- calls pfSymbolSymbol, 300
- calls pfTagged?, 300
- calls pfTaggedExpr, 300
- calls pfTaggedTag, 300
- calls pfTuple?, 300
- calls pfTyped?, 301
- calls pfTypedId, 301
- calls pfTypedType, 301

- calls pfWhere?, 301
- calls pfWhereExpr, 301
- calls pfWhile?, 300
- calls pfWhileCond, 300
- calls pfWrong?, 301
- calls spadThrow, 301
- calls tokPart, 302
- uses \$QuietCommand, 302
- uses \$insideRule, 302
- uses \$insideSEQ, 302
- defun, 300
- pf2sex1
 - calledby pfCollectArgTran, 317
- pfAbSynOp, 412
 - calledby macLambdaParameterHandling, 231
 - calledby pf2Sex1, 302
 - calledby pfCopyWithPos, 236
 - calledby pfLeaf?, 247
 - calledby pfLiteral?, 248
 - calledby pfLiteralClass, 248
 - calledby pfMapParts, 237
 - calledby pfSexpr,strip, 250
 - calls ifcar, 412
 - defun, 412
- pfAbSynOp?, 412
 - calledby intloopProcess, 64
 - calledby pfAnd?, 254
 - calledby pfApplication?, 255
 - calledby pfAssign?, 256
 - calledby pfBreak?, 258
 - calledby pfCoerceto?, 259
 - calledby pfCollect?, 260
 - calledby pfDefinition?, 261
 - calledby pfDo?, 262
 - calledby pfExit?, 263
 - calledby pfForin?, 266
 - calledby pfFree?, 265
 - calledby pfFromdom?, 268
 - calledby pfId?, 246
 - calledby pfIf?, 269
 - calledby pfIterate?, 271
 - calledby pfLambda?, 273
 - calledby pfLam, 272
 - calledby pfLocal?, 274
 - calledby pfLoop?, 276
 - calledby pfMLambda?, 278
 - calledby pfMacro?, 277
 - calledby pfNot?, 279
 - calledby pfNothing?, 245
 - calledby pfNovalue?, 280
 - calledby pfOr?, 280
 - calledby pfPretend?, 282
 - calledby pfRestrict?, 283
 - calledby pfReturn?, 284
 - calledby pfRule?, 286
 - calledby pfSequence?, 287
 - calledby pfSuchthat?, 288
 - calledby pfSymbol?, 252
 - calledby pfTagged?, 289
 - calledby pfTuple?, 292
 - calledby pfTyped?, 291
 - calledby pfWhere?, 294
 - calledby pfWhile?, 296
 - calledby pfWrong?, 297
 - calls eqcar, 412
 - defun, 412
- pfAdd, 252
 - calledby npAdd, 159
 - calledby npDefaultValue, 195
 - calls pfNothing, 252
 - calls pfTree, 252
 - defun, 252
- pfAnd, 253
 - calledby pfInfApplication, 271
 - calls pfTree, 253
 - defun, 253
- pfAnd?, 254
 - calledby pf2Sex1, 301
 - calls pfAbSynOp?, 254
 - defun, 254
- pfAndLeft, 254
 - calledby pf2Sex1, 301
 - defun, 254
- pfAndRight, 255
 - calledby pf2Sex1, 301
 - defun, 255
- pfAppend, 255
 - calledby npPPg, 210
 - calledby npPileDefinitionlist, 189
 - calledby npSDefaultItem, 169
 - calledby npSLocalItem, 172

- calledby npSemiListing, 193
- calledby npSigItemList, 154
- calledby pfUnSequence, 293
- defun, 255
- pfApplication, 253
 - calledby npApplication2, 163
 - calledby npApplication, 162
 - calledby npEncl, 182
 - calledby npInterval, 199
 - calledby npLeftAssoc, 207
 - calledby npRightAssoc, 206
 - calledby npSelector, 163
 - calledby npSynthetic, 198
 - calledby npTerm, 201
 - calledby pfBraceBar, 257
 - calledby pfBrace, 257
 - calledby pfBracketBar, 257
 - calledby pfBracket, 257
 - calledby pfFix, 265
 - calledby pfFromDom, 267
 - calledby pfInfApplication, 271
 - calls pfTree, 253
 - defun, 253
- pfApplication2Sex, 305
 - calledby pf2Sex1, 300
 - calls hasOptArgs?, 306
 - calls opTran, 305
 - calls pf0TupleParts, 306
 - calls pf2Sex1, 306
 - calls pf2Sex, 306
 - calls pfApplicationArg, 306
 - calls pfApplicationOp, 305
 - calls pfOp2Sex, 305
 - calls pfSuchThat2Sex, 306
 - calls pfTuple?, 306
 - uses \$insideApplication, 306
 - uses \$insideRule, 306
 - defun, 305
- pfApplication?, 255
 - calledby macExpand, 222
 - calledby pf2Sex1, 300
 - calledby pfCheckItOut, 239
 - calledby pfCheckMacroOut, 240
 - calledby pfCollect1?, 242
 - calledby pfFlattenApp, 241
 - calledby pfFromDom, 267
 - calledby pfSexpr,strip, 250
 - calls pfAbSynOp?, 255
 - defun, 255
- pfApplicationArg, 254
 - calledby pf0ApplicationArgs, 237
 - calledby pfApplication2Sex, 306
 - calledby pfCollectVariable1, 242
 - calledby pfFlattenApp, 242
 - calledby pfFromDom, 267
 - calledby pfSexpr,strip, 250
 - defun, 254
- pfApplicationOp, 254
 - calledby macApplication, 223
 - calledby pfApplication2Sex, 305
 - calledby pfCollect1?, 242
 - calledby pfFlattenApp, 242
 - calledby pfFromDom, 267
 - calledby pfSexpr,strip, 250
 - defun, 254
- pfAssign, 255
 - calledby npAssignment, 217
 - calls pfTree, 255
 - defun, 255
- pfAssign?, 256
 - calledby pf2Sex1, 301
 - calls pfAbSynOp?, 256
 - defun, 256
- pfAssignLhsItems, 256
 - calledby pf0AssignLhsItems, 256
 - defun, 256
- pfAssignRhs, 256
 - calledby pf2Sex1, 301
 - defun, 256
- pfAttribute, 253
 - calledby npSCategory, 153
 - calls pfTree, 253
 - defun, 253
- pfBrace, 257
 - calledby npBraced, 186
 - calls pfApplication, 257
 - calls pfIdPos, 257
 - calls tokPosn, 257
 - defun, 257
- pfBraceBar, 257
 - calledby npBraced, 186
 - calls pfApplication, 257

- calls pfIdPos, 257
- calls tokPosn, 257
- defun, 257
- pfBracket, 257
 - calledby npBracketed, 186
 - calls pfApplication, 257
 - calls pfIdPos, 257
 - calls tokPosn, 257
 - defun, 257
- pfBracketBar, 257
 - calledby npBracketed, 186
 - calls pfApplication, 257
 - calls pfIdPos, 258
 - calls tokPosn, 258
 - defun, 257
- pfBreak, 258
 - calledby npBreak, 174
 - calls pfTree, 258
 - defun, 258
- pfBreak?, 258
 - calledby pf2Sex1, 301
 - calls pfAbSynOp?, 258
 - defun, 258
- pfBreakFrom, 258
 - calledby pf2Sex1, 301
 - defun, 258
- pfCharPosn, 235
 - calledby ppos, 357
 - calls poCharPosn, 235
 - defun, 235
- pfCheckArg, 241
 - calledby pfCheckMacroOut, 240
 - calls pf0TupleParts, 241
 - calls pfCheckId, 241
 - calls pfListOf, 241
 - calls pfTuple?, 241
 - defun, 241
- pfCheckId, 241
 - calledby pfCheckArg, 241
 - calledby pfCheckMacroOut, 240
 - calls npTrapForm, 241
 - calls pfId?, 241
 - defun, 241
- pfCheckItOut, 239
 - calledby npDef, 187
 - calls npTrapForm, 239
- calls pf0TupleParts, 239
- calls pfApplication?, 239
- calls pfCollect1?, 239
- calls pfCollectVariable1, 239
- calls pfDefinition?, 239
- calls pfFlattenApp, 239
- calls pfId?, 239
- calls pfListOf, 239
- calls pfNothing, 239
- calls pfTagged?, 239
- calls pfTaggedExpr, 239
- calls pfTaggedTag, 239
- calls pfTaggedToTyped1, 239
- calls pfTaggedToTyped, 239
- calls pfTransformArg, 239
- calls pfTuple?, 239
- calls pfTyped, 239
- defun, 239
- pfCheckMacroOut, 240
 - calledby npMdef, 164
 - calls npTrapForm, 240
 - calls pfApplication?, 240
 - calls pfCheckArg, 240
 - calls pfCheckId, 240
 - calls pfFlattenApp, 240
 - calls pfId?, 240
 - defun, 240
- pfCoerceto, 259
 - calledby npCoerceTo, 220
 - calls pfTree, 259
 - defun, 259
- pfCoerceto?, 259
 - calledby pf2Sex1, 300
 - calls pfAbSynOp?, 259
 - defun, 259
- pfCoercetoExpr, 259
 - calledby pf2Sex1, 300
 - defun, 259
- pfCoercetoType, 259
 - calledby pf2Sex1, 300
 - defun, 259
- pfCollect, 260
 - calledby npExpress, 179
 - calls pfTree, 260
 - defun, 260
- pfCollect1?, 242

- calledby pfCheckItOut, 239
- calledby pfFlattenApp, 242
- calledby pfTaggedToTyped1, 244
- calls pfApplication?, 242
- calls pfApplicationOp, 242
- calls pfId?, 242
- calls pfIdSymbol, 242
- defun, 242
- pfCollect2Sex, 314
 - calledby pf2Sex1, 300
 - calls loopIters2Sex, 314
 - calls pf2Sex1, 314
 - calls pfCollectBody, 314
 - calls pfCollectIterators, 314
 - calls pfParts, 314
 - defun, 314
- pfCollect?, 260
 - calledby pf2Sex1, 300
 - calledby pfCollectArgTran, 317
 - calls pfAbSynOp?, 260
 - defun, 260
- pfCollectArgTran, 317
 - calledby pfLambdaTran, 316
 - calls pf2sex1, 317
 - calls pfCollect?, 317
 - calls pfCollectBody, 317
 - calls pfCollectIterators, 317
 - calls pfParts, 317
 - defun, 317
- pfCollectBody, 260
 - calledby pfCollect2Sex, 314
 - calledby pfCollectArgTran, 317
 - defun, 260
- pfCollectIterators, 260
 - calledby pfCollect2Sex, 314
 - calledby pfCollectArgTran, 317
 - defun, 260
- pfCollectVariable1, 242
 - calledby pfCheckItOut, 239
 - calledby pfTaggedToTyped1, 244
 - calls pf0TupleParts, 242
 - calls pfApplicationArg, 242
 - calls pfSuch, 242
 - calls pfTaggedToTyped, 242
 - calls pfTypedId, 242
 - calls pfTypedType, 243
- calls pfTyped, 242
- defun, 242
- pfCopyWithPos, 236
 - calledby macId, 227
 - calledby pfCopyWithPos, 236
 - calls pfAbSynOp, 236
 - calls pfCopyWithPos, 236
 - calls pfLeaf?, 236
 - calls pfLeaf, 236
 - calls pfParts, 236
 - calls pfTree, 236
 - calls tokPart, 236
 - defun, 236
- pfDefinition, 261
 - calledby npDef, 187
 - calls pfTree, 261
 - defun, 261
- pfDefinition2Sex, 315
 - calledby pf2Sex1, 301
 - calls pf0DefinitionLhsItems, 315
 - calls pf2Sex1, 315
 - calls pfDefinitionRhs, 315
 - calls pfLambdaTran, 315
 - calls systemError, 315
 - uses \$insideApplication, 315
 - defun, 315
- pfDefinition?, 261
 - calledby pf2Sex1, 301
 - calledby pfCheckItOut, 239
 - calledby pfTaggedToTyped1, 244
 - calls pfAbSynOp?, 261
 - defun, 261
- pfDefinitionLhsItems, 261
 - calledby pf0DefinitionLhsItems, 262
 - defun, 261
- pfDefinitionRhs, 261
 - calledby pfDefinition2Sex, 315
 - defun, 261
- pfDo, 262
 - calledby pfLoop1, 275
 - calledby pfLp, 276
 - calls pfTree, 262
 - defun, 262
- pfDo?, 262
 - calledby pf2Sex1, 301
 - calls pfAbSynOp?, 262

- defun, 262
- pfDoBody, 262
 - calledby pf2Sex1, 301
 - defun, 262
- pfDocument, 246
 - calledby npParse, 141
 - calledby npRecoverTrap, 190
 - calls pfLeaf, 246
 - defun, 246
- pfEnSequence, 263
 - calledby npEnclosed, 211
 - calledby npItem, 142
 - calledby npPDefinition, 183
 - calledby npPP, 210
 - calls pfListOf, 263
 - calls pfSequence, 263
 - calls pfTuple, 263
 - defun, 263
- pfExit, 263
 - calledby npPileExit, 216
 - calls pfTree, 263
 - defun, 263
- pfExit?, 263
 - calledby pf2Sex1, 300
 - calls pfAbSynOp?, 263
 - defun, 263
- pfExitCond, 263
 - calledby pf2Sex1, 300
 - defun, 263
- pfExitExpr, 264
 - calledby pf2Sex1, 300
 - defun, 264
- pfExport, 264
 - calledby npExport, 171
 - calls pfTree, 264
 - defun, 264
- pfExpression, 264
 - calledby pfSymb, 251
 - calls ifcar, 264
 - calls pfLeaf, 264
 - defun, 264
- pfFileName, 236
 - calledby ppos, 357
 - calls poFileName, 236
 - defun, 236
- pfFirst, 264
 - calledby pfLam, 272
 - calledby pfSourceStok, 243
 - defun, 264
- pfFix, 265
 - calledby npFix, 166
 - calls pfApplication, 265
 - calls pfId, 265
 - defun, 265
- pfFlattenApp, 241
 - calledby pfCheckItOut, 239
 - calledby pfCheckMacroOut, 240
 - calledby pfFlattenApp, 242
 - calls pfApplication?, 241
 - calls pfApplicationArg, 242
 - calls pfApplicationOp, 242
 - calls pfCollect1?, 242
 - calls pfFlattenApp, 242
 - defun, 241
- pfForin, 266
 - calledby npForIn, 178
 - calls pfTree, 266
 - defun, 266
- pfForin?, 266
 - calledby pf2Sex1, 300
 - calls pfAbSynOp?, 266
 - defun, 266
- pfForinLhs, 267
 - calledby pf0ForinLhs, 267
 - defun, 267
- pfForinWhole, 267
 - calledby pf2Sex1, 300
 - defun, 267
- pfFree, 265
 - calledby npFree, 173
 - calls pfTree, 265
 - defun, 265
- pfFree?, 265
 - calledby pf2Sex1, 301
 - calls pfAbSynOp?, 265
 - defun, 265
- pfFreeItems, 266
 - calledby pf0FreeItems, 266
 - defun, 266
- pfFromDom, 267
 - calledby npFromdom1, 203
 - calledby npFromdom, 203

- calls pfApplication?, 267
- calls pfApplicationArg, 267
- calls pfApplicationOp, 267
- calls pfApplication, 267
- calls pfFromdom, 267
- defun, 267
- pfFromdom, 268
 - calledby pfFromDom, 267
 - calls pfTree, 268
 - defun, 268
- pfFromdom?, 268
 - calledby pf2Sex1, 300
 - calls pfAbSynOp?, 268
 - defun, 268
- pfFromdomDomain, 269
 - calledby pf2Sex1, 300
 - defun, 269
- pfFromdomWhat, 268
 - calledby pf2Sex1, 300
 - defun, 268
- pfGlobalLinePosn, 235
 - calledby syIgnoredFromTo, 191
 - calls poGlobalLinePosn, 235
 - defun, 235
- pfHide, 269
 - calledby npAngleBared, 186
 - calls pfTree, 269
 - defun, 269
- pfId, 246
 - calledby pfFix, 265
 - calledby pfSuch, 244
 - calledby pfTaggedToTyped, 289
 - calls pfLeaf, 246
 - defun, 246
- pfId?, 246
 - calledby macOMLambdaApply, 224
 - calledby macOSubstituteOuter, 231
 - calledby macExpand, 222
 - calledby macMacro, 229
 - calledby pfCheckId, 241
 - calledby pfCheckItOut, 239
 - calledby pfCheckMacroOut, 240
 - calledby pfCollect1?, 242
 - calledby pfSexpr,strip, 250
 - calledby pfTaggedToTyped, 289
 - calls pfAbSynOp?, 246
 - defun, 246
- pfIdPos, 246
 - calledby pfBraceBar, 257
 - calledby pfBrace, 257
 - calledby pfBracketBar, 258
 - calledby pfBracket, 257
 - calls pfLeaf, 246
 - defun, 246
- pfIdSymbol, 247
 - calledby macId, 227
 - calledby macLambdaParameterHandling, 231
 - calledby macMacro, 229
 - calledby macSubstituteId, 232
 - calledby pf2Sex1, 300
 - calledby pfCollect1?, 242
 - calledby pfInfApplication, 271
 - calledby pfSexpr,strip, 250
 - calls tokPart, 247
 - defun, 247
- pfIf, 269
 - calledby npElse, 196
 - calledby pfIfThenOnly, 270
 - calls pfTree, 269
 - defun, 269
- pfIf?, 269
 - calledby pf2Sex1, 300
 - calls pfAbSynOp?, 269
 - defun, 269
- pfIfCond, 270
 - calledby pf2Sex1, 300
 - calledby pfTweakIf, 290
 - defun, 270
- pfIfElse, 270
 - calledby pf2Sex1, 300
 - calledby pfTweakIf, 290
 - defun, 270
- pfIfThen, 270
 - calledby pf2Sex1, 300
 - calledby pfTweakIf, 290
 - defun, 270
- pfIfThenOnly, 270
 - calledby npElse, 196
 - calls pfIf, 270
 - calls pfNothing, 270
 - defun, 270

- pfImmediate?
 - calledby ppos, 357
- pfImport, 271
 - calledby npImport, 180
 - calls pfTree, 271
 - defun, 271
- pfInfApplication, 271
 - calledby npInterval, 199
 - calledby npLeftAssoc, 207
 - calledby npRightAssoc, 206
 - calledby npSynthetic, 198
 - calledby pfSuch, 244
 - calledby pfTaggedToTyped, 290
 - calls pfAnd, 271
 - calls pfApplication, 271
 - calls pfIdSymbol, 271
 - calls pfListOf, 271
 - calls pfOr, 271
 - calls pfTuple, 271
 - defun, 271
- pfInline, 272
 - calledby npInline, 174
 - calls pfTree, 272
 - defun, 272
- pfIterate, 271
 - calledby npIterate, 174
 - calls pfTree, 271
 - defun, 271
- pfIterate?, 271
 - calledby pf2Sex1, 301
 - calls pfAbSynOp?, 271
 - defun, 271
- pfLam, 272
 - calledby npLambda, 149
 - calls pfAbSynOp?, 272
 - calls pfFirst, 272
 - calls pfLambda, 272
 - calls pfNothing, 272
 - calls pfSecond, 272
 - defun, 272
- pfLambda, 273
 - calledby pfLam, 272
 - calledby pfPushBody, 249
 - calls pfTree, 273
 - defun, 273
- pfLambda2Sex, 317
 - calledby pf2Sex1, 301
 - calls pfLambdaTran, 317
 - defun, 317
- pfLambda?, 273
 - calledby mac0SubstituteOuter, 231
 - calledby macExpand, 222
 - calledby macLambdaParameterHandling, 231
 - calledby pf2Sex1, 301
 - calledby pfLambdaTran, 316
 - calls pfAbSynOp?, 273
 - defun, 273
- pfLambdaArgs, 274
 - calledby pf0LambdaArgs, 274
 - defun, 274
- pfLambdaBody, 273
 - calledby pfLambdaTran, 316
 - defun, 273
- pfLambdaRets, 273
 - calledby pfLambdaTran, 316
 - defun, 273
- pfLambdaTran, 316
 - calledby pfDefinition2Sex, 315
 - calledby pfLambda2Sex, 317
 - calls pf0LambdaArgs, 316
 - calls pf2Sex1, 316
 - calls pfCollectArgTran, 316
 - calls pfLambda?, 316
 - calls pfLambdaBody, 316
 - calls pfLambdaRets, 316
 - calls pfNothing?, 316
 - calls pfTyped?, 316
 - calls pfTypedId, 316
 - calls pfTypedType, 316
 - calls systemError, 316
 - defun, 316
- pfLeaf, 247
 - calledby macLambdaParameterHandling, 231
 - calledby pfCopyWithPos, 236
 - calledby pfDocument, 246
 - calledby pfExpression, 264
 - calledby pfIdPos, 246
 - calledby pfId, 246
 - calledby pfSymbol, 251
 - calls ifcar, 247

- calls pfNoPosition, 247
- calls tokConstruct, 247
- defun, 247
- pfLeaf?, 247
 - calledby mac0SubstituteOuter, 231
 - calledby macLambdaParameterHandling, 231
 - calledby pfCopyWithPos, 236
 - calledby pfMapParts, 236
 - calledby pfSexpr,strip, 250
 - calledby pfSourcePosition, 238
 - calledby pfSourceStok, 243
 - calledby pfSymb, 251
 - calls pfAbSynOp, 247
 - defun, 247
- pfLeafPosition, 248
 - calledby macLambdaParameterHandling, 231
 - calledby pfSourcePosition, 238
 - calls tokPosn, 248
 - defun, 248
- pfLeafToken, 248
 - calledby pfLiteral2Sex, 304
 - calls tokPart, 248
 - defun, 248
- pfLhsRule2Sex, 318
 - calledby pfRule2Sex, 318
 - calls pf2Sex1, 318
 - uses \$insideRule, 318
 - defun, 318
- pfLinePosn, 235
 - calledby ppos, 357
 - calls poLinePosn, 235
 - defun, 235
- pfListOf, 245
 - calledby npAssignVariable, 217
 - calledby npBPileDefinition, 188
 - calledby npEnclosed, 211
 - calledby npExpress, 179
 - calledby npListing, 155
 - calledby npParse, 141
 - calledby npRecoverTrap, 190
 - calledby npSigItemlist, 154
 - calledby npTypeVariable, 156
 - calledby npVariable, 213
 - calledby pfCheckArg, 241
 - calledby pfCheckItOut, 239
 - calledby pfEnSequence, 263
 - calledby pfInfApplication, 271
 - calledby pfLoop1, 275
 - calledby pfLp, 276
 - calledby pfSequenceToList, 239
 - calledby pfTransformArg, 244
 - calledby pfTupleListOf, 292
 - calledby pfTweakIf, 290
 - calledby pfUnSequence, 293
 - calls pfTree, 245
 - defun, 245
- pfLiteral2Sex, 304
 - calledby pf2Sex1, 300
 - calls float2Sex, 304
 - calls keyedSystemError, 304
 - calls pfLeafToken, 304
 - calls pfLiteralClass, 304
 - calls pfLiteralString, 304
 - calls pfSymbolSymbol, 304
 - uses \$insideRule, 304
 - defun, 304
- pfLiteral?, 248
 - calledby pf2Sex1, 300
 - calledby pfSexpr,strip, 250
 - calls pfAbSynOp, 248
 - defun, 248
- pfLiteralClass, 248
 - calledby pfLiteral2Sex, 304
 - calls pfAbSynOp, 248
 - defun, 248
- pfLiteralString, 249
 - calledby pfLiteral2Sex, 304
 - calledby pfSexpr,strip, 250
 - calls tokPart, 249
 - defun, 249
- pfLocal, 274
 - calledby npLocal, 173
 - calls pfTree, 274
 - defun, 274
- pfLocal?, 274
 - calledby pf2Sex1, 301
 - calls pfAbSynOp?, 274
 - defun, 274
- pfLocalItems, 275
 - calledby pf0LocalItems, 275

