

Contents

Volume	0:	<i>Axiom Jenks and Sutor</i>
Volume	1:	<i>Axiom Tutorial</i>
Volume	2:	<i>Axiom Users Guide</i>
Volume	3:	<i>Axiom Programmers Guide</i>
Volume	4:	<i>Axiom Developers Guide</i>
Volume	5:	<i>Axiom Interpreter</i>
Volume	6:	<i>Axiom Command</i>
Volume	7:	<i>Axiom Hyperdoc</i>
Volume	7.1:	<i>Axiom Hyperdoc Pages</i>
Volume	8:	<i>Axiom Graphics</i>
Volume	8.1:	<i>Axiom Gallery</i>
Volume	9:	<i>Axiom Compiler</i>
Volume	10:	<i>Axiom Algebra: Implementation</i>
Volume	10.1:	<i>Axiom Algebra: Theory</i>
Volume	10.2:	<i>Axiom Algebra: Categories</i>
Volume	10.3:	<i>Axiom Algebra: Domains</i>
Volume	10.4:	<i>Axiom Algebra: Packages</i>
Volume	10.5:	<i>Axiom Algebra: Numerics</i>
Volume	11:	<i>Axiom Browser</i>
Volume	12:	<i>Axiom Crystal</i>
Volume	13:	<i>Axiom Proving Axiom Correct</i>
Bibliography:		<i>Axiom Bibliography</i>

Volume 0: Axiom Jenks and Sutor

Contributors	6
Introduction to Axiom	1
Symbolic Computation	1
Numeric Computation	2
Graphics	3
HyperDoc	4
Interactive Programming	5
Data Structures	6
Mathematical Structures	7
Pattern Matching	8
Polymorphic Algorithms	9
Extensibility	10
A Technical Introduction to Axiom	13
1.1 Types are Defined by Abstract Datatype Programs	13
1.2 The Type of Basic Objects is a Domain or Subdomain	14
1.3 Domains Have Types Called Categories	14
1.4 Operations Can Refer To Abstract Types	14
1.5 Categories Form Hierarchies	15
1.6 Domains Belong to Categories by Assertion	15
1.7 Packages Are Clusters of Polymorphic Operations	16
1.8 The Interpreter Builds Domains Dynamically	16
1.9 Axiom Code is Compiled	17
1.10 Axiom is Extensible	17
1.11 Using Axiom as a Pocket Calculator	18
Basic Arithmetic	18
Type Conversion	20
Useful Functions	21
1.12 Using Axiom as a Symbolic Calculator	25
Expressions Involving Symbols	25
Complex Numbers	26
Number Representations	28
Modular Arithmetic	32
1.13 General Points about Axiom	33
Computation Without Output	33
Accessing Earlier Results	33
Splitting Expressions Over Several Lines	33
Comments and Descriptions	34
Control of Result Types	34
1.14 Data Structures in Axiom	36
Lists	36
Segmented Lists	44

Streams	45
Arrays, Vectors, Strings, and Bits	47
Flexible Arrays	50
1.15 Functions, Choices, and Loops	52
Reading Code from a File	52
Blocks	52
Functions	56
Choices	59
Loops	60
1 An Overview of Axiom	1
1.1 Starting Up and Winding Down	1
Clef	2
1.2 Typographic Conventions	3
1.3 The Axiom Language	3
Arithmetic Expressions	4
Previous Results	4
Some Types	5
Symbols, Variables, Assignments, and Declarations	6
Conversion	9
Calling Functions	10
Some Predefined Macros	11
Long Lines	11
Comments	12
1.4 Numbers	12
1.5 Data Structures	20
1.6 Expanding to Higher Dimensions	27
1.7 Writing Your Own Functions	29
1.8 Polynomials	35
1.9 Limits	36
1.10 Series	38
1.11 Derivatives	40
1.12 Integration	43
1.13 Differential Equations	47
1.14 Solution of Equations	49
1.15 System Commands	51
Undo	52
1.16 Graphics	55
2 Using Types and Modes	57
2.1 The Basic Idea	57
Domain Constructors	59
2.2 Writing Types and Modes	64
Types with No Arguments	65
Types with One Argument	66
Types with More Than One Argument	67

	Modes	67
	Abbreviations	68
2.3	Declarations	69
2.4	Records	72
2.5	Unions	76
	Unions Without Selectors	76
	Unions With Selectors	80
2.6	The “Any” Domain	81
2.7	Conversion	82
2.8	Subdomains Again	85
2.9	Package Calling and Target Types	89
2.10	Resolving Types	93
2.11	Exposing Domains and Packages	94
2.12	Commands for Snooping	97
3	Using HyperDoc	101
3.1	Headings	102
3.2	Key Definitions	102
3.3	Scroll Bars	103
3.4	Input Areas	103
3.5	Radio Buttons and Toggles	104
3.6	Search Strings	104
	Logical Searches	105
3.7	Example Pages	105
3.8	X Window Resources for HyperDoc	106
4	Input Files and Output Styles	109
4.1	Input Files	109
4.2	The .axiom.input File	110
4.3	Common Features of Using Output Formats	111
4.4	Monospace Two-Dimensional Mathematical Format	112
4.5	TeX Format	113
4.6	IBM Script Formula Format	113
4.7	FORTRAN Format	114
5	Overview of Interactive Language	119
5.1	Immediate and Delayed Assignments	119
5.2	Blocks	123
5.3	if-then-else	127
5.4	Loops	129
	Compiling vs. Interpreting Loops	129
	return in Loops	129
	break in Loops	130
	break vs. => in Loop Bodies	132
	More Examples of break	132
	iterate in Loops	135

while Loops	135
for Loops	138
for i in n..m repeat	138
for i in n..m by s repeat	140
for i in n.. repeat	141
for x in l repeat	141
“Such that” Predicates	142
Parallel Iteration	143
Mixing Loop Modifiers	146
5.5 Creating Lists and Streams with Iterators	146
5.6 An Example: Streams of Primes	149
6 User-Defined Functions, Macros and Rules	153
6.1 Functions vs. Macros	153
6.2 Macros	154
6.3 Introduction to Functions	157
6.4 Declaring the Type of Functions	158
6.5 One-Line Functions	160
6.6 Declared vs. Undeclared Functions	162
6.7 Functions vs. Operations	164
6.8 Delayed Assignments vs. Functions with No Arguments	165
6.9 How Axiom Determines What Function to Use	166
6.10 Compiling vs. Interpreting	168
6.11 Piece-Wise Function Definitions	170
A Basic Example	170
Picking Up the Pieces	173
Predicates	176
6.12 Caching Previously Computed Results	178
6.13 Recurrence Relations	179
6.14 Making Functions from Objects	182
6.15 Functions Defined with Blocks	186
6.16 Free and Local Variables	189
6.17 Anonymous Functions	196
Some Examples	196
Declaring Anonymous Functions	198
6.18 Example: A Database	200
6.19 Example: A Famous Triangle	203
6.20 Example: Testing for Palindromes	206
6.21 Rules and Pattern Matching	208
7 Graphics	217
7.1 Two-Dimensional Graphics	218
Plotting Two-Dimensional Functions of One Variable	218
Plotting Two-Dimensional Parametric Plane Curves	220
Plotting Plane Algebraic Curves	223
Two-Dimensional Options	224

	Color	229
	Palette	230
	Two-Dimensional Control-Panel	232
	Operations for Two-Dimensional Graphics	234
	Addendum: Building Two-Dimensional Graphs	237
	Addendum: Appending a Graph to a Viewport Window Containing a Graph	244
7.2	Three-Dimensional Graphics	245
	Plotting Three-Dimensional Functions of Two Variables	245
	Plotting Three-Dimensional Parametric Space Curves	247
	Plotting Three-Dimensional Parametric Surfaces	248
	Axiom Images	251
	Three-Dimensional Options	260
	The makeObject Command	266
	Building Three-Dimensional Objects From Primitives	267
	Coordinate System Transformations	273
	Three-Dimensional Clipping	278
	Three-Dimensional Control-Panel	278
	Operations for Three-Dimensional Graphics	283
	Customization using .Xdefaults	286
8	Advanced Problem Solving	289
8.1	Numeric Functions	289
8.2	Polynomial Factorization	301
	Integer and Rational Number Coefficients	301
	Finite Field Coefficients	302
	Simple Algebraic Extension Field Coefficients	303
	Factoring Rational Functions	305
8.3	Manipulating Symbolic Roots of a Polynomial	305
	Using a Single Root of a Polynomial	305
	Using All Roots of a Polynomial	307
8.4	Computation of Eigenvalues and Eigenvectors	309
8.5	Solution of Linear and Polynomial Equations	312
	Solution of Systems of Linear Equations	312
	Solution of a Single Polynomial Equation	315
	Solution of Systems of Polynomial Equations	317
8.6	Limits	319
8.7	Laplace Transforms	323
8.8	Integration	324
8.9	Working with Power Series	328
	Creation of Power Series	328
	Coefficients of Power Series	331
	Power Series Arithmetic	332
	Functions on Power Series	333
	Converting to Power Series	336
	Power Series from Formulas	340
	Substituting Numerical Values in Power Series	343

Example: Bernoulli Polynomials and Sums of Powers	344
8.10 Solution of Differential Equations	348
Closed-Form Solutions of Linear Differential Equations	348
Closed-Form Solutions of Non-Linear Differential Equations	351
Power Series Solutions of Differential Equations	356
8.11 Finite Fields	358
Modular Arithmetic and Prime Fields	358
Extensions of Finite Fields	362
Irreducible Modulus Polynomial Representations	364
Cyclic Group Representations	367
Normal Basis Representations	370
Conversion Operations for Finite Fields	372
Utility Operations for Finite Fields	376
8.12 Primary Decomposition of Ideals	383
8.13 Computation of Galois Groups	386
8.14 Non-Associative Algebras and Modelling Genetic Laws	395
9 Some Examples of Domains and Packages	401
9.1 ApplicationProgramInterface	401
9.2 ArrayStack	402
9.3 AssociationList	406
9.4 BalancedBinaryTree	409
9.5 BasicOperator	411
9.6 BinaryExpansion	415
9.7 BinarySearchTree	417
9.8 CardinalNumber	419
9.9 CartesianTensor	423
9.10 Character	434
9.11 CharacterClass	437
9.12 CliffordAlgebra	439
The Complex Numbers as a Clifford Algebra	440
The Quaternion Numbers as a Clifford Algebra	441
The Exterior Algebra on a Three Space	443
The Dirac Spin Algebra	445
9.13 Complex	447
9.14 ContinuedFraction	450
9.15 CycleIndicators	457
9.16 DeRhamComplex	467
9.17 DecimalExpansion	475
9.18 Dequeue	476
9.19 DistributedMultivariatePolynomial	483
9.20 DoubleFloat	485
9.21 EqTable	488
9.22 Equation	489
9.23 EuclideanGroebnerBasisPackage	491
9.24 Exit	492

9.25	Expression	493
9.26	Factored	499
	Decomposing Factored Objects	499
	Expanding Factored Objects	501
	Arithmetic with Factored Objects	501
	Creating New Factored Objects	504
	Factored Objects with Variables	505
9.27	FactoredFunctions2	506
9.28	File	508
9.29	FileName	510
9.30	FlexibleArray	514
9.31	Float	517
	Introduction to Float	517
	Conversion Functions	518
	Output Functions	521
	An Example: Determinant of a Hilbert Matrix	523
9.32	Fraction	525
9.33	FullPartialFractionExpansion	528
9.34	GeneralDistributedMultivariatePolynomial	533
9.35	GeneralSparseTable	535
9.36	GroebnerFactorizationPackage	536
9.37	GroebnerPackage	539
9.38	Heap	539
9.39	HexadecimalExpansion	541
9.40	HomogeneousDistributedMultivariatePolynomial	543
9.41	Integer	545
	Basic Functions	545
	Primes and Factorization	551
	Some Number Theoretic Functions	552
9.42	IntegerLinearDependence	554
9.43	IntegerNumberTheoryFunctions	556
9.44	Kernel	562
9.45	KeyedAccessFile	566
9.46	LexTriangularPackage	570
9.47	LazardSetSolvingPackage	597
9.48	Library	607
9.49	LieExponentials	609
9.50	LiePolynomial	611
9.51	LinearOrdinaryDifferentialOperator	616
	Differential Operators with Series Coefficients	616
9.52	LinearOrdinaryDifferentialOperator1	621
	Differential Operators with Rational Function Coefficients	621
9.53	LinearOrdinaryDifferentialOperator2	626
	Differential Operators with Constant Coefficients	626
	Differential Operators with Matrix Coefficients Operating on Vectors	628
9.54	List	632

Creating Lists	632
Accessing List Elements	633
Changing List Elements	635
Other Functions	637
Dot, Dot	638
9.55 LyndonWord	639
9.56 Magma	643
9.57 MakeFunction	647
9.58 MappingPackage1	649
9.59 Matrix	654
Creating Matrices	655
Operations on Matrices	660
9.60 Multiset	664
9.61 MultivariatePolynomial	666
9.62 None	669
9.63 NottinghamGroup	670
9.64 Octonion	671
9.65 OneDimensionalArray	674
9.66 Operator	676
9.67 OrderedVariableList	680
9.68 OrderlyDifferentialPolynomial	681
9.69 PartialFraction	689
9.70 Permanent	692
9.71 Permutation	693
9.72 Polynomial	693
9.73 Quaternion	703
9.74 Queue	706
9.75 RadixExpansion	708
9.76 RealClosure	711
9.77 RealSolvePackage	725
9.78 RegularTriangularSet	727
9.79 RomanNumeral	742
9.80 Segment	744
9.81 SegmentBinding	746
9.82 Set	748
9.83 SingleInteger	752
9.84 SparseTable	754
9.85 SquareMatrix	756
9.86 SquareFreeRegularTriangularSet	757
9.87 Stack	763
9.88 Stream	765
9.89 String	768
9.90 StringTable	774
9.91 Symbol	775
9.92 Table	780
9.93 TextFile	784

9.94 TwoDimensionalArray	786
9.95 TwoDimensionalViewport	790
9.96 UnivariatePolynomial	800
9.97 UnivariateSkewPolynomial	808
A second example	810
A third example	811
A fourth example	812
9.98 UniversalSegment	813
9.99 Vector	815
9.100 Void	817
9.101 WuWenTsunTriangularSet	819
9.102 XPBWPolynomial	823
9.103 XPolynomial	830
9.104 XPolynomialRing	833
9.105 ZeroDimensionalSolvePackage	837
10 Interactive Programming	865
10.1 Drawing Ribbons Interactively	865
10.2 A Ribbon Program	870
10.3 Coloring and Positioning Ribbons	871
10.4 Points, Lines, and Curves	872
10.5 A Bouquet of Arrows	875
10.6 Diversion: When Things Go Wrong	876
10.7 Drawing Complex Vector Fields	876
10.8 Drawing Complex Functions	878
10.9 Functions Producing Functions	880
10.10 Automatic Newton Iteration Formulas	881
11 Packages	885
11.1 Names, Abbreviations, and File Structure	885
11.2 Syntax	886
11.3 Abstract Datatypes	887
11.4 Capsules	887
11.5 Input Files vs. Packages	888
11.6 Compiling Packages	889
11.7 Parameters	890
11.8 Conditionals	892
11.9 Testing	893
11.10 How Packages Work	895
12 Categories	899
12.1 Definitions	900
12.2 Exports	901
12.3 Documentation	901
12.4 Hierarchies	902
12.5 Membership	903

12.6 Defaults	903
12.7 Axioms	905
12.8 Correctness	905
12.9 Attributes	906
12.10Parameters	907
12.11Conditionals	908
12.12Anonymous Categories	909
13 Domains	911
13.1 Domains vs. Packages	911
13.2 Definitions	911
13.3 Category Assertions	912
13.4 A Demo	914
13.5 Browse	915
13.6 Representation	915
13.7 Multiple Representations	916
13.8 Add Domain	916
13.9 Defaults	917
13.10Origins	918
13.11Short Forms	918
13.12Example 1: Clifford Algebra	919
13.13Example 2: Building A Query Facility	920
A Little Query Language	921
The Database Constructor	922
Query Equations	924
DataLists	924
Index Cards	925
Creating a Database	925
Putting It All Together	926
Example Queries	927
14 Browse	931
14.1 The Front Page: Searching the Library	931
14.2 The Constructor Page	935
Constructor Page Buttons	937
Cross Reference	942
Views Of Constructors	945
Giving Parameters to Constructors	946
14.3 Miscellaneous Features of Browse	947
The Description Page for Operations	947
Views of Operations	949
Capitalization Convention	952