- defun, 275
- pfLoop, 275
 - calledby pfLoop1, 275
 - calledby pfLp, 276
 - calls pfTree, 275
 - defun, 275
- pfLoop1, 275
 - calledby npLoop, 175
 - calls pfDo, 275
 - calls pfListOf, 275
 - calls pfLoop, 275
 - defun, 275
- pfLoop?, 276
 - calledby pf2Sex1, 300
 - calls pfAbSynOp?, 276
 - defun, 276
- pfLoopIterators, 276
 - defun, 276
- pfLp, 276
 - calledby npLoop, 175
 - calls pfDo, 276
 - calls pfListOf, 276
 - calls pfLoop, 276
 - defun, 276
- pfMacro, 277
 - calledby macMacro, 229
 - calledby npMdef, 165
 - calls pfTree, 277
 - defun, 277
- pfMacro?, 277
 - calledby macExpand, 222
 - calledby pf2Sex1, 301
 - calls pfAbSynOp?, 277
 - defun, 277
- pfMacroLhs, 277
 - calledby macMacro, 229
 - defun, 277
- pfMacroRhs, 277
 - calledby macMacro, 229
 - defun, 277
- pfMapParts, 236
 - calledby macApplication, 223
 - calledby macExpand, 222
 - calledby macLambda,mac, 229
 - calledby macWhere,mac, 228
 - calls pfAbSynOp, 237
 - calls pfLeaf?, 236
 - calls pfParts, 236
 - calls pfTree, 237
 - defun, 236
- pfMLambda, 278
 - calledby pfPushMacroBody, 243
 - calls pfTree, 278
 - defun, 278
- pfMLambda?, 278
 - calledby macApplication, 223
 - calledby macLambdaParameterHandling, 231
 - calledby macMacro, 229
 - calledby pf2Sex1, 301
 - calls pfAbSynOp?, 278
 - defun, 278
- pfMLambdaArgs, 278
 - defun, 278
- pfMLambdaBody, 279
 - calledby mac0GetName, 226
 - calledby mac0MLambdaApply, 223
 - defun, 279
- pfname, 91
 - calledby thefname, 91
 - calls PathnameString, 91
 - defun, 91
- pfNoPosition, 414
 - calledby pfLeaf, 247
 - calledby tokPosn, 413
 - calls poNoPosition, 414
 - defun, 414
- pfNoPosition?, 412
 - calledby ppos, 357
 - calledby tokConstruct, 411
 - calls poNoPosition?, 412
 - defun, 412
- pfNot?, 279
 - calledby pf2Sex1, 301
 - calls pfAbSynOp?, 279
 - defun, 279
- pfNotArg, 279
 - calledby pf2Sex1, 301
 - defun, 279
- pfNothing, 245
 - calledby macMacro, 229
 - calledby npAdd, 159

- calledby npBreak, 174
- calledby npDefaultValue, 195
- calledby npIterate, 174
- calledby npLocalDecl, 173
- calledby npPileBracketed, 188
- calledby npPrimary2, 158
- calledby npQualType, 181
- calledby npReturn, 178
- calledby npSignature, 154
- calledby npVariableName, 214
- calledby npWith, 150
- calledby pfAdd, 252
- calledby pfCheckItOut, 239
- calledby pfIfThenOnly, 270
- calledby pfLam, 272
- calledby pfPushBody, 249
- calledby pfReturnNoName, 285
- calledby pfTaggedToTyped1, 244
- calledby pfTaggedToTyped, 289
- calls pfTree, 245
- defun, 245
- pfNothing?, 245
 - calledby macMacro, 229
 - calledby pf2Sex1, 300
 - calledby pfLambdaTran, 316
 - calledby pfTweakIf, 290
 - calls pfAbSynOp?, 245
 - defun, 245
- pfNoValue, 279
 - calledby npItem, 142
 - calledby npVoid, 179
 - calls pfTree, 279
 - defun, 279
- pfNoValue?, 280
 - calledby pf2Sex1, 301
 - calls pfAbSynOp?, 280
 - defun, 280
- pfNoValueExpr, 280
 - calledby pf2Sex1, 301
 - defun, 280
- pfOp2Sex, 308
 - calledby pfApplication2Sex, 305
 - calls pf2Sex1, 308
 - calls pfSymbol?, 308
 - calls pmDontQuote?, 308
 - uses \$insideRule, 308
 - uses \$quotedOpList, 308
 - defun, 308
- pfOr, 280
 - calledby pfInfApplication, 271
 - calls pfTree, 280
 - defun, 280
- pfOr?, 280
 - calledby pf2Sex1, 301
 - calls pfAbSynOp?, 280
 - defun, 280
- pfOrLeft, 281
 - calledby pf2Sex1, 301
 - defun, 281
- pform
 - calledby mac0InfiniteExpansion, 225
 - calledby mac0MLambdaApply, 224
 - calledby macMacro, 229
 - calledby phMacro, 221
- pfOrRight, 281
 - calledby pf2Sex1, 301
 - defun, 281
- pfParen, 281
 - calledby npParened, 185
 - defun, 281
- pfParts, 249
 - calledby mac0SubstituteOuter, 231
 - calledby macLambdaParameterHandling, 231
 - calledby npDefaultValue, 170
 - calledby npLocalDecl, 172
 - calledby npSDefaultItem, 169
 - calledby npSLocalItem, 172
 - calledby npSQualTypelist, 181
 - calledby npSigDecl, 157
 - calledby npSigItemList, 154
 - calledby pf0AssignLhsItems, 256
 - calledby pf0DefinitionLhsItems, 262
 - calledby pf0ForinLhs, 267
 - calledby pf0FreeItems, 266
 - calledby pf0LambdaArgs, 274
 - calledby pf0LocalItems, 275
 - calledby pf0LoopIterators, 276
 - calledby pf0MLambdaArgs, 278
 - calledby pf0SequenceArgs, 287
 - calledby pf0TupleParts, 293
 - calledby pf0WhereContext, 295

- calledby pfCollect2Sex, 314
- calledby pfCollectArgTran, 317
- calledby pfCopyWithPos, 236
- calledby pfMapParts, 236
- calledby pfSexpr,strip, 250
- calledby pfSourcePosition, 238
- calledby pfSourceStok, 243
- calledby pfWDec, 294
- defun, 249
- pfFile, 249
 - calledby npPileBracketed, 188
 - defun, 249
- pfPretend, 281
 - calledby npPretend, 219
 - calls pfTree, 281
 - defun, 281
- pfPretend?, 282
 - calledby pf2Sex1, 300
 - calls pfAbSynOp?, 282
 - defun, 282
- pfPretendExpr, 282
 - calledby pf2Sex1, 300
 - defun, 282
- pfPretendType, 282
 - calledby pf2Sex1, 300
 - defun, 282
- pfPrintSrcLines
 - calledby displayParserMacro, 462
- pfPushBody, 249
 - calledby npDef, 187
 - calledby pfPushBody, 249
 - calls pfLambda, 249
 - calls pfNothing, 249
 - calls pfPushBody, 249
 - defun, 249
- pfPushMacroBody, 243
 - calledby npMdef, 165
 - calledby pfPushMacroBody, 243
 - calls pfMLambda, 243
 - calls pfPushMacroBody, 243
 - defun, 243
- pfQualType, 282
 - calledby npQualType, 181
 - calls pfTree, 282
 - defun, 282
- pfRestrict, 283
 - calledby npRestrict, 220
 - calls pfTree, 283
 - defun, 283
- pfRestrict?, 283
 - calledby pf2Sex1, 301
 - calls pfAbSynOp?, 283
 - defun, 283
- pfRestrictExpr, 283
 - calledby pf2Sex1, 301
 - defun, 283
- pfRestrictType, 283
 - calledby pf2Sex1, 301
 - defun, 283
- pfRetractTo, 284
 - calledby npColonQuery, 219
 - calls pfTree, 284
 - defun, 284
- pfReturn, 284
 - calledby npReturn, 178
 - calledby pfReturnNoName, 285
 - calls pfTree, 284
 - defun, 284
- pfReturn?, 284
 - calledby pf2Sex1, 301
 - calls pfAbSynOp?, 284
 - defun, 284
- pfReturnExpr, 284
 - calledby pf2Sex1, 301
 - defun, 284
- pfReturnNoName, 285
 - calledby npReturn, 178
 - calls pfNothing, 285
 - calls pfReturn, 285
 - defun, 285
- pfReturnTyped, 285
 - calledby npLambda, 149
 - calls pfTree, 285
 - defun, 285
- pfRhsRule2Sex, 319
 - calledby pfRule2Sex, 318
 - calls pf2Sex1, 319
 - uses \$insideRule, 319
 - defun, 319
- pfRule, 285
 - calledby npSingleRule, 194
 - calls pfTree, 285

- defun, 285
- pfRule2Sex, 318
 - calledby pf2Sex1, 301
 - calls pfLhsRule2Sex, 318
 - calls pfRhsRule2Sex, 318
 - calls pfRuleLhsItems, 318
 - calls pfRuleRhs, 318
 - calls ruleLhsTran, 318
 - calls rulePredicateTran, 318
 - uses \$multiVarPredicateList, 318
 - uses \$predicateList, 318
 - uses \$quotedOpList, 318
 - defun, 318
- pfRule?, 286
 - calledby pf2Sex1, 301
 - calls pfAbSynOp?, 286
 - defun, 286
- pfRuleLhsItems, 286
 - calledby pfRule2Sex, 318
 - defun, 286
- pfRuleRhs, 286
 - calledby pfRule2Sex, 318
 - defun, 286
- pfSecond, 286
 - calledby pfLam, 272
 - defun, 286
- pfSequence, 287
 - calledby npBPileDefinition, 188
 - calledby pfEnSequence, 263
 - calls pfTree, 287
 - defun, 287
- pfSequence2Sex, 310
 - calledby pf2Sex1, 300
 - calls pf0SequenceArgs, 310
 - calls pf2Sex1, 310
 - uses \$insideSEQ, 310
 - defun, 310
- pfSequence2Sex0, 310
 - calledby pfSequence2Sex0, 310
 - calls pfSequence2Sex0, 310
 - defun, 310
- pfSequence?, 287
 - calledby pf2Sex1, 300
 - calledby pfSequenceToList, 238
 - calledby pfUnSequence, 293
 - calls pfAbSynOp?, 287
 - defun, 287
- pfSequenceArgs, 287
 - calledby pf0SequenceArgs, 287
 - calledby pfSequenceToList, 238
 - defun, 287
- pfSequenceToList, 238
 - calledby npDefinition, 167
 - calls pfListOf, 239
 - calls pfSequence?, 238
 - calls pfSequenceArgs, 238
 - defun, 238
- pfSexpr, 250
 - calledby pfSymb, 251
 - calls pfSexpr,strip, 250
 - defun, 250
- pfSexpr,strip, 250
 - calledby pfSexpr,strip, 250
 - calledby pfSexpr, 250
 - calls pf0TupleParts, 250
 - calls pfAbSynOp, 250
 - calls pfApplication?, 250
 - calls pfApplicationArg, 250
 - calls pfApplicationOp, 250
 - calls pfId?, 250
 - calls pfIdSymbol, 250
 - calls pfLeaf?, 250
 - calls pfLiteral?, 250
 - calls pfLiteralString, 250
 - calls pfParts, 250
 - calls pfSexpr,strip, 250
 - calls pfTuple?, 250
 - calls tokPart, 250
 - defun, 250
- pfSourcePosition, 238
 - calledby mac0ExpandBody, 224
 - calledby mac0MLambdaApply, 223
 - calledby macId, 227
 - calledby macMacro, 229
 - calledby pfSourcePosition, 238
 - calls pfLeaf?, 238
 - calls pfLeafPosition, 238
 - calls pfParts, 238
 - calls pfSourcePosition, 238
 - calls poNoPosition?, 238
 - uses \$nopos, 238
 - defun, 238

- pfSourceStok, 243
 - calledby npTrapForm, 212
 - calledby pfSourceStok, 243
 - calls pfFirst, 243
 - calls pfLeaf?, 243
 - calls pfParts, 243
 - calls pfSourceStok, 243
 - defun, 243
- pfSpread, 239
 - calledby npDefaultDecl, 170
 - calledby npLocalDecl, 172
 - calledby npSigDecl, 157
 - calls pfTyped, 239
 - defun, 239
- pfSuch, 244
 - calledby pfCollectVariable1, 242
 - calledby pfTaggedToTyped, 289
 - calls pfId, 244
 - calls pfInfApplication, 244
 - defun, 244
- pfSuchthat, 288
 - calledby npSuchThat, 176
 - calls pfTree, 288
 - defun, 288
- pfSuchThat2Sex, 307
 - calledby pfApplication2Sex, 306
 - calls pf0TupleParts, 307
 - calls pf2Sex1, 307
 - calls pf2Sex, 307
 - uses \$predicateList, 307
 - defun, 307
- pfSuchthat?, 288
 - calledby pf2Sex1, 301
 - calls pfAbSynOp?, 288
 - defun, 288
- pfSuchthatCond, 288
 - calledby pf2Sex1, 301
 - defun, 288
- pfSymb, 251
 - calledby npConstTok, 184
 - calledby npDDInfKey, 208
 - calledby npInfixOperator, 160
 - calls ifcar, 251
 - calls pfExpression, 251
 - calls pfLeaf?, 251
 - calls pfSexpr, 251
 - calls pfSymbol, 251
 - calls tokPart, 251
 - defun, 251
- pfSymbol, 251
 - calledby pfSymb, 251
 - calls ifcar, 251
 - calls pfLeaf, 251
 - defun, 251
- pfSymbol?, 252
 - calledby pf2Sex1, 300
 - calledby pfOp2Sex, 308
 - calls pfAbSynOp?, 252
 - defun, 252
- pfSymbolSymbol, 252
 - calledby pf2Sex1, 300
 - calledby pfLiteral2Sex, 304
 - calls tokPart, 252
 - defun, 252
- pfTagged, 288
 - calledby npTagged, 218
 - calls pfTree, 288
 - defun, 288
- pfTagged?, 289
 - calledby pf2Sex1, 300
 - calledby pfCheckItOut, 239
 - calledby pfTaggedToTyped, 289
 - calls pfAbSynOp?, 289
 - defun, 289
- pfTaggedExpr, 289
 - calledby pf2Sex1, 300
 - calledby pfCheckItOut, 239
 - calledby pfTaggedToTyped, 289
 - defun, 289
- pfTaggedTag, 289
 - calledby pf2Sex1, 300
 - calledby pfCheckItOut, 239
 - calledby pfTaggedToTyped, 289
 - defun, 289
- pfTaggedToTyped, 289
 - calledby pfCheckItOut, 239
 - calledby pfCollectVariable1, 242
 - calledby pfTaggedToTyped1, 244
 - calls pfId?, 289
 - calls pfId, 289
 - calls pfInfApplication, 290
 - calls pfNothing, 289

- calls pfSuch, 289
- calls pfTagged?, 289
- calls pfTaggedExpr, 289
- calls pfTaggedTag, 289
- calls pfTyped, 289
- defun, 289
- pfTaggedToTyped1, 244
 - calledby pfCheckItOut, 239
 - calledby pfTransformArg, 244
 - calls pfCollect1?, 244
 - calls pfCollectVariable1, 244
 - calls pfDefinition?, 244
 - calls pfNothing, 244
 - calls pfTaggedToTyped, 244
 - calls pfTyped, 244
 - defun, 244
- pfTransformArg, 244
 - calledby pfCheckItOut, 239
 - calls pf0TupleParts, 244
 - calls pfListOf, 244
 - calls pfTaggedToTyped1, 244
 - calls pfTuple?, 244
 - defun, 244
- pfTree, 252
 - calledby pfAdd, 252
 - calledby pfAnd, 253
 - calledby pfApplication, 253
 - calledby pfAssign, 255
 - calledby pfAttribute, 253
 - calledby pfBreak, 258
 - calledby pfCoerceto, 259
 - calledby pfCollect, 260
 - calledby pfCopyWithPos, 236
 - calledby pfDefinition, 261
 - calledby pfDo, 262
 - calledby pfExit, 263
 - calledby pfExport, 264
 - calledby pfForin, 266
 - calledby pfFree, 265
 - calledby pfFromdom, 268
 - calledby pfHide, 269
 - calledby pfIf, 269
 - calledby pfImport, 271
 - calledby pfInline, 272
 - calledby pfIterate, 271
 - calledby pfLambda, 273
 - calledby pfListOf, 245
 - calledby pfLocal, 274
 - calledby pfLoop, 275
 - calledby pfMLambda, 278
 - calledby pfMacro, 277
 - calledby pfMapParts, 237
 - calledby pfNothing, 245
 - calledby pfNoval, 279
 - calledby pfOr, 280
 - calledby pfPretend, 281
 - calledby pfQualType, 282
 - calledby pfRestrict, 283
 - calledby pfRetractTo, 284
 - calledby pfReturnTyped, 285
 - calledby pfReturn, 284
 - calledby pfRule, 285
 - calledby pfSequence, 287
 - calledby pfSuchthat, 288
 - calledby pfTagged, 288
 - calledby pfTuple, 292
 - calledby pfTweakIf, 290
 - calledby pfTyped, 290
 - calledby pfTyping, 291
 - calledby pfWDeclare, 294
 - calledby pfWhere, 294
 - calledby pfWhile, 295
 - calledby pfWith, 296
 - calledby pfWrong, 296
 - defun, 252
- pfTuple, 292
 - calledby npEnclosed, 211
 - calledby pfEnSequence, 263
 - calledby pfInfApplication, 271
 - calledby pfTupleListOf, 292
 - calls pfTree, 292
 - defun, 292
- pfTuple?, 292
 - calledby pf0FlattenSyntacticTuple, 237
 - calledby pf2Sex1, 300
 - calledby pfApplication2Sex, 306
 - calledby pfCheckArg, 241
 - calledby pfCheckItOut, 239
 - calledby pfSexpr,strip, 250
 - calledby pfTransformArg, 244
 - calls pfAbSynOp?, 292
 - defun, 292

- pfTupleListOf, 292
 - calledby npTuple, 146
 - calls pfListOf, 292
 - calls pfTuple, 292
 - defun, 292
- pfTupleParts, 293
 - calledby pf0TupleParts, 293
 - defun, 293
- pfTweakIf, 290
 - calledby npWConditional, 195
 - calls pfIfCond, 290
 - calls pfIfElse, 290
 - calls pfIfThen, 290
 - calls pfListOf, 290
 - calls pfNothing?, 290
 - calls pfTree, 290
 - defun, 290
- pfTyped, 290
 - calledby npDecl, 214
 - calledby npVariableName, 214
 - calledby pfCheckItOut, 239
 - calledby pfCollectVariable1, 242
 - calledby pfSpread, 239
 - calledby pfTaggedToTyped1, 244
 - calledby pfTaggedToTyped, 289
 - calls pfTree, 290
 - defun, 290
- pfTyped?, 291
 - calledby pf2Sex1, 301
 - calledby pfLambdaTran, 316
 - calls pfAbSynOp?, 291
 - defun, 291
- pfTypedId, 291
 - calledby macLambdaParameterHandling, 231
 - calledby pf2Sex1, 301
 - calledby pfCollectVariable1, 242
 - calledby pfLambdaTran, 316
 - defun, 291
- pfTypedType, 291
 - calledby pf2Sex1, 301
 - calledby pfCollectVariable1, 243
 - calledby pfLambdaTran, 316
 - defun, 291
- pfTyping, 291
 - calledby npTyping, 168
 - calls pfTree, 291
 - defun, 291
- pfUnSequence, 293
 - calledby npCategoryL, 152
 - calledby npDefaultItemlist, 169
 - calledby npLocalItemlist, 171
 - calledby npQualTypelist, 180
 - calls pf0SequenceArgs, 293
 - calls pfAppend, 293
 - calls pfListOf, 293
 - calls pfSequence?, 293
 - defun, 293
- pfWDec, 293
 - calledby npSignature, 154
 - calls pfParts, 294
 - calls pfWDeclare, 293
 - defun, 293
- pfWDeclare, 294
 - calledby pfWDec, 293
 - calls pfTree, 294
 - defun, 294
- pfWhere, 294
 - calledby npLetQualified, 167
 - calledby npQualified, 147
 - calls pfTree, 294
 - defun, 294
- pfWhere?, 294
 - calledby macExpand, 222
 - calledby pf2Sex1, 301
 - calls pfAbSynOp?, 294
 - defun, 294
- pfWhereContext, 295
 - calledby pf0WhereContext, 295
 - defun, 295
- pfWhereExpr, 295
 - calledby pf2Sex1, 301
 - defun, 295
- pfWhile, 295
 - calledby npWhile, 177
 - calls pfTree, 295
 - defun, 295
- pfWhile?, 296
 - calledby pf2Sex1, 300
 - calls pfAbSynOp?, 296
 - defun, 296
- pfWhileCond, 296

- calledby pf2Sex1, 300
 - defun, 296
- pfWith, 296
 - calledby npWith, 150
 - calls pfTree, 296
 - defun, 296
- pfWrong, 296
 - calledby npParse, 141
 - calledby npRecoverTrap, 190
 - calls pfTree, 296
 - defun, 296
- pfWrong?, 297
 - calledby pf2Sex1, 301
 - calls pfAbSynOp?, 297
 - defun, 297
- phInterpret, 67
 - calls intInterpretPform, 67
 - calls ncEltQ, 67
 - calls ncPutQ, 67
 - defun, 67
- phIntReportMsgs, 66
 - calls ncEltQ, 66
 - calls ncPutQ, 66
 - calls processMsgList, 66
 - uses \$erMsgToss, 66
 - defun, 66
- phMacro, 221
 - calls macroExpanded, 221
 - calls ncEltQ, 221
 - calls ncPutQ, 221
 - calls pform, 221
 - defun, 221
- phParse, 66
 - calls ncPutQ, 66
 - defun, 66
- pileCforest, 340
 - calledby insertpile, 335
 - calledby pileCtree, 340
 - calls enPile, 340
 - calls separatePiles, 340
 - calls tokPart, 340
 - defun, 340
- pileColumn, 337
 - calledby eqpileTree, 339
 - calledby pileTree, 337
 - calls tokPosn, 337
- defun, 337
- pileCtree, 340
 - calledby pileForests, 338
 - calls dqAppend, 340
 - calls pileCforest, 340
 - defun, 340
- pileForest, 338
 - calledby pileForests, 337
 - calls pileForest1, 338
 - calls pileTree, 338
 - defun, 338
- pileForest1, 338
 - calledby pileForest1, 339
 - calledby pileForest, 338
 - calls eqpileTree, 338
 - calls pileForest1, 339
 - defun, 338
- pileForests, 337
 - calledby eqpileTree, 339
 - calledby pileForests, 338
 - calledby pileTree, 337
 - calls npNull, 338
 - calls pileCtree, 338
 - calls pileForests, 338
 - calls pileForest, 337
 - defun, 337
- pilePlusComment, 336
 - calledby insertpile, 335
 - calledby pilePlusComments, 336
 - calls tokType, 336
 - defun, 336
- pilePlusComments, 336
 - calledby insertpile, 335
 - calledby pilePlusComments, 336
 - calls npNull, 336
 - calls pilePlusComments, 336
 - calls pilePlusComment, 336
 - defun, 336
- pileTree, 337
 - calledby insertpile, 335
 - calledby pileForest, 338
 - calls npNull, 337
 - calls pileColumn, 337
 - calls pileForests, 337
 - defun, 337
- placep

- calledby unwritable?, 604
 - calledby writify,writifyInner, 605
- PLUSCOMMENT, 106
 - defvar, 106
- pmDontQuote?, 309
 - calledby pfOp2Sex, 308
 - defun, 309
- pname, 1047
 - calledby clearCmdParts, 503
 - calledby coerceTraceArgs2E, 862
 - calledby coerceTraceFunValue2E, 865
 - calledby displayType, 458
 - calledby displayValue, 457
 - calledby fixObjectForPrinting, 454
 - calledby gensymInt, 614
 - calledby getAliasIfTracedMapParameter, 888
 - calledby getStFromMsg, 354
 - calledby hasOption, 449
 - calledby isSharpVarWithNum, 884
 - calledby letPrint2, 885
 - calledby letPrint3, 886
 - calledby letPrint, 883
 - calledby mac0InfiniteExpansion,name, 226
 - calledby newHelpSpad2Cmd, 571
 - calledby npMissing, 151
 - calledby reportUndo, 926
 - calledby rewrite, 602, 603
 - calledby selectOption, 478
 - calledby setFortDir, 723
 - calledby setFortTmpDir, 721
 - calledby setOutputCharacters, 764
 - calledby stupidIsSpadFunction, 904
 - calledby undo, 920
 - defun, 1047
- poCharPosn, 377
 - calledby compareposns, 370
 - calledby pfCharPosn, 235
 - calledby posPointers, 378
 - calledby processChPosesForOneLine, 376
 - calledby putFTText, 379
 - defun, 377
- poFileName, 360
 - calledby decideHowMuch, 359
 - calledby pfFileName, 236
 - calls lnFileName, 360
 - calls poGetLineObject, 360
 - defun, 360
- poGetLineObject, 361
 - calledby poFileName, 360
 - calledby poGlobalLinePosn, 72
 - calledby poLinePosn, 361
 - calledby poPosImmediate?, 360
 - defun, 361
- poGlobalLinePosn, 72
 - calledby compareposns, 370
 - calledby listDecideHowMuch, 361
 - calledby makeMsgFromLine, 371
 - calledby ncloopDQlines, 71
 - calledby pfGlobalLinePosn, 235
 - calledby processMsgList, 369
 - calledby thisPosIsEqual, 374
 - calledby thisPosIsLess, 374
 - calls lnGlobalNum, 72
 - calls ncBug, 72
 - calls poGetLineObject, 72
 - defun, 72
- poLinePosn, 361
 - calledby decideHowMuch, 359
 - calledby makeMsgFromLine, 371
 - calledby pfLinePosn, 235
 - calls lnLocalNum, 361
 - calls poGetLineObject, 361
 - defun, 361
- poNopos?, 360
 - calledby decideHowMuch, 359
 - calledby erMsgSep, 370
 - calledby listDecideHowMuch, 361
 - calledby poPosImmediate?, 360
 - calledby thisPosIsEqual, 374
 - calledby thisPosIsLess, 374
 - defun, 360
- poNoPosition, 414
 - calledby pfNoPosition, 414
 - uses \$nopus, 414
 - defun, 414
- poNoPosition?, 413
 - calledby pfNoPosition?, 412
 - calledby pfSourcePosition, 238
 - calls eqcar, 413
 - defun, 413
- poPosImmediate?, 360

- calledby decideHowMuch, 359
- calledby listDecideHowMuch, 361
- calls lnImmediate?, 360
- calls poGetLineObject, 360
- calls poNopos?, 360
- defun, 360
- porigin, 88
 - calledby inclmsgFileCycle, 92
 - calledby ppos, 357
 - calls stringp, 88
 - defun, 88
- posend, 129
 - calledby scanW, 128
 - defun, 129
- posPointers, 378
 - calledby processChPosesForOneLine, 376
 - calls IFCAR, 378
 - calls getMsgPos2, 378
 - calls getMsgPos, 378
 - calls insertPos, 378
 - calls poCharPosn, 378
 - uses getMsgFTTag, 378
 - defun, 378
- poundsign
 - calledby dewritify, dewritifyInner, 610
 - calledby displaySetVariableSettings, 655
 - calledby getTraceOptions, 850
 - calledby isDomainOrPackage, 873
 - calledby newHelpSpad2Cmd, 571
 - calledby set1, 806
 - calledby setOutputLibrary, 662
 - calledby trace1, 846
 - calledby traceReply, 897
- pp
 - calledby reportUndo, 926
- pp2Cols
 - calledby filterAndFormatConstructors, 942
- ppos, 357
 - calledby getPosStL, 356
 - calls pfCharPosn, 357
 - calls pfFileName, 357
 - calls pfImmediate?, 357
 - calls pfLinePosn, 357
 - calls pfNoPosition?, 357
 - calls porigin, 357
 - defun, 357
- pquit, 632
 - calls pquitSpad2Cmd, 632
 - defun, 632
- pquit help page, 631
 - manpage, 631
- pquitSpad2Cmd, 632
 - calledby pquit, 632
 - calls quitSpad2Cmd, 632
 - uses \$quitCommandType, 632
 - defun, 632
- pred2English
 - calledby displayCondition, 463
- prefix2String
 - calledby displayMode, 465
 - calledby displayProperties, 460
 - calledby displayType, 458
 - calledby displayValue, 457
 - calledby evalDomain, 911
 - calledby spadUntrace, 894
 - calledby traceReply, 897
- previousInterpreterFrame, 559
 - calledby frameSpad2Cmd, 564
 - calls updateCurrentInterpreterFrame, 559
 - calls updateFromCurrentInterpreterFrame, 559
 - uses \$interpreterFrameRing, 559
 - defun, 559
- print
 - calledby letPrint2, 885
 - calledby letPrint3, 886
- printAsTeX, 61
 - calledby printTypeAndTimeSaturn, 60
 - uses \$texOutputStream, 61
 - defun, 61
- printDashedLine
 - calledby spadTrace, 875
- printLabelledList, 472
 - calledby printSynonyms, 472
 - calls blankList, 472
 - calls concat, 472
 - calls entryWidth, 472
 - calls fillerSpaces, 472
 - calls sayBrightly, 472
 - calls sayMessage, 472
 - calls substring, 472
 - defun, 472

- printStatisticsSummary, 57
 - calledby recordAndPrint, 56
 - calls sayKeyedMsg, 57
 - calls statisticsSummary, 57
 - uses \$collectOutput, 57
 - defun, 57
- printStorage, 58
 - calledby recordAndPrint, 56
 - calls makeLongSpaceString, 58
 - uses \$collectOutput, 58
 - uses \$interpreterTimedClasses, 58
 - uses \$interpreterTimedNames, 58
 - defun, 58
- printSynonyms, 472
 - calledby npProcessSynonym, 471
 - calledby synonymSpad2Cmd, 830
 - calledby whatSpad2Cmd, 938
 - calls centerAndHighlight, 472
 - calls filterListOfStringsWithFn, 472
 - calls printLabelledList, 472
 - calls specialChar, 472
 - calls synonymsForUserLevel, 472
 - uses \$CommandSynonymAlist, 472
 - uses \$linelength, 472
 - defun, 472
- printTypeAndTime, 58
 - calledby recordAndPrint, 56
 - calls printTypeAndTimeNormal, 58
 - calls printTypeAndTimeSaturn, 58
 - uses \$saturn, 58
 - defun, 58
- printTypeAndTimeNormal, 59
 - calledby printTypeAndTime, 58
 - calls justifyMyType, 59
 - calls makeLongTimeString, 59
 - calls msgText, 59
 - calls objMode, 59
 - calls objNewWrap, 59
 - calls qcar, 59
 - calls retract, 59
 - calls sameUnionBranch, 59
 - calls sayKeyedMsg, 59
 - uses \$collectOutput, 59
 - uses \$interpreterTimedClasses, 59
 - uses \$interpreterTimedNames, 59
 - uses \$outputLines, 59
 - uses \$printTimeIfTrue, 59
 - uses \$printTypeIfTrue, 59
 - defun, 59
- printTypeAndTimeSaturn, 60
 - calledby printTypeAndTime, 58
 - calls devaluate, 60
 - calls form2StringAsTeX, 60
 - calls makeLongTimeString, 60
 - calls printAsTeX, 60
 - uses \$interpreterTimedClasses, 60
 - uses \$interpreterTimedNames, 60
 - uses \$printTimeIfTrue, 60
 - uses \$printTypeIfTrue, 60
 - defun, 60
- prior-token
 - usedby token-stack-show, 969
- probeName, 982
 - defun, 982
- processChPosesForOneLine, 376
 - calledby queueUpErrors, 372
 - calls getMsgFTTag?, 376
 - calls getMsgPos, 376
 - calls getMsgPrefix, 376
 - calls makeLeaderMsg, 376
 - calls poCharPosn, 376
 - calls posPointers, 376
 - calls putFTText, 376
 - calls setMsgPrefix, 376
 - calls size, 376
 - calls strconc, 376
 - uses \$preLength, 376
 - defun, 376
- processInteractive, 49
 - calledby intInterpretPform, 67
 - calls clrhash, 50
 - calls initializeTimedNames, 49
 - calls processInteractive1, 50
 - calls qcar, 50
 - calls reportInstantiations, 50
 - calls updateHist, 50
 - calls writeHistModesAndValues, 50
 - uses \$Coerce, 50
 - uses \$ProcessInteractiveValue, 50
 - uses \$StreamFrame, 50
 - uses \$analyzingMapList, 50
 - uses \$compErrorMessageStack, 50

- uses \$compilingLoop, 50
- uses \$compilingMap, 50
- uses \$declaredMode, 50
- uses \$defaultFortVar, 50
- uses \$domPvar, 50
- uses \$fortVar, 50
- uses \$freeVars, 50
- uses \$inRetract, 50
- uses \$instantCanCoerceCount, 50
- uses \$instantCoerceCount, 50
- uses \$instantMmCondCount, 50
- uses \$instantRecord, 50
- uses \$interpOnly, 50
- uses \$interpreterTimedClasses, 50
- uses \$interpreterTimedNames, 50
- uses \$lastLineInSEQ, 50
- uses \$localVars, 50
- uses \$mapList, 50
- uses \$minivectorCode, 50
- uses \$minivectorNames, 50
- uses \$minivector, 50
- uses \$op, 50
- uses \$reportInstantiations, 50
- uses \$timeGlobalName, 50
- uses \$whereCacheList, 50
- defun, 49
- processInteractive1, 52
 - calledby processInteractive, 50
 - calls interpretTopLevel, 52
 - calls objMode, 52
 - calls objValUnwrap, 52
 - calls recordAndPrint, 52
 - calls recordFrame, 52
 - calls startTimingProcess, 52
 - calls stopTimingProcess, 52
 - uses \$InteractiveFrame, 52
 - uses \$ProcessInteractiveValue, 52
 - uses \$e, 52
 - defun, 52
- processKeyedError, 353
 - calledby ncBug, 368
 - calledby ncHardError, 352
 - calledby ncSoftError, 351
 - calls CallerName, 353
 - calls getMsgKey, 353
 - calls getMsgPrefix?, 353
 - calls getMsgTag?, 353
 - calls msgImPr?, 353
 - calls msgOutputter, 353
 - calls sayBrightly, 353
 - uses \$ncMsgList, 353
 - defun, 353
- processMsgList, 369
 - calledby phIntReportMsgs, 66
 - calls erMsgSort, 369
 - calls getMsgPos, 369
 - calls listOutputter, 369
 - calls makeMsgFromLine, 369
 - calls poGlobalLinePosn, 369
 - calls queueUpErrors, 369
 - uses \$noRepList, 369
 - uses \$outputList, 369
 - defun, 369
- processSynonymLine, 833
 - calledby npProcessSynonym, 471
 - calledby synonymSpad2Cmd, 830
 - calls processSynonymLine,removeKeyFromLine, 833
 - defun, 833
- processSynonymLine,removeKeyFromLine, 832
 - calledby processSynonymLine, 833
 - calls dropLeadingBlanks, 832
 - calls maxindex, 832
 - defun, 832
- processSynonyms, 33
 - calledby doSystemCommand, 444
 - calledby intProcessSynonyms, 33
 - calledby processSynonyms, 33
 - calls concat, 33
 - calls lassoc, 33
 - calls processSynonyms, 33
 - calls rplacstr, 33
 - calls size, 33
 - calls strconc, 33
 - calls string2id-n, 33
 - calls strpos, 33
 - calls substring, 33
 - uses \$CommandSynonymAlist, 34
 - uses line, 34
 - defun, 33
- protectedEVAL, 47
 - calledby serverReadLine, 44

- calls resetStackLimits, 47
- calls sendHTErrorSignal, 47
- defun, 47
- prTraceNames, 896
 - calls exit, 896
 - calls prTraceNames,fn, 896
 - calls seq, 896
 - uses /tracenames, 896
 - defun, 896
- prTraceNames,fn, 896
 - calledby prTraceNames, 896
 - calls devaluate, 896
 - calls exit, 896
 - calls isDomainOrPackage, 896
 - calls qcar, 896
 - calls qcdr, 896
 - calls seq, 896
 - defun, 896
- pspacers, 857
 - calls bright, 857
 - calls concat, 857
 - calls sayBrightly, 857
 - uses /spacelist, 857
 - defun, 857
- ptimers, 857
 - calledby trace1, 846
 - calls bright, 857
 - calls concat, 857
 - calls float, 857
 - calls quotient, 857
 - calls sayBrightly, 857
 - uses /timerlist, 857
 - defun, 857
- punctuation?, 118
 - calledby scanToken, 114
 - defun, 118
- put, 1041
 - defun, 1041
- putalist
 - calledby interpFunctionDepAlists, 463
 - calledby npProcessSynonym, 471
 - calledby synonymSpad2Cmd, 830
- putDatabaseStuff, 365
 - calledby msgCreate, 348
 - calls getMsgInfoFromKey, 365
 - calls setMsgText, 365
 - calls setMsgUnforcedAttrList, 365
 - defun, 365
- putFTText, 379
 - calledby processChPosesForOneLine, 376
 - calls getMsgFTTag?, 379
 - calls getMsgPos2, 379
 - calls getMsgPos, 379
 - calls getMsgText, 379
 - calls poCharPosn, 379
 - calls setMsgText, 379
 - defun, 379
- putHist, 588
 - calledby importFromFrame, 561
 - calledby recordAndPrint, 56
 - calledby restoreHistory, 595
 - calledby undoChanges, 591
 - calledby undoFromFile, 592
 - calledby undoInCore, 591
 - calledby writeHistModesAndValues, 601
 - calls get, 588
 - calls putIntSymTab, 589
 - calls recordNewValue, 589
 - calls recordOldValue, 588
 - uses \$HiFiAccess, 589
 - defun, 588
- putIntSymTab
 - calledby putHist, 589
- putTarget
 - calledby evaluateType1, 916
 - calledby interpret1, 54
- pvarPredTran, 322
 - calledby rulePredicateTran, 319
 - defun, 322
- qassq
 - calledby getMsgCatAttr, 358
 - calledby ncEltQ, 416
 - calledby ncPutQ, 417
 - calledby setMsgCatlessAttr, 365
 - calledby setMsgUnforcedAttr, 367
 - calledby tokPosn, 413
- qcar
 - calledby /tracereply, 892
 - calledby ?t, 901
 - calledby NRTevalDomain, 1073
 - calledby ScanOrPairVec,ScanOrInner, 613

- calledby abbreviationsSpad2Cmd, 481
- calledby dewritify,dewritifyInner, 610
- calledby displayProperties, 459
- calledby evaluateType1, 916
- calledby evaluateType, 914
- calledby frameSpad2Cmd, 564
- calledby funfind,LAM, 872
- calledby getTraceOption, 852
- calledby hasPair, 889
- calledby mkEvalable, 911
- calledby ncAlist, 415
- calledby ncTag, 415
- calledby prTraceNames,fn, 896
- calledby printTypeAndTimeNormal, 59
- calledby processInteractive, 50
- calledby reportOperations, 813
- calledby reportOpsFromUnitDirectly, 820
- calledby reportSpadTrace, 890
- calledby restoreHistory, 595
- calledby retract, 1057
- calledby selectOption, 478
- calledby setExposeAddConstr, 698
- calledby setExposeAddGroup, 696
- calledby setExposeAdd, 696
- calledby setExposeDropConstr, 701
- calledby setExposeDropGroup, 700
- calledby setExposeDrop, 699
- calledby setExpose, 695
- calledby setInputLibrary, 665
- calledby setOutputAlgebra, 760
- calledby setOutputCharacters, 764
- calledby setOutputFormula, 788
- calledby setOutputFortran, 767
- calledby setOutputHtml, 778
- calledby setOutputMathml, 774
- calledby setOutputOpenMath, 783
- calledby setOutputTex, 794
- calledby showSpad2Cmd, 812
- calledby spadClosure?, 609
- calledby spadReply,printName, 892
- calledby trace1, 846
- calledby traceReply, 897
- calledby traceSpad2Cmd, 845
- calledby transOnlyOption, 858
- calledby undoSteps, 928
- calledby undo, 920
- calledby untraceDomainConstructor,keepTraced?, 880
- calledby whatSpad2Cmd,fixpat, 937
- calledby writify,writifyInner, 605
- qcdr
 - calledby ?t, 901
 - calledby ScanOrPairVec,ScanOrInner, 613
 - calledby abbreviationsSpad2Cmd, 481
 - calledby dewritify,dewritifyInner, 610
 - calledby displayProperties, 459
 - calledby evaluateType1, 916
 - calledby evaluateType, 914
 - calledby frameSpad2Cmd, 564
 - calledby getTraceOption, 852
 - calledby hasPair, 889
 - calledby mkEvalable, 911
 - calledby ncAlist, 416
 - calledby prTraceNames,fn, 896
 - calledby readHiFi, 599
 - calledby restoreHistory, 595
 - calledby selectOption, 478
 - calledby setExposeAdd, 696
 - calledby setExposeDrop, 699
 - calledby setExpose, 695
 - calledby setInputLibrary, 665
 - calledby setOutputAlgebra, 760
 - calledby setOutputCharacters, 764
 - calledby setOutputFormula, 788
 - calledby setOutputFortran, 767
 - calledby setOutputHtml, 778
 - calledby setOutputMathml, 774
 - calledby setOutputOpenMath, 783
 - calledby setOutputTex, 794
 - calledby spadClosure?, 609
 - calledby trace1, 846
 - calledby traceSpad2Cmd, 845
 - calledby transOnlyOption, 858
 - calledby undoSteps, 928
 - calledby undo, 920
 - calledby writify,writifyInner, 605
- qcsiz
 - calledby isSharpVarWithNum, 884
- qenum, 1048
 - calledby scanEsc, 124
 - calledby scanExponent, 126
 - calledby scanIgnoreLine, 113

- calledby scanInsert, 138
- calledby scanNumber, 132
- calledby scanToken, 114
- calledby scanW, 128
- calledby splell, 122
- calledby startsComment?, 115
- calledby startsNegComment?, 117
- calledby substringMatch, 119
- defun, 1048
- qrplaca
 - calledby dewritify,dewritifyInner, 610
 - calledby writify,writifyInner, 605
- qrplacd
 - calledby dewritify,dewritifyInner, 610
 - calledby writify,writifyInner, 605
- qsabsval, 1062
 - defmacro, 1062
- qsadd1, 1061
 - defmacro, 1061
- qsdifference, 1061
 - defmacro, 1061
- qsetvelt
 - calledby dewritify,dewritifyInner, 610
 - calledby writify,writifyInner, 605
- qslessp, 1061
 - calledby trace1, 846
 - defmacro, 1061
- qsmax, 1063
 - defmacro, 1063
- qsmin, 1063
 - defmacro, 1063
- qsminus, 1062
 - defmacro, 1062
- qsoddp, 1063
 - defmacro, 1063
- qsplus, 1062
 - defmacro, 1062
- qsquotient, 1060
 - defun, 1060
- qsremainder, 1060
 - defun, 1060
- qssub1, 1061
 - defmacro, 1061
- qstimes, 1062
 - defmacro, 1062
- qszerop, 1063
 - defmacro, 1063
- queryClients, 508
 - calledby close, 509
 - calls sockGetInt, 508
 - calls sockSendInt, 508
 - uses \$QueryClients, 508
 - uses \$SessionManager, 508
 - defun, 508
- queryUserKeyedMsg
 - calledby close, 508
 - calledby historySpad2Cmd, 580
 - calledby importFromFrame, 561
 - calledby listConstructorAbbreviations, 482
 - calledby quitSpad2Cmd, 636
 - calledby yesanswer, 535
- QUESTION, 107
 - defvar, 107
- queueUpErrors, 372
 - calledby processMsgList, 369
 - calls processChPosesForOneLine, 372
 - uses \$outputList, 372
 - defun, 372
- quit, 636
 - calls quitSpad2Cmd, 636
 - defun, 636
- quit help page, 635
 - manpage, 635
- quitSpad2Cmd, 636
 - calledby pquitSpad2Cmd, 632
 - calledby quit, 636
 - calls leaveScratchpad, 636
 - calls queryUserKeyedMsg, 636
 - calls sayKeyedMsg, 636
 - calls string2id-n, 636
 - calls tersyscommand, 636
 - calls upcase, 636
 - uses \$quitCommandType, 636
 - defun, 636
- QUOTIENT
 - calledby Else?, 80
 - calledby Elseif?, 79
- quotient
 - calledby If?, 79
 - calledby Top?, 79
 - calledby ptimers, 857
- quotient2, 1081