15 What's New in Axiom Version 2.0	953
15.1 Important Things to Read First	953
15.2 The NAG Library Link	953
Interpreting NAG Documentation	954
Using the Link	955
Providing values for Argument Subprograms	956
General Fortran-generation utilities in Axiom	958
Some technical information	966
15.3 Interactive Front-end and Language	967
15.4 Library	967
15.5 HyperTex	969
15.6 Documentation	969
 A Axiom System Commands	 971
A.1 Introduction	971
A.2)abbreviation	972
A.3)browse	974
A.4)cd	974
A.5)close	975
A.6)clear	975
A.7)compile	977
A.8)display	979
A.9)edit	981
A.10)fin	981
A.11)frame	982
A.12)help	983
A.13)history	984
A.14)include	986
A.15)library	986
A.16)lisp	987
A.17)regress	988
A.18)tangle	991
A.19)trace	991
A.20)pquit	992
A.21)quit	992
A.22)read	993
A.23)set	994
A.24)show	995
A.25)spool	995
A.26)synonym	996
A.27)system	997
A.28)trace	997
A.29)undo	1001
A.30)what	1002
 B Categories	 1005

<i>CONTENTS</i>	13
C Domains	1017
D Packages	1049
E Operations	1065
F Programs for Axiom Images	1189
F.1 images1.input	1189
F.2 images2.input	1190
F.3 images3.input	1190
F.4 images5.input	1190
F.5 images6.input	1191
F.6 images7.input	1192
F.7 images8.input	1193
F.8 conformal.input	1193
F.9 tknot.input	1197
F.10 ntube.input	1197
F.11 dhtri.input	1199
F.12 tetra.input	1200
F.13 antoine.input	1201
F.14 scherk.input	1202
G Glossary	1205
H License	1225

Volume 1: Axiom Tutorial

1	Axiom Features	1
1.1	Introduction to Axiom	1
	Symbolic Computation	1
	Numeric Computation	2
	Mathematical Structures	3
	HyperDoc	4
	Interactive Programming	5
	Graphics	6
	Data Structures	7
	Pattern Matching	8
	Polymorphic Algorithms	9
	Extensibility	10
	Open Source	11
2	Ten Fundamental Ideas	13
	Types are Defined by Abstract Datatype Programs	14
	The Type of Basic Objects is a Domain or Subdomain	14
	Domains Have Types Called Categories	15
	Operations Can Refer To Abstract Types	15
	Categories Form Hierarchies	15
	Domains Belong to Categories by Assertion	16
	Packages Are Clusters of Polymorphic Operations	17
	The Interpreter Builds Domains Dynamically	17
	Axiom Code is Compiled	18
	Axiom is Extensible	18
3	Starting Axiom	21
3.1	Starting Up and Winding Down	21
	Clef	22
	Typographic Conventions	22
3.2	The Axiom Language	23
	Arithmetic Expressions	23
	Previous Results	24
	Some Types	25
	Symbols, Variables, Assignments, and Declarations	26
	Conversion	28
	Calling Functions	29
	Some Predefined Macros	30
	Long Lines	31
	Comments	31
3.3	Using Axiom as a Pocket Calculator	31
	Basic Arithmetic	31
	Type Conversion	33

Useful Functions	35
3.4 Using Axiom as a Symbolic Calculator	38
Expressions Involving Symbols	38
Complex Numbers	39
Number Representations	41
Modular Arithmetic	45
3.5 General Points about Axiom	46
Computation Without Output	46
Accessing Earlier Results	47
Splitting Expressions Over Several Lines	47
Comments and Descriptions	47
Control of Result Types	48
Using system commands	49
Using undo	50
3.6 Data Structures in Axiom	53
Lists	53
Segmented Lists	61
Streams	62
Arrays, Vectors, Strings, and Bits	64
Flexible Arrays	67
3.7 Functions, Choices, and Loops	70
Reading Code from a File	70
Blocks	70
Functions	74
Choices	77
Loops	77
3.8 Numbers	87
3.9 Data Structures	95
3.10 Expanding to Higher Dimensions	102
3.11 Writing Your Own Functions	104
3.12 Polynomials	109
3.13 Limits	111
3.14 Series	113
3.15 Derivatives	115
3.16 Integration	118
3.17 Differential Equations	121
3.18 Solution of Equations	124
4 Graphics	127
Plotting 2D graphs	128
Palette	133
Two-Dimensional Control-Panel	134
Operations for Two-Dimensional Graphics	137
Building Two-Dimensional Graphs Manually	140
Appending a Graph to a Viewport Window Containing a Graph	149
Plotting 3D Graphs	150

Three-Dimensional Options	152
Three-Dimensional Control-Panel	153
Operations for Three-Dimensional Graphics	158
Customization using .Xdefaults	161
5 Using Types and Modes	163
5.1 The Basic Idea	163
Domain Constructors	165
5.2 Writing Types and Modes	170
Types with No Arguments	171
Types with One Argument	171
Types with More Than One Argument	173
Modes	173
Abbreviations	173
5.3 Declarations	175
5.4 Records	178
5.5 Unions	182
Unions Without Selectors	182
Unions With Selectors	185
5.6 The “Any” Domain	187
5.7 Conversion	188
5.8 Subdomains Again	191
5.9 Package Calling and Target Types	194
5.10 Resolving Types	198
5.11 Exposing Domains and Packages	200
5.12 Commands for Snooping	202
6 Using HyperDoc	205
6.1 Headings	206
6.2 Key Definitions	206
6.3 Scroll Bars	207
6.4 Input Areas	207
6.5 Radio Buttons and Toggles	208
6.6 Search Strings	208
Logical Searches	209
6.7 Example Pages	209
6.8 X Window Resources for HyperDoc	209
7 Input Files and Output Styles	211
7.1 Input Files	211
7.2 The .axiom.input File	212
7.3 Common Features of Using Output Formats	212
7.4 Monospace Two-Dimensional Mathematical Format	214
7.5 TeX Format	214
7.6 IBM Script Formula Format	215
7.7 FORTRAN Format	216

8	Axiom System Commands	221
8.1	Introduction	221
8.2	)abbreviation	222
8.3	)boot	224
8.4	)cd	224
8.5	)close	225
8.6	)clear	225
8.7	)compile	227
8.8	)display	229
8.9	)edit	230
8.10	)fin	231
8.11	)frame	231
8.12	)hd	233
8.13	)help	233
8.14	)history	234
8.15	)library	236
8.16	)lisp	237
8.17	)ltrace	238
8.18	)pquit	238
8.19	)quit	239
8.20	)read	239
8.21	)set	240
8.22	)show	241
8.23	)spool	242
8.24	)synonym	242
8.25	)system	243
8.26	)trace	243
8.27	)undo	247
8.28	)what	249
8.29	Makefile	250

Volume 2: Axiom Users Guide

1	Axiom and Category Theory	1
1.1	Covariance and Contravariance	1
1.2	Axiom Type Lattice	2
1.3	Terms to Understand	2
1.4	Category Definition	3
1.5	Monoids and Groups	4
2	Axiom Implementation Details	5
2.1	Makefile	5
3	Writing Spad Code	7
3.1	The Description: label and the)describe command	7

<i>CONTENTS</i>	19
-----------------	----

Volume 3: Axiom Programmers Guide

1 Details for Programmers	1
1.1 Makefile	1

Volume 4: Axiom Developers Guide

0.1	What is the purpose of the HACKPI domain?	1
0.2	How Axiom Builds	1
0.2.1	The environment variables	1
0.3	The runtime structure of Axiom	3
0.3.1	The build step	3
0.3.2	Where each output file is created	7
0.4	How Axiom Works	14
0.4.1	Input and Type Selection	14
0.4.2	A simple integral	19
0.4.3	A simple integral, expansion 1 interpreter	20
0.4.4	A simple integral, expansion 2 integrate	23
0.4.5	A simple integral, expansion 2 internalIntegrate	26
0.4.6	A simple integral, expansion 3 univariate	28
0.4.7	A simple integral, expansion 4 integrate	30
0.4.8	A simple integral, expansion 5 monomialIntegrate	32
0.4.9	A simple integral, expansion 6 HermiteIntegrate	35
0.5	Tools	38
0.5.1	svn	38
0.5.2	git	38
0.5.3	cvs	39
0.6	Common Lisps	42
0.6.1	GCL	42
0.6.2	CCL	43
0.6.3	CMU CL	43
0.6.4	Franz Lisp	44
0.6.5	Lucid Common Lisp	44
0.6.6	Symbolics Common Lisp	44
0.6.7	Golden Common Lisp	44
0.6.8	VM/LISP 370	44
0.6.9	Maclisp	44
0.7	Changing GCL versions	44
0.8	Literate Programming	47
0.8.1	Pamphlet files	47
0.8.2	noweb	48
0.9	Databases	49
0.9.1	libcheck	49
0.9.2	asq	49
0.10	Axiom internal representations	50
0.11	Spad to internal function calling	52
0.11.1	getdatabase output	52
0.12	axiom command	62
0.13	help command documentation	62
0.13.1	help documentation for algebra	62
0.13.2	Adding help documentation in Makefile	63

0.13.3	Using help documentation for regression testing	64
0.13.4	help documentation as algebra test files	64
0.14	debugsys	64
0.14.1	debugging hyperdoc	65
0.15	Understanding a compiled function	65
0.16	The axiom.input startup file	74
0.17	Where are Axiom symbols stored?	74
0.18	Translating individual boot files to common lisp	77
0.19	Directories	78
0.19.1	The mnt/linux/bin directory	78
0.19.2	The mnt/linux/doc directory	80
0.19.3	The mnt/linux/algebra directory	83
0.19.4	The mnt/linux/lib directory	84
0.19.5	The mnt/linux/lib directory	86
0.20	The)set command	86
0.20.1	The example bug	91
0.20.2	Operating system level I/O trace (strace)	108
0.21	How to make graphs in algebra books	109
0.22	Adding or Editing pages in Hyperdoc	110
0.23	Graphviz file creation	111
0.24	Adding Algebra	113
0.24.1	Adding algebra to the books	113
0.24.2	Creating a stand-alone pamphlet file	124
0.25	Makefile	125

Volume 5: Axiom Interpreter

1	The Interpreter	1
2	The Fundamental Data Structures	3
2.1	The global variables	3
	Credits	3
	defvar \$creditlist	3
	defvar \$current-directory	5
	defvar \$defaultMsgDatabaseName	6
	defvar \$directory-list	6
	defvar \$InitialModemapFrame	7
	defvar \$library-directory-list	7
	defvar \$msgDatabaseName	7
	defvar \$openServerIfTrue	8
	defvar \$relative-directory-list	8
	defvar \$relative-library-directory-list	9
	defvar \$spadroot	9
	defvar \$SpadServer	10
	defvar \$SpadServerName	10
	defvar \$IOindex	10
3	Starting Axiom	13
3.1	Variables Used	13
3.2	Data Structures	13
3.3	Functions	13
	Set the restart hook	13
	restart function (The restart function)	14
	defun Non-interactive restarts	16
	defun The startup banner messages	17
	defun Make a vector of filler characters	18
	Starts the interpreter but do not read in profiles	18
	defvar \$quitTag	18
	defun runspad	19
	defun Reset the stack limits	19
4	Handling Terminal Input	21
4.1	Streams	21
	defvar \$curinstream	21
	defvar \$curoutstream	21
	defvar \$errorinstream	21
	defvar \$erroroutstream	22
	defvar \$*eof*	22
	defvar \$*whitespace*	22
	defvar \$InteractiveMode	22

defvar \$boot	23
Top-level read-parse-eval-print loop	23
defun ncIntLoop	23
defvar \$intTopLevel	24
defvar \$intRestart	24
defun intloop	24
defvar \$ncMsgList	25
defun SpadInterpretStream	25
defvar \$promptMsg	26
defun GCL cmpnote function	26
defvar \$newcompErrorCount	26
defvar \$npos	26
4.2 The Read-Eval-Print Loop	28
defun intloopReadConsole	28
4.3 Helper Functions	29
Get the value of an environment variable	29
defvar \$intCoerceFailure	30
defvar \$intSpadReader	30
defun InterpExecuteSpadSystemCommand	30
defun ExecuteInterpSystemCommand	31
defun Handle Synonyms	31
defun Synonym File Reader	31
defun init-memory-config	32
Set spadroot to be the AXIOM shell variable	33
Does the string start with this prefix?	34
defun Interpret a line of lisp code	34
Get the current directory	34
Prepend the absolute path to a filename	35
Make the initial modemap frame	35
defun ncloopEscaped	35
defun intloopProcessString	36
defun ncloopParse	36
defun next	36
defun next1	37
defun incString	37
Call the garbage collector	37
defun reroot	38
defun setCurrentLine	40
Show the Axiom prompt	40
defvar \$frameAlist	41
defvar \$frameNumber	41
defvar \$currentFrameNum	41
defvar \$EndServerSession	42
defvar \$NeedToSignalSessionManager	42
defvar \$sockBufferLength	42
READ-LINE in an Axiom server system	42

defun protectedEVAL	45
defvar \$QuietCommand	45
defun executeQuietCommand	45
defun parseAndInterpret	46
defun parseFromString	46
defvar \$interpOnly	47
defvar \$minivectorNames	47
defvar \$domPvar	47
defun processInteractive	48
defvar \$ProcessInteractiveValue	50
defvar \$HTCompanionWindowID	50
defun processInteractive1	50
defun interpretTopLevel	51
defvar \$genValue	51
defun Type analyzes and evaluates expression x, returns object	52
defun Dispatcher for the type analysis routines	52
defun interpret2	53
defun Result Output Printing	54
defun printStatisticsSummary	56
defun printStorage	56
defun printTypeAndTime	56
defun printTypeAndTimeNormal	57
defun printTypeAndTimeSaturn	58
defun printAsTeX	59
defun sameUnionBranch	59
defun msgText	60
defun Right-justify the Type output	60
defun Destructively fix quotes in strings	61
Include a file into the stream	61
defun intloopInclude0	61
defun intloopProcess	62
defun intloopSpadProcess	63
defun intloopSpadProcess,interp	64
defun phParse	64
defun phIntReportMsgs	64
defun phInterpret	65
defun intInterpretPform	65
defun zeroOneTran	66
defun ncConversationPhase	66
defun ncConversationPhase,wrapup	66
defun ncError	67
defun intloopEchoParse	67
defun ncloopPrintLines	68
defun mkLineList	68
defun nonBlank	69
defun ncloopDQlines	70

defun poGlobalLinePosn	70
defun streamChop	70
defun ncloopInclude0	71
defun incStream	71
defun incRenumber	72
defun incZip	72
defun incZip1	72
defun inclGen	73
defun inclGen1	73
defun incRenumberLine	73
defun incRenumberItem	74
defun incHandleMessage	74
defun incLude	75
defmacro Rest	75
defvar \$Top	75
defvar \$IfSkipToEnd	75
defvar \$IfKeepPart	76
defvar \$IfSkipPart	76
defvar \$ElseifSkipToEnd	76
defvar \$ElseifKeepPart	76
defvar \$ElseifSkipPart	76
defvar \$ElseSkipToEnd	77
defvar \$ElseKeepPart	77
defvar \$Top?	77
defvar \$If?	77
defvar \$Elseif?	78
defvar \$Else?	78
defvar \$SkipEnd?	78
defvar \$KeepPart?	79
defvar \$SkipPart?	79
defvar \$Skipping?	79
defun incLude1	79
defun xlPrematureEOF	84
defun xlMsg	84
defun xlOK	84
defun xlOK1	85
defun incAppend	85
defun incAppend1	85
defun incLine	86
defun incLine1	86
defun inclmsgPrematureEOF	86
defun theorigin	86
defun porigin	87
defun ifCond	87
defun xlSkip	87
defun xlSay	88

defun inclmsgSay	88
defun theid	88
defun xlNoSuchFile	89
defun inclmsgNoSuchFile	89
defun thefname	89
defun pfname	89
defun xlCannotRead	90
defun inclmsgCannotRead	90
defun xlFileCycle	90
defun inclmsgFileCycle	90
defun xlConActive	91
defun inclmsgConActive	92
defun xlConStill	92
defun inclmsgConStill	92
defun xlConsole	92
defun inclmsgConsole	93
defun xlSkippingFin	93
defun inclmsgFinSkipped	93
defun xlPrematureFin	93
defun inclmsgPrematureFin	94
defun assertCond	94
defun xlIfSyntax	94
defun inclmsgIfSyntax	95
defun xlIfBug	95
defun inclmsgIfBug	96
defun xlCmdBug	96
defun inclmsgCmdBug	96
defvar \$incCommands	96
defvar \$pfMacros	97
defun incClassify	97
defun incCommand?	98
defun incPrefix?	99
defun incCommandTail	99
defun incDrop	100
defun inclFname	100
defun incFileInput	100
defun incConsoleInput	100
defun incNConsoles	101
defun incActive?	101
defun incRgen	101
defun Delay	102
defvar \$StreamNil	102
defun incRgen1	102