- defun, 1081
- qv32len, 1056
 - defmacro, 1056
- qvelt
 - calledby dewritify,dewritifyInner, 610
 - calledby writify,writifyInner, 605
- qymaxindex
 - calledby dewritify,dewritifyInner, 610
 - calledby writify,writifyInner, 605
- RADIXCHAR, 106
 - defvar, 106
- random, 1081
 - defun, 1081
- rassoc
 - calledby rassocSub, 869
 - calledby saveMapSig, 851
- rassocSub, 869
 - calledby ?t, 901
 - calledby isSubForRedundantMapName, 871
 - calledby traceReply, 897
 - calls rassoc, 869
 - defun, 869
- rdefinstream, 1068
 - calls rdefiostream, 1068
 - defun, 1068
- rdefiostream
 - calledby rdefinstream, 1068
 - calledby rdefoutstream, 1068
 - calledby readHiFi, 599
 - calledby saveHistory, 593
 - calledby setHistoryCore, 583
 - calledby writeHiFi, 600
- rdefoutstream, 1068
 - calls rdefiostream, 1068
 - defun, 1068
- rdigit?, 133
 - calls strpos, 133
 - defun, 133
- read, 640
 - calledby undo, 920
 - calls readSpad2Cmd, 640
 - defun, 640
- read help page, 639
 - manpage, 639
- read-line
 - calledby serverReadLine, 44
- readHiFi, 599
 - calledby fetchOutput, 598
 - calledby restoreHistory, 595
 - calledby setHistoryCore, 583
 - calledby showInOut, 598
 - calledby showInput, 597
 - calledby undoFromFile, 592
 - calledby undoInCore, 591
 - calledby writeInputLines, 585
 - calls assoc, 599
 - calls histFileName, 599
 - calls keyedSystemError, 599
 - calls object2Identifier, 599
 - calls qcdr, 599
 - calls rdefiostream, 599
 - calls rshut, 599
 - calls spadread, 599
 - uses \$internalHistoryTable, 599
 - uses \$useInternalHistoryTable, 599
 - defun, 599
- readSpad2Cmd, 640
 - calledby read, 640
 - calls /read, 640
 - calls findfile, 640
 - calls makePathname, 640
 - calls member, 640
 - calls mergePathnames, 640
 - calls namestring, 640
 - calls optionError, 640
 - calls pathnameName, 640
 - calls pathnameTypeId, 640
 - calls pathname, 640
 - calls selectOptionLC, 640
 - calls throwKeyedMsg, 640
 - calls upcase, 640
 - uses /editfile, 641
 - uses \$InteractiveMode, 640
 - uses \$UserLevel, 640
 - uses \$findfile, 640
 - uses \$options, 640
 - defun, 640
- readSpadProfileIfThere, 959
 - calledby restart, 17
 - uses /editfile, 959
 - defun, 959

- reclaim, 39
 - calledby clearCmdCompletely, 500
 - defun, 39
- recordAndPrint, 56
 - calledby processInteractive1, 52
 - calls mkCompanionPage, 56
 - calls objNewWrap, 56
 - calls output, 56
 - calls printStatisticsSummary, 56
 - calls printStorage, 56
 - calls printTypeAndTime, 56
 - calls putHist, 56
 - calls recordAndPrintTest, 56
 - uses \$EmptyMode, 56
 - uses \$HTCompanionWindowID, 56
 - uses \$QuietCommand, 56
 - uses \$Void, 56
 - uses \$algebraOutputStream, 56
 - uses \$collectOutput, 56
 - uses \$e, 56
 - uses \$mkTestFlag, 56
 - uses \$mkTestOutputType, 56
 - uses \$outputMode, 56, 57
 - uses \$printAnyIfTrue, 57
 - uses \$printStatisticsSummaryIfTrue, 56
 - uses \$printStorageIfTrue, 56
 - uses \$printTimeIfTrue, 56
 - uses \$printTypeIfTrue, 56
 - uses \$printVoidIfTrue, 56
 - uses \$runTestFlag, 56
 - defun, 56
- recordAndPrintTest
 - calledby recordAndPrint, 56
- recordFrame, 921
 - calledby processInteractive1, 52
 - calledby undoSteps, 928
 - calls diffAlist, 921
 - calls exit, 921
 - calls kar, 921
 - calls seq, 921
 - uses \$InteractiveFrame, 921
 - uses \$frameRecord, 921
 - uses \$previousBindings, 921
 - uses \$undoFlag, 921
 - defun, 921
- recordNewValue, 589
 - calledby clearCmdParts, 503
 - calledby putHist, 589
 - calledby undoFromFile, 592
 - calls recordNewValue0, 589
 - calls startTimingProcess, 589
 - calls stopTimingProcess, 589
 - defun, 589
- recordNewValue0, 589
 - calledby recordNewValue, 589
 - calls assq, 589
 - uses \$HistRecord, 589
 - defun, 589
- recordOldValue, 590
 - calledby clearCmdParts, 503
 - calledby putHist, 588
 - calledby undoFromFile, 592
 - calls recordOldValue0, 590
 - calls startTimingProcess, 590
 - calls stopTimingProcess, 590
 - defun, 590
- recordOldValue0, 590
 - calledby recordOldValue, 590
 - calls assq, 590
 - uses \$HistList, 590
 - defun, 590
- reduce-stack-clear
 - calledby ioclear, 970
- redundant, 374
 - calls msgNoRep?, 374
 - calls sameMsg?, 374
 - uses \$noRepList, 374
 - defun, 374
- refvecp
 - calledby isDomainOrPackage, 873
 - calledby spadTrace, 874
- regress help page, 643
 - manpage, 643
- remainder
 - calledby KeepPart?, 80
 - calledby SkipEnd?, 80
 - calledby SkipPart?, 81
- remainder2, 1081
 - defun, 1081
- remalist
 - calledby clearParserMacro, 451
- remdup

- calledby clearCmdParts, 503
- calledby displayMacros, 536
- calledby displayOperationsFromLisplib, 818
- calledby displayProperties, 459
- calledby reportOpsFromLisplib, 816
- calledby reportOpsFromUnitDirectly, 820
- remFile, 357
 - calledby getPosStL, 356
 - calls IFCDR, 357
 - defun, 357
- remLine, 362
 - calledby getPosStL, 356
 - calls IFCAR, 357
 - defun, 362
- removeAttributes
 - calledby getMsgInfoFromKey, 366
- removeOption, 859
 - calledby spadTrace, 874
 - defun, 859
- remover, 895
 - calledby remover, 895
 - calledby spadUntrace, 894
 - calls remover, 895
 - defun, 895
- removeTracedMapSigs, 862
 - calledby untrace, 860
 - uses \$tracedMapSignatures, 862
 - defun, 862
- removeUndoLines, 931
 - calls charPosition, 931
 - calls concat, 932
 - calls exit, 931
 - calls maxindex, 932
 - calls seq, 931
 - calls spaddifference, 932
 - calls stringPrefix?, 931
 - calls substring, 931
 - calls trimString, 931
 - calls undoCount, 932
 - uses \$IOindex, 932
 - uses \$currentLine, 932
 - defun, 931
- removeZeroOneDestructively
 - calledby reportOperations, 814
- remprop
 - calledby loadLib, 1038
- rempropI
 - calledby restoreHistory, 595
- rep, 371
 - calledby makeMsgFromLine, 371
 - defun, 371
- repeat, 402
 - syntax, 402
- replaceFile, 983
 - defun, 983
- replaceSharps, 956
 - calledby evaluateType1, 915
 - calls subCopy, 956
 - local ref \$FormalMapVariableList, 956
 - local ref \$TriangleVariableList, 956
 - defun, 956
- reportInstantiations
 - calledby processInteractive, 50
- reportOperations, 813
 - calledby showSpad2Cmd, 812
 - calls bright, 813
 - calls evaluateType, 814
 - calls isDomainValuedVariable, 813
 - calls isNameOfType, 813
 - calls isType, 814
 - calls mkAtree, 814
 - calls opOf, 814
 - calls qcar, 813
 - calls removeZeroOneDestructively, 814
 - calls reportOpsFromLisplib0, 814
 - calls reportOpsFromUnitDirectly0, 814
 - calls sayBrightly, 813
 - calls sayKeyedMsg, 813
 - calls unabbrev, 814
 - uses \$doNotAddEmptyModeIfTrue, 814
 - uses \$env, 814
 - uses \$eval, 814
 - uses \$genValue, 814
 - uses \$quadSymbol, 814
 - defun, 813
- reportOpsFromLisplib, 816
 - calledby reportOpsFromLisplib0, 815
 - calledby reportOpsFromLisplib1, 815
 - calls bright, 816
 - calls centerAndHighlight, 816
 - calls concat, 816

- calls constructor?, 816
- calls dc1, 816
- calls displayOperationsFromLisplib, 816
- calls eqsubstlist, 816
- calls form2StringWithWhere, 816
- calls form2String, 816
- calls formatAttribute, 816
- calls getConstructorSignature, 816
- calls getdatabase, 816
- calls isExposedConstructor, 816
- calls kdr, 816
- calls msort, 816
- calls namestring, 816
- calls nreverse0, 816
- calls remdup, 816
- calls say2PerLine, 816
- calls sayBrightly, 816
- calls sayKeyedMsg, 816
- calls selectOptionLC, 816
- calls specialChar, 816
- calls strconc, 816
- uses \$FormalMapVariableList, 816
- uses \$linelength, 816
- uses \$options, 816
- uses \$showOptions, 816
- defun, 816
- reportOpsFromLisplib0, 815
 - calledby reportOperations, 814
 - calls reportOpsFromLisplib1, 815
 - calls reportOpsFromLisplib, 815
 - uses \$useEditorForShowOutput, 815
 - defun, 815
- reportOpsFromLisplib1, 815
 - calledby reportOpsFromLisplib0, 815
 - calls defiostream, 815
 - calls editFile, 815
 - calls erase, 815
 - calls pathname, 815
 - calls reportOpsFromLisplib, 815
 - calls sayShowWarning, 815
 - calls shut, 815
 - uses \$erase, 815
 - uses \$sayBrightlyStream, 815
 - defun, 815
- reportOpsFromUnitDirectly, 819
 - calledby displayOperationsFromLisplib, 818
 - calledby reportOpsFromUnitDirectly0, 819
 - calledby reportOpsFromUnitDirectly1, 823
 - calls bright, 820
 - calls centerAndHighlight, 820
 - calls concat, 820
 - calls evalDomain, 820
 - calls formatAttribute, 820
 - calls formatOpType, 820
 - calls formatOperation, 820
 - calls getOplistForConstructorForm, 820
 - calls getdatabase, 820
 - calls getl, 820
 - calls isExposedConstructor, 820
 - calls member, 819
 - calls msort, 820
 - calls namestring, 820
 - calls nreverse0, 820
 - calls qcar, 820
 - calls remdup, 820
 - calls say2PerLine, 820
 - calls sayBrightly, 820
 - calls selectOptionLC, 820
 - calls specialChar, 820
 - calls strconc, 820
 - calls systemErrorHere, 820
 - uses \$CategoryFrame, 820
 - uses \$commentedOps, 820
 - uses \$linelength, 820
 - uses \$options, 820
 - uses \$showOptions, 820
 - defun, 819
- reportOpsFromUnitDirectly0, 819
 - calledby reportOperations, 814
 - calls reportOpsFromUnitDirectly1, 819
 - calls reportOpsFromUnitDirectly, 819
 - uses \$useEditorForShowOutput, 819
 - defun, 819
- reportOpsFromUnitDirectly1, 823
 - calledby reportOpsFromUnitDirectly0, 819
 - calls defiostream, 823
 - calls editFile, 823
 - calls erase, 823
 - calls pathname, 823
 - calls reportOpsFromUnitDirectly, 823

- calls sayShowWarning, 823
 - calls shut, 823
 - uses \$erase, 824
 - uses \$sayBrightlyStream, 823
 - defun, 823
- reportOpSymbol
 - calledby displayOperations, 535
- reportSpadTrace, 890
 - calledby ?t, 901
 - calledby spadTrace,isTraceable, 874
 - calledby spadTrace, 875
 - calls qcar, 890
 - calls sayBrightly, 890
 - uses \$traceNoisely, 890
 - defun, 890
- reportUndo, 925
 - calledby diffAlist, 923
 - calls concat, 926
 - calls exit, 926
 - calls lassoc, 926
 - calls pname, 926
 - calls pp, 926
 - calls sayBrightlyNT, 926
 - calls sayBrightly, 926
 - calls seq, 926
 - uses \$InteractiveFrame, 926
 - defun, 925
- reportWhatOptions, 939
 - calledby whatSpad2Cmd, 938
 - calls sayBrightly, 939
 - uses \$whatOptions, 939
 - defun, 939
- reroot, 40
 - calledby initroot, 35
 - calls make-absolute-filename, 41
 - uses \$current-directory, 41
 - uses \$defaultMsgDatabaseName, 41
 - uses \$directory-list, 41
 - uses \$library-directory-list, 41
 - uses \$msgDatabaseName, 41
 - uses \$relative-directory-list, 41
 - uses \$relative-library-directory-list, 41
 - uses \$spadroot, 41
 - defun, 40
- reset-stack-limits
 - calledby resetStackLimits, 21
- resetCounters, 856
 - calledby trace1, 846
 - calls concat, 856
 - uses /countlist, 856
 - defun, 856
- resetHashtable, 999
 - calls browseopen, 999
 - calls categoryopen, 999
 - calls compressopen, 999
 - calls initial-getdatabase, 999
 - calls interpopen, 999
 - calls operationopen, 999
 - uses *allconstructors*, 1000
 - uses *browse-stream*, 999
 - uses *category-stream*, 999
 - uses *category-stream-stamp*, 999
 - uses *compress-stream-stamp*, 1000
 - uses *compressvector*, 1000
 - uses *hascategory-hash*, 1000
 - uses *interp-stream*, 999
 - uses *interp-stream-stamp*, 1000
 - uses *operation-hash*, 1000
 - uses *operation-stream*, 999
 - uses *operation-stream-stamp*, 1000
 - uses *sourcefiles*, 999
 - defun, 999
- resetInCoreHist, 586
 - calledby clearCmdAll, 501
 - calledby historySpad2Cmd, 580
 - uses \$HistListAct, 586
 - uses \$HistListLen, 586
 - uses \$HistList, 586
 - defun, 586
- resetSpacers, 856
 - calledby trace1, 846
 - calls concat, 856
 - uses /spacelist, 856
 - defun, 856
- resetStackLimits, 21
 - calledby intloop, 26
 - calledby protectedEVAL, 47
 - calledby runspad, 21
 - calls reset-stack-limits, 21
 - defun, 21
- resetTimers, 856
 - calledby trace1, 846

- calls concat, 856
 - uses /timerlist, 856
 - defun, 856
- resetWorkspaceVariables, 652
 - calls copy, 652
 - calls initializeSetVariables, 652
 - uses /countlist, 652
 - uses /editfile, 652
 - uses /pretty, 652
 - uses /sourcefiles, 652
 - uses /spacelist, 652
 - uses /timerlist, 652
 - uses \$CommandSynonymAlist, 652
 - uses \$IOindex, 652
 - uses \$InitialCommandSynonymAlist, 652
 - uses \$UserAbbreviationsAlist, 652
 - uses \$boot, 652
 - uses \$coerceIntByMapCounter, 652
 - uses \$compileMapFlag, 652
 - uses \$dependeeClosureAlist, 652
 - uses \$echoLineStack, 652
 - uses \$env, 652
 - uses \$existingFiles, 652
 - uses \$e, 652
 - uses \$functionTable, 652
 - uses \$msgAlist, 652
 - uses \$msgDatabaseName, 652
 - uses \$msgDatabase, 652
 - uses \$operationNameList, 652
 - uses \$setOptions, 652
 - uses \$slamFlag, 652
 - uses \$sourceFiles, 652
 - defun, 652
- resolveTT
 - calledby unifyStructVar, 429
- Rest, 77
 - calledby incLude1, 81
 - defmacro, 77
- restart
 - calls get-current-directory, 17
 - calls init-memory-config, 17
 - calls initHist, 17
 - calls initializeInterpreterFrameRing, 17
 - calls initroot, 17
 - calls makeInitialModemapFrame, 17
 - calls openserver, 17
 - calls readSpadProfileIfThere, 17
 - calls restart0, 17
 - calls spadStartUpMsgs, 17
 - calls spad, 18
 - calls statisticsInitialization, 17
 - uses \$IOindex, 18
 - uses \$InteractiveFrame, 18
 - uses \$SpadServername, 18
 - uses \$SpadServer, 18
 - uses \$current-directory, 18
 - uses \$currentLine, 18
 - uses \$displayStartMsgs, 18
 - uses \$openServerIfTrue, 18
 - uses \$printLoadMsgs, 18
- restart function, 16
- restart0, 18
 - calledby restart, 17
 - calls browseopen, 19
 - calls categoryopen, 19
 - calls compressopen, 18
 - calls getEnv, 19
 - calls interpopen, 19
 - calls operationopen, 19
 - defun, 18
- restoreHistory, 595
 - calledby historySpad2Cmd, 580
 - calls \$fcopy, 595
 - calls clearCmdSortedCaches, 595
 - calls clearSpad2Cmd, 595
 - calls disableHist, 595
 - calls get, 595
 - calls histFileErase, 595
 - calls histFileName, 595
 - calls identp, 595
 - calls makeHistFileName, 595
 - calls makeInputFilename, 595
 - calls namestring, 595
 - calls putHist, 595
 - calls qcar, 595
 - calls qcdr, 595
 - calls readHiFi, 595
 - calls rempropI, 595
 - calls rkeyids, 595
 - calls sayKeyedMsg, 595
 - calls throwKeyedMsg, 595
 - calls updateInCoreHist, 595

- uses \$HiFiAccess, 595
 - uses \$InteractiveFrame, 595
 - uses \$e, 595
 - uses \$internalHistoryTable, 595
 - uses \$oldHistoryFileName, 595
 - uses \$options, 595
 - uses \$useInternalHistoryTable, 595
- defun, 595
- retract, 1057
 - calledby printTypeAndTimeNormal, 59
 - calls isWrapped, 1057
 - calls objMode, 1057
 - calls objNew, 1058
 - calls objVal, 1057
 - calls qcar, 1057
 - calls retract1, 1058
 - local ref \$EmptyMode, 1058
 - defun, 1057
- retract1
 - calledby retract, 1058
- rkeyids
 - calledby restoreHistory, 595
 - calledby setHistoryCore, 583
- rplac
 - calledby spadTrace, 875
 - calledby spadUntrace, 894
- rplacstr
 - calledby processSynonyms, 33
- rread, 603
 - calledby SPADRREAD, 603
 - calledby rread, 603
 - calls rread, 603
 - defun, 603
- rshut
 - calledby readHiFi, 599
 - calledby saveDependentsHashTable, 1021
 - calledby saveHistory, 594
 - calledby saveUsersHashTable, 1022
 - calledby setHistoryCore, 583
 - calledby writeHiFi, 600
- ruleLhsTran, 322
 - calledby pfRule2Sex, 318
 - calls nsubst, 322
 - calls patternVarsOf, 322
 - uses \$multiVarPredicateList, 322
 - uses \$predicateList, 322
- defun, 322
- rulePredicateTran, 319
 - calledby pfRule2Sex, 318
 - calls patternVarsOf, 319
 - calls pvarPredTran, 319
 - uses \$multiVarPredicateList, 319
 - defun, 319
- runspad, 21
 - calledby spad, 20
 - calls exit, 21
 - calls ncTopLevel, 21
 - calls resetStackLimits, 21
 - calls seq, 21
 - uses \$quitTag, 21
 - catches, 21
 - defun, 21
- rwrite, 602
 - calledby rwrite, 602
 - calledby saveDependentsHashTable, 1021
 - calledby saveUsersHashTable, 1022
 - calledby spadrwrite0, 602
 - calls identp, 603
 - calls pname, 602, 603
 - calls rwrite, 602
 - defun, 602
- safeWritify, 604
 - calledby spadrwrite0, 602
 - calls writify, 605
 - catches, 604
 - defun, 604
- sameMsg?, 376
 - calledby redundant, 374
 - calls getMsgArgL, 376
 - calls getMsgKey, 376
 - defun, 376
- sameUnionBranch, 61
 - calledby printTypeAndTimeNormal, 59
 - defun, 61
- satisfiesRegularExpressions, 941
 - calledby filterListOfStringsWithFn, 941
 - calledby filterListOfStrings, 940
 - calls strpos, 941
 - defun, 941
- satisfiesUserLevel, 449
 - calledby commandsForUserLevel, 446

- calledby displaySetVariableSettings, 655
 - calledby set1, 806
 - uses \$UserLevel, 449
 - defun, 449
- save-system
 - calledby spad-save, 988
- saveDependentsHashTable, 1021
 - calledby make-databases, 1018
 - calls erase, 1021
 - calls hget, 1021
 - calls hkeys, 1021
 - calls msort, 1021
 - calls rshut, 1021
 - calls rwrite, 1021
 - calls writeLib1, 1021
 - local ref \$depTb, 1021
 - local ref \$erase, 1021
 - defun, 1021
- saveHistory, 593
 - calledby historySpad2Cmd, 580
 - calls histFileErase, 593
 - calls histFileName, 593
 - calls histInputFileName, 593
 - calls makeHistFileName, 593
 - calls makeInputFilename, 593
 - calls namestring, 594
 - calls object2Identifier, 594
 - calls rdefiostream, 593
 - calls rshut, 594
 - calls sayKeyedMsg, 593
 - calls spadrwrite0, 593
 - calls throwKeyedMsg, 593
 - calls writeInputLines, 593
 - uses \$HiFiAccess, 594
 - uses \$internalHistoryTable, 594
 - uses \$seen, 594
 - uses \$useInternalHistoryTable, 594
 - defun, 593
- saveMapSig, 851
 - calledby trace1, 846
 - calls addassoc, 851
 - calls getMapSig, 851
 - calls rassoc, 851
 - uses \$mapSubNameAlist, 851
 - uses \$tracedMapSignatures, 851
 - defun, 851
- savesystem, 648
 - calls helpSpad2Cmd, 648
 - calls spad-save, 648
 - defun, 648
- savesystem help page, 647
 - manpage, 647
- saveUsersHashTable, 1022
 - calledby make-databases, 1018
 - calls erase, 1022
 - calls hget, 1022
 - calls hkeys, 1022
 - calls msort, 1022
 - calls rshut, 1022
 - calls rwrite, 1022
 - calls writeLib1, 1022
 - local ref \$erase, 1022
 - local ref \$usersTb, 1022
 - defun, 1022
- say
 - calledby displaySetVariableSettings, 655
 - calledby newHelpSpad2Cmd, 571
 - calledby trace1, 846
 - calledby whatCommands, 940
 - calledby workfilesSpad2Cmd, 947
- say2PerLine
 - calledby displayOperationsFromLisplib, 819
 - calledby reportOpsFromLisplib, 816
 - calledby reportOpsFromUnitDirectly, 820
- sayAsManyPerLineAsPossible
 - calledby apropos, 943
 - calledby displayWorkspaceNames, 452
 - calledby setExposeAddGroup, 697
 - calledby setOutputCharacters, 764
 - calledby whatCommands, 940
- sayBrightly
 - calledby ?t, 901
 - calledby break, 904
 - calledby describeFortPersistence, 754
 - calledby describeInputLibraryArgs, 666
 - calledby describeOutputLibraryArgs, 663
 - calledby describeSetFortDir, 724
 - calledby describeSetFortTmpDir, 722
 - calledby describeSetLinkerArgs, 726
 - calledby describeSetNagHost, 752
 - calledby describeSetOutputAlgebra, 762