5 The Token Scanner	105
defvar \$SPACE	105
defvar \$ESCAPE	105
defvar \$STRINGCHAR	105
defvar \$PLUSCOMMENT	106
defvar \$MINUSCOMMENT	106
defvar \$RADIXCHAR	106
defvar \$DOT	106
defvar \$EXPONENT1	107
defvar \$EXPONENT2	107
defvar \$CLOSEPAREN	107
defvar \$QUESTION	107
defvar \$scanKeyWords	108
defvar \$infgeneric	110
defun lineoftoks	111
defun nextline	112
defun scanIgnoreLine	113
defun constoken	113
defun scanToken	114
defun lfid	115
defun startsComment?	115
defun scanComment	116
defun lfcomment	116
defun startsNegComment?	117
defun scanNegComment	117
defun lfnegcomment	118
defun punctuation?	118
defun scanPunct	118
defun subMatch	119
defun substringMatch	119
defun scanKeyTr	120
defun keyword	121
defun keyword?	121
defun scanPossFloat	121
defun digit?	122
defun lfkey	122
defun spleI	122
defun spleI1	122
defun scanEsc	123
defvar \$scanCloser	125
defun scanCloser?	125
defun scanWord	126
defun scanExponent	126
defun lffloat	127
defmacro idChar?	128
defun scanW	128

defun posend	129
defun scanSpace	129
defun lfspaces	130
defun scanString	130
defun lfstring	130
defun scanS	131
defun scanTransform	132
defun scanNumber	132
defun rdigit?	133
defun lfinteger	133
defun lfrinteger	134
defun scanCheckRadix	134
defun scanEscape	135
defun scanError	135
defun lferror	135
defvar \$scanKeyTable	136
defun scanKeyTableCons	136
defvar \$scanDict	137
defun scanDictCons	137
defun scanInsert	138
defvar \$scanPun	139
defun scanPunCons	139
6 Input Stream Parser	141
defun Input Stream Parser	141
defun npItem	142
defun npItem1	142
defun npFirstTok	143
defun Push one item onto \$stack	143
defun Pop one item off \$stack	144
defun Pop the second item off \$stack	144
defun Pop the third item off \$stack	144
defun npQualDef	145
defun Advance over a keyword	145
defun Advance the input stream	145
defun npComma	146
defun npTuple	146
defun npCommaBackSet	146
defun npQualifiedDefinition	147
defun npQualified	147
defun npDefinitionOrStatement	147
defun npBackTrack	148
defun npGives	148
defun npLambda	148
defun npType	149
defun npMatch	150

defun npSuch	150
defun npWith	150
defun npCompMissing	151
defun npMissing	151
defun npRestore	152
defun Peek for keyword s, no advance of token stream	152
defun npCategoryL	152
defun npCategory	153
defun npSCategory	153
defun npSignature	154
defun npSigItemlist	154
defun npListing	155
defun Always produces a list, fn is applied to it	155
defun npSigItem	156
defun npTypeVariable	156
defun npSignatureDefinee	156
defun npTypeVariablelist	157
defun npSigDecl	157
defun npPrimary	157
defun npPrimary2	158
defun npADD	158
defun npAdd	159
defun npAtom2	159
defun npInfixOperator	160
defun npInfixOp	161
defun npPrefixColon	161
defun npApplication	162
defun npDotted	162
defun npAnyNo	162
defun npSelector	163
defun npApplication2	163
defun npPrimary1	164
defun npMacro	164
defun npMdef	164
defun npMDEF	165
defun npMDEFinition	165
defun npFix	166
defun npLet	166
defun npLetQualified	166
defun npDefinition	167
defun npDefinitionItem	167
defun npTyping	168
defun npDefaultItemlist	168
defun npSDefaultItem	169
defun npDefaultItem	169
defun npDefaultDecl	170

defun npStatement	170
defun npExport	171
defun npLocalItemList	171
defun npSLocalItem	172
defun npLocalItem	172
defun npLocalDecl	172
defun npLocal	173
defun npFree	173
defun npInline	174
defun npIterate	174
defun npBreak	174
defun npLoop	175
defun npIterators	175
defun npIterator	176
defun npSuchThat	176
defun Apply argument 0 or more times	177
defun npWhile	177
defun npForIn	177
defun npReturn	178
defun npVoid	179
defun npExpress	179
defun npExpress1	179
defun npConditionalStatement	180
defun npImport	180
defun npQualTypelist	180
defun npSQualTypelist	181
defun npQualType	181
defun npAndOr	181
defun npEncAp	182
defun npEncl	182
defun npAtom1	183
defun npPDefinition	183
defun npDollar	183
defun npConstTok	184
defun npBDefinition	185
defun npBracketed	185
defun npParened	185
defun npBracked	186
defun npBraced	186
defun npAngleBared	186
defun npDefn	187
defun npDef	187
defun npBPileDefinition	188
defun npPileBracketed	188
defun npPileDefinitionlist	189
defun npListAndRecover	189

defun npRecoverTrap	190
defun npMoveTo	191
defun syIgnoredFromTo	191
defun syGeneralErrorHere	192
defun sySpecificErrorHere	192
defun sySpecificErrorAtToken	192
defun npDefinitionlist	193
defun npSemiListing	193
defun npSemiBackSet	193
defun npRule	193
defun npSingleRule	194
defun npDefTail	194
defun npDefaultValue	194
defun npWConditional	195
defun npConditional	195
defun npElse	196
defun npBacksetElse	197
defun npLogical	197
defun npDisjand	197
defun npDiscrim	197
defun npQuiver	198
defun npRelation	198
defun npSynthetic	198
defun npBy	199
defun	199
defun npSegment	200
defun npArith	200
defun npSum	201
defun npTerm	201
defun npRemainder	201
defun npProduct	202
defun npPower	202
defun npAmpersandFrom	202
defun npFromdom	202
defun npFromdom1	203
defun npAmpersand	204
defun npName	204
defvar \$npTokToNames	204
defun npId	204
defun npSymbolVariable	205
defun npRightAssoc	206
defun p o p o p o p = (((p o p) o p) o p)	206
defun npInfGeneric	207
defun npDDInfKey	208
defun npInfKey	208
defun npPushId	209

defvar \$npPParg	209
defun npPP	209
defun npPPff	210
defun npPPg	210
defun npPPf	211
defun npEnclosed	211
defun npState	212
defun npTrap	212
defun npTrapForm	212
defun npVariable	213
defun npVariablelist	213
defun npVariableName	213
defun npDecl	214
defun npParenthesized	214
defun npParenthesize	215
defun npMissingMate	215
defun npExit	215
defun npPileExit	216
defun npAssign	216
defun npAssignment	217
defun npAssignVariable	217
defun npColon	217
defun npTagged	218
defun npTypedForm1	218
defun npTypified	218
defun npTypeStyle	219
defun npPretend	219
defun npColonQuery	219
defun npCoerceTo	220
defun npTypedForm	220
defun npRestrict	220
defun npListofFun	221
6.1 Macro handling	221
defun phMacro	221
defun macroExpanded	222
defun macExpand	222
defun macApplication	223
defun mac0MLambdaApply	223
defun mac0ExpandBody	224
defun mac0InfiniteExpansion	225
defun mac0InfiniteExpansion,name	226
defun mac0GetName	226
defun macId	227
defun mac0Get	228
defun macWhere	228
defun macWhere,mac	228

defun macLambda	228
defun macLambda,mac	229
defun Add appropriate definition the a Macro pform	229
defun Add a macro to the global pfMacros list	230
defun macSubstituteOuter	230
defun mac0SubstituteOuter	231
defun macLambdaParameterHandling	231
defun macSubstituteId	232
7 Pftrees	233
7.1 Abstract Syntax Trees Overview	233
7.2 Structure handlers	235
defun pfGlobalLinePosn	235
defun pfCharPosn	235
defun pfLinePosn	235
defun pfFileName	236
defun pfCopyWithPos	236
defun pfMapParts	236
defun pf0ApplicationArgs	237
defun pf0FlattenSyntacticTuple	237
defun pfSourcePosition	238
defun Convert a Sequence node to a list	238
defun pfSpread	239
defun Deconstruct nodes to lists	239
defun pfCheckMacroOut	240
defun pfCheckArg	241
defun pfCheckId	241
defun pfFlattenApp	241
defun pfCollect1?	242
defun pfCollectVariable1	242
defun pfPushMacroBody	243
defun pfSourceStok	243
defun pfTransformArg	244
defun pfTaggedToTyped1	244
defun pfSuch	244
7.3 Special Nodes	245
defun Create a Listof node	245
defun pfNothing	245
defun Is this a Nothing node?	245
7.4 Leaves	246
defun Create a Document node	246
defun Construct an Id node	246
defun Is this an Id node?	246
defun Construct an Id leaf node	246
defun Return the Id part	247
defun Construct a Leaf node	247

	defun Is this a leaf node?	247
	defun Return the token position of a leaf node	248
	defun Return the Leaf Token	248
	defun Is this a Literal node?	248
	defun Create a LiteralClass node	248
	defun Return the LiteralString	249
	defun Return the parts of a tree node	249
	defun Return the argument unchanged	249
	defun pfPushBody	249
	defun An S-expression which people can read.	250
	defun Create a human readable S-expression	250
	defun Construct a Symbol or Expression node	251
	defun Construct a Symbol leaf node	251
	defun Is this a Symbol node?	252
	defun Return the Symbol part	252
7.5	Trees	252
	defun Construct a tree node	252
	defun Construct an Add node	252
	defun Construct an And node	253
	defun pfAttribute	253
	defun Return an Application node	253
	defun Return the Arg part of an Application node	254
	defun Return the Op part of an Application node	254
	defun Is this an And node?	254
	defun Return the Left part of an And node	254
	defun Return the Right part of an And node	255
	defun Flatten a list of lists	255
	defun Is this an Application node?	255
	defun Create an Assign node	255
	defun Is this an Assign node?	256
	defun Return the parts of an LhsItem of an Assign node	256
	defun Return the LhsItem of an Assign node	256
	defun Return the RHS of an Assign node	256
	defun Construct an application node for a brace	257
	defun Construct an Application node for brace-bars	257
	defun Construct an Application node for a bracket	257
	defun Construct an Application node for bracket-bars	257
	defun Create a Break node	258
	defun Is this a Break node?	258
	defun Return the From part of a Break node	258
	defun Construct a Coerceto node	259
	defun Is this a CoerceTo node?	259
	defun Return the Expression part of a CoerceTo node	259
	defun Return the Type part of a CoerceTo node	259
	defun Return the Body of a Collect node	260
	defun Return the Iterators of a Collect node	260

defun Create a Collect node	260
defun Is this a Collect node?	260
defun pfDefinition	261
defun Return the Lhs of a Definition node	261
defun Return the Rhs of a Definition node	261
defun Is this a Definition node?	261
defun Return the parts of a Definition node	262
defun Create a Do node	262
defun Is this a Do node?	262
defun Return the Body of a Do node	262
defun Construct a Sequence node	263
defun Construct an Exit node	263
defun Is this an Exit node?	263
defun Return the Cond part of an Exit	263
defun Return the Expression part of an Exit	264
defun Create an Export node	264
defun Construct an Expression leaf node	264
defun pfFirst	264
defun Create an Application Fix node	265
defun Create a Free node	265
defun Is this a Free node?	265
defun Return the parts of the Items of a Free node	266
defun Return the Items of a Free node	266
defun Construct a ForIn node	266
defun Is this a ForIn node?	266
defun Return all the parts of the LHS of a ForIn node	267
defun Return the LHS part of a ForIn node	267
defun Return the Whole part of a ForIn node	267
defun pfFromDom	267
defun Construct a Fromdom node	268
defun Is this a Fromdom node?	268
defun Return the What part of a Fromdom node	268
defun Return the Domain part of a Fromdom node	269
defun Construct a Hide node	269
defun pfIf	269
defun Is this an If node?	269
defun Return the Cond part of an If	270
defun Return the Then part of an If	270
defun pfIfThenOnly	270
defun Return the Else part of an If	270
defun Construct an Import node	271
defun Construct an Iterate node	271
defun Is this an Iterate node?	271
defun Handle an infix application	271
defun Create an Inline node	272
defun pfLam	272

defun pfLambda	273
defun Return the Body part of a Lambda node	273
defun Return the Rets part of a Lambda node	273
defun Is this a Lambda node?	273
defun Return the Args part of a Lambda node	274
defun Return the Args of a Lambda Node	274
defun Construct a Local node	274
defun Is this a Local node?	274
defun Return the parts of Items of a Local node	275
defun Return the Items of a Local node	275
defun Construct a Loop node	275
defun pfLoop1	275
defun Is this a Loop node?	276
defun Return the Iterators of a Loop node	276
defun pf0LoopIterators	276
defun pfLp	276
defun Create a Macro node	277
defun Is this a Macro node?	277
defun Return the Lhs of a Macro node	277
defun Return the Rhs of a Macro node	277
defun Construct an MLambda node	278
defun Is this an MLambda node?	278
defun Return the Args of an MLambda	278
defun Return the parts of an MLambda argument	278
defun pfMLambdaBody	279
defun Is this a Not node?	279
defun Return the Arg part of a Not node	279
defun Construct a NoValue node	279
defun Is this a Novalue node?	280
defun Return the Expr part of a Novalue node	280
defun Construct an Or node	280
defun Is this an Or node?	280
defun Return the Left part of an Or node	281
defun Return the Right part of an Or node	281
defun Return the part of a parenthesised expression	281
defun pfPretend	281
defun Is this a Pretend node?	282
defun Return the Expression part of a Pretend node	282
defun Return the Type part of a Pretend node	282
defun Construct a QualType node	282
defun Construct a Restrict node	283
defun Is this a Restrict node?	283
defun Return the Expr part of a Restrict node	283
defun Return the Type part of a Restrict node	283
defun Construct a RetractTo node	284
defun Construct a Return node	284

defun Is this a Return node?	284
defun Return the Expr part of a Return node	284
defun pfReturnNoName	285
defun Construct a ReturnTyped node	285
defun Construct a Rule node	285
defun Return the Lhs of a Rule node	286
defun Return the Rhs of a Rule node	286
defun Is this a Rule node?	286
defun pfSecond	286
defun Construct a Sequence node	287
defun Return the Args of a Sequence node	287
defun Is this a Sequence node?	287
defun Return the parts of the Args of a Sequence node	287
defun Create a Suchthat node	288
defun Is this a SuchThat node?	288
defun Return the Cond part of a SuchThat node	288
defun Create a Tagged node	288
defun Is this a Tagged node?	289
defun Return the Expression portion of a Tagged node	289
defun Return the Tag of a Tagged node	289
defun pfTaggedToTyped	289
defun pfTweakIf	290
defun Construct a Typed node	290
defun Is this a Typed node?	291
defun Return the Type of a Typed node	291
defun Return the Id of a Typed node	291
defun Construct a Typing node	291
defun Return a Tuple node	292
defun Return a Tuple from a List	292
defun Is this a Tuple node?	292
defun Return the Parts of a Tuple node	293
defun Return the parts of a Tuple	293
defun Return a list from a Sequence node	293
defun The comment is attached to all signatutres	293
defun Construct a WDeclare node	294
defun Construct a Where node	294
defun Is this a Where node?	294
defun Return the parts of the Context of a Where node	295
defun Return the Context of a Where node	295
defun Return the Expr part of a Where node	295
defun Construct a While node	295
defun Is this a While node?	296
defun Return the Cond part of a While node	296
defun Construct a With node	296
defun Create a Wrong node	296
defun Is this a Wrong node?	297

8 Pftree to s-expression translation	299
defun Pftree to s-expression translation	299
defun Pftree to s-expression translation inner function	300
defun Convert a Literal to an S-expression	304
defun Convert a float to an S-expression	305
defun Change an Application node to an S-expression	305
defun Convert a SuchThat node to an S-expression	307
defun pfOp2Sex	308
defun pmDontQuote?	309
defun hasOptArgs?	309
defun Convert a Sequence node to an S-expression	310
defun pfSequence2Sex0	310
defun Convert a loop node to an S-expression	311
defun Change a Collect node to an S-expression	314
defun Convert a Definition node to an S-expression	315
defun Convert a Lambda node to an S-expression	316
defun pfCollectArgTran	317
defun Convert a Lambda node to an S-expression	317
defun Convert a Rule node to an S-expression	318
defun Convert the Lhs of a Rule to an S-expression	318
defun Convert the Rhs of a Rule to an S-expression	319
defun Convert a Rule predicate to an S-expression	319
defun patternVarsOf	321
defun patternVarsOf1	321
defun pvarPredTran	322
defun Convert the Lhs of a Rule node to an S-expression	322
defvar \$dotdot	323
defun Translate ops into internal symbols	323
9 Keyed Message Handling	325
defvar \$cacheMessages	326
defvar \$msgAlist	326
defvar \$testingErrorPrefix	326
defvar \$texFormatting	327
defvar \$*msghash*	327
defvar \$msgdbPrims	327
defvar \$msgdbPunct	327
defvar \$msgdbNoBlanksBeforeGroup	328
defvar \$msgdbNoBlanksAfterGroup	328
defun Fetch a message from the message database	328
defun Cache messages read from message database	328
defun getKeyedMsg	329
defun Say a message using a keyed lookup	329
defun Handle msg formatting and print to file	330
defun Break a message into words	330
defun Write a msg into spadmsg.listing file	331

defun sayMSG	331
10 Stream Utilities	333
defun npNull	333
defun StreamNull	333
11 Code Piles	335
defun insertpile	335
defun pilePlusComment	336
defun pilePlusComments	336
defun pileTree	337
defun pileColumn	337
defun pileForests	337
defun pileForest	338
defun pileForest1	338
defun eqpileTree	339
defun pileCtree	340
defun pileCforest	340
defun enPile	340
defun firstTokPosn	341
defun lastTokPosn	341
defun separatePiles	341
12 Dequeue Functions	343
defun dqUnit	343
defun dqConcat	343
defun dqAppend	344
defun dqToList	344
13 Message Handling	345
13.1 The Line Object	345
defun Line object creation	345
defun Line element 0; Extra blanks	345
defun Line element 1; String	345
defun Line element 2; Global number	346
defun Line element 2; Set Global number	346
defun Line elemnt 3; Local number	346
defun Line element 4; Place of origin	346
defun Line element 4: Is it a filename?	347
defun Line element 4: Is it a filename?	347
defun Line element 4; Get filename	347
13.2 Messages	347
defun msgCreate	347
defun getMsgPosTagOb	348
defun getMsgKey	348
defun getMsgArgL	349

defun getMsgPrefix	349
defun setMsgPrefix	349
defun getMsgText	349
defun setMsgText	349
defun getMsgPrefix?	350
defun getMsgTag	350
defun getMsgTag?	350
defun line?	351
defun leader?	351
defun toScreen?	351
defun ncSoftError	351
defun ncHardError	352
defun desiredMsg	352
defun processKeyedError	353
defun msgOutputter	353
defun listOutputter	354
defun getStFromMsg	354
defvar \$preLength	355
defun getPreStL	355
defun getPosStL	356
defun ppos	357
defun remFile	357
defun showMsgPos?	357
defvar \$imPrGuys	358
defun msgImPr?	358
defun getMsgCatAttr	358
defun getMsgPos	359
defun getMsgFTTag?	359
defun decideHowMuch	359
defun poNopos?	360
defun poPosImmediate?	360
defun poFileName	360
defun poGetLineObject	361
defun poLinePosn	361
defun listDecideHowMuch	361
defun remLine	362
defun getMsgKey?	362
defun getMsgLitSym	362
defun tabbing	362
defvar \$toWhereGuys	363
defun getMsgToWhere	363
defun toFile?	363
defun alreadyOpened?	363
defun setMsgForcedAttrList	364
defun setMsgForcedAttr	364
defvar \$attrCats	364

defun whichCat	365
defun setMsgCatlessAttr	365
defun putDatabaseStuff	365
defun getMsgInfoFromKey	366
defun setMsgUnforcedAttrList	366
defun setMsgUnforcedAttr	367
defvar \$imPrTagGuys	367
defun initImPr	367
defun initToWhere	368
defun ncBug	368
defun processMsgList	369
defun erMsgSort	369
defun erMsgCompare	370
defun compareposns	370
defun erMsgSep	370
defun makeMsgFromLine	371
defun rep	371
defun getLinePos	372
defun getLineText	372
defun queueUpErrors	372
defun thisPosIsLess	374
defun thisPosIsEqual	374
defun redundant	374
defvar \$repGuys	375
defun msgNoRep?	375
defun sameMsg?	376
defun processChPosesForOneLine	376
defun poCharPosn	377
defun makeLeaderMsg	377
defun posPointers	378
defun getMsgPos2	378
defun insertPos	379
defun putFTText	379
defun From	380
defun To	380
defun FromTo	380

14 The Interpreter Syntax 383

14.1 syntax assignment	383
14.2 syntax blocks	386
14.3 system clef	388
14.4 syntax collection	389
14.5 syntax for	391
14.6 syntax if	395
14.7 syntax iterate	397
14.8 syntax leave	398

14.9 syntax parallel	399
14.10 syntax repeat	402
14.11 syntax suchthat	406
14.12 syntax syntax	407
14.13 syntax while	407
15 Abstract Syntax Trees (ptrees)	411
defun Construct a leaf token	411
defun Return a part of a node	412
defun Compare a part of a node	412
defun pfNoPosition?	412
defun poNoPosition?	413
defun tokType	413
defun tokPart	413
defun tokPosn	413
defun pfNoPosition	414
defun poNoPosition	414
16 Attributed Structures	415
defun ncTag	415
defun ncAlist	415
defun ncEltQ	416
defun ncPutQ	416
17 Function Selection	419
defun ofCategory	419
defun isPartialMode	420
defun hasCaty	420
defun domArg	422
defun domArg2	422
defun hasSig	423
defun hasAtt	424
defun hasSigAnd	425
defun hasSigOr	426
defun hasAttSig	426
defun hasCate1	427
defun hasCatExpression	427
defun unifyStruct	428
defun unifyStructVar	429
defun containsVars	430
defun isPatternVar	431
defun containsVars1	431
defun hasCaty1	432
defun mkDomPvar	433
defun hasCate	433
defun constructSubst	434

defun hasCateSpecial	434
defun hasCateSpecialNew	436
defun defaultTargetFE	437
defun isEqualOrSubDomain	438
18 System Command Handling	441
18.1 Variables Used	443
defvar \$systemCommands	443
defvar \$syscommands	444
defvar \$noParseCommands	444
18.2 Functions	445
defun handleNoParseCommands	445
defun Handle a top level command	446
defun Split block into option block	447
defun Tokenize a system command	447
defun Handle system commands	448
defun Select commands matching this user level	448
defun No command begins with this string	449
defun No option begins with this string	449
defvar \$oldline	449
defun No command/option begins with this string	449
defun Option not available at this user level	450
defun Command not available at this user level	450
defun Command not available error message	450
defun satisfiesUserLevel	451
defun hasOption	451
defun terminateSystemCommand	452
defun Terminate a system command	452
defun commandAmbiguityError	452
defun getParserMacroNames	453
defun clearParserMacro	453
defun displayMacro	453
defun displayWorkspaceNames	454
defun getWorkspaceNames	455
defun fixObjectForPrinting	456
defun displayProperties,sayFunctionDeps	456
defun displayValue	459
defun displayType	460
defun getAndSay	461
defun displayProperties	461
defun displayParserMacro	464
defun displayCondition	465
defun interpFunctionDepAlists	465
defun displayModemap	466
defun displayMode	466
defun Split into tokens delimited by spaces	467

defun Convert string tokens to their proper type	467
defun Is the argument string an integer?	468
defun Handle parsed system commands	468
defun Parse a system command	469
defun Get first word in a string	469
defun Unabbreviate keywords in commands	469
defun The command is ambiguous error	470
defun Remove the spaces surrounding a string	471
defun Remove the lisp command prefix	471
defun Handle the)lisp command	472
defun The)boot command is no longer supported	472
defun Handle the)system command	472
defun Handle the)synonym command	473
defun Handle the synonym system command	473
defun printSynonyms	474
defun Print a list of each matching synonym	474
defvar \$tokenCommands	475
defvar \$InitialCommandSynonymAlist	476
defun Print the current version information	476
defvar \$CommandSynonymAlist	478
defun ncloopCommand	478
defun ncloopPrefix?	479
defun selectOptionLC	479
defun selectOption	479
19)abbreviations help page Command	481
19.1 abbreviations help page man page	481
19.2 Functions	483
defun abbreviations	483
defun abbreviationsSpad2Cmd	483
defun listConstructorAbbreviations	484
20)boot help page Command	487
20.1 boot help page man page	487
20.2 Functions	488
21)browse help page Command	489
21.1 browse help page man page	489
21.2 Overview	489
21.3 Browsers, MathML, and Fonts	490
21.4 The axServer/multiServ loop	491
21.5 The)browse command	492
21.6 Variables Used	493
21.7 Functions	493
21.8 The server support code	493

22)cd help page Command	495
22.1 cd help page man page	495
22.2 Variables Used	496
22.3 Functions	496
23)clear help page Command	497
23.1 clear help page man page	497
23.2 Variables Used	499
defvar \$clearOptions	499
23.3 Functions	499
defun clear	499
defvar \$clearExcept	499
defun clearSpad2Cmd	500
defun clearCmdSortedCaches	501
defun compiledLookupCheck	501
defvar \$functionTable	502
defun clearCmdCompletely	502
defun clearCmdAll	503
defun clearMacroTable	504
defun clearCmdExcept	504
defun clearCmdParts	505
24)close help page Command	509
24.1 close help page man page	509
24.2 Functions	510
defun queryClients	510
defun close	510
25)compile help page Command	513
25.1 compile help page man page	513
25.2 Functions	515
defvar \$/editfile	515
26)copyright help page Command	517
26.1 copyright help page man page	517
26.2 Functions	522
defun copyright	522
defun trademark	523
27)credits help page Command	525
27.1 credits help page man page	525
27.2 Variables Used	525
27.3 Functions	525
defun credits	525

28)describe help page Command	527
28.1 describe help page man page	527
defvar \$describeOptions	528
28.2 Functions	528
defun Print comment strings from algebra libraries	528
defun describeSpad2Cmd	528
defun cleanline	529
defun flatten	531
29)display help page Command	533
29.1 display help page man page	533
defvar \$displayOptions	535
29.2 Functions	535
defun display	535
displaySpad2Cmd	535
defun abbQuery	536
defun displayOperations	537
defun yesanswer	537
defun displayMacros	538
defun sayExample	539
defun cleanupLine	540
30)edit help page Command	543
30.1 edit help page man page	543
30.2 Functions	544
defun edit	544
defun editSpad2Cmd	544
defun Implement the)edit command	545
defun updateSourceFiles	546
31)fin help page Command	547
31.1 fin help page man page	547
defun Exit from the interpreter to lisp	548
31.2 Functions	548
32)frame help page Command	549
32.1 frame help page man page	549
32.2 Variables Used	551
Primary variables	551
Used variables	552
32.3 Data Structures	552
Frames and the Interpreter Frame Ring	552
32.4 Accessor Functions	552
0th Frame Component – frameName	552
defun frameName	552
1st Frame Component – frameInteractive	553

2nd Frame Component – frameIOIndex	553
3rd Frame Component – frameHiFiAccess	553
4th Frame Component – frameHistList	553
5th Frame Component – frameHistListLen	554
6th Frame Component – frameHistListAct	554
7th Frame Component – frameHistRecord	554
8th Frame Component – frameHistoryTable	554
9th Frame Component – frameExposureData	555
32.5 Functions	555
Initializing the Interpreter Frame Ring	555
Creating a List of all of the Frame Names	556
Get Named Frame Environment (aka Interactive)	556
Create a new, empty Interpreter Frame	556
Collecting up the Environment into a Frame	557
Update from the Current Frame	558
Find a Frame in the Frame Ring by Name	559
Update the Current Interpreter Frame	559
Move to the next Interpreter Frame in Ring	560
Change to the Named Interpreter Frame	560
Move to the previous Interpreter Frame in Ring	561
Add a New Interpreter Frame	561
Close an Interpreter Frame	562
Display the Frame Names	563
Import items from another frame	563
The top level frame command	565
The top level frame command handler	566
32.6 Frame File Messages	567
33)help help page Command	569
33.1 help help page man page	569
33.2 Functions	572
The top level help command	572
The top level help command handler	572
defun newHelpSpad2Cmd	572
34)history help page Command	575
34.1 history help page man page	575
34.2 Initialized history variables	578
defvar \$oldHistoryFileName	578
defvar \$historyFileType	579
defvar \$historyDirectory	579
defvar \$useInternalHistoryTable	579
34.3 Data Structures	579
34.4 Functions	579
defun makeHistFileName	579
defun oldHistFileName	580

defun histFileName	580
defun histInputFileName	580
defun initHist	581
defun initHistList	581
The top level history command	582
The top level history command handler	582
defun setHistoryCore	584
defvar \$underbar	586
defun writeInputLines	587
defun resetInCoreHist	588
defun changeHistListLen	589
defun updateHist	589
defun updateInCoreHist	590
defun putHist	590
defun recordNewValue	591
defun recordNewValue0	591
defun recordOldValue	592
defun recordOldValue0	592
defun undoInCore	592
defun undoChanges	593
defun undoFromFile	594
defun saveHistory	595
defun restoreHistory	597
defun setIOindex	599
defun showInput	599
defun showInOut	600
defun fetchOutput	600
Read the history file using index n	601
Write information of the current step to history file	602
Disable history if an error occurred	603
defun writeHistModesAndValues	603
34.5 Lisplib output transformations	604
defun spadwrite0	604
defun Random write to a stream	604
defun spadwrite	605
defun spadread	605
defun Random read a key from a stream	605
defun unwritable?	606
defun writifyComplain	606
defun safeWritify	606
defun writify,writifyInner	607
defun writify	610
defun spadClosure?	611
defvar \$NonNullStream	611
defvar \$NullStream	611
defun dewritify,dewritifyInner	612

defun dewritify	615
defun ScanOrPairVec,ScanOrInner	615
defun ScanOrPairVec	616
defun gensymInt	616
defun charDigitVal	617
defun histFileErase	617
34.6 History File Messages	618
35)include help page Command	621
35.1 include help page man page	621
35.2 Functions	621
defun nclloopInclude1	621
Returns the first non-blank substring of the given string	622
Open the include file and read it in	622
Return the include filename	622
Return the next token	623
36)library help page Command	625
36.1 library help page man page	625
37)lisp help page Command	627
37.1 lisp help page man page	627
37.2 Functions	628
38)load help page Command	629
38.1 load help page man page	629
defun The)load command (obsolete)	629
39)ltrace help page Command	631
39.1 ltrace help page man page	631
defun The top level)ltrace function	632
39.2 Variables Used	632
39.3 Functions	632
40)pquit help page Command	633
40.1 pquit help page man page	633
40.2 Functions	634
The top level pquit command	634
The top level pquit command handler	634
41)quit help page Command	637
41.1 quit help page man page	637
41.2 Functions	638
The top level quit command	638
The top level quit command handler	638
Leave the Axiom interpreter	639