- calledby describeSetOutputFormula, 790
- calledby describeSetOutputFortran, 769
- calledby describeSetOutputHtml, 780
- calledby describeSetOutputMathml, 776
- calledby describeSetOutputOpenMath, 785
- calledby describeSetOutputTex, 796
- calledby displayCondition, 463
- calledby displayMacros, 536
- calledby displayMacro, 452
- calledby displayModemap, 464
- calledby displayMode, 464
- calledby displaySetOptionInformation, 653
- calledby displaySetVariableSettings, 655
- calledby displayWorkspaceNames, 452
- calledby msgOutputter, 353
- calledby pcounters, 858
- calledby printLabelledList, 472
- calledby processKeyedError, 353
- calledby pspacers, 857
- calledby ptimers, 857
- calledby reportOperations, 813
- calledby reportOpsFromLisplib, 816
- calledby reportOpsFromUnitDirectly, 820
- calledby reportSpadTrace, 890
- calledby reportUndo, 926
- calledby reportWhatOptions, 939
- calledby sayShowWarning, 824
- calledby setFortDir, 723
- calledby setFortTmpDir, 721
- calledby setOutputCharacters, 764
- calledby traceReply, 897
- calledby workfilesSpad2Cmd, 948
- calledby zsystemdevelopment1, 952
- sayBrightly1, 1051
 - calledby sayMSG2File, 331
 - defun, 1051
- saybrightly1
 - calledby saymsg, 331
 - calls brightprint-0, 1051
 - calls brightprint, 1051
- sayBrightlyLength
 - calledby traceReply, 897
- sayBrightlyNT
 - calledby letPrint, 883
 - calledby reportUndo, 926
- sayExample, 537
 - defun, 537
- sayexample
 - calls cleanupLine, 538
 - calls sayNewLine, 538
- sayKeyedMsg, 329
 - calledby abbQuery, 534
 - calledby abbreviationsSpad2Cmd, 481
 - calledby apropos, 943
 - calledby changeHistListLen, 587
 - calledby clearCmdAll, 501
 - calledby clearCmdCompletely, 500
 - calledby clearCmdParts, 503
 - calledby clearSpad2Cmd, 498
 - calledby commandAmbiguityError, 450
 - calledby commandErrorMessage, 448
 - calledby describeSetStreamsCalculate, 799
 - calledby displayExposedConstructors, 702
 - calledby displayExposedGroups, 702
 - calledby displayFrameNames, 561
 - calledby displayHiddenConstructors, 703
 - calledby displayOperations, 535
 - calledby displayProperties, 459
 - calledby handleNoParseCommands, 468
 - calledby helpSpad2Cmd, 570
 - calledby historySpad2Cmd, 580
 - calledby history, 580
 - calledby importFromFrame, 561
 - calledby listConstructorAbbreviations, 483
 - calledby loadLibNoUpdate, 1039
 - calledby loadLib, 1037
 - calledby load, 627
 - calledby localdatabase, 1013
 - calledby localnrlib, 1015
 - calledby newHelpSpad2Cmd, 571
 - calledby npsystem, 470
 - calledby printStatisticsSummary, 57
 - calledby printTypeAndTimeNormal, 59
 - calledby quitSpad2Cmd, 636
 - calledby reportOperations, 813
 - calledby reportOpsFromLisplib, 816
 - calledby restoreHistory, 595
 - calledby saveHistory, 593
 - calledby set1, 806
 - calledby setExposeAddConstr, 698
 - calledby setExposeAddGroup, 697
 - calledby setExposeAdd, 696

- calledby setExposeDropConstr, 701
- calledby setExposeDropGroup, 700
- calledby setExposeDrop, 699
- calledby setExpose, 695
- calledby setHistoryCore, 583
- calledby setOutputAlgebra, 760
- calledby setOutputFormula, 788
- calledby setOutputFortran, 767
- calledby setOutputHtml, 778
- calledby setOutputMathml, 774
- calledby setOutputOpenMath, 783
- calledby setOutputTex, 794
- calledby showSpad2Cmd, 812
- calledby spadStartUpMsgs, 19
- calledby trace1, 846
- calledby undoInCore, 591
- calledby userLevelErrorMessage, 449
- calledby whatCommands, 940
- calledby whatSpad2Cmd, 938
- calledby workfilesSpad2Cmd, 947
- calledby writeInputLines, 585
- calledby writifyComplain, 604
- calls sayKeyedMsgLocal, 329
- uses \$texFormatting, 330
- defun, 329
- sayKeyedMsgLocal, 330
 - calledby sayKeyedMsg, 329
 - calls flowSegmentedMsg, 330
 - calls getKeyedMsg, 330
 - calls sayMSG2File, 330
 - calls sayMSG, 330
 - calls segmentKeyedMsg, 330
 - calls substituteSegmentedMsg, 330
 - uses \$displayMsgNumber, 330
 - uses \$linelength, 330
 - uses \$margin, 330
 - uses \$printMsgsToFile, 330
 - defun, 330
- sayMessage
 - calledby apropos, 943
 - calledby clearCmdParts, 503
 - calledby describeSpad2Cmd, 527
 - calledby displaySetOptionInformation, 653
 - calledby displaySpad2Cmd, 534
 - calledby displayWorkspaceNames, 452
 - calledby filterAndFormatConstructors, 942
 - calledby printLabelledList, 472
 - calledby set1, 806
 - calledby setFortPers, 754
 - calledby setOutputCharacters, 764
 - calledby setStreamsCalculate, 799
 - calledby traceReply, 897
 - calledby updateFromCurrentInterpreter-Frame, 556
 - calledby whatCommands, 940
 - calledby zsystemdevelopment1, 952
- sayMSG, 331
 - calledby ?t, 901
 - calledby commandAmbiguityError, 450
 - calledby displayProperties,sayFunctionDeps, 456
 - calledby displayProperties, 460
 - calledby displaySetOptionInformation, 653
 - calledby displayType, 458
 - calledby displayValue, 457
 - calledby evalDomain, 911
 - calledby getAndSay, 459
 - calledby initializeSetVariables, 651
 - calledby sayKeyedMsgLocal, 330
 - calledby set1, 806
 - calledby setExposeAddGroup, 696
 - calledby setExposeAdd, 695
 - calledby setExposeDropConstr, 701
 - calledby setExposeDropGroup, 700
 - calledby setExposeDrop, 699
 - calledby setExpose, 695
 - calledby showInOut, 598
 - calledby showInput, 597
 - calledby spadStartUpMsgs, 19
 - calledby spadUntrace, 893
 - calledby traceDomainLocalOps, 878
 - calledby traceReply, 897
 - calledby untraceDomainLocalOps, 878
 - uses \$algebraOutputStream, 331
 - defun, 331
- saymsg
 - calls saybrightly1, 331
- sayMSG2File, 331
 - calledby sayKeyedMsgLocal, 330
 - calls defiostream, 331
 - calls makePathname, 331
 - calls sayBrightly1, 331

- calls shut, 331
- defun, 331
- sayNewLine
 - calledby sayexample, 538
- sayShowWarning, 824
 - calledby reportOpsFromLisplib1, 815
 - calledby reportOpsFromUnitDirectly1, 823
 - calls sayBrightly, 824
 - defun, 824
- scanCheckRadix, 134
 - calledby scanNumber, 132
 - uses \$linepos, 134
 - uses \$n, 134
 - defun, 134
- scanCloser, 125
 - usedby scanCloser?, 125
 - defvar, 125
- scanCloser?, 125
 - calledby scanKeyTr, 120
 - calls keyword, 125
 - uses scanCloser, 125
 - defun, 125
- scanComment, 116
 - calledby scanToken, 114
 - calls lfcomment, 116
 - calls substring, 116
 - uses \$ln, 116
 - uses \$n, 116
 - uses \$sz, 116
 - defun, 116
- scanDict, 137
 - defvar, 137
- scanDictCons, 137
 - calls hkeys, 137
 - defun, 137
- scanError, 135
 - calledby scanPunct, 118
 - calledby scanToken, 114
 - calls lferror, 135
 - calls lnExtraBlanks, 135
 - calls ncSoftError, 135
 - uses \$linepos, 135
 - uses \$ln, 135
 - uses \$n, 135
 - defun, 135
- scanEsc, 123
 - calledby scanEscape, 135
 - calledby scanEsc, 124
 - calledby scanS, 131
 - calledby scanW, 128
 - calledby spleI1, 122
 - calls nextline, 124
 - calls qenum, 124
 - calls scanEsc, 124
 - calls startsComment?, 124
 - calls startsNegComment?, 124
 - calls strposl, 124
 - uses \$ln, 124
 - uses \$n, 124
 - uses \$r, 124
 - uses \$sz, 124
 - defun, 123
- scanEscape, 135
 - calledby scanToken, 114
 - calls scanEsc, 135
 - calls scanWord, 135
 - uses \$n, 135
 - defun, 135
- scanExponent, 126
 - calledby scanNumber, 132
 - calledby scanPossFloat, 121
 - calls concat, 126
 - calls digit?, 126
 - calls lffloat, 126
 - calls qenum, 126
 - calls spleI, 126
 - uses \$ln, 126
 - uses \$n, 126
 - uses \$sz, 126
 - defun, 126
- scanIgnoreLine, 113
 - calledby lineoftoks, 111
 - calls incPrefix?, 113
 - calls qenum, 113
 - defun, 113
- scanInsert, 138
 - calls qenum, 138
 - defun, 138
- scanKeyTable, 136
 - defvar, 136
- scanKeyTableCons, 136
 - defun, 136

- scanKeyTr, 120
 - calledby scanPunct, 118
 - calls keyword, 120
 - calls lfkey, 120
 - calls scanCloser?, 120
 - calls scanPossFloat, 120
 - uses \$floatok, 120
 - defun, 120
- scanKeyWords, 108
 - defvar, 108
- scanNegComment, 117
 - calledby scanToken, 114
 - calls lfnegcomment, 117
 - calls substring, 117
 - uses \$ln, 117
 - uses \$n, 117
 - uses \$sz, 117
 - defun, 117
- scanNumber, 132
 - calledby scanToken, 114
 - calls concat, 132
 - calls lfinteger, 132
 - calls lfrinteger, 132
 - calls qenum, 132
 - calls scanCheckRadix, 132
 - calls scanExponent, 132
 - calls spleI1, 132
 - calls spleI, 132
 - uses \$floatok, 132
 - uses \$ln, 132
 - uses \$n, 132
 - uses \$sz, 132
 - defun, 132
- ScanOrPairVec, 614
 - calledby dewritify, 613
 - calledby writify, 608
 - calls ScanOrPairVec,ScanOrInner, 614
 - uses \$seen, 614
 - catches, 614
 - defun, 614
- ScanOrPairVec,ScanOrInner, 613
 - calledby ScanOrPairVec,ScanOrInner, 613
 - calledby ScanOrPairVec, 614
 - calls ScanOrPairVec,ScanOrInner, 613
 - calls hget, 613
 - calls hput, 613
 - calls qcar, 613
 - calls qcdr, 613
 - calls vecp, 613
 - uses \$seen, 613
 - defun, 613
 - throws, 613
- scanPossFloat, 121
 - calledby scanKeyTr, 120
 - calls digit?, 121
 - calls lfkey, 121
 - calls scanExponent, 121
 - calls spleI, 121
 - uses \$ln, 121
 - uses \$n, 121
 - uses \$sz, 121
 - defun, 121
- scanPun, 139
 - defvar, 139
- scanPunCons, 139
 - calls hkeys, 139
 - defun, 139
- scanPunct, 118
 - calledby scanToken, 114
 - calls scanError, 118
 - calls scanKeyTr, 118
 - calls subMatch, 118
 - uses \$ln, 118
 - uses \$n, 118
 - defun, 118
- scanS, 131
 - calledby scanString, 130
 - calledby scanS, 131
 - calls concat, 131
 - calls lnExtraBlanks, 131
 - calls ncSoftError, 131
 - calls scanEsc, 131
 - calls scanS, 131
 - calls scanTransform, 131
 - calls strpos, 131
 - calls substring, 131
 - uses \$linepos, 131
 - uses \$ln, 131
 - uses \$n, 131
 - uses \$sz, 131
 - defun, 131
- scanSpace, 129

- calledby scanToken, 114
- calls lfspaces, 129
- calls strposl, 129
- uses \$floatok, 129
- uses \$ln, 129
- uses \$n, 129
- defun, 129
- scanString, 130
 - calledby scanToken, 114
 - calls lfstring, 130
 - calls scanS, 130
 - uses \$floatok, 130
 - uses \$n, 130
 - defun, 130
- scanToken, 114
 - calls constoken, 114
 - calls digit?, 114
 - calls dqUnit, 114
 - calls lfid, 114
 - calls lnExtraBlanks, 114
 - calls punctuation?, 114
 - calls qenum, 114
 - calls scanComment, 114
 - calls scanError, 114
 - calls scanEscape, 114
 - calls scanNegComment, 114
 - calls scanNumber, 114
 - calls scanPunct, 114
 - calls scanSpace, 114
 - calls scanString, 114
 - calls scanWord, 114
 - calls startsComment?, 114
 - calls startsId?, 114
 - calls startsNegComment?, 114
 - uses \$linepos, 114
 - uses \$ln, 114
 - uses \$n, 114
 - defun, 114
- scanTransform, 132
 - calledby scanS, 131
 - defun, 132
- scanW, 128
 - calledby scanWord, 126
 - calledby scanW, 128
 - calls concat, 128
 - calls idChar?, 128
 - calls posend, 128
 - calls qenum, 128
 - calls scanEsc, 128
 - calls scanW, 128
 - calls substring, 128
 - uses \$ln, 128
 - uses \$n, 128
 - uses \$sz, 128
 - defun, 128
- scanWord, 126
 - calledby scanEscape, 135
 - calledby scanToken, 114
 - calls keyword?, 126
 - calls lfid, 126
 - calls lfkey, 126
 - calls scanW, 126
 - uses \$floatok, 126
 - defun, 126
- search, 962
 - calledby getProplist, 962
 - calls searchCurrentEnv, 962
 - calls searchTailEnv, 962
 - defun, 962
- searchCurrentEnv, 962
 - calledby search, 962
 - calls assq, 962
 - calls kdr, 962
 - defun, 962
- searchTailEnv, 963
 - calledby search, 962
 - calls assq, 963
 - calls kdr, 963
 - defun, 963
- sec, 1098
 - defun, 1098
- sech, 1100
 - defun, 1100
- segmentKeyedMsg, 330
 - calledby getMsgInfoFromKey, 366
 - calledby msgText, 61
 - calledby sayKeyedMsgLocal, 330
 - calls string2Words, 330
 - defun, 330
- selectOption, 477
 - calledby selectOptionLC, 477
 - calledby set1, 806

- calledby systemCommand, 446
- calledby unAbbreviateKeyword, 467
- calls identp, 477
- calls member, 477
- calls pname, 478
- calls qcar, 478
- calls qcdr, 478
- calls stringPrefix?, 477
- defun, 477
- selectOptionLC, 477
 - calledby abbreviationsSpad2Cmd, 481
 - calledby clearCmdParts, 503
 - calledby clearSpad2Cmd, 498
 - calledby close, 508
 - calledby describeSpad2Cmd, 527
 - calledby displaySpad2Cmd, 534
 - calledby frameSpad2Cmd, 564
 - calledby getTraceOption, 852
 - calledby historySpad2Cmd, 580
 - calledby newHelpSpad2Cmd, 571
 - calledby readSpad2Cmd, 640
 - calledby reportOpsFromLisplib, 816
 - calledby reportOpsFromUnitDirectly, 820
 - calledby setExposeAdd, 696
 - calledby setExposeDrop, 699
 - calledby setExpose, 695
 - calledby setInputLibrary, 665
 - calledby synonymsForUserLevel, 831
 - calledby systemCommand, 446
 - calledby trace1, 846
 - calledby unAbbreviateKeyword, 467
 - calledby whatSpad2Cmd, 938
 - calledby workfilesSpad2Cmd, 947
 - calledby zsystemdevelopment1, 952
 - calls downcase, 477
 - calls object2Identifier, 477
 - calls selectOption, 477
 - defun, 477
- sendHTErrorSignal
 - calledby protectedEVAL, 47
- separatePiles, 341
 - calledby pileCforest, 340
 - calledby separatePiles, 341
 - calls dqConcat, 341
 - calls dqUnit, 341
 - calls lastTokPosn, 341
 - calls separatePiles, 341
 - calls tokConstruct, 341
 - defun, 341
- SEQ
 - calledby funfind,LAM, 872
- seq
 - calledby /tracereply, 892
 - calledby abbreviationsSpad2Cmd, 481
 - calledby apropos, 943
 - calledby clearCmdParts, 503
 - calledby coerceSpadArgs2E, 863
 - calledby dewritify,dewritifyInner, 610
 - calledby diffAlist, 923
 - calledby displayMacros, 536
 - calledby displayProperties,sayFunctionDeps, 456
 - calledby displayProperties, 460
 - calledby flattenOperationAlist, 881
 - calledby getAliasIfTracedMapParameter, 888
 - calledby getBpiNameIfTracedMap, 888
 - calledby getPreviousMapSubNames, 868
 - calledby getTraceOption,hn, 851
 - calledby getTraceOptions, 850
 - calledby getTraceOption, 852
 - calledby getWorkspaceNames, 453
 - calledby historySpad2Cmd, 581
 - calledby importFromFrame, 561
 - calledby isListOfIdentifiersOrStrings, 867
 - calledby isListOfIdentifiers, 866
 - calledby orderBySlotNumber, 891
 - calledby prTraceNames,fn, 896
 - calledby prTraceNames, 896
 - calledby recordFrame, 921
 - calledby removeUndoLines, 931
 - calledby reportUndo, 926
 - calledby runspad, 21
 - calledby set1, 806
 - calledby spadReply,printName, 892
 - calledby spadReply, 893
 - calledby spadTrace,isTraceable, 873
 - calledby spadTrace, 874
 - calledby spadUntrace, 894
 - calledby subTypes, 864
 - calledby trace1, 846
 - calledby traceDomainConstructor, 878

- calledby traceReply, 897
- calledby undoFromFile, 592
- calledby undoLocalModemapHack, 931
- calledby undoSingleStep, 929
- calledby untraceDomainConstructor,keepTraced, 44
- 880
- calledby untraceDomainConstructor, 881
- calledby whatConstructors, 943
- calledby whatSpad2Cmd, 938
- calledby writify,writifyInner, 605
- serverReadLine, 44
 - calledby intloopReadConsole, 30
 - calls addNewInterpreterFrame, 44
 - calls changeToNamedInterpreterFrame, 44
 - calls executeQuietCommand, 44
 - calls is-console[9], 45
 - calls lassoc, 44
 - calls mkprompt, 44
 - calls parseAndInterpret, 44
 - calls protectedEVAL, 44
 - calls read-line, 44
 - calls serverSwitch, 45
 - calls sockGetInt, 44
 - calls sockGetString, 44
 - calls sockSendInt, 44
 - calls sockSendString, 44
 - calls unescapeStringsInForm, 44
 - uses *eof*, 45
 - uses \$CallInterp, 45
 - uses \$CreateFrameAnswer, 45
 - uses \$CreateFrame, 45
 - uses \$EndOfOutput, 45
 - uses \$EndServerSession, 45
 - uses \$EndSession, 45
 - uses \$KillLispSystem, 45
 - uses \$LispCommand, 45
 - uses \$MenuServer, 45
 - uses \$NeedToSignalSessionManager, 45
 - uses \$NonSmanSession, 45
 - uses \$QuietSpadCommand, 45
 - uses \$SessionManager, 45
 - uses \$SpadCommand, 45
 - uses \$SpadServer, 45
 - uses \$SwitchFrames, 45
 - uses \$currentFrameNum, 45
 - uses \$frameAlist, 45
 - uses \$frameNumber, 45
 - uses \$sockBufferLength, 45
 - uses in-stream, 45
 - catches, 44
 - defun, 44
 - serverSwitch
 - calledby serverReadLine, 45
 - set, 805
 - calledby browse, 491
 - calls set1, 805
 - uses \$setOptions, 805
 - defun, 805
 - set help page, 649
 - manpage, 649
 - set-hole-size
 - calledby init-memory-config, 34
 - set-restart-hook, 15
 - defun, 15
 - set1, 806
 - calledby set1, 807
 - calledby set, 805
 - calls bright, 806
 - calls displaySetOptionInformation, 806
 - calls displaySetVariableSettings, 806
 - calls downcase, 806
 - calls exit, 806
 - calls kdr, 806
 - calls lassoc, 806
 - calls literals, 807
 - calls object2String, 806
 - calls poundsign, 806
 - calls satisfiesUserLevel, 806
 - calls sayKeyedMsg, 806
 - calls sayMSG, 806
 - calls sayMessage, 806
 - calls selectOption, 806
 - calls seq, 806
 - calls set1, 807
 - calls translateYesNo2TrueFalse, 807
 - calls tree, 807
 - calls use-fast-links, 807
 - uses \$UserLevel, 807
 - uses \$displaySetValue, 807
 - uses \$setOptionNames, 807
 - defun, 806
 - setCurrentLine, 41

- calledby intloopEchoParse, 69
- calledby intloopProcessString, 37
- calledby intloopProcess, 64
- calledby intloopReadConsole, 30
- uses \$currentLine, 42
- defun, 41
- setdatabase, 1008
 - calledby abbreviationsSpad2Cmd, 481
 - calls make-database, 1008
 - defun, 1008
- setdifference
 - calledby displayWorkspaceNames, 452
 - calledby untraceMapSubNames, 871
- setelt
 - calledby setExposeAddConstr, 698
 - calledby setExposeAddGroup, 696
 - calledby setExposeDropConstr, 701
 - calledby setExposeDropGroup, 700
- setelt32, 1057
 - defmacro, 1057
- setExpose, 694
 - calledby setExpose, 695
 - calls displayExposedConstructors, 695
 - calls displayExposedGroups, 694
 - calls displayHiddenConstructors, 695
 - calls namestring, 695
 - calls pathname, 695
 - calls qcar, 695
 - calls qcdr, 695
 - calls sayKeyedMsg, 695
 - calls sayMSG, 695
 - calls selectOptionLC, 695
 - calls setExposeAdd, 695
 - calls setExposeDrop, 695
 - calls setExpose, 695
 - defun, 694
- setExposeAdd, 695
 - calledby setExposeAdd, 696
 - calledby setExpose, 695
 - calls centerAndHighlight, 695
 - calls displayExposedConstructors, 695
 - calls displayExposedGroups, 695
 - calls qcar, 696
 - calls qcdr, 696
 - calls sayKeyedMsg, 696
 - calls sayMSG, 695
- calls selectOptionLC, 696
- calls setExposeAddConstr, 696
- calls setExposeAddGroup, 696
- calls setExposeAdd, 696
- calls specialChar, 695
- uses \$linelength, 696
- defun, 695
- setExposeAddConstr, 698
 - calledby localnrLib, 1015
 - calledby setExposeAdd, 696
 - calls centerAndHighlight, 698
 - calls clearClams, 698
 - calls delete, 698
 - calls displayExposedConstructors, 698
 - calls getdatabase, 698
 - calls member, 698
 - calls msort, 698
 - calls qcar, 698
 - calls sayKeyedMsg, 698
 - calls setelt, 698
 - calls specialChar, 698
 - calls unabbrev, 698
 - uses \$interpreterFrameName, 698
 - uses \$linelength, 698
 - uses \$localExposureData, 698
 - defun, 698
- setExposeAddGroup, 696
 - calledby setExposeAdd, 696
 - calls centerAndHighlight, 697
 - calls clearClams, 696
 - calls displayExposedConstructors, 696
 - calls displayExposedGroups, 696
 - calls displayHiddenConstructors, 696
 - calls getalist, 697
 - calls member, 697
 - calls msort, 697
 - calls namestring, 697
 - calls object2String, 696
 - calls pathname, 697
 - calls qcar, 696
 - calls sayAsManyPerLineAsPossible, 697
 - calls sayKeyedMsg, 697
 - calls sayMSG, 696
 - calls setelt, 696
 - calls specialChar, 697
 - uses \$globalExposureGroupAlist, 697