42)read help page Command	641
42.1 read help page man page	641
defun The)read command	642
defun Implement the)read command	642
defun /read	644
43)regress help page Command	645
43.1 regress help page man page	645
44)savesystem help page Command	649
44.1 savesystem help page man page	649
defun The)savesystem command	650
45)set help page Command	651
45.1 set help page man page	651
45.2 Overview	652
45.3 Variables Used	653
45.4 Functions	653
Initialize the set variables	653
Reset the workspace variables	654
Display the set option information	655
Display the set variable settings	657
Translate options values to t or nil	658
Translate t or nil to option values	659
45.5 The list structure	659
45.6 breakmode	660
defvar \$BreakMode	661
45.7 debug	661
45.8 debug lambda type	662
defvar \$lambdatype	662
45.9 debug dalymode	662
defvar \$dalymode	663
45.10 compile	663
45.11 compile output	664
45.12 Variables Used	664
45.13 Functions	664
The set output command handler	664
Describe the set output library arguments	665
defvar \$output-library	665
Open the output library	666
45.14 compile input	666
45.15 Variables Used	667
45.16 Functions	667
The set input library command handler	667
Describe the set input library arguments	668
Add the input library to the list	668

defvar \$input-libraries	668
Drop an input library from the list	669
45.17expose	669
45.18Variables Used	670
defvar \$globalExposureGroupAlist	670
defvar \$localExposureDataDefault	696
defvar \$localExposureData	697
45.19Functions	697
The top level set expose command handler	697
The top level set expose add command handler	698
Expose a group	699
The top level set expose add constructor handler	700
The top level set expose drop handler	701
The top level set expose drop group handler	702
The top level set expose drop constructor handler	703
Display exposed groups	705
Display exposed constructors	705
Display hidden constructors	705
45.20functions	706
45.21functions cache	706
45.22Variables Used	707
defvar \$cacheAlist	707
45.23Functions	708
The top level set functions cache handler	708
defvar \$compileDontDefineFunctions	712
45.24functions recurrence	712
defvar \$compileRecurrence	712
45.25fortran	713
ints2floats	714
defvar \$fortInts2Floats	714
fortindent	715
defvar \$fortIndent	715
fortlength	715
defvar \$fortLength	716
typedecs	716
defvar \$printFortranDecs	716
defaulttype	717
defvar \$defaultFortranType	717
precision	718
defvar \$fortranPrecision	718
intrinsic	719
defvar \$useIntrinsicFunctions	719
explength	719
defvar \$maximumFortranExpressionLength	720
segment	720
defvar \$fortranSegment	720

optlevel	721
defvar \$fortranOptimizationLevel	721
startindex	722
defvar \$fortranArrayStartingIndex	722
calling	722
defvar \$fortranTmpDir	723
The top level set fortran calling tempfile handler	724
Validate the output directory	724
Describe the set fortran calling tempfile	725
defvar \$fortranDirectory	726
defun setFortDir	726
defun describeSetFortDir	727
defvar \$fortranLibraries	728
defun setLinkerArgs	728
defun describeSetLinkerArgs	729
45.26hyperdoc	729
fullscreen	730
defvar \$fullScreenSysVars	730
mathwidth	731
defvar \$historyDisplayWidth	731
45.27help	731
fullscreen	732
defvar \$useFullScreenHelp	732
45.28history	733
defvar \$HiFiAccess	733
45.29messages	734
any	735
defvar \$printAnyIfTrue	735
autoload	736
defvar \$printLoadMsgs	736
bottomup	736
defvar \$reportBottomUpFlag	737
coercion	737
defvar \$reportCoerceIfTrue	738
dropmap	738
defvar \$displayDroppedMap	738
expose	739
defvar \$giveExposureWarning	739
file	740
defvar \$printMsgsToFile	740
frame	740
defvar \$frameMessages	741
highlighting	741
defvar \$highlightAllowed	742
instant	742
defvar \$reportInstantiations	742

instead	743
defvar \$reportEachInstantiation—	743
interponly	744
defvar \$reportInterpOnly	744
naglink	744
defvar \$nagMessages	745
number	745
defvar \$displayMsgNumber	746
prompt	746
defvar \$inputPromptType	746
selection	747
set	748
defvar \$displaySetValue	748
startup	748
defvar \$displayStartMsgs	749
summary	749
defvar \$printStatsSummaryIfTrue	749
testing	750
defvar \$testingSystem	750
time	751
defvar \$printTimeIfTrue	751
type	752
defvar \$printTypeIfTrue	752
void	752
defvar \$printVoidIfTrue	753
45.30 naglink	753
host	754
defvar \$nagHost	754
defun setNagHost	755
defun describeSetNagHost	755
persistence	755
defvar \$fortPersistence	756
defun setFortPers	756
defun describeFortPersistence	757
messages	758
double	758
defvar \$nagEnforceDouble	758
45.31 output	759
abbreviate	760
defvar \$abbreviateTypes	760
algebra	761
defvar \$algebraFormat	761
defvar \$algebraOutputFile	762
defvar \$algebraOutputStream	762
defun setOutputAlgebra	763
defun describeSetOutputAlgebra	765

characters	766
defun setOutputCharacters	766
fortran	768
defvar \$fortranFormat	769
defvar \$fortranOutputFile	769
defun setOutputFortran	770
defun describeSetOutputFortran	772
fraction	773
defvar \$fractionDisplayType	773
length	774
defvar \$margin	774
defvar \$linelength	774
mathml	775
defvar \$mathmlFormat	775
defvar \$mathmlOutputFile	775
defun setOutputMathml	776
defun describeSetOutputMathml	778
html	779
defvar \$htmlFormat	780
defvar \$htmlOutputFile	780
defun setOutputHtml	781
defun describeSetOutputHtml	783
openmath	784
defvar \$openMathFormat	784
defvar \$openMathOutputFile	785
defun setOutputOpenMath	785
defun describeSetOutputOpenMath	788
script	788
defvar \$formulaFormat	789
defvar \$formulaOutputFile	789
defun setOutputFormula	790
defun describeSetOutputFormula	792
scripts	793
defvar \$linearFormatScripts	793
showeditor	794
defvar \$useEditorForShowOutput	794
tex	795
defvar \$texFormat	795
defvar \$texOutputFile	796
defun setOutputTex	796
defun describeSetOutputTex	798
45.32quit	799
defvar \$quitCommandType	800
45.33streams	800
calculate	801
defvar \$streamCount	801

defun setStreamsCalculate	801
defun describeSetStreamsCalculate	802
showall	802
defvar \$streamsShowAll	803
45.34system	803
functioncode	804
defvar \$reportCompilation	804
optimization	805
defvar \$reportOptimization	805
prettyprint	805
defvar \$prettyprint	806
45.35userlevel	806
defvar \$UserLevel	807
defvar \$setOptionNames	808
45.36Set code	808
defun set	808
defun set1	808
46)show help page Command	813
46.1 show help page man page	813
defun The)show command	814
defun The internal)show command	814
defun reportOperations	815
defun reportOpsFromLisplib0	817
defun reportOpsFromLisplib1	817
defun reportOpsFromLisplib	818
defun isExposedConstructor	820
defun displayOperationsFromLisplib	820
defun reportOpsFromUnitDirectly0	821
defun reportOpsFromUnitDirectly	821
defun getOplistForConstructorForm	824
defun getOplistWithUniqueSignatures	825
defun reportOpsFromUnitDirectly1	825
defun sayShowWarning	826
47)spool help page Command	827
47.1 spool help page man page	827
48)summary help page Command	829
48.1 summary help page man page	829
defun summary	830

49)synonym help page Command	831
49.1 synonym help page man page	831
defun The)synonym command	832
defun The)synonym command implementation	832
defun Return a sublist of applicable synonyms	833
defun Get the system command from the input line	833
defun Remove system keyword	834
defun processSynonymLine	835
50)system help page Command	837
50.1 system help page man page	837
51)tangle help page Command	839
51.1 tangle help page man page	839
52)trace help page Command	841
52.1 trace help page man page	841
The trace global variables	845
defvar \$traceNoisely	846
defvar \$reportSpadtrace	846
defvar \$optionAlist	846
defvar \$tracedMapSignatures	846
defvar \$traceOptionList	846
defun trace	847
defun traceSpad2Cmd	847
defun trace1	848
defun getTraceOptions	852
defun saveMapSig	853
defun getMapSig	853
defun getTraceOption,hn	853
defun getTraceOption	854
defun traceOptionError	857
defun resetTimers	858
defun resetSpacers	858
defun resetCounters	858
defun ptimers	859
defun pspacers	859
defun pcounters	860
defun transOnlyOption	860
defun stackTraceOptionError	861
defun removeOption	861
defun domainToGenvar	861
defun genDomainTraceName	862
defun untrace	862
defun transTraceItem	863
defun removeTracedMapSigs	864

defun coerceTraceArgs2E	864
defun coerceSpadArgs2E	865
defun subTypes	866
defun coerceTraceFunValue2E	867
defun coerceSpadFunValue2E	868
defun isListOfIdentifiers	868
defun isListOfIdentifiersOrStrings	869
defun getMapSubNames	869
defun getPreviousMapSubNames	870
defun lassocSub	871
defun rassocSub	871
defun isUncompiledMap	871
defun isInterpOnlyMap	872
defun augmentTraceNames	872
defun isSubForRedundantMapName	873
defun untraceMapSubNames	873
defun funfind,LAM	874
defmacro funfind	874
defun isDomainOrPackage	875
defun isTraceGensym	875
defun spadTrace,g	875
defun spadTrace,isTraceable	875
defun spadTrace	876
defun traceDomainLocalOps	880
defun untraceDomainLocalOps	880
defun traceDomainConstructor	880
defun untraceDomainConstructor,keepTraced?	882
defun untraceDomainConstructor	883
defun flattenOperationAlist	883
defun mapLetPrint	884
defun letPrint	885
defun Identifier beginning with a sharpsign-number?	886
defun Identifier beginning with a sharpsign?	886
defun isgenvar	886
defun letPrint2	887
defun letPrint3	888
defun getAliasIfTracedMapParameter	889
defun getBpiNameIfTracedMap	890
defun hasPair	891
defun shortenForPrinting	891
defun spadTraceAlias	891
defun getOption	892
defun reportSpadTrace	892
defun orderBySlotNumber	893
defun /tracereply	894
defun spadReply,printName	894

defun spadReply	895
defun spadUntrace	895
defun remover	897
defun prTraceNames,fn	898
defun prTraceNames	898
defvar \$constructors	899
defun traceReply	899
defun addTraceItem	902
defun ?t	902
defun tracelet	904
defun breaklet	905
defun stupidIsSpadFunction	906
defun break	906
defun compileBoot	907
53)undo help page Command	909
53.1 undo help page man page	909
53.2 Evaluation	910
defun evalDomain	913
defun mkEvalable	913
defun mkEvalableUnion	915
defun mkEvalableRecord	915
defun mkEvalableMapping	915
defun evaluateType	916
defun Eval args passed to a constructor	917
defvar \$noEvalTypeMsg	919
defun throwEvalTypeMsg	919
defun makeOrdinal	920
defun evaluateSignature	920
53.3 Data Structures	920
53.4 Functions	921
Initial Undo Variables	921
defvar \$undoFlag	921
defvar \$frameRecord	921
defvar \$previousBindings	921
defvar \$reportundo	922
defun undo	922
defun recordFrame	923
defun diffAlist	924
defun reportUndo	927
defun clearFrame	929
Undo previous n commands	929
defun undoSteps	930
defun undoSingleStep	931
defun undoLocalModemapHack	933
Remove undo lines from history write	933

54)what help page Command	937
54.1 what help page man page	937
defvar \$whatOptions	939
defun what	939
defun whatSpad2Cmd,fixpat	939
defun whatSpad2Cmd	940
defun Show keywords for)what command	941
defun The)what commands implementation	941
defun Find all names contained in a pattern	942
defun Find function of names contained in pattern	943
defun satisfiesRegularExpressions	943
defun filterAndFormatConstructors	944
defun whatConstructors	945
Display all operation names containing the fragment	945
55)with help page Command	947
55.1 with help page man page	947
defun with	947
56)workfiles help page Command	949
56.1 workfiles help page man page	949
defun workfiles	949
defun workfilesSpad2Cmd	949
57)zsystemdevelopment help page Command	953
57.1 zsystemdevelopment help page man page	953
defun zsystemdevelopment	953
defun zsystemDevelopmentSpad2Cmd	953
defun zsystemdevelopment1	954
58 Handlers for Special Forms	957
defun getAndEvalConstructorArgument	958
defun replaceSharps	958
defun isDomainValuedVariable	959
defun evalCategory	959
59 Handling input files	961
defun Handle .axiom.input file	961
defvar \$boot-line-stack	961
defvar \$in-stream	961
defvar \$out-stream	962
defvar \$file-closed	962
defvar \$echo-meta	962
defvar \$noSubsumption	962
defvar \$envHashTable	963
defun Dynamically add bindings to the environment	963

defun Fetch a property list for a symbol from CategoryFrame	964
defun Search for a binding in the environment list	964
defun Search for a binding in the current environment	964
defun searchTailEnv	965
60 File Parsing	967
defun Bind a variable in the interactive environment	967
defvar \$line-handler	967
defvar \$spad-errors	967
defvar \$xtokenreader	968
defun Initialize the spad reader	968
defun spad-syntax-error	969
defun spad-long-error	969
defun spad-short-error	970
defun spad-error-loc	970
defun iostat	970
defun next-lines-show	971
defun token-stack-show	971
defun ioclear	972
defun Set boot-line-stack to nil	972
61 Handling output	975
61.1 Special Character Tables	975
defvar \$defaultSpecialCharacters	975
defvar \$plainSpecialCharacters0	976
defvar \$plainSpecialCharacters1	976
defvar \$plainSpecialCharacters2	977
defvar \$plainSpecialCharacters3	977
defvar \$plainRTspecialCharacters	978
defvar \$RTspecialCharacters	978
defvar \$specialCharacters	979
defvar \$specialCharacterAlist	979
defun Look up a special character code for a symbol	980
62 Stream and File Handling	981
defun make-instream	981
defun make-outstream	981
defun make-appendstream	982
defun defiostream	982
defun shut	982
defun eofp	983
defun makeStream	983
defun Construct a new input file name	983
defun getDirectoryList	984
defun probeName	984
defun makeFullNamestring	985

<i>CONTENTS</i>	61
defun Replace a file by erase and rename	985
63 The Spad Server Mechanism	987
defun openserver	987
64 Axiom Build-time Functions	989
defun spad-save	989
65 Exposure Groups	991
66 Databases	993
66.1 Database structure	993
kaf File Format	993
Database Files	994
defstruct \$database	996
defvar \$*defaultdomain-list*	996
defvar \$*operation-hash*	997
defvar \$*hasCategory-hash*	997
defvar \$*miss*	997
Database streams	998
defvar \$*interp-stream*	998
defvar \$*interp-stream-stamp*	998
defvar \$*operation-stream*	998
defvar \$*operation-stream-stamp*	999
defvar \$*browse-stream*	999
defvar \$*browse-stream-stamp*	999
defvar \$*category-stream*	999
defvar \$*category-stream-stamp*	1000
defvar \$*allconstructors*	1000
defvar \$*allOperations*	1000
defun Reset all hash tables before saving system	1000
defun Preload algebra into saved system	1001
defun Open the interp database	1003
defun Open the browse database	1005
defun Open the category database	1006
defun Open the operations database	1007
defun Add operations from newly compiled code	1007
defun Show all database attributes of a constructor	1008
defun Set a value for a constructor key in the database	1009
defun Delete a value for a constructor key in the database	1009
defun Get constructor information for a database key	1010
defun The <code>)library</code> top level command	1013
defun Read a local filename and update the hash tables	1014
defun Update the database from an <code>nrllib index.kaf</code> file	1015
defun updateDatabase	1017
defun Make new databases	1018

defun saveDependentsHashTable	1022
defun saveUsersHashTable	1022
defun Construct the proper database full pathname	1023
Building the interp.daase from hash tables	1023
defun Write the interp database	1027
Building the browse.daase from hash tables	1029
defun Write the browse database	1029
Building the category.daase from hash tables	1030
defun Write the category database	1030
Building the operation.daase from hash tables	1031
defun Write the operations database	1031
Database support operations	1032
defun Data preloaded into the image at build time	1032
defun Return all constructors	1032
defun Return all operations	1033
67 System Statistics	1035
defun statisticsInitialization	1035
67.1 Lisp Library Handling	1035
defun loadLib	1035
defun isSystemDirectory	1037
defun loadLibNoUpdate	1037
defun loadFunctor	1038
68 Special Lisp Functions	1039
68.1 Axiom control structure macros	1039
defun put	1039
defmacro while	1039
defmacro whileWithResult	1040
68.2 Filename Handling	1040
defun namestring	1040
defun pathnameName	1040
defun pathnameType	1040
defun pathnameTypeId	1041
defun mergePathnames	1041
defun pathnameDirectory	1041
defun Axiom pathnames	1042
defun makePathname	1042
defun Delete a file	1042
defun wrap	1043
defun lotsof	1043
defmacro startsId?	1044
defun hput	1044
defmacro hget	1044
defun hkeys	1044
defun digitp	1045

defun pname	1045
defun size	1045
defun strpos	1045
defun strposl	1046
defun qenum	1046
defmacro identp	1046
defun concat	1047
defun canFuncall?	1047
defun brightprint	1048
defun brightprint-0	1048
defun member	1048
defun messageprint	1048
defun messageprint-1	1049
defun messageprint-2	1049
defun sayBrightly1	1049
defmacro assq	1050
defun A version of GET that works with lists	1050
69 Record, Union, Mapping, and Enumeration	1051
70 Common Lisp Algebra Support	1053
70.1 ApplicationProgramInterface	1053
defun Report what domains get instantiated	1053
70.2 InputForm	1054
defun unparseInputForm	1054
70.3 Void	1054
defun voidValue	1054
70.4 U8Vector	1054
defmacro qvlenU8	1054
defmacro eltU8	1055
defmacro seteltU8	1055
defun getRefvU8	1055
70.5 U16Vector	1055
defmacro qvlenU16	1055
defmacro eltU16	1056
defmacro seteltU16	1056
defun getRefvU16	1056
70.6 U32Vector	1056
defmacro qvlenU32	1056
defmacro eltU32	1057
defmacro seteltU32	1057
defun getRefvU32	1057
70.7 U8Matrix	1057
defmacro aref2U8	1057
defmacro setAref2U8	1058
defmacro anrowsU8	1058