- uses \$interpreterFrameName, 697
 - uses \$linelength, 697
 - uses \$localExposureData, 697
 - defun, 696
- setExposeDrop, 699
 - calledby setExposeDrop, 699
 - calledby setExpose, 695
 - calls centerAndHighlight, 699
 - calls displayHiddenConstructors, 699
 - calls qcar, 699
 - calls qcdr, 699
 - calls sayKeyedMsg, 699
 - calls sayMSG, 699
 - calls selectOptionLC, 699
 - calls setExposeDropConstr, 699
 - calls setExposeDropGroup, 699
 - calls setExposeDrop, 699
 - calls specialChar, 699
 - uses \$linelength, 699
 - defun, 699
- setExposeDropConstr, 701
 - calledby setExposeDrop, 699
 - calls centerAndHighlight, 701
 - calls clearClams, 701
 - calls delete, 701
 - calls displayExposedConstructors, 701
 - calls displayHiddenConstructors, 701
 - calls getdatabase, 701
 - calls member, 701
 - calls msort, 701
 - calls qcar, 701
 - calls sayKeyedMsg, 701
 - calls sayMSG, 701
 - calls setelt, 701
 - calls specialChar, 701
 - calls unabbrev, 701
 - uses \$interpreterFrameName, 701
 - uses \$linelength, 701
 - uses \$localExposureData, 701
 - defun, 701
- setExposeDropGroup, 700
 - calledby setExposeDrop, 699
 - calls centerAndHighlight, 700
 - calls clearClams, 700
 - calls delete, 700
 - calls displayExposedConstructors, 700
 - calls displayExposedGroups, 700
 - calls displayHiddenConstructors, 700
 - calls getalist, 700
 - calls member, 700
 - calls qcar, 700
 - calls sayKeyedMsg, 700
 - calls sayMSG, 700
 - calls setelt, 700
 - calls specialChar, 700
 - uses \$globalExposureGroupAlist, 700
 - uses \$interpreterFrameName, 700
 - uses \$linelength, 700
 - uses \$localExposureData, 700
 - defun, 700
- setFortDir, 723
 - calls bright, 724
 - calls describeSetFortDir, 723
 - calls pname, 723
 - calls sayBrightly, 723
 - calls validateOutputDirectory, 723
 - uses \$fortranDirectory, 724
 - defun, 723
- setFortPers, 754
 - calls bright, 754
 - calls describeFortPersistence, 754
 - calls sayMessage, 754
 - calls terminateSystemCommand, 754
 - uses \$fortPersistence, 754
 - defun, 754
- setFortTmpDir, 721
 - calls bright, 721
 - calls describeSetFortTmpDir, 721
 - calls pname, 721
 - calls sayBrightly, 721
 - calls validateOutputDirectory, 721
 - uses \$fortranTmpDir, 721
 - defun, 721
- setFunctionsCache, 705
 - defun, 705
- setHistoryCore, 582
 - calledby historySpad2Cmd, 580
 - calls boot-equal, 583
 - calls disableHist, 583
 - calls histFileErase, 583
 - calls histFileName, 583
 - calls object2Identifier, 583

- calls rdefiostream, 583
- calls readHiFi, 583
- calls rkeyids, 583
- calls rshut, 583
- calls sayKeyedMsg, 583
- calls spadwrite, 583
- uses \$HiFiAccess, 583
- uses \$IOindex, 583
- uses \$internalHistoryTable, 583
- uses \$useInternalHistoryTable, 583
- defun, 582
- setInputLibrary, 665
 - calledby setInputLibrary, 665
 - calls addInputLibrary, 665
 - calls describeInputLibraryArgs, 665
 - calls dropInputLibrary, 665
 - calls qcar, 665
 - calls qcdr, 665
 - calls selectOptionLC, 665
 - calls setInputLibrary, 665
 - uses input-libraries, 665
 - defun, 665
- setIOindex, 597
 - uses \$IOindex, 597
 - defun, 597
- setletprintflag
 - calledby breaklet, 903
 - calledby spadTrace, 875
 - calledby spadUntrace, 894
 - calledby tracelet, 902
- setLinkerArgs, 726
 - calls describeSetLinkerArgs, 726
 - calls object2String, 726
 - uses \$fortranLibraries, 726
 - defun, 726
- setMsgCatlessAttr, 365
 - calledby setMsgForcedAttr, 364
 - calledby setMsgUnforcedAttr, 367
 - calls ifcdr, 365
 - calls ncAlist, 365
 - calls ncPutQ, 365
 - calls qassq, 365
 - defun, 365
- setMsgForcedAttr, 364
 - calledby setMsgForcedAttrList, 364
 - calls ncPutQ, 364
 - calls setMsgCatlessAttr, 364
 - defun, 364
- setMsgForcedAttrList, 364
 - calledby msgCreate, 348
 - calls setMsgForcedAttr, 364
 - calls whichCat, 364
 - defun, 364
- setMsgPrefix, 349
 - calledby processChPosesForOneLine, 376
 - defun, 349
- setMsgText, 349
 - calledby putDatabaseStuff, 365
 - calledby putFTText, 379
 - defun, 349
- setMsgUnforcedAttr, 367
 - calledby initImPr, 367
 - calledby initToWhere, 368
 - calledby setMsgUnforcedAttrList, 366
 - calls ncAlist, 367
 - calls ncPutQ, 367
 - calls qassq, 367
 - calls setMsgCatlessAttr, 367
 - defun, 367
- setMsgUnforcedAttrList, 366
 - calledby putDatabaseStuff, 365
 - calls setMsgUnforcedAttr, 366
 - calls whichCat, 366
 - defun, 366
- setNagHost, 752
 - calls describeSetNagHost, 752
 - calls object2String, 752
 - uses \$nagHost, 752
 - defun, 752
- setOutputAlgebra, 760
 - calledby describeSetOutputAlgebra, 762
 - calledby spad, 20
 - calls \$filep, 760
 - calls concat, 760
 - calls defiostream, 760
 - calls describeSetOutputAlgebra, 760
 - calls make-outstream, 760
 - calls member, 760
 - calls object2String, 760
 - calls pathnameDirectory, 760
 - calls pathnameName, 760
 - calls pathnameType, 760

- calls qcar, 760
- calls qcdr, 760
- calls sayKeyedMsg, 760
- calls shut, 760
- calls upcase, 760
- uses \$algebraFormat, 760
- uses \$algebraOutputFile, 760
- uses \$algebraOutputStream, 760
- uses \$filep, 760
- defun, 760
- setOutputCharacters, 764
 - calledby setOutputCharacters, 764
 - calls bright, 764
 - calls concat, 764
 - calls downcase, 764
 - calls pname, 764
 - calls qcar, 764
 - calls qcdr, 764
 - calls sayAsManyPerLineAsPossible, 764
 - calls sayBrightly, 764
 - calls sayMessage, 764
 - calls setOutputCharacters, 764
 - calls specialChar, 764
 - uses \$RTspecialCharacters, 764
 - uses \$plainRTspecialCharacters, 764
 - uses \$specialCharacterAlist, 764
 - uses \$specialCharacters, 764
 - defun, 764
- setOutputFormula, 787
 - calledby describeSetOutputFormula, 790
 - calls \$filep, 788
 - calls concat, 788
 - calls defiostream, 787
 - calls describeSetOutputFormula, 788
 - calls make-outstream, 788
 - calls member, 788
 - calls object2String, 788
 - calls pathnameDirectory, 788
 - calls pathnameName, 788
 - calls pathnameType, 788
 - calls qcar, 788
 - calls qcdr, 788
 - calls sayKeyedMsg, 788
 - calls shut, 788
 - calls upcase, 788
 - uses \$filep, 788
 - uses \$formulaFormat, 788
 - uses \$formulaOutputFile, 788
 - uses \$formulaOutputStream, 788
 - defun, 787
- setOutputFortran, 767
 - calledby describeSetOutputFortran, 769
 - calls \$filep, 767
 - calls concat, 767
 - calls defiostream, 767
 - calls describeSetOutputFortran, 767
 - calls makeStream, 767
 - calls member, 767
 - calls object2String, 767
 - calls pathnameDirectory, 767
 - calls pathnameName, 767
 - calls pathnameType, 767
 - calls qcar, 767
 - calls qcdr, 767
 - calls sayKeyedMsg, 767
 - calls shut, 767
 - calls upcase, 767
 - uses \$filep, 767
 - uses \$fortranFormat, 767
 - uses \$fortranOutputFile, 767
 - uses \$fortranOutputStream, 767
 - defun, 767
- setOutputHtml, 778
 - calledby describeSetOutputHtml, 780
 - calls \$filep, 778
 - calls concat, 778
 - calls defiostream, 778
 - calls describeSetOutputHtml, 778
 - calls make-outstream, 778
 - calls member, 778
 - calls object2String, 778
 - calls pathnameDirectory, 778
 - calls pathnameName, 778
 - calls pathnameType, 778
 - calls qcar, 778
 - calls qcdr, 778
 - calls sayKeyedMsg, 778
 - calls shut, 778
 - calls upcase, 778
 - uses \$filep, 779
 - uses \$htmlFormat, 779
 - uses \$htmlOutputFile, 779

- uses \$htmlOutputStream, 778
 - defun, 778
- setOutputLibrary, 662
 - calls describeOutputLibraryArgs, 662
 - calls filep, 662
 - calls openOutputLibrary, 662
 - calls poundsign, 662
 - uses \$outputLibraryName, 662
 - defun, 662
- setOutputMathml, 774
 - calledby describeSetOutputMathml, 776
 - calls \$filep, 774
 - calls concat, 774
 - calls defiostream, 774
 - calls describeSetOutputMathml, 774
 - calls make-outstream, 774
 - calls member, 774
 - calls object2String, 774
 - calls pathnameDirectory, 774
 - calls pathnameName, 774
 - calls pathnameType, 774
 - calls qcar, 774
 - calls qcdr, 774
 - calls sayKeyedMsg, 774
 - calls shut, 774
 - calls upcase, 774
 - uses \$filep, 774
 - uses \$mathmlFormat, 774
 - uses \$mathmlOutputFile, 774
 - uses \$mathmlOutputStream, 774
 - defun, 774
- setOutputOpenMath, 783
 - calledby describeSetOutputOpenMath, 785
 - calls \$filep, 783
 - calls concat, 783
 - calls defiostream, 783
 - calls describeSetOutputOpenMath, 783
 - calls make-outstream, 783
 - calls member, 783
 - calls object2String, 783
 - calls pathnameDirectory, 783
 - calls pathnameName, 783
 - calls pathnameType, 783
 - calls qcar, 783
 - calls qcdr, 783
 - calls sayKeyedMsg, 783
 - calls shut, 783
 - calls upcase, 783
 - uses \$filep, 783
 - uses \$openMathFormat, 783
 - uses \$openMathOutputFile, 783
 - uses \$openMathOutputStream, 783
 - defun, 783
- setOutputTex, 794
 - calledby describeSetOutputTex, 796
 - calls \$filep, 794
 - calls concat, 794
 - calls defiostream, 794
 - calls describeSetOutputTex, 794
 - calls make-outstream, 794
 - calls member, 794
 - calls object2String, 794
 - calls pathnameDirectory, 794
 - calls pathnameName, 794
 - calls pathnameType, 794
 - calls qcar, 794
 - calls qcdr, 794
 - calls sayKeyedMsg, 794
 - calls shut, 794
 - calls upcase, 794
 - uses \$filep, 794
 - uses \$texFormat, 794
 - uses \$texOutputFile, 794
 - uses \$texOutputStream, 794
 - defun, 794
- setStreamsCalculate, 799
 - calls bright, 799
 - calls describeSetStreamsCalculate, 799
 - calls object2String, 799
 - calls sayMessage, 799
 - calls terminateSystemCommand, 799
 - uses \$streamCount, 799
 - defun, 799
- shortenForPrinting, 889
 - calledby letPrint, 883
 - calls devaluate, 889
 - calls isDomainOrPackage, 889
 - defun, 889
- show, 812
 - calls showSpad2Cmd, 812
 - defun, 812
- show help page, 811

- manpage, 811
- showdatabase, 1007
 - calls getdatabase, 1007
 - defun, 1007
- showHistory
 - calledby historySpad2Cmd, 580
- showInOut, 598
 - calls assq, 598
 - calls disableHist, 598
 - calls objMode, 598
 - calls objValUnwrap, 598
 - calls readHiFi, 598
 - calls sayMSG, 598
 - calls spadPrint, 598
 - defun, 598
- showInput, 597
 - calls disableHist, 597
 - calls readHiFi, 597
 - calls sayMSG, 597
 - calls tab, 597
 - defun, 597
- showMsgPos?, 357
 - calledby getPosStL, 356
 - calls leader?, 358
 - calls msgImPr?, 357
 - uses \$erMsgToss, 358
 - defun, 357
- showSpad2Cmd, 812
 - calledby show, 812
 - calls helpSpad2Cmd, 812
 - calls member, 812
 - calls qcar, 812
 - calls reportOperations, 812
 - calls sayKeyedMsg, 812
 - uses \$InteractiveFrame, 813
 - uses \$env, 813
 - uses \$e, 813
 - uses \$options, 813
 - uses \$showOptions, 813
 - defun, 812
- shut, 980
 - calledby reportOpsFromLisplib1, 815
 - calledby reportOpsFromUnitDirectly1, 823
 - calledby sayMSG2File, 331
 - calledby setOutputAlgebra, 760
 - calledby setOutputFormula, 788
 - calledby setOutputFortran, 767
 - calledby setOutputHtml, 778
 - calledby setOutputMathml, 774
 - calledby setOutputOpenMath, 783
 - calledby setOutputTex, 794
 - calledby writeInputLines, 585
 - calledby zsystemdevelopment1, 952
 - calls is-console[9], 980
 - defun, 980
- size, 1047
 - calledby abbreviationsSpad2Cmd, 481
 - calledby getPreStL, 355
 - calledby isgenvar, 884
 - calledby makeMsgFromLine, 371
 - calledby processChPosesForOneLine, 376
 - calledby processSynonyms, 33
 - calledby substringMatch, 119
 - calledby writeInputLines, 585
 - defun, 1047
- SkipEnd?, 80
 - calledby incLude1, 82
 - calls remainder, 80
 - defvar, 80
- SkipPart?, 81
 - calledby incLude1, 82
 - calls remainder, 81
 - defvar, 81
- Skipping?, 81
 - calledby incLude1, 81
 - calls KeepPart?, 81
 - defvar, 81
- sockGetInt
 - calledby queryClients, 508
 - calledby serverReadLine, 44
- sockGetString
 - calledby executeQuietCommand, 47
 - calledby serverReadLine, 44
- sockSendInt
 - calledby close, 508
 - calledby queryClients, 508
 - calledby serverReadLine, 44
- sockSendString
 - calledby serverReadLine, 44
- sortBy
 - calledby workfilesSpad2Cmd, 947
- SPACE, 105

- defvar, 105
- spad, 20
 - calledby restart, 18
 - calls runspad, 20
 - calls setOutputAlgebra, 20
 - uses \$PrintCompilerMessageIfTrue, 20
 - defun, 20
- spad-error-loc, 968
 - calledby spad-long-error, 967
 - defun, 968
- spad-long-error, 967
 - calledby spad-syntax-error, 967
 - calls iostat, 967
 - calls spad-error-loc, 967
 - uses out-stream, 967
 - uses spaderrorstream, 967
 - defun, 967
- spad-save, 987
 - calledby savesystem, 648
 - calls save-system, 988
 - uses \$SpadServer, 988
 - uses \$openServerIfTrue, 988
 - defun, 987
- spad-short-error, 968
 - calledby spad-syntax-error, 967
 - calls line-past-end-p, 968
 - calls line-print, 968
 - uses \$current-line, 968
 - defun, 968
- spad-syntax-error, 967
 - calls bumperrorcount, 967
 - calls consoleinputp, 967
 - calls ioclear, 967
 - calls spad-long-error, 967
 - calls spad-short-error, 967
 - uses debugmode, 967
 - defun, 967
 - throws, 967
- spad2BootCoerce, 1059
 - defun, 1059
- spadcall
 - calledby basicLookupCheckDefaults, 1072
 - calledby basicLookup, 1069
 - calledby clearCmdSortedCaches, 499
 - calledby letPrint3, 886
 - calledby lookupInDomainVector, 1071
- spadClosure?, 609
 - calledby writify, writifyInner, 605
 - calls bpiname, 609
 - calls qcar, 609
 - calls qcdr, 609
 - calls vecp, 609
 - defun, 609
- spadConstant, 1149
 - defmacro, 1149
- spaddifference
 - calledby changeHistListLen, 587
 - calledby charDigitVal, 615
 - calledby dewritify, dewritifyInner, 610
 - calledby displaySetVariableSettings, 655
 - calledby fetchOutput, 598
 - calledby getAliasIfTracedMapParameter, 887
 - calledby removeUndoLines, 932
 - calledby undoCount, 927
 - calledby undoInCore, 590
 - calledby undoSteps, 928
 - calledby undo, 920
 - calledby writeInputLines, 585
- spaderrorstream
 - usedby init-boot/spad-reader, 966
 - usedby spad-long-error, 967
- SpadInterpretStream, 27
 - calledby intloop, 26
 - calls intloopInclude, 29
 - calls intloopReadConsole, 29
 - calls mkprompt, 29
 - uses \$erMsgToss, 29
 - uses \$fn, 29
 - uses \$inclAssertions, 29
 - uses \$lastPos, 29
 - uses \$libQuiet, 29
 - uses \$ncMsgList, 29
 - uses \$newcompErrorCount, 29
 - uses \$nopus, 29
 - uses \$okToExecuteMachineCode, 29
 - uses \$promptMsg, 29
 - uses \$systemCommandFunction, 29
 - defun, 27
- spadPrint
 - calledby showInOut, 598
- spadReply, 893

- calledby spadTrace, 875
- calledby spadUntrace, 894
- calls exit, 893
- calls seq, 893
- calls spadReply,printName, 893
- uses /tracenames, 893
- defun, 893
- spadReply,printName, 892
 - calledby spadReply, 893
 - calls devaluate, 892
 - calls exit, 892
 - calls isDomainOrPackage, 892
 - calls qcar, 892
 - calls seq, 892
 - defun, 892
- SPADRREAD
 - calls dewritify, 603
 - calls rread, 603
- spadrread, 603
 - calledby readHiFi, 599
 - defun, 603
- spadrwrite, 603
 - calledby setHistoryCore, 583
 - calledby writeHiFi, 600
 - calls spadwrite0, 603
 - calls throwKeyedMsg, 603
 - defun, 603
- spadrwrite0, 602
 - calledby saveHistory, 593
 - calledby spadwrite, 603
 - calls rwrite, 602
 - calls safeWritify, 602
 - defun, 602
- spadStartUpMsgs, 19
 - calledby restart, 17
 - calls fillerSpaces, 19
 - calls sayKeyedMsg, 19
 - calls sayMSG, 19
 - calls specialChar, 19
 - uses *build-version*, 19
 - uses *yearweek*, 19
 - uses \$linelength, 19
 - uses \$msgAlist, 19
 - uses \$opSysName, 19
 - defun, 19
- spadsysnamep
 - calledby coerceTraceArgs2E, 862
 - calledby coerceTraceFunValue2E, 865
- spadThrow
 - calledby pf2Sex1, 301
 - calledby tersyscommand, 450
 - calledby throwEvalTypeMsg, 917
- spadTrace, 874
 - calledby traceDomainConstructor, 879
 - calls aldorTrace, 874
 - calls as-insert, 874
 - calls assoc, 874
 - calls bpiname, 875
 - calls bpitrace, 875
 - calls constructSubst, 875
 - calls exit, 874
 - calls flattenOperationAlist, 874
 - calls getOperationAlistFromLisplib, 874
 - calls getOption, 874
 - calls isDomainOrPackage, 874
 - calls kdr, 874
 - calls opOf, 874
 - calls printDashedLine, 875
 - calls refvecp, 874
 - calls removeOption, 874
 - calls reportSpadTrace, 875
 - calls rplac, 875
 - calls seq, 874
 - calls setletprintflag, 875
 - calls spadReply, 875
 - calls spadTrace,g, 874
 - calls spadTrace,isTraceable, 874
 - calls spadTraceAlias, 875
 - calls subTypes, 875
 - calls userError, 874
 - uses /tracenames, 875
 - uses \$fromSpadTrace, 875
 - uses \$letAssoc, 875
 - uses \$reportSpadTrace, 875
 - uses \$traceNoisely, 875
 - uses \$tracedModemap, 875
 - defun, 874
- spadTrace,g, 873
 - calledby spadTrace, 874
 - defun, 873
- spadTrace,isTraceable, 873
 - calledby spadTrace, 874