	defmacro ancotsU8	1058
	defmacro makeMatrixU8	1058
	defmacro makeMatrix1U8	1059
70.8	U16Matrix	1059
	defmacro aref2U16	1059
	defmacro setAref2U16	1059
	defmacro anrowsU16	1059
	defmacro ancotsU16	1060
	defmacro makeMatrixU16	1060
	defmacro makeMatrix1U16	1060
70.9	U32Matrix	1060
	defmacro aref2U32	1060
	defmacro setAref2U32	1061
	defmacro anrowsU32	1061
	defmacro ancotsU32	1061
	defmacro makeMatrixU32	1061
	defmacro makeMatrix1U32	1062
70.10	U32VectorPolynomialOperations	1062
	defmacro qsMulAdd6432	1062
	defmacro qsMulMod32	1062
	defmacro qsMod6432	1062
	defmacro qsMulAddMod6432	1063
	defmacro qsMul6432	1063
	defmacro qsDot26432	1063
	defmacro qsDot2Mod6432	1063
70.11	DirectProduct	1064
	defun vec2list	1064
70.12	AlgebraicFunction	1064
	defun retract	1064
70.13	Any	1066
	defun spad2BootCoerce	1066
70.14	ParametricLinearEquations	1066
	defun algCoerceInteractive	1066
70.15	NumberFormats	1067
	defun ncParseFromString	1067
70.16	SingleInteger	1067
	defun qsquotient	1067
	defun qsremainder	1067
	defmacro qsdifference	1067
	defmacro qslessp	1068
	defmacro qsadd1	1068
	defmacro qssub1	1068
	defmacro qsminus	1068
	defmacro qsplus	1069
	defmacro qstimes	1069
	defmacro qsabsval	1069

defmacro qsoddp	1069
defmacro qszerop	1070
defmacro qsmx	1070
defmacro qsmn	1070
70.17 Boolean	1070
defun The Boolean = function support	1070
70.18 IndexedBits	1071
defmacro truth-to-bit	1071
defun IndexedBits new function support	1071
defmacro bit-to-truth	1071
defmacro bvec-elt	1071
defmacro bvec-setelt	1072
defmacro bvec-size	1072
defun IndexedBits concat function support	1072
defun IndexedBits copy function support	1072
defun IndexedBits = function support	1072
defun IndexedBits < function support	1073
defun IndexedBits And function support	1073
defun IndexedBits Or function support	1073
defun IndexedBits xor function support	1073
defun IndexedBits nand function support	1074
defun IndexedBits nor function support	1074
defun IndexedBits not function support	1074
70.19 KeyedAccessFile	1074
defun KeyedAccessFile defstream function support	1074
defun KeyedAccessFile defstream function support	1075
70.20 Table	1075
defun Table InnerTable support	1075
defun compiledLookup	1076
defun basicLookup	1076
defun lookupInDomainVector	1078
defun basicLookupCheckDefaults	1078
defun oldCompLookup	1079
defun NRTevalDomain	1079
70.21 Plot3d	1080
defvar \$numericFailure	1080
defvar \$oldBreakMode	1080
defmacro trapNumericErrors	1080
70.22 DoubleFloatVector	1081
defmacro dlen	1081
defmacro make-double-vector	1081
defmacro make-double-vector1	1081
defmacro delt	1082
defmacro dsetelt	1082
70.23 ComplexDoubleFloatVector	1082
defmacro make-cdouble-vector	1082

defmacro cdelt	1082
defmacro cdsetelt	1083
defmacro cdlen	1083
70.24DoubleFloatMatrix	1084
defmacro make-double-matrix	1084
defmacro make-double-matrix1	1084
defmacro daref2	1084
defmacro dsetaref2	1084
defmacro danrows	1085
defmacro dancols	1085
70.25ComplexDoubleFloatMatrix	1085
defmacro make-cdouble-matrix	1085
defmacro cdaref2	1085
defmacro cdsetaref2	1086
defmacro cdanrows	1086
defmacro cdancols	1087
70.26Integer	1087
defun Integer divide function support	1087
defun Integer quo function support	1087
defun Integer quo function support	1088
defun Integer random function support	1088
70.27IndexCard	1088
defun IndexCard origin function support	1088
defun IndexCard origin function support	1089
defun IndexCard elt function support	1089
70.28OperationsQuery	1089
defun OperationQuery getDatabase function support	1089
70.29Database	1090
defun Database elt function support	1090
70.30FileName	1090
defun FileName filename function implementation	1090
defun FileName filename support function	1091
defun FileName directory function implementation	1091
defun FileName directory function support	1091
defun FileName name function implementation	1092
defun FileName extension function implementation	1092
defun FileName exists? function implementation	1092
defun FileName readable? function implementation	1092
defun FileName writeable? function implementation	1093
defun FileName writeable? function support	1093
defun FileName new function implementation	1093
70.31DoubleFloat	1094
defmacro DFLessThan	1094
defmacro DFUnaryMinus	1094
defmacro DFMinusp	1094
defmacro DFZerop	1094

defmacro DFAdd	1095
defmacro DFSubtract	1095
defmacro DFMultiply	1095
defmacro DFIntegerMultiply	1095
defmacro DFMax	1096
defmacro DFMin	1096
defmacro DFEql	1096
defmacro DFDivide	1096
defmacro DFIntegerDivide	1097
defmacro DFSqrt	1097
defmacro DFLogE	1097
defmacro DFLog	1097
defmacro DFIntegerExpt	1098
defmacro DFExpt	1098
defmacro DFExp	1098
defmacro DFSin	1098
defmacro DFCos	1099
defmacro DFTan	1099
defmacro DFAasin	1099
defmacro DFAcos	1099
defmacro DFAtan	1100
defmacro DFAtan2	1100
defmacro DFSinh	1100
defmacro DFCosh	1101
defmacro DFTanh	1101
defmacro DFAsinh	1101
defmacro DFAcosh	1102
defmacro DFAtanh	1102
defun Machine specific float numerator	1102
defun Machine specific float denominator	1103
defun Machine specific float sign	1103
defun Machine specific float bit length	1103
defun Decode floating-point values	1103
defun The cotangent routine	1104
defun The inverse cotangent function	1104
defun The secant function	1104
defun The inverse secant function	1105
defun The cosecant function	1105
defun The inverse cosecant function	1105
defun The hyperbolic cosecant function	1106
defun The hyperbolic cotangent function	1106
defun The hyperbolic secant function	1106
defun The inverse hyperbolic cosecant function	1106
defun The inverse hyperbolic cotangent function	1107
defun The inverse hyperbolic secant function	1107

71 OpenMath	1109
71.1 A Technical Overview[?]	1109
The OpenMath Architecture	1109
OpenMath Encodings	1111
Content Dictionaries	1112
OpenMath in Action	1114
71.2 Technical Details[?]	1115
71.3 The Structure of the API	1115
71.4 OpenMath Expressions	1116
Expressions	1116
Symbols	1116
Encoding and Decoding OpenMath Expressions	1116
71.5 Big Integers	1117
71.6 Functions Dealing with OpenMath Devices	1117
71.7 Functions to Write OpenMath Expressions to Devices	1118
Beginning and Ending Objects	1118
Writing Basic Objects	1119
Writing Structured Objects	1119
71.8 Functions to Extract OpenMath Expressions from Devices	1120
Testing the type of the current token	1120
Extracting the current token	1121
71.9 Comments in the SGML/XML Encodings	1124
71.10 I/O Functions for Devices	1125
71.11 Communications	1125
Functions to Initiate an OMconn	1126
71.12 Parameters	1127
71.13 Miscellaneous Functions and Variables	1127
71.14 The OM.h header file	1128
71.15 Axiom OpenMath stub functions	1137
Axiom specific functions	1137
defun om-Read	1137
defun om-listCDs	1138
defun om-listSymbols	1138
defun om-supportsCD	1138
defun om-supportsSymbol	1138
Lisp conversion functions	1139
defun om-setDevEncoding	1139
Device manipulation functions	1139
defun om-openFileDev	1139
defun om-openStringDev	1140
defun om-closeDev	1140
Connection manipulation functions	1140
defun om-makeConn	1140
defun om-closeConn	1140
defun om-getConnInDev	1141
defun om-getConnOutDev	1141

Client/Server functions	1141
defun om-bindTCP	1141
defun om-connectTCP	1142
Device input/output functions	1142
defun om-getApp	1143
defun om-getAtp	1144
defun om-getAttr	1144
defun om-getBind	1144
defun om-getBVar	1144
defun om-getByteArray	1145
defun om-getEndApp	1145
defun om-getEndAtp	1145
defun om-getEndAttr	1145
defun om-getEndBind	1146
defun om-getEndBVar	1146
defun om-getEndError	1146
defun om-getEndObject	1146
defun om-getError	1147
defun om-getFloat	1147
defun om-getInt	1147
defun om-getObject	1147
defun om-getString	1148
defun om-getSymbol	1148
defun om-getType	1148
defun om-getVar	1148
defun om-putApp	1149
defun om-putAtp	1149
defun om-putAttr	1149
defun om-putBind	1149
defun om-putBVar	1150
defun om-putByteArray	1150
defun om-putEndApp	1150
defun om-putEndAtp	1150
defun om-putEndAttr	1151
defun om-putEndBind	1151
defun om-putEndBVar	1151
defun om-putEndError	1151
defun om-putEndObject	1152
defun om-putError	1152
defun om-putFloat	1152
defun om-putInt	1152
defun om-putObject	1153
defun om-putString	1153
defun om-putSymbol	1153
defun om-putVar	1153
defun om-stringToStringPtr	1154

defun om-stringPtrToString	1154
72 NRLIB code.lisp support code	1155
defun makeByteWordVec2	1155
defmacro spadConstant	1155
73 Monitoring execution	1157
defvar \$*monitor-domains*	1163
defvar \$*monitor-nrlibs*	1163
defvar \$*monitor-table*	1164
defstruct \$monitor-data	1164
defstruct \$libstream	1164
defun Initialize the monitor statistics hashtable	1164
defun End the monitoring process, we cannot restart	1165
defun Return a list of the monitor-data structures	1165
defun Add a function to be monitored	1166
defun Remove a function being monitored	1166
defun Enable all (or optionally one) function for monitoring	1166
defun Disable all (or optionally one) function for monitoring	1167
defun Reset the table count for the table (or a function)	1167
defun Incr the count of fn by 1	1168
defun Decr the count of fn by 1	1168
defun Return the monitor information for a function	1169
defun Hang a monitor call on all of the defuns in a file	1169
defun Return a list of the functions with zero count fields	1169
defun Return a list of functions with non-zero counts	1170
defun Write out a list of symbols or structures to a file	1170
defun Save the *monitor-table* in loadable form	1171
defun restore a checkpointed file	1171
defun Printing help documentation	1172
Monitoring algebra files	1174
defun Monitoring algebra code.lsp files	1174
defun Monitor autoloading files	1174
defun Monitor an nrlib	1175
defun Given a monitor-data item, extract the nrlib name	1175
defun Is this an exposed algebra function?	1176
defun Monitor exposed domains	1176
defun Generate a report of the monitored domains	1177
defun Parse an)abbrev expression for the domain name	1178
defun Given a spad file, report all nrlibs it creates	1178
defun Print percent of functions tested	1179
defun Find all monitored symbols containing the string	1179

74 HyperDoc Basic Command support	1181
defun Basic Command matrix entry	1182
defun Read Matrix	1182
defun Input Matrix By Formula	1183
defun Basic Command Matrix by Formula generate	1185
defun Input Explicit Matrix	1185
defun Basic Command generate explicit matrix	1187
defun Basic Command generate matrix	1188
defun Basic Command iteration	1189
defun Indefinite Integration Basic Command	1189
defun bcIndefiniteIntegrateGen	1190
defun Definite Integration Basic Command	1190
defun bcDefiniteIntegrateGen	1192
defun Sum Basic Command	1192
defun bcSumGen	1194
defun Sum Basic Command	1194
defun bcProductGen	1195
defun Differentiate Basic Command	1195
defun bcDifferentiateGen	1196
defun Draw Basic Command	1197
defun Draw Basic Command by Function	1198
defun bcDraw2DfunGen	1199
defun Draw Basic Command by Parameters	1200
defun bcDraw2DparGen	1201
defun Draw Basic Command by Equation Solution	1202
defun bcDraw2DSolveGen	1203
defun Draw Basic Command by 3D function	1204
defun bcDraw3DfunGen	1205
defun Draw Basic Command by 3D parameterized tube	1206
defun bcDraw3DparGen	1207
defun Draw Basic Command by 3D parameterized function	1208
defun bcDraw3Dpar1Gen	1209
defun Series Basic Command	1210
defun Series Basic Command expand around a point	1211
defun bcSeriesExpansionGen	1212
defun Series Basic Command series by formula	1212
defun Taylor Series Basic Command	1213
defun bcSeriesByFormulaGen	1215
defun Laurent Series Basic Command	1215
defun Puiseux Series Basic Command	1217
defun bcTaylorSeriesGen	1219
defun bcLaurentSeriesGen	1219
defun bcPuiseuxSeriesGen	1219
defun bcSeriesGen	1219
defun Limit Basic Command	1220
defun Real Limit Basic Command	1221

defun Real Limit Basic Command options	1222
defun bcRealLimitGen1	1223
defun Complex Limit Basic Command	1223
defun bcComplexLimitGen	1225
defvar \$systemType	1225
defvar \$numberOfEquations	1226
defvar \$solutionMethod	1226
defun Solve Basic Command	1226
defun Linear Solve Basic Command	1227
defun Linear Solve Equations Basic Command	1228
defun bcSystemSolve	1228
defun bcSolveSingle	1229
defun bcSystemSolveEqns1	1229
defun bcLinearSolveEqns1	1230
defun bcInputSolveInfo	1230
defun bcInputEquations	1231
defun Create a variable string	1233
defun bcMakeUnknowns	1233
defun bcMakeEquations	1234
defun bcMakeLinearEquations	1234
defun bcInputEquationsEnd	1235
defun bcSolveEquationsNumerically	1235
defun bcSolveNumerically1	1236
defun bcSolveEquations	1236
defun Linear Solve Basic Command trampoline	1237
defun Linear Solve Basic Command options	1237
defun bcLinearExtractMatrix	1238
defun Linear Solve Basic Command options	1238
defun bcLinearSolveMatrixInhomoGen	1239
defun bcLinearSolveMatrixHomo	1240
defun bcLinearMatrixGen	1240
defun linearFinalRequest	1241
defun explainLinear	1241
defun finalExactRequest	1241
defun bcLinearSolveEqnsGen	1242
defun bcGenEquations	1242
defun Output the final formula	1243
defun convert arguments into function call syntax	1243
defun bcString2HyString2	1244
defun bcString2HyString	1244
defun find a character position in a string	1244
defun Basic Command result page	1244
defun Basic Command result page – NAG version	1245
defun bcOptional	1245
defun create a vertical space on a page	1246
defun break a string into words	1246

defun format words into a string	1246
defun format a vector	1246
defun format an error message	1247
defun format intervals	1247
defun Basic Command page not ready	1247
defun pad a string with blanks	1248
defun construct a name string	1248
defun construct a name string	1248
defvar \$bcParseOnly	1249
defvar \$htLineList	1249
defvar \$curpage	1249
defvar \$activePageList	1249
defun httpDestroyPage	1250
defun httpName	1250
defun httpSetName	1250
defun httpDomainConditions	1250
defun httpSetDomainConditions	1251
defun httpDomainVariableAlist	1251
defun httpSetDomainVariableAlist	1251
defun httpDomainPvarSubstList	1251
defun httpSetDomainPvarSubstList	1251
defun httpRadioButtonAlist	1252
defun httpButtonValue	1252
defun httpSetRadioButtonAlist	1252
defun httpInputAreaAlist	1253
defun httpSetInputAreaAlist	1253
defun httpAddInputAreaProp	1253
defun httpPropertyList	1253
defun httpProperty	1254
defun httpSetProperty	1254
defun httpLabelInputString	1254
defun httpLabelFilteredInputString	1255
defun replacePercentByDollar,fn	1255
defun replacePercentByDollar	1256
defun httpSetLabelInputString	1256
defun httpLabelSpadValue	1256
defun httpSetLabelSpadValue	1257
defun httpLabelErrorMsg	1257
defun httpSetLabelErrorMsg	1257
defun httpLabelType	1258
defun httpLabelDefault	1258
defun httpLabelSpadType	1258
defun httpLabelFilter	1259
defun httpPageDescription	1259
defun httpSetPageDescription	1259
defun httpAddToPageDescription	1260

defun issue a single hypertext line or group of lines	1260
defun bcHt	1260
defun bcIssueHt	1261
defun mapStringize	1261
defun basicStringize	1261
defun stringize	1262
defun htInitPage	1262
defun htAddHeading	1262
defun htShowPage	1263
defun show the page which has been computed	1263
defun make a page given the description in itemList	1263
defun htMakePage1	1264
defun htMakeErrorPage	1265
defun htQuote	1265
defun htProcessToggleButtons	1265
defun htProcessBcButtons	1266
defun htProcessBcStrings	1268
defun bcSadFaces	1269
defun htLispLinks	1269
defun htLispMemoLinks	1270
defun htBcLinks	1270
defun htBcLispLinks	1271
defun beforeAfter	1272
defun mkCurryFun	1272
defun htRadioButtons	1273
defun htBcRadioButtons	1274
defun setUpDefault	1275
defun buttonNames	1276
defun htInputStrings	1276
defun htProcessDomainConditions	1277
defun renamePatternVariables	1278
defun renamePatternVariables1	1278
defun substFromAlist	1280
defun computeDomainVariableAlist	1280
defun pvarCondList	1281
defun pvarCondList1	1281
defun pvarsOfPattern	1282
defun htMakeTemplates,substLabel	1282
defun htMakeTemplates	1283
defun templateParts	1284
defun htMakeDoneButton	1284
defun htProcessDoneButton	1285
defun htMakeButton	1285
defun bchtMakeButton	1287
defun htProcessDoitButton	1288
defun htMakeDoitButton	1288

defun doDoitButton	1289
defun executeInterpreterCommand	1289
defun htDoneButton	1289
defun typeCheckInputAreas	1290
defun checkCondition	1292
defun condErrorMsg	1293
defun parseAndEval	1294
defun parseAndEval1	1294
defun oldParseString	1295
defun makeSpadCommand	1295
defun htMakeInputList	1296
defun bracketString	1296
defun quoteString	1297
defvar \$funnyQuote	1297
defvar \$funnyBacks	1297
defun htEscapeString	1297
defun htsv	1298
defun htSetVars	1298
defun htShowSetTree	1298
defun htShowCount	1300
defun htShowSetTreeValue	1301
defun mkSetTitle	1302
defun listOfStrings2String	1302
defun htShowSetPage	1302
defun htShowLiteralsPage	1303
defun htSetLiterals	1303
defun htSetLiteral	1304
defun htShowIntegerPage	1305
defun htSetInteger	1306
defun htShowFunctionPage	1306
defun htShowFunctionPageContinued	1307
defun htSetvarDoneButton	1308
defun htFunctionSetLiteral	1308
defun htSetFunCommand	1309
defun htSetFunCommandContinue	1309
defun htKill	1310
defun htSetNotAvailable	1310
defun htDoNothing	1311
defun htCheck	1311
defun parseWord	1312
defun htCheckList	1312
defun translateYesNoToTrueFalse	1313
defun chkNameList	1313
defun chkPosInteger	1314
defun chkOutputFileName	1315
defun chkDirectory	1315

defun chkNonNegativeInteger	1315
defun chkRange	1315
defun chkAllNonNegativeInteger	1316
defun htMakePathKey,fn	1316
defun htMakePathKey	1317
defun htMarkTree	1317
defun htSetHistory	1317
defun htSetOutputLibrary	1318
defun htSetInputLibrary	1318
defun htSetExpose	1318
defun htSetOutputCharacters	1319
defun htSetLinkerArgs	1319
defun htSetCache	1319
defun htCacheAddChoice	1320
defun htMakeLabel	1321
defun htCacheSet	1321
defun htAllOrNum	1323
defun htCacheOne	1323
defvar \$historyDisplayWidth	1324
defvar \$newline	1324
defun downlink	1324
defun downlinkSaturn	1324
defun dbNonEmptyPattern	1325
defun htSystemVariables,gn	1325
defun htSystemVariables,fn	1326
defun htSystemVariables,displayOptions	1326
defun htSystemVariables,functionTail	1328
defun htSystemVariables	1329
defun htSetSystemVariableKind	1331
defun htSetSystemVariable	1331
defun htGloss	1332
defun htGlossPage	1332
defun gatherGlossLines	1334
defun htGlossSearch	1336
defun htGreekSearch	1336
defun htTextSearch	1338
defun htTutorialSearch	1340
defun mkUnixPattern	1341

75 Browser Support Code 1343

75.1 Pages Initiated from HyperDoc Pages	1343
defun conPage	1343
defun gets line quickly for constructor name or abbreviation	1344
defun conPageConEntry	1344
defun kdPageInfo	1345
defun kArgPage	1346

defun reportCategory	1347
defun reportAO	1348
defun mkDomTypeForm	1348
defun domainDescendantsOf	1349
75.2 Branches of Constructor Page	1350
defun kiPage	1350
defun kePage	1351
defun kePageOpAlist	1353
defun kePageDisplay	1354
defun ksPage	1355
defun dbSearchOrder	1356
defun kcPage	1357
defun kcpPage	1361
defun reduceAlistForDomain	1362
defun kcaPage	1362
defun kcdPage	1362
defun kcdPage	1363
defun kcaPage1	1363
defun kccPage	1364
defun augmentHasArgs	1365
defun kcdePage	1366
defun getDependentsOfConstructor	1367
defun kcuPage	1367
defun getUsersOfConstructor	1368
defun kcnPage	1368
defun koPageInputAreaUnchanged?	1370
defun kDomainName	1370
defun kArgumentCheck	1371
defun dbMkEvalable	1372
defun topLevelInterpEval	1372
defun kisValidType	1372
defun kCheckArgumentNumbers	1373
defun parseNoMacroFromString	1373
defun mkConform	1374
75.3 Operation Page for a Domain Form from Scratch	1375
defun conOpPage	1375
defun conOpPage1	1375
defun dbCompositeWithMap	1377
defun dbExtractUnderlyingDomain	1377
75.4 Operation Page from Main Page	1377
defun koPage	1377
defun koPageFromKKPage	1378
defun koPageAux	1379
defun koPageAux1	1379
defun koaPageFilterByName	1380
75.5 Get Constructor Documentation	1380

defun dbConstructorDoc,hn	1380
defun dbConstructorDoc,gn	1381
defun dbConstructorDoc	1381
defun dbDocTable	1382
defun originsInOrder	1382
defun dbAddDocTable	1383
defun dbGetDocTable,hn	1384
defun dbGetDocTable,gn	1384
defun dbGetDocTable	1385
defun kTestPred	1386
defun dbAddChainDomain	1386
defun dbSubConform	1386
defun dbAddChain	1387
75.6 Constructor Page Menu	1387
defun dbShowCons	1387
defun conPageChoose	1389
defun dbShowCons1	1389
defun dbConsExposureMessage	1391
defun dbShowConsKindsFilter	1391
defun dbShowConsDoc	1392
defun dbShowConsDoc1	1393
defun getConstructorDocumentation	1394
defun dbSelectCon	1394
defun dbShowConditions	1394
defun dbConsHeading	1395
defun dbShowConstructorLines	1397
defun bcUnixTable	1397
Special Code for Union, Mapping, and Record	1398
defun dbSpecialDescription	1398
defun dbSpecialOperations	1398
defun dbSpecialExports	1399
defun dbSpecialExpandIfNecessary	1400
defun mkConArgSublis	1405
defun digits2Names	1405
defun lefts	1406
Build Library Database (libdb.text,...)	1406
defun dbMkForm	1406
defun libConstructorSig	1406
 76 The Interpreter	 1409
 77 The Global Variables	 1449
77.1 Star Global Variables	1449
eof	1449
features	1449
package	1449

standard-input	1450
standard-output	1450
top-level-hook	1450
77.2 Dollar Global Variables	1452
\$boot	1453
coerceFailure	1453
\$currentLine	1453
\$displayStartMsgs	1453
\$e	1453
\$erMsgToss	1453
\$fn	1453
\$frameRecord	1453
\$HiFiAccess	1454
\$HistList	1454
\$HistListAct	1454
\$HistListLen	1454
\$HistRecord	1454
\$historyFileType	1455
\$internalHistoryTable	1455
\$interpreterFrameName	1455
\$interpreterFrameRing	1455
\$InteractiveFrame	1455
\$sintRestart	1455
\$sintTopLevel	1455
\$IOindex	1456
\$lastPos	1456
\$libQuiet	1456
\$msgDatabaseName	1456
\$ncMsgList	1456
\$newcompErrorCount	1456
\$newspad	1456
\$nopos	1456
\$oldHistoryFileName	1457
\$okToExecuteMachineCode	1457
\$options	1457
\$previousBindings	1457
\$PrintCompilerMessageIfTrue	1457
\$reportundo	1457
\$spad	1457
\$SpadServer	1458
\$SpadServerName	1458
\$systemCommandFunction	1458
top_level	1458
\$quitTag	1458
\$useInternalHistoryTable	1458
\$undoFlag	1458

80

CONTENTS

78 Index

1461

Volume 6: Axiom Command

1	Overview	1
2	The axiom Command	3
	[-ht | -noht]	3
	[-gr | -nogr]	4
	[-clef | -noclef]	4
	[-nonag | -nag]	5
	[-noiw | -iw]	5
	[-ihere | -noihere]	6
	[-nox]	6
	[-go | -nogo]	7
	[-ws wsname]	7
	[-list]	7
	[-grprog fname]	7
	[-nagprog fname]	8
	[-htprog fname]	8
	[-clefprog fname]	8
	[-sessionprog fname]	8
	[-clientprog fname]	8
	[-h]	8
3	The sman program	17
3.1	sman.h	17
3.2	sman	18
	includes	18
	variables	18
	process_arguments	20
	should_I_clef	23
	in_X	23
	set_up_defaults	23
	process_options	24
	death_handler	24
	nagman_handler	24
	sman_catch_signals	25
	fix_env	26
	init_term_io	26
	strPrefix	27
	check_spad_proc	27
	clean_up_old_sockets	28
	fork_you	28
	exec_command_env	29
	spawn_of_hell	29
	start_the_spadclient	30

start_the_local_spadclient	30
start_the_nagman	31
start_the_session_manager	31
start_the_hypertext	32
start_the_graphics	32
fork_Axiom	32
start_the_Axiom	34
clean_up_sockets	35
read_from_spad_io	35
read_from_manager	36
manage_spad_io	37
init_spad_process_list	38
print_spad_process_list	38
find_child	38
kill_all_children	39
clean_up_terminal	39
monitor_children	39
main sman	41
sman	42
4 Support Routines	45
4.1 Command Completion	45
5 The viewman program	47
6 The nagman program	49
6.1 nag.x	49
6.2 nagman	50
includes	50
variables	51
term	52
size_of_file	53
rpcloop	53
catchSignals	59
main nagman	60
nagman	61
7 The hypertext program	63
8 The clef program	65
9 The session program	67
9.1 session	67
includes	67
variables	68
usr1_handler	68

<i>CONTENTS</i>	83
usr2_handler	68
term_handler	69
pr	69
close_client	70
read_SpadServer_command	71
test_sock_for_process	72
read_menu_client_command	72
read_from_spad_io	73
kill_spad	74
accept_session_connection	74
read_from_session	76
manage_sessions	77
main sessionmanager	78
session	80
10 The spadclient program	81
10.1 spadclient	81
11 The Command Completion List	83
12 Research Topics	167
12.1 Proofs	167
12.2 Indefinites	167
12.3 Provisos	168
13 Makefile	169
13.1 Environment variables	169
13.2 The axiom command	170
13.3 session	170
13.4 nagman	170
13.5 spadclient	171
13.6 sman	171

Volume 7: Axiom Hyperdoc

1	Overview	1
1.1	The Original Plan	2
1.2	External Variables	3
1.3	hypertex	4
1.4	htsearch	4
1.5	spadbuf	4
1.6	hthits	4
1.7	ex2ht	4
1.8	htadd	4
2	The hypertex language	5
3	Hypertex Call Graph	31
4	Shared Code	87
	BeStruct	87
4.1	Shared Code for file handling	87
	strpostfix	87
	extendHT	88
	buildHtFilename	88
	pathname	90
	htFileOpen	91
	dbFileOpen	91
	tempFileOpen	93
4.2	Shared Code for Hash Table Handling	93
	halloc	93
	hashInit	94
	freeHash	94
	hashInsert	95
	hashFind	95
	hashReplace	95
	hashDelete	96
	hashMap	96
	hashCopyEntry	97
	hashCopyTable	97
	stringHash	97
	stringEqual	98
	allocString	98
4.3	Shared Code for Error Handling	98
	jump	98
	dumpToken	99
	printPageAndFilename	99
	printNextTenTokens	100

printToken	100
tokenName	101
htperror	102
4.4 Shared Code for Lexical Analyzer	103
parserInit	104
initScanner	104
saveScannerState	105
restoreScannerState	105
ungetChar	106
getChar	106
getChar1	107
ungetToken	109
getToken	109
pushBeStack	112
checkAndPopBeStack	113
clearBeStack	113
beType	114
beginType	115
endType	116
keywordType	117
getExpectedToken	118
spadErrorHandler	118
resetConnection	119
spadBusy	119
connectSpad	120
4.5 htadd shared code	120
4.6 hypertext shared code	124
5 Shared include files	129
5.1 debug.c	129
5.2 hyper.h	129
6 The spadbuf function	141
6.1 spadbuf Call Graph	141
6.2 Constants and Headers	142
System includes	142
Local includes	142
6.3 externs	143
6.4 local variables	143
6.5 Code	144
spadbufInterHandler	144
spadbufFunctionChars	144
interpIO	145
.	146
main	147

7	The ex2ht function	149
7.1	ex2ht Call Graph	149
7.2	ex2ht Source Code	150
7.3	Constants and Headers	150
	System includes	150
	Local includes	151
7.4	defines	151
7.5	local variables	151
7.6	Code	151
	allocString	151
	strPrefix	152
	getExTitle	152
	exToHt	153
	emitHeader	154
	emitFooter	154
	emitMenuEntry	154
	emitSpadCommand	155
	openCoverPage	155
	closeCoverPage	156
	closeCoverFile	156
	emitCoverLink	156
	addFile	157
	main	157
8	The htadd command	159
8.1	htadd Call Graph	159
8.2	Constants and Headers	164
	System includes	164
	structs	164
	Local includes	164
	extern references	165
	defines	165
	forward declarations	166
	local variables	166
8.3	The Shared Code	167
8.4	Code	167
	parseArgs	167
	writable	168
	buildDBFilename	168
	addfile	170
	updateDB	171
	addNewPages	172
	copyFile	173
	getFilename	174
	deleteFile	175
	deleteDB	175

main	176
9 The hthits function	179
9.1 hthits Call Graph	179
9.2 Constants and Headers	181
System includes	181
defines	181
structs	181
Local includes	182
local variables	182
cmdline	182
handleHtdb	182
handleFile	183
handleFilePages	185
handlePage	185
searchPage	186
squirt	187
splitpage	187
untexbuf	188
badDB	189
regerr	189
main	189
10 The hypertext command	191
10.1 Constants and Headers	191
System includes	191
10.2 structs	192
Local includes	192
10.3 structs	192
10.4 defines	193
10.5 externs	197
10.6 local variables	200
10.7 The Shared Code	204
10.8 Code	209
sigusr2Handler	209
sigcldHandler	209
cleanSocket	209
initHash	210
initPageStructs	210
checkArguments	210
makeServerConnections	212
10.9 Condition Handling	213
insertCond	213
changeCond	214
checkMemostack	214
checkCondition	215