- calls bpiname, 874
- calls exit, 874
- calls gensymp, 874
- calls reportSpadTrace, 874
- calls seq, 873
- defun, 873
- spadTraceAlias, 889
 - calledby spadTrace, 875
 - calls internl, 889
 - defun, 889
- spadUntrace, 893
 - calls assoc, 893
 - calls bpiname, 894
 - calls bpiuntrace, 894
 - calls bright, 894
 - calls delasc, 894
 - calls devaluate, 893
 - calls exit, 894
 - calls getOption, 893
 - calls isDomainOrPackage, 893
 - calls prefix2String, 894
 - calls remover, 894
 - calls rplac, 894
 - calls sayMSG, 893
 - calls seq, 894
 - calls setletprintf, 894
 - calls spadReply, 894
 - calls userError, 893
 - uses /tracenames, 894
 - uses \$letAssoc, 894
 - defun, 893
- specialChar, 978
 - calledby displayOperationsFromLisplib, 818
 - calledby displaySetOptionInformation, 653
 - calledby displaySetVariableSettings, 655
 - calledby filterAndFormatConstructors, 942
 - calledby printSynonyms, 472
 - calledby reportOpsFromLisplib, 816
 - calledby reportOpsFromUnitDirectly, 820
 - calledby setExposeAddConstr, 698
 - calledby setExposeAddGroup, 697
 - calledby setExposeAdd, 695
 - calledby setExposeDropConstr, 701
 - calledby setExposeDropGroup, 700
 - calledby setExposeDrop, 699
 - calledby setOutputCharacters, 764
 - calledby spadStartUpMsgs, 19
 - calledby whatCommands, 940
 - calledby workfilesSpad2Cmd, 947
 - calls assq, 978
 - calls ifcdr, 978
 - uses \$specialCharacterAlist, 978
 - uses \$specialCharacters, 978
 - defun, 978
- spleI, 122
 - calledby scanExponent, 126
 - calledby scanNumber, 132
 - calledby scanPossFloat, 121
 - calls spleI1, 122
 - defun, 122
- spleI1, 122
 - calledby scanNumber, 132
 - calledby spleI, 122
 - calledby spleI, 122
 - calls concat, 122
 - calls qenum, 122
 - calls scanEsc, 122
 - calls spleI1, 122
 - calls substring, 122
 - uses \$ln, 122
 - uses \$n, 123
 - uses \$sz, 123
 - defun, 122
- splitIntoOptionBlocks, 445
 - calledby doSystemCommand, 444
 - calls stripSpaces, 445
 - defun, 445
- spool help page, 825
- manpage, 825
- squeeze, 1025
 - calledby write-browsedb, 1032
 - calledby write-categorydb, 1033
 - calledby write-interpdb, 1030
 - calledby write-operationdb, 1034
 - uses *compressvector*, 1025
 - defun, 1025
- ST
 - calledby intloopInclude, 63
- stackTraceOptionError, 859
 - calledby getTraceOption, 852
 - calledby getTraceOption, 852

- calledby traceOptionError, 855
 - calledby transOnlyOption, 858
 - uses \$traceErrorStack, 859
 - defun, 859
- startsComment?, 115
 - calledby scanEsc, 124
 - calledby scanToken, 114
 - calls qenum, 115
 - uses \$ln, 115
 - uses \$n, 115
 - uses \$sz, 115
 - defun, 115
- startsId?, 1046
 - calledby scanToken, 114
 - defmacro, 1046
- startsNegComment?, 117
 - calledby scanEsc, 124
 - calledby scanToken, 114
 - calls qenum, 117
 - uses \$ln, 117
 - uses \$n, 117
 - uses \$sz, 117
 - defun, 117
- startTimingProcess
 - calledby evalDomain, 911
 - calledby loadLib, 1037
 - calledby localnrlib, 1015
 - calledby processInteractive1, 52
 - calledby recordNewValue, 589
 - calledby recordOldValue, 590
 - calledby updateHist, 587
- statisticsInitialization
 - calledby restart, 17
 - calls gbc-time, 1037
- statisticsSummary
 - calledby printStatisticsSummary, 57
- stopTimingProcess
 - calledby evalDomain, 911
 - calledby interpretTopLevel, 53
 - calledby loadLibNoUpdate, 1039
 - calledby loadLib, 1038
 - calledby processInteractive1, 52
 - calledby recordNewValue, 589
 - calledby recordOldValue, 590
 - calledby updateHist, 587
- strconc
 - calledby displayMacro, 452
 - calledby displayValue, 457
 - calledby editFile, 543
 - calledby fixObjectForPrinting, 454
 - calledby makeMsgFromLine, 371
 - calledby processChPosesForOneLine, 376
 - calledby processSynonyms, 33
 - calledby reportOpsFromLisplib, 816
 - calledby reportOpsFromUnitDirectly, 820
 - calledby whatCommands, 940
- streamChop, 72
 - calledby ncloopDQlines, 71
 - calledby streamChop, 72
 - calls StreamNull, 72
 - calls ncloopPrefix?, 72
 - calls streamChop, 72
 - defun, 72
- StreamNil, 104
 - usedby incRgen1, 104
 - defvar, 104
- StreamNull, 333
 - calledby incAppend1, 87
 - calledby incLude1, 81
 - calledby incZip1, 74
 - calledby intloopProcess, 64
 - calledby ncloopDQlines, 71
 - calledby next1, 38
 - calledby npNull, 333
 - calledby parseFromString, 48
 - calledby streamChop, 72
 - calls eqcar, 333
 - defun, 333
- string-concatenate
 - calledby concat, 1049
- string2id-n
 - calledby close, 509
 - calledby historySpad2Cmd, 580
 - calledby importFromFrame, 561
 - calledby listConstructorAbbreviations, 482
 - calledby processSynonyms, 33
 - calledby quitSpad2Cmd, 636
 - calledby synonymsForUserLevel, 831
 - calledby yesanswer, 535
- string2pint-n
 - calledby getAliasIfTracedMapParameter, 887

- string2Words
 - calledby segmentKeyedMsg, 330
- STRINGCHAR, 105
 - defvar, 105
- stringimage
 - calledby constructSubst, 434
- stringMatches?, 1084
 - calls basicMatch?, 1084
 - defun, 1084
- stringp
 - calledby porigin, 88
- stringPrefix?
 - calledby clearCmdExcept, 502
 - calledby hasOption, 449
 - calledby removeUndoLines, 931
 - calledby selectOption, 477
 - calledby undo, 920
- stringSpaces
 - calledby getFirstWord, 467
- StringToDir, 1084
 - calledby fnameMake, 1084
 - calls lastc, 1084
 - defun, 1084
- stripLisp, 469
 - calledby handleNoParseCommands, 468
 - defun, 469
- stripSpaces, 469
 - calledby dumbTokenize, 465
 - calledby handleNoParseCommands, 468
 - calledby parseSystemCmd, 467
 - calledby splitIntoOptionBlocks, 445
 - defun, 469
- strpos, 1047
 - calledby getSystemCommandLine, 831
 - calledby processSynonyms, 33
 - calledby rdigit?, 133
 - calledby satisfiesRegularExpressions, 941
 - calledby scanS, 131
 - calledby stupidIsSpadFunction, 904
 - defun, 1047
- strposl, 1048
 - calledby nextline, 112
 - calledby scanEsc, 124
 - calledby scanSpace, 129
 - defun, 1048
- stupidIsSpadFunction, 904
 - calledby breaklet, 903
 - calledby tracelet, 902
 - calls pname, 904
 - calls strpos, 904
 - defun, 904
- subCopy
 - calledby domArg2, 422
 - calledby hasAtt, 424
 - calledby hasCate, 433
 - calledby hasCaty, 420
 - calledby hasSigAnd, 425
 - calledby hasSig, 423
 - calledby replaceSharps, 956
 - calledby unifyStructVar, 429
- sublislis
 - calledby localnrlib, 1015
- subMatch, 119
 - calledby scanPunct, 118
 - calls substringMatch, 119
 - defun, 119
- subseq
 - calledby getFirstWord, 467
- substituteSegmentedMsg
 - calledby getMsgInfoFromKey, 366
 - calledby msgText, 62
 - calledby sayKeyedMsgLocal, 330
- substring
 - calledby ExecuteInterpSystemCommand, 33
 - calledby alqlGetKindString, 1083
 - calledby alqlGetOrigin, 1082
 - calledby alqlGetParams, 1082
 - calledby doSystemCommand, 444
 - calledby getAliasIfTracedMapParameter, 887
 - calledby getSystemCommandLine, 831
 - calledby incDrop, 101
 - calledby lineoftoks, 111
 - calledby mkprompt, 42
 - calledby printLabelledList, 472
 - calledby processSynonyms, 33
 - calledby removeUndoLines, 931
 - calledby scanComment, 116
 - calledby scanNegComment, 117
 - calledby scanS, 131
 - calledby scanW, 128

- calledby spleI1, 122
 - calledby writeInputLines, 585
- substringMatch, 119
 - calledby subMatch, 119
 - calls qenum, 119
 - calls size, 119
 - defun, 119
- subTypes, 864
 - calledby spadTrace, 875
 - calledby subTypes, 864
 - calls exit, 864
 - calls lassoc, 864
 - calls seq, 864
 - calls subTypes, 864
 - defun, 864
- suchthat, 406
 - syntax, 406
- summary, 828
 - calls concat, 828
 - calls getenviron, 828
 - calls obey, 828
 - defun, 828
- summary help page, 827
 - manpage, 827
- syGeneralErrorHere, 192
 - calledby npListAndRecover, 189
 - calledby npTrapForm, 212
 - calls sySpecificErrorHere, 192
 - defun, 192
- syIgnoredFromTo, 191
 - calledby npRecoverTrap, 190
 - calls FromTo, 191
 - calls From, 191
 - calls To, 191
 - calls ncSoftError, 191
 - calls pfGlobalLinePosn, 191
 - defun, 191
- synonym, 830
 - calls synonymSpad2Cmd, 830
 - defun, 830
- synonym help page, 829
 - manpage, 829
- synonymsForUserLevel, 831
 - calledby printSynonyms, 472
 - calls commandsForUserLevel, 831
 - calls selectOptionLC, 831
 - calls string2id-n, 831
 - uses \$UserLevel, 831
 - uses \$systemCommands, 831
 - defun, 831
- synonymSpad2Cmd, 830
 - calledby synonym, 830
 - calls getSystemCommandLine, 830
 - calls printSynonyms, 830
 - calls processSynonymLine, 830
 - calls putalist, 830
 - calls terminateSystemCommand, 830
 - uses \$CommandSynonymAlist, 830
 - defun, 830
- syntax
 - assignment, 383
 - blocks, 386
 - clef, 388
 - collection, 389
 - for, 391
 - if, 395
 - iterate, 397
 - leave, 398
 - parallel, 399
 - repeat, 402
 - suchthat, 406
 - while, 407
- sySpecificErrorAtToken, 192
 - calledby sySpecificErrorHere, 192
 - calls ncSoftError, 192
 - calls tokPosn, 192
 - defun, 192
- sySpecificErrorHere, 192
 - calledby syGeneralErrorHere, 192
 - calls sySpecificErrorAtToken, 192
 - uses \$stok, 192
 - defun, 192
- system help page, 835
 - manpage, 835
- systemCommand, 446
 - calledby handleParsedSystemCommands, 466
 - calledby handleTokenizeSystemCommands, 445
 - calls commandsForUserLevel, 446
 - calls helpSpad2Cmd, 446
 - calls selectOptionLC, 446

- calls selectOption, 446
 - uses \$CategoryFrame, 446
 - uses \$e, 446
 - uses \$options, 446
 - uses \$syscommands, 446
 - uses \$systemCommands, 446
 - defun, 446
- systemError
 - calledby pfDefinition2Sex, 315
 - calledby pFLambdaTran, 316
- systemErrorHere
 - calledby interpret2, 55
 - calledby reportOpsFromUnitDirectly, 820
- tab
 - calledby showInput, 597
- tabbing, 362
 - calledby getStFromMsg, 354
 - calls getMsgPrefix?, 362
 - uses \$preLength, 362
 - defun, 362
- take
 - calledby ?t, 901
- tangle help page, 837
 - manpage, 837
- terminateSystemCommand, 450
 - calledby commandAmbiguityError, 450
 - calledby commandErrorMessage, 448
 - calledby displayProperties, 460
 - calledby npProcessSynonym, 471
 - calledby setFortPers, 754
 - calledby setStreamsCalculate, 799
 - calledby synonymSpad2Cmd, 830
 - calledby userLevelErrorMessage, 449
 - calls tersyscommand, 450
 - defun, 450
- tersyscommand, 450
 - calledby library, 1013
 - calledby quitSpad2Cmd, 636
 - calledby terminateSystemCommand, 450
 - calls spadThrow, 450
 - defun, 450
- The restart function, 16
- thefname, 91
 - calledby inclmsgCannotRead, 92
 - calledby inclmsgNoSuchFile, 91
- calls pname, 91
 - defun, 91
- theid, 90
 - defun, 90
- theorigin, 88
 - defun, 88
- thisPosIsEqual, 374
 - calls poGlobalLinePosn, 374
 - calls poNopos?, 374
 - defun, 374
- thisPosIsLess, 374
 - calls poGlobalLinePosn, 374
 - calls poNopos?, 374
 - defun, 374
- throwEvalTypeMsg, 917
 - calledby evaluateType1, 915
 - calledby evaluateType, 914
 - calls spadThrow, 917
 - calls throwKeyedMsg, 917
 - local ref \$noEvalTypeMsg, 917
 - defun, 917
- throwKeyedMsg
 - calledby addNewInterpreterFrame, 559
 - calledby closeInterpreterFrame, 560
 - calledby close, 508
 - calledby fetchOutput, 598
 - calledby frameSpad2Cmd, 564
 - calledby getTraceOptions, 850
 - calledby getTraceOption, 852
 - calledby importFromFrame, 561
 - calledby readSpad2Cmd, 640
 - calledby restoreHistory, 595
 - calledby saveHistory, 593
 - calledby spadwrite, 603
 - calledby throwEvalTypeMsg, 917
 - calledby trace1, 846
 - calledby transTraceItem, 861
 - calledby workfilesSpad2Cmd, 947
 - calledby writeInputLines, 585
- throwKeyedMsgCannotCoerceWithValue
 - calledby evaluateType1, 916
 - calledby interpret2, 55
- throwListOfKeyedMsgs
 - calledby getTraceOptions, 850
- throws
 - cacheKeyedMsg, 329

- fin, 546
 - intloopReadConsole, 30
 - monitor-file, 1163
 - monitor-readinterp, 1170
 - monitor-spadfile, 1172
 - ncError, 69
 - npMissing, 151
 - npTrap, 212
 - npTrapForm, 212
 - ScanOrPairVec,ScanOrInner, 613
 - spad-syntax-error, 967
 - writify,writifyInner, 605
- timedEVALFUN
 - calledby getAndEvalConstructorArgument, 956
- tmp1
 - calledby diffAlist, 923
- To, 380
 - calledby syIgnoredFromTo, 191
 - defun, 380
- toFile?, 363
 - calledby msgOutputter, 353
 - calls getMsgToWhere, 363
 - uses \$fn, 363
 - defun, 363
- tokConstruct, 411
 - calledby enPile, 340
 - calledby npDDInfKey, 208
 - calledby npDollar, 183
 - calledby npFirstTok, 143
 - calledby npId, 204
 - calledby npInfixOperator, 160
 - calledby npPrefixColon, 161
 - calledby npPushId, 209
 - calledby npSymbolVariable, 205
 - calledby pfLeaf, 247
 - calledby separatePiles, 341
 - calls ifcar, 411
 - calls ncPutQ, 411
 - calls pfNoPosition?, 411
 - defun, 411
- token-stack-show, 969
 - calledby iostat, 968
 - calls token-type, 969
 - uses current-token, 969
 - uses next-token, 969
 - uses prior-token, 969
 - uses valid-tokens, 969
 - defun, 969
- token-type
 - calledby token-stack-show, 969
- tokPart, 413
 - calledby intloopProcess, 64
 - calledby npDDInfKey, 208
 - calledby npFirstTok, 143
 - calledby npInfixOperator, 160
 - calledby npSymbolVariable, 205
 - calledby pf2Sex1, 302
 - calledby pfCopyWithPos, 236
 - calledby pfIdSymbol, 247
 - calledby pfLeafToken, 248
 - calledby pfLiteralString, 249
 - calledby pfSexpr,strip, 250
 - calledby pfSymbolSymbol, 252
 - calledby pfSymb, 251
 - calledby pileCforest, 340
 - defun, 413
- tokPosn, 413
 - calledby firstTokPosn, 341
 - calledby lastTokPosn, 341
 - calledby ncloopDQlines, 71
 - calledby npConstTok, 184
 - calledby npDDInfKey, 208
 - calledby npDollar, 183
 - calledby npFirstTok, 143
 - calledby npId, 205
 - calledby npInfixOperator, 160
 - calledby npMissingMate, 215
 - calledby npMissing, 151
 - calledby npParse, 141
 - calledby npPrefixColon, 161
 - calledby npPushId, 209
 - calledby npRecoverTrap, 190
 - calledby npSymbolVariable, 205
 - calledby npTrapForm, 212
 - calledby npTrap, 212
 - calledby pfBraceBar, 257
 - calledby pfBrace, 257
 - calledby pfBracketBar, 258
 - calledby pfBracket, 257
 - calledby pfLeafPosition, 248
 - calledby pileColumn, 337

- calledby sySpecificErrorAtToken, 192
 - calls ncAlist, 413
 - calls pfNoPosition, 413
 - calls qassq, 413
 - defun, 413
- tokTran, 465
 - calledby handleParsedSystemCommands, 466
 - calledby handleTokenSizeSystemCommands, 445
 - calledby parseSystemCmd, 467
 - calls isIntegerString, 465
 - defun, 465
- tokType, 413
 - calledby npConstTok, 184
 - calledby pilePlusComment, 336
 - calls ncTag, 413
 - defun, 413
- Top, 77
 - usedby incStream, 73
 - usedby incString, 39
 - defvar, 77
- Top?, 79
 - calledby incLude1, 81
 - calledby xIfSyntax, 96
 - calls quotient, 79
 - defvar, 79
- toplevel
 - calledby loadLibNoUpdate, 1039
- toScreen?, 351
 - calledby msgOutputter, 353
 - calls getMsgToWhere, 351
 - defun, 351
- TPDHERE
 - Beware that this function occurs with lowercase also, 165
 - Beware that this function occurs with uppercase also, 164
 - Make this more international, not EBCDIC, 978
 - Note that there is also an npADD function, 159
 - Note that there is also an npAdd function, 158
 - Remove all boot references from top level, 470
- The pform function has a leading percent sign. fix this, 66, 221, 223, 225, 229
- The variable al is undefined, 365
- This could probably be replaced by the default assoc using eql, 1052
- This function should be replaced by fillerspaces, 371
- This should probably be a macro or eliminated, 469
- Well this makes no sense., 197
- getMsgFTTag is nonsense, 378
- note that the file interp.exposed no longer exists., 1170
- rewrite this using (dolist (item seqList)...), 310
- rewrite using dsetq, 311
- trace, 845
 - calledby ltrace, 630
 - calls traceSpad2Cmd, 845
 - defun, 845
- trace help page, 839
- manpage, 839
- trace1, 846
 - calledby trace1, 846
 - calledby traceSpad2Cmd, 845
 - calls /trace,0, 846
 - calls ?t, 846
 - calls addassoc, 846
 - calls centerAndHighlight, 846
 - calls delete, 846
 - calls devaluate, 846
 - calls exit, 846
 - calls getTraceOptions, 846
 - calls getTraceOption, 846
 - calls hasOption, 846
 - calls isFunctor, 846
 - calls lassoc, 846
 - calls pcounters, 846
 - calls poundsign, 846
 - calls ptimers, 846
 - calls qcar, 846
 - calls qcdr, 846
 - calls qslessp, 846
 - calls resetCounters, 846
 - calls resetSpacers, 846

- calls resetTimers, 846
- calls saveMapSig, 846
- calls sayKeyedMsg, 846
- calls say, 846
- calls selectOptionLC, 846
- calls seq, 846
- calls throwKeyedMsg, 846
- calls trace1, 846
- calls transTraceItem, 846
- calls unabbrev, 846
- calls untraceDomainLocalOps, 846
- calls untrace, 846
- calls vecp, 846
- uses \$lastUntraced, 846
- uses \$optionAlist, 847
- uses \$options, 846
- uses \$traceNoisely, 846
- defun, 846
- traceDomainConstructor, 878
 - calls concat, 879
 - calls embed, 879
 - calls exit, 879
 - calls getOption, 878
 - calls loadFunctor, 879
 - calls mkq, 879
 - calls seq, 878
 - calls spadTrace, 879
 - calls traceDomainLocalOps, 879
 - uses \$ConstructorCache, 879
 - defun, 878
- traceDomainLocalOps, 878
 - calledby traceDomainConstructor, 879
 - calls sayMSG, 878
 - defun, 878
- tracelet, 902
 - calls bpiname, 902
 - calls compileBoot, 902
 - calls delete, 902
 - calls gensymp, 902
 - calls isgenvar, 902
 - calls lassoc, 902
 - calls setletprintf, 902
 - calls stupidIsSpadFunction, 902
 - calls union, 902
 - uses \$QuickLet, 902
 - uses \$letAssoc, 902
 - uses \$traceletFunctions, 902
 - uses \$traceletflag, 902
 - defun, 902
- traceOptionError, 855
 - calls commandAmbiguityError, 855
 - calls stackTraceOptionError, 855
 - defun, 855
- traceReply, 897
 - calledby traceSpad2Cmd, 845
 - calls abbreviate, 897
 - calls addTraceItem, 897
 - calls concat, 897
 - calls exit, 897
 - calls flowSegmentedMsg, 897
 - calls isDomainOrPackage, 897
 - calls isFunctor, 897
 - calls isSubForRedundantMapName, 897
 - calls isgenvar, 897
 - calls poundsign, 897
 - calls prefix2String, 897
 - calls qcar, 897
 - calls rassocSub, 897
 - calls sayBrightlyLength, 897
 - calls sayBrightly, 897
 - calls sayMSG, 897
 - calls sayMessage, 897
 - calls seq, 897
 - calls userError, 897
 - uses /tracenames, 898
 - uses \$constructors, 897
 - uses \$domains, 897
 - uses \$linelength, 897
 - uses \$packages, 897
 - defun, 897
- traceSpad2Cmd, 845
 - calledby trace, 845
 - calls augmentTraceNames, 845
 - calls getMapSubNames, 845
 - calls qcar, 845
 - calls qcdr, 845
 - calls trace1, 845
 - calls traceReply, 845
 - uses \$mapSubNameAlist, 845
 - defun, 845
- trademark, 521
 - defun, 521

- translateTrueFalse2YesNo, 657
 - calledby displaySetOptionInformation, 653
 - calledby displaySetVariableSettings, 655
 - defun, 657
- translateYesNo2TrueFalse, 656
 - calledby initializeSetVariables, 651
 - calledby set1, 807
 - calls member, 656
 - defun, 656
- transOnlyOption, 858
 - calledby getTraceOption, 852
 - calledby transOnlyOption, 858
 - calls qcar, 858
 - calls qcdr, 858
 - calls stackTraceOptionError, 858
 - calls transOnlyOption, 858
 - calls upcase, 858
 - defun, 858
- transTraceItem, 861
 - calledby trace1, 846
 - calledby transTraceItem, 861
 - calledby untrace, 860
 - calls constructor?, 861
 - calls devaluate, 861
 - calls domainToGenvar, 861
 - calls get, 861
 - calls member, 861
 - calls objMode, 861
 - calls objVal, 861
 - calls throwKeyedMsg, 861
 - calls transTraceItem, 861
 - calls unabbrev, 861
 - calls vecp, 861
 - uses \$doNotAddEmptyModeIfTrue, 861
 - defun, 861
- trapNumericErrors, 1074
 - defmacro, 1074
- tree
 - calledby displaySetVariableSettings, 655
 - calledby initializeSetVariables, 651
 - calledby set1, 807
- trimString
 - calledby removeUndoLines, 931
- truth-to-bit, 1064
 - defmacro, 1064
- typeIsASmallInteger
 - calledby defaultTargetFE, 437
 - calledby clearCmdParts, 503
- unabbrev
 - calledby reportOperations, 814
 - calledby setExposeAddConstr, 698
 - calledby setExposeDropConstr, 701
 - calledby trace1, 846
 - calledby transTraceItem, 861
- unabbrevAndLoad
 - calledby domainToGenvar, 859
- unAbbreviateKeyword, 467
 - calledby doSystemCommand, 444
 - calls commandsForUserLevel, 467
 - calls selectOptionLC, 467
 - calls selectOption, 467
 - uses \$currentLine, 467
 - uses \$syscommands, 467
 - uses \$systemCommands, 467
 - uses line, 468
 - defun, 467
- underbar
 - usedby writeInputLines, 585
- underDomainOf
 - calledby hasCateSpecialNew, 435
- undo, 920
 - calls identp, 920
 - calls pname, 920
 - calls qcar, 920
 - calls qcdr, 920
 - calls read, 920
 - calls spaddifference, 920
 - calls stringPrefix?, 920
 - calls undoCount, 920
 - calls undoSteps, 920
 - calls userError, 920
 - uses \$InteractiveFrame, 920
 - uses \$options, 920
 - defun, 920
- undo help page, 907
 - manpage, 907
- undoChanges, 591
 - calledby undoChanges, 591
 - calledby undoInCore, 590
 - calls boot-equal, 591

- calls putHist, 591
 - calls undoChanges, 591
 - uses \$HistList, 591
 - uses \$InteractiveFrame, 592
 - defun, 591
- undoCount, 927
 - calledby removeUndoLines, 932
 - calledby undo, 920
 - calls concat, 927
 - calls spaddifference, 927
 - calls userError, 927
 - uses \$IOindex, 927
 - defun, 927
- undoFromFile, 592
 - calls assq, 592
 - calls disableHist, 592
 - calls exit, 592
 - calls putHist, 592
 - calls readHiFi, 592
 - calls recordNewValue, 592
 - calls recordOldValue, 592
 - calls seq, 592
 - calls updateHist, 592
 - uses \$HiFiAccess, 592
 - uses \$InteractiveFrame, 592
 - defun, 592
- undoInCore, 590
 - calls assq, 591
 - calls disableHist, 591
 - calls putHist, 591
 - calls readHiFi, 591
 - calls sayKeyedMsg, 591
 - calls spaddifference, 590
 - calls undoChanges, 590
 - calls updateHist, 591
 - uses \$HiFiAccess, 591
 - uses \$HistListLen, 591
 - uses \$HistList, 591
 - uses \$IOindex, 591
 - uses \$InteractiveFrame, 591
 - defun, 590
- undoLocalModemapHack, 931
 - calledby undoSingleStep, 929
 - calls exit, 931
 - calls seq, 931
 - defun, 931
- undoSingleStep, 929
 - calledby undoSteps, 928
 - calls assq, 929
 - calls exit, 929
 - calls lassoc, 929
 - calls seq, 929
 - calls undoLocalModemapHack, 929
 - defun, 929
- undoSteps, 928
 - calledby undo, 920
 - calls copy, 928
 - calls qcar, 928
 - calls qcdr, 928
 - calls recordFrame, 928
 - calls spaddifference, 928
 - calls undoSingleStep, 928
 - calls writeInputLines, 928
 - uses \$IOindex, 928
 - uses \$InteractiveFrame, 928
 - uses \$frameRecord, 928
 - defun, 928
- unembed
 - calledby untraceDomainConstructor, 881
- unescapeStringsInForm, 62
 - calledby serverReadLine, 44
 - calledby unescapeStringsInForm, 62
 - calls unescapeStringsInForm, 62
 - uses \$funnyBacks, 62
 - uses \$funnyQuote, 62
 - defun, 62
- unifyStruct, 428
 - calledby hasAtt, 424
 - calledby hasCaty, 420
 - calledby hasSig, 423
 - calledby unifyStructVar, 429
 - calledby unifyStruct, 428
 - calls isPatternVar, 428
 - calls unifyStructVar, 428
 - calls unifyStruct, 428
 - defun, 428
- unifyStructVar, 429
 - calledby unifyStruct, 428
 - calls augmentSub, 429
 - calls canCoerce, 429
 - calls constructor?, 429
 - calls contained, 429

- calls containsVars, 429
- calls isPatternVar, 429
- calls lassoc, 429
- calls resolveTT, 429
- calls subCopy, 429
- calls unifyStruct, 429
- local def \$hope, 429
- local ref \$Coerce, 429
- local ref \$Subst, 429
- local ref \$domPvar, 429
- defun, 429
- union
 - calledby breaklet, 903
 - calledby getMapSubNames, 867
 - calledby tracelet, 902
- unionq
 - calledby getMapSubNames, 867
- unparseInputForm, 1055
 - local def \$InteractiveMode, 1055
 - local def \$formatSigAsTex, 1055
 - defun, 1055
- unsqueeze, 1026
 - calledby browseOpen, 1004
 - calledby categoryOpen, 1005
 - calledby getdatabase, 1009
 - calledby interpOpen, 1003
 - calledby operationOpen, 1006
 - uses *compressvector*, 1026
 - defun, 1026
- untrace, 860
 - calledby trace1, 846
 - calls /untrace,0, 860
 - calls copy, 860
 - calls lassocSub, 860
 - calls removeTracedMapSigs, 860
 - calls transTraceItem, 860
 - uses /tracenames, 860
 - uses \$lastUntraced, 860
 - uses \$mapSubNameAlist, 860
 - defun, 860
- untraceDomainConstructor, 881
 - calls concat, 881
 - calls delete, 881
 - calls exit, 881
 - calls seq, 881
 - calls unembed, 881
 - calls untraceDomainConstructor,keepTraced?, 881
 - uses /tracenames, 881
 - defun, 881
- untraceDomainConstructor,keepTraced?, 880
 - calledby untraceDomainConstructor, 881
 - calls /untrace,0, 880
 - calls boot-equal, 880
 - calls devaluate, 880
 - calls exit, 880
 - calls isDomainOrPackage, 880
 - calls kar, 880
 - calls qcar, 880
 - calls seq, 880
 - defun, 880
- untraceDomainLocalOps, 878
 - calledby trace1, 846
 - calls sayMSG, 878
 - defun, 878
- untraceMapSubNames, 871
 - calledby clearCmdAll, 501
 - calledby clearCmdParts, 503
 - calls /untrace,2, 871
 - calls assocright, 871
 - calls getPreviousMapSubNames, 871
 - calls setdifference, 871
 - uses \$lastUntraced, 871
 - uses \$mapSubNameAlist, 871
 - defun, 871
- unwritable?, 604
 - calls placep, 604
 - calls vecp, 604
 - defun, 604
- upcase
 - calledby close, 508
 - calledby historySpad2Cmd, 580
 - calledby importFromFrame, 561
 - calledby listConstructorAbbreviations, 482
 - calledby pathnameTypeId, 1043
 - calledby quitSpad2Cmd, 636
 - calledby readSpad2Cmd, 640
 - calledby setOutputAlgebra, 760
 - calledby setOutputFormula, 788
 - calledby setOutputFortran, 767
 - calledby setOutputHtml, 778
 - calledby setOutputMathml, 774

- calledby setOutputOpenMath, 783
- calledby setOutputTex, 794
- calledby transOnlyOption, 858
- calledby yesanswer, 535
- updateCategoryTable
 - calledby loadLib, 1037
 - calledby localnrlib, 1015
- updateCurrentInterpreterFrame, 557
 - calledby addNewInterpreterFrame, 559
 - calledby changeToNamedInterpreterFrame, 558
 - calledby clearCmdAll, 501
 - calledby clearSpad2Cmd, 498
 - calledby previousInterpreterFrame, 559
 - calledby updateHist, 587
 - calls createCurrentInterpreterFrame, 557
 - calls updateFromCurrentInterpreterFrame, 557
 - uses \$interpreterFrameRing, 557
 - defun, 557
- updateDatabase, 1017
 - calledby loadLib, 1037
 - calledby localnrlib, 1015
 - calls clearAllSlams, 1017
 - calls clearClams, 1017
 - calls constructor?, 1017
 - local ref \$forceDatabaseUpdate, 1017
 - defun, 1017
- updateFromCurrentInterpreterFrame, 556
 - calledby addNewInterpreterFrame, 559
 - calledby changeToNamedInterpreterFrame, 558
 - calledby closeInterpreterFrame, 560
 - calledby initializeInterpreterFrameRing, 553
 - calledby nextInterpreterFrame, 558
 - calledby previousInterpreterFrame, 559
 - calledby updateCurrentInterpreterFrame, 557
 - calls sayMessage, 556
 - uses \$HiFiAccess, 556
 - uses \$HistListAct, 556
 - uses \$HistListLen, 556
 - uses \$HistList, 556
 - uses \$HistRecord, 556
 - uses \$IOindex, 556
- uses \$InteractiveFrame, 556
- uses \$frameMessages, 556
- uses \$internalHistoryTable, 556
- uses \$interpreterFrameName, 556
- uses \$interpreterFrameRing, 556
- uses \$localExposureData, 556
- defun, 556
- updateHist, 587
 - calledby processInteractive, 50
 - calledby undoFromFile, 592
 - calledby undoInCore, 591
 - calls disableHist, 587
 - calls startTimingProcess, 587
 - calls stopTimingProcess, 587
 - calls updateCurrentInterpreterFrame, 587
 - calls updateInCoreHist, 587
 - calls writeHiFi, 587
 - uses \$HiFiAccess, 588
 - uses \$HistRecord, 588
 - uses \$IOindex, 587
 - uses \$currentLine, 588
 - uses \$mkTestInputStack, 588
 - defun, 587
- updateInCoreHist, 588
 - calledby restoreHistory, 595
 - calledby updateHist, 587
 - uses \$HistListAct, 588
 - uses \$HistListLen, 588
 - uses \$HistList, 588
 - defun, 588
- updateSourceFiles, 544
 - calledby editSpad2Cmd, 542
 - calledby workfilesSpad2Cmd, 947
 - calls insert, 544
 - calls makeInputFilename, 544
 - calls member, 544
 - calls pathnameName, 544
 - calls pathnameTypeId, 544
 - calls pathnameType, 544
 - calls pathname, 544
 - uses \$sourceFiles, 544
 - defun, 544
- use-fast-links
 - calledby set1, 807
- userError
 - calledby spadTrace, 874

- calledby spadUntrace, 893
 - calledby traceReply, 897
 - calledby undoCount, 927
 - calledby undo, 920
- userLevelErrorMessage, 448
 - calledby commandUserLevelError, 448
 - calledby optionUserLevelError, 448
 - calls commandAmbiguityError, 448
 - calls sayKeyedMsg, 449
 - calls terminateSystemCommand, 449
 - uses \$UserLevel, 449
 - defun, 448
- valid-tokens
 - usedby token-stack-show, 969
- validateOutputDirectory, 722
 - calledby setFortDir, 723
 - calledby setFortTmpDir, 721
 - defun, 722
- values
 - calledby clearCmdParts, 503
- vec2list, 1057
 - defun, 1057
- vecp
 - calledby ScanOrPairVec,ScanOrInner, 613
 - calledby basicLookupCheckDefaults, 1072
 - calledby basicLookup, 1070
 - calledby dewritify,dewritifyInner, 610
 - calledby spadClosure?, 609
 - calledby trace1, 846
 - calledby transTraceItem, 861
 - calledby unwritable?, 604
 - calledby writify,writifyInner, 605
- version
 - calledby zsystemdevelopment1, 952
- vmread
 - calledby dewritify,dewritifyInner, 610
- voidValue, 1056
 - defun, 1056
- warn
 - calledby getdatabase, 1009
- what, 937
 - calls whatSpad2Cmd, 937
 - defun, 937
- what help page, 935
 - manpage, 935
- whatCommands, 939
 - calledby whatSpad2Cmd, 938
 - calls blankList, 940
 - calls centerAndHighlight, 939
 - calls commandsForUserLevel, 940
 - calls filterListOfStrings, 940
 - calls sayAsManyPerLineAsPossible, 940
 - calls sayKeyedMsg, 940
 - calls sayMessage, 940
 - calls say, 940
 - calls specialChar, 940
 - calls strconc, 940
 - uses \$UserLevel, 940
 - uses \$linelength, 940
 - uses \$systemCommands, 940
 - defun, 939
- whatConstructors, 943
 - calledby filterAndFormatConstructors, 942
 - calls boot-equal, 943
 - calls exit, 943
 - calls getdatabase, 943
 - calls msort, 943
 - calls seq, 943
 - defun, 943
- whatSpad2Cmd, 938
 - calledby listConstructorAbbreviations, 483
 - calledby whatSpad2Cmd, 938
 - calledby what, 937
 - calls apropos, 938
 - calls exit, 938
 - calls filterAndFormatConstructors, 938
 - calls printSynonyms, 938
 - calls reportWhatOptions, 938
 - calls sayKeyedMsg, 938
 - calls selectOptionLC, 938
 - calls seq, 938
 - calls whatCommands, 938
 - calls whatSpad2Cmd,fixpat, 938
 - calls whatSpad2Cmd, 938
 - uses \$e, 938
 - uses \$whatOptions, 938
 - defun, 938
- whatSpad2Cmd,fixpat, 937
 - calledby whatSpad2Cmd, 938
 - calls downcase, 937

- calls qcar, 937
- defun, 937
- whichCat, 365
 - calledby setMsgForcedAttrList, 364
 - calledby setMsgUnforcedAttrList, 366
 - calls ListMember?, 365
 - uses \$attrCats, 365
 - defun, 365
- while, 407, 1041
 - defmacro, 1041
 - syntax, 407
- whileWithResult, 1042
 - defmacro, 1042
- with, 945
 - calls library, 945
 - defun, 945
- with help page, 945
 - manpage, 945
- workfiles, 947
 - calls workfilesSpad2Cmd, 947
 - defun, 947
- workfiles help page, 947
 - manpage, 947
- workfilesSpad2Cmd, 947
 - calledby workfiles, 947
 - calls centerAndHighlight, 947
 - calls delete, 947
 - calls makeInputFilename, 947
 - calls namestring, 947
 - calls pathname, 947
 - calls sayBrightly, 948
 - calls sayKeyedMsg, 947
 - calls say, 947
 - calls selectOptionLC, 947
 - calls sortby, 947
 - calls specialChar, 947
 - calls throwKeyedMsg, 947
 - calls updateSourceFiles, 947
 - uses \$linelength, 948
 - uses \$options, 948
 - uses \$sourceFiles, 948
 - defun, 947
- wrap, 1045
 - calledby wrap, 1045
 - calls lotsof, 1045
 - calls wrap, 1045
- defun, 1045
- write-browsedb, 1032
 - calledby make-databases, 1018
 - calls allConstructors, 1032
 - calls squeeze, 1032
 - uses *print-pretty*, 1032
 - uses *sourcefiles*, 1032
 - uses \$spadroot, 1032
 - defun, 1032
- write-categorydb, 1033
 - calledby make-databases, 1018
 - calls genCategoryTable, 1033
 - calls squeeze, 1033
 - uses *hasCategory-hash*, 1033
 - uses *print-pretty*, 1033
 - defun, 1033
- write-compress, 1024
 - calledby make-databases, 1018
 - calls allConstructors, 1024
 - calls allOperations, 1024
 - uses *attributes*, 1024
 - uses *compress-stream*, 1024
 - uses *compressVectorLength*, 1024
 - defun, 1024
- write-interpdb, 1030
 - calledby make-databases, 1018
 - calls squeeze, 1030
 - uses *ancestors-hash*, 1030
 - uses *print-pretty*, 1030
 - uses \$spadroot, 1030
 - defun, 1030
- write-operationdb, 1034
 - calledby make-databases, 1018
 - calls squeeze, 1034
 - uses *operation-hash*, 1034
 - defun, 1034
- write-warndata, 1035
 - calledby make-databases, 1018
 - uses \$topicHash, 1035
 - defun, 1035
- writeablep
 - calledby myWritable?, 1086
- writeHiFi, 600
 - calledby updateHist, 587
 - calls histFileName, 600
 - calls object2Identifier, 600

- calls rdefiostream, 600
- calls rshut, 600
- calls spadrrwrite, 600
- uses \$HistRecord, 600
- uses \$IOindex, 600
- uses \$currentLine, 600
- uses \$internalHistoryTable, 600
- uses \$useInternalHistoryTable, 600
- defun, 600
- writeHistModesAndValues, 601
 - calledby processInteractive, 50
 - calls get, 601
 - calls putHist, 601
 - uses \$InteractiveFrame, 601
 - defun, 601
- writeInputLines, 585
 - calledby historySpad2Cmd, 580
 - calledby saveHistory, 593
 - calledby undoSteps, 928
 - calls concat, 585
 - calls defiostream, 585
 - calls histFileErase, 585
 - calls histInputFileName, 585
 - calls namestring, 585
 - calls readHiFi, 585
 - calls sayKeyedMsg, 585
 - calls shut, 585
 - calls size, 585
 - calls spaddifference, 585
 - calls substring, 585
 - calls throwKeyedMsg, 585
 - uses \$HiFiAccess, 585
 - uses \$IOindex, 585
 - uses underbar, 585
 - defun, 585
- writeLib1
 - calledby saveDependentsHashTable, 1021
 - calledby saveUsersHashTable, 1022
- writify, 608
 - calledby safeWritify, 605
 - calls ScanOrPairVec, 608
 - calls function, 608
 - calls writify,writifyInner, 608
 - uses \$seen, 608
 - uses \$writifyComplained, 608
 - defun, 608
- writify,writifyInner, 605
 - calledby writify,writifyInner, 605
 - calledby writify, 608
 - calls boot-equal, 605
 - calls constructor?, 605
 - calls devaluate, 605
 - calls exit, 605
 - calls hashtable-class, 605
 - calls hget, 605
 - calls hkeys, 605
 - calls hput, 605
 - calls isDomainOrPackage, 605
 - calls mkEvaluable, 605
 - calls placep, 605
 - calls qcar, 605
 - calls qcdr, 605
 - calls qrplaca, 605
 - calls qrplacd, 605
 - calls qsetvelt, 605
 - calls qvelt, 605
 - calls qvmaxindex, 605
 - calls seq, 605
 - calls spadClosure?, 605
 - calls vecp, 605
 - calls writify,writifyInner, 605
 - uses \$NonNullStream, 605
 - uses \$NullStream, 605
 - uses \$seen, 605
 - defun, 605
 - throws, 605
- writifyComplain, 604
 - calls sayKeyedMsg, 604
 - uses \$writifyComplained, 604
 - defun, 604
- xlCannotRead, 91
 - calledby incLude1, 81
 - calls inclmsgCannotRead, 91
 - calls xlMsg, 91
 - defun, 91
- xlCmdBug, 98
 - calledby incLude1, 82
 - calls inclmsgCmdBug, 98
 - calls xlMsg, 98
 - defun, 98
- xlConActive, 93

- calledby incLude1, 82
- calls inclmsgConActive, 93
- calls xIMsg, 93
- defun, 93
- xIConsole, 94
 - calledby incLude1, 82
 - calls inclmsgConsole, 94
 - calls xIMsg, 94
 - defun, 94
- xIConStill, 94
 - calledby incLude1, 82
 - calls inclmsgConStill, 94
 - calls xIMsg, 94
 - defun, 94
- xIFileCycle, 92
 - calledby incLude1, 81
 - calls inclmsgFileCycle, 92
 - calls xIMsg, 92
 - defun, 92
- xIIfBug, 97
 - calledby incLude1, 82
 - calls inclmsgIfBug, 97
 - calls xIMsg, 97
 - defun, 97
- xIIfSyntax, 96
 - calledby incLude1, 82
 - calls Else?, 96
 - calls Top?, 96
 - calls inclmsgIfSyntax, 96
 - calls xIMsg, 96
 - defun, 96
- xIMsg, 86
 - calledby xICannotRead, 91
 - calledby xICmdBug, 98
 - calledby xIConActive, 93
 - calledby xIConStill, 94
 - calledby xIConsole, 94
 - calledby xIFileCycle, 92
 - calledby xIIfBug, 97
 - calledby xIIfSyntax, 96
 - calledby xINoSuchFile, 90
 - calledby xIPrematureEOF, 86
 - calledby xIPrematureFin, 95
 - calledby xISay, 89
 - calledby xISkippingFin, 95
 - calls incLine, 86
 - defun, 86
- xINoSuchFile, 90
 - calledby incLude1, 81
 - calls inclmsgNoSuchFile, 90
 - calls xIMsg, 90
 - defun, 90
- xIOK, 86
 - calledby incLude1, 81
 - calls lxOK1, 86
 - defun, 86
- xIOK1, 86
 - calledby incLude1, 81
 - calls incLine1, 86
 - defun, 86
- xIPrematureEOF, 86
 - calledby incLude1, 81
 - calls inclmsgPrematureEOF, 86
 - calls xIMsg, 86
 - defun, 86
- xIPrematureFin, 95
 - calledby incLude1, 82
 - calls inclmsgPrematureFin, 95
 - calls xIMsg, 95
 - defun, 95
- xISay, 89
 - calledby incLude1, 81
 - calls inclmsgSay, 90
 - calls xIMsg, 89
 - defun, 89
- xISkip, 89
 - calledby incLude1, 81
 - calls CONCAT, 89
 - calls incLine, 89
 - defun, 89
- xISkippingFin, 95
 - calledby incLude1, 82
 - calls inclmsgFinSkipped, 95
 - calls xIMsg, 95
 - defun, 95
- xtokenreader, 966
 - usedby init-boot/spad-reader, 966
 - defvar, 966
- yesanswer, 535
 - calledby displayOperations, 535
 - calls queryUserKeyedMsg, 535

- calls string2id-n, 535
- calls upcase, 535
- defun, 535
- zeroOneTran, 68
 - calledby intInterpretPform, 67
 - calls nsubst, 68
 - defun, 68
- zsystemdevelopment, 951
 - calls zsystemDevelopmentSpad2Cmd, 951
 - defun, 951
- zsystemdevelopment help page, 951
 - manpage, 951
- zsystemdevelopment1, 952
 - calledby zsystemDevelopmentSpad2Cmd, 951
 - calls /D,1, 952
 - calls /comp, 952
 - calls bright, 952
 - calls defiostream, 952
 - calls kaddr, 952
 - calls kadr, 952
 - calls kar, 952
 - calls next, 952
 - calls sayBrightly, 952
 - calls sayMessage, 952
 - calls selectOptionLC, 952
 - calls shut, 952
 - calls version, 952
 - uses /version, 952
 - uses /wsname, 952
 - uses \$InteractiveMode, 952
 - uses \$options, 952
 - catches, 952
 - defun, 952
- zsystemDevelopmentSpad2Cmd, 951
 - calledby zsystemdevelopment, 951
 - calls zsystemdevelopment1, 951
 - uses \$InteractiveMode, 951
 - defun, 951