10.10	Dialog Handling	216
	redrawWin	216
	mystrncpy	216
	incLineNumbers	216
	decLineNumbers	217
	decreaseLineNumbers	217
	overwriteBuffer	217
	moveSymForward	219
	clearCursorline	220
	insertBuffer	220
	addBufferToSym	222
	drawInputsymbol	223
	updateInputsymbol	224
	drawCursor	224
	moveCursorHome	225
	moveCursorEnd	226
	void moveCursorForward	226
	moveCursorDown	227
	moveCursorUp	227
	clearCursor	228
	moveCursorBackward	229
	moveRestBack	229
	deleteRestOfLine	230
	backOverEoln	231
	moveBackOneChar	233
	backOverChar	235
	deleteEoln	235
	deleteOneChar	237
	deleteChar	238
	toughEnter	238
	enterNewLine	240
	dialog	241
10.11	Format and Display a page	244
	showPage	244
	exposePage	246
	scrollPage	247
	pastePage	248
10.12	Event Handling	249
	mainEventLoop	249
	handleEvent	250
	createWindow	253
	quitHyperDoc	253
	findPage	254
	downlink	255
	memolink	255
	killAxiomPage	255

killPage	256
returnlink	256
uplink	257
windowlinkHandler	257
makeWindowLink	257
lispwindowlinkHandler	258
pasteButton	258
helpForHyperDoc	259
findButtonInList	259
getHyperLink	260
handleButton	260
exitHyperDoc	264
setWindow	265
clearExposures	266
getNewWindow	266
setCursor	269
changeCursor	269
handleMotionEvent	269
initCursorState	270
initCursorStates	270
makeBusyCursor	270
makeBusyCursors	271
HyperDocErrorHandler	271
setErrorHandlers	271
10.13Line Extent Computation	272
computeInputExtent	272
computePunctuationExtent	272
computeWordExtent	274
computeVerbatimExtent	275
computeSpadsrctxtExtent	275
computeDashExtent	275
computeTextExtent	276
computeBeginItemsExtent	283
computeItemExtent	284
computeMitemExtent	284
endifExtent	284
computeIfcondExtent	285
computeCenterExtent	286
computeBfExtent	287
computeEmExtent	287
computeItExtent	287
computeRmExtent	288
computeButtonExtent	288
endbuttonExtent	289
computePastebuttonExtent	290
endpastebuttonExtent	290

computePasteExtent	291
computeSpadcommandExtent	291
computeSpadsrcExtent	292
endSpadcommandExtent	292
endSpadsrcExtent	293
computeMboxExtent	294
computeBoxExtent	294
computeIrExtent	295
computeImageExtent	296
computeTableExtent	296
computeTitleExtent	297
computeHeaderExtent	298
computeFooterExtent	299
computeScrollingExtent	299
startNewline	300
centerNodes	300
punctuationWidth	301
inputStringWidth	301
wordWidth	302
verbatimWidth	302
widthOfDash	302
textWidth	303
totalWidth	307
initExtents	309
initTitleExtents	309
initText	310
textHeight	310
textHeight1	310
maxX	313
Xvalue	315
trailingSpace	316
insertBitmapFile	316
insertPixmapFile	317
plh	318
10.14 Handling forms	318
computeFormPage	319
windowWidth	319
windowHeight	319
formHeaderExtent	320
formFooterExtent	320
formScrollingExtent	321
10.15 Managing the HyperDoc group stack	321
popGroupStack	321
pushGroupStack	322
initGroupStack	322
emTopGroup	323

rmTopGroup	323
lineTopGroup	323
bfTopGroup	324
ttTopGroup	324
pushActiveGroup	324
pushSpadGroup	325
initTopGroup	325
centerTopGroup	325
copyGroupStack	326
freeGroupStack	326
10.16 Handle input, output, and Axiom communication	327
makeRecord	327
verifyRecord	327
ht2Input	328
makeInputFileName	328
makePasteFileName	329
makeTheInputFile	329
makeInputFileFromPage	330
strCopy	331
inListAndNewer	332
makeInputFileList	333
printPasteLine	333
getSpadOutput	334
getGraphOutput	334
sendCommand	335
printPaste	336
printGraphPaste	336
10.17 X Window window initialization code	337
initializeWindowSystem	337
initTopWindow	339
openFormWindow	340
initFormWindow	341
setNameAndIcon	342
getBorderProperties	342
openWindow	343
setSizeHints	344
getGCs	346
loadFont	347
ingItColorsAndFonts	347
changeText	351
getColor	351
mergeDatabases	352
isIt850	354
10.18 Handling user page interaction	354
fillBox	354
toggleInputBox	355

toggleRadioBox	355
clearRbs	356
changeInputFocus	356
nextInputFocus	357
prevInputFocus	357
returnItem	358
deleteItem	358
10.19 Manipulate the item stack	359
pushItemStack	359
clearItemStack	359
popItemStack	360
copyItemStack	360
freeItemStack	361
10.20 Keyboard handling	361
handleKey	361
getModifierMask	364
initKeyin	365
10.21 Handle page macros	366
scanHyperDoc	366
number	367
loadMacro	367
initParameterElem	369
pushParameters	369
popParameters	370
parseMacro	370
getParameterStrings	371
parseParameters	373
10.22 Memory management routines	374
freeIfNonNULL	374
allocHdWindow	374
freeHdWindow	375
allocNode	375
freeNode	376
allocIfnode	379
allocCondnode	380
freeCond	380
allocPage	380
freePage	381
freePaste	382
freePastebutton	383
freePastearea	383
freeString	384
freeDepend	384
dontFree	384
freeLines	385
freeInputItem	385

freeInputList	385
freeInputBox	386
freeRadioBoxes	386
allocInputline	386
allocPasteNode	387
allocPatchstore	387
freePatch	388
allocInputbox	388
allocRbs	388
allocButtonList	389
freeButtonList	389
resizeBuffer	389
10.23Page parsing routines	390
PushMR	390
PopMR	390
loadPage	391
displayPage	391
formatPage	392
parseFromString	393
parseTitle	393
parseHeader	394
initParsePage	394
initParsePatch	395
parsePage	395
parseHyperDoc	396
parsePageFromSocket	403
parsePageFromUnixfd	404
startScrolling	405
startFooter	405
endAPage	406
parseReplacepage	407
windowEqual	407
windowCode	407
windowId	407
readHtDb	408
readHtFile	409
makeLinkWindow	412
makePasteWindow	414
makeSpecialPage	414
main	415
addDependencies	415
isNumber	416
parserError	417
getFilename	417
getInputString	418
getWhere	419

findFp	419
10.24Handle InputString, SimpleBox, RadioBox input	420
makeInputWindow	420
makeBoxWindow	421
initializeDefault	421
parseInputstring	422
parseSimplebox	424
parseRadiobox	425
addBoxToRbList	427
checkOthers	428
insertItem	428
initPasteItem	429
repasteItem	429
currentItem	430
alreadyThere	430
parseRadioboxes	431
10.25Routines for paste-in areas	432
parsePaste	432
parsePastebutton	434
parsePatch	435
loadPatch	437
10.26parsing routines for node types	438
parseIfcond	438
parseCondnode	440
parseHasreturnto	441
parseNewcond	441
parseSetcond	441
parseBeginItems	442
parseItem	443
parseMitem	443
parseVerbatim	444
parseInputPix	445
parseCenterline	446
parseCommand	446
parseButton	447
parseSpadcommand	448
parseSpadsrc	449
parseEnv	449
parseValue1	450
parseValue2	451
parseTable	451
parseBox	452
parseMbox	453
parseFree	453
parseHelp	454
10.27Reading bitmaps	454

HTReadBitmapFile	454
readHot	457
readWandH	457
insertImageStruct	458
10.28Scrollbar handling routines	458
makeScrollBarWindows	459
drawScroller3DEffects	461
showScrollBars	462
moveScroller	463
drawScrollLines	463
calculateScrollBarMeasures	464
linkScrollBars	465
scrollUp	466
scrollUpPage	467
scrollToFirstPage	467
scrollDown	467
scrollDownPage	468
scrollScroller	468
hideScrollBars	469
getScrollBarMinimumSize	470
ch	470
changeWindowBackgroundPixmap	470
10.29Display text object	471
showText	471
showLink	476
showPaste	477
showPastebutton	478
showInput	478
showSimpleBox	479
showSpadcommand	479
showImage	480
10.30Axiom communication interface	481
issueSpadcommand	481
sendPile	482
issueDependentCommands	483
markAsExecuted	484
startUserBuffer	484
clearExecutionMarks	485
acceptMenuConnection	486
acceptMenuServerConnection	487
printToString	488
printToString1	488
issueServerCommand	493
issueServerpaste	494
issueUnixcommand	495
issueUnixlink	495

issueUnixpaste	496
serviceSessionSocket	496
switchFrames	497
sendLispCommand	497
escapeString	497
unescapeString	498
closeClient	498
printSourceToString	499
printSourceToString1	499
10.31 Produce titlebar	507
makeTitleBarWindows	507
showTitleBar	508
linkTitleBarWindows	509
readTitleBarImages	510
getTitleBarMinimumSize	511
main	511
11 The htsearch script	515
12 The presea script	517
12.1 token.h	518
13 The Bitmaps	523
13.1 ht_icon	523
13.2 exit.bitmap	524
13.3 help2.bitmap	524
13.4 return3.bitmap	525
13.5 up3.bitmap	526
13.6 noop.bitmap	526
13.7 exit3d.bitmap	527
13.8 help3d.bitmap	528
13.9 home3d.bitmap	528
13.10 up3d.bitmap	529
13.11 noop3d.bitmap	530

Volume 7.1: Axiom Hyperdoc

1	Release Notes	1
1.1	releasenotes.ht	1
	What is new in Axiom	1
	Online Information	3
	August 2014 Release Notes	4
	May 2012 Release Notes	14
	March 2012 Release Notes	17
	January 2012 Release Notes	19
	November 2011 Release Notes	22
	September 2011 Release Notes	25
	July 2011 Release Notes	27
	May 2011 Release Notes	29
	March 2011 Release Notes	32
	January 2011 Release Notes	34
	November 2010 Release Notes	36
	September 2010 Release Notes	38
	July 2010 Release Notes	42
	May 2010 Release Notes	45
	March 2010 Release Notes	49
	January 2010 Release Notes	52
	November 2009 Release Notes	55
	September 2009 Release Notes	57
	July 2009 Release Notes	60
	May 2009 Release Notes	62
	March 2009 Release Notes	67
	January 2009 Release Notes	73
	November 23, 2008 Release Notes	78
	September 23, 2008 Release Notes	80
	July 23, 2008 Release Notes	83
	May 27, 2008 Release Notes	87
	March 25, 2008 Release Notes	88
	January 25, 2008 Release Notes	91
	November 23, 2007 Release Notes	97
	Feature Complete Release Feb 2005	101
2	Special hyperdoc pages	103
2.1	util.ht	103
	Names of software and facilities	103
	Special hooks to Unix	103
	HyperDoc menu macros	104
	Bitmaps and bitmap manipulation macros	105
	HyperDoc button objects	106
	Standard HyperDoc button configurations	106

HyperDoc graphics macros	106
TeX and LaTeX compatibility macros	107
Book and .ht page macros	109
Browse macros	112
Support for output and graph paste-ins	113
Hook for including a local menu item on the rootpage	113
Not Connected to Axiom	114
Do You Really Want to Exit?	114
Missing Page	114
Something is Wrong	115
Sorry!	115
3 Hyperdoc pages	117
3.1 rootpage.ht	117
Axiom HyperDoc Top Level	117
Axiom – The Scientific Computation System	119
System Commands	120
Axiom Examples	121
Axiom Reference	123
NAG Documentation	125
3.2 algebra.ht	131
Abstract Algebra	131
Number Theory	132
3.3 alist.ht	132
AssociationList	132
3.4 array1.ht	138
OneDimensionalArray	138
3.5 array2.ht	143
TwoDimensionalArray	143
3.6 basic.ht	155
Basic Commands	155
Calculus	156
3.7 bbtree.ht	157
BalancedBinaryTree	157
3.8 binary.ht	163
BinaryExpansion	163
3.9 bmcats.ht	168
Bit Map Catalog	168
3.10 bop.ht	169
BasicOperator	169
3.11 bstree.ht	178
BinarySearchTree	178
3.12 card.ht	185
CardinalNumber	185
3.13 carten.ht	195
CartesianTensor	195

3.14	cclass.ht	221
	CharacterClass	221
3.15	char.ht	228
	Character	228
	CliffordAlgebra	234
	The Complex Numbers as a Clifford Algebra	235
	The Quaternion Numbers as a Clifford Algebra	239
	The Exterior Algebra on a Three Space	244
	The Dirac Spin Algebra	250
3.16	complex.ht	254
	Complex	254
3.17	contfrac.ht	262
	ContinuedFraction	262
3.18	cphelp.ht	279
	Control Panel Bits	279
3.19	cycles.ht	279
	CycleIndicators	279
3.20	coverex.ht	304
	Examples Of Axiom Commands	304
	Differentiation	305
	Integration	310
	Laplace Transforms	317
	Limits	320
	Matrices	325
	2-D Graphics	333
	3-D Graphics	335
	Series	337
	Summations	342
3.21	decimal.ht	348
	Decimal Expansion	348
3.22	derham.ht	352
	DeRhamComplex	352
3.23	dfloat.ht	369
	DoubleFloat	369
3.24	dmp.ht	375
	DistributedMultivariatePoly	375
3.25	eq.ht	380
	Equation	380
3.26	eqtbl.ht	386
	EqTable	386
3.27	evalex.ht	389
	Example of Standard Evaluation	389
	Example of Standard Evaluation	390
3.28	exdiff.ht	391
	Computing Derivatives	391
	Derivatives of Functions of Several Variables	392

	Derivatives of Higher Order	393
	Multiple Derivatives I	394
	Multiple Derivatives II	396
	Derivatives of Functions Involving Formal Integrals	396
	Exit	398
3.29	exlap.ht	402
	Laplace transform with a single pole	402
	Laplace transform of a trigonometric function	402
	Laplace transform requiring a definite integration	403
	Laplace transform of exponentials	404
	Laplace transform of an exponential integral	405
	Laplace transform of special functions	406
3.30	exint.ht	406
	Integral of a Rational Function	406
	Integral of a Rational Function with a Real Parameter	409
	Integral of a Rational Function with a Complex Parameter	410
	Two Similar Integrands Producing Very Different Results	410
	An Integral Which Does Not Exist	412
	A Trigonometric Function of a Quadratic	413
	Integrating a Function with a Hidden Algebraic Relation	414
	Details for integrating a function with a Hidden Algebraic Relation	415
	An Integral Involving a Root of a Transcendental Function	416
	An Integral of a Non-elementary Function	417
3.31	exlimit.ht	417
	Computing Limits	417
	Limits of Functions with Parameters	418
	One-sided Limits	419
	Two-sided Limits	420
	Limits at Infinity	422
	Real Limits vs. Complex Limits	423
	Complex Limits at Infinity	424
3.32	exmatrix.ht	426
	Basic Arithmetic Operations on Matrices	426
	Constructing new Matrices	429
	Trace of a Matrix	433
	Determinant of a Matrix	433
	Inverse of a Matrix	434
	Rank of a Matrix	435
3.33	expr.ht	436
	Expression	436
3.34	explot2d.ht	449
	Plotting Functions of One Variable	449
	Plotting Parametric Curves	449
	Plotting Using Polar Coordinates	450
	Plotting Plane Algebraic Curves	451
3.35	explot3d.ht	451

	Plotting Functions of Two Variables	451
	Plotting Parametric Surfaces	452
	Plotting Parametric Curves	453
3.36	expose.ht	454
	Exposure	454
	System Defined Exposure Groups	455
	What is an Exposure Group?	456
	Details on Exposure	457
3.37	exseries.ht	457
	Converting Expressions to Series	457
	Manipulating Power Series	459
	Functions on Power Series	461
	Substituting Numerical Values in Power Series	462
3.38	exsum.ht	464
	Summing the Entries of a List I	464
	Summing the Entries of a List II	465
	Approximating e	466
	Closed Form Summations	467
	Sums of Cubes	468
	Sums of Polynomials	470
	Sums of General Functions	471
	Infinite Sums	472
3.39	farray.ht	472
	FlexibleArray	472
3.40	file.ht	480
	File	480
3.41	float.ht	487
	Float	487
	Introduction to Float	488
	Conversion Functions	490
	Output Functions	498
	An Example: Determinant of a Hilbert Matrix	502
3.42	fname.ht	507
	FileName	507
3.43	fr.ht	516
	Factored	516
	Decomposing Factored Objects	518
	Expanding Factored Objects	523
	Arithmetic with Factored Objects	525
	Creating New Factored Objects	532
	Factored Objects with Variables	536
3.44	fr2.ht	539
	FactoredFunctions2	539
3.45	frac.ht	543
	Fraction	543
3.46	fparfrac.ht	549

	FullPartialFracExpansion	549
3.47	function.ht	560
	Functions in Axiom	560
	Rational Functions	561
	Algebraic Functions	564
	Elementary Functions	567
	Simplification	568
3.48	gbf.ht	575
	GroebnerFactorizationPkg	575
3.49	gloss.ht	579
	Glossary	579
3.50	graphics.ht	601
	Graphics	601
	Graphics Examples	602
	Assorted Graphics Examples	603
	Three Dimensional Graphics	605
	Functions of One Variable	610
	Parametric Curves	612
	Polar Coordinates	614
	Implicit Curves	616
	Lists of Points	619
	Three Dimensional Graphing	628
	Functions of Two Variables	629
	Parametric Space Curves	631
	Parametric Tube Plots	633
	Parametric Surfaces	636
	Building 3D Objects	638
	Two Dimensional Graphics	643
	Functions of One Variable	643
	Parametric Curves	646
	Polar Coordinates	648
	Implicit Curves	650
	Lists of Points	652
	Stand-alone Viewport	662
3.51	grpthy.ht	664
	Group Theory	664
	Representations of A_6 A_6	665
	Representation Theory	684
	Group Theory	685
3.52	gstbl.ht	687
	GeneralSparseTable	687
3.53	heap.ht	690
	Heap	690
3.54	hexadec.ht	692
	HexadecimalExpansion	692
3.55	int.ht	696

	Integer	696
	Basic Functions	698
	Primes and Factorization	712
	Some Number Theoretic Functions	716
3.56	intheory.ht	722
	IntegerNumberTheoryFunctions	722
3.57	kafle.ht	734
	KeyedAccessFile	734
3.58	kernel.ht	743
	Kernel	743
3.59	lazm3pk.ht	752
	LazardSetSolvingPackage	752
3.60	lexp.ht	778
	LieExponentials	778
3.61	lextripk.ht	784
	LexTriangularPackage	784
3.62	lib.ht	840
	Library	840
3.63	link.ht	844
	The Axiom Link to NAG Software	844
	Use of the Link from HyperDoc	845
	C02 Zeros of Polynomials	846
	C05 Roots of One or More Transcendental Equations	847
	C06 Summation of Series	847
	D01 Quadrature	849
	D02 Ordinary Differential Equations	851
	D03 Partial Differential Equations	852
	E01 Interpolation	853
	E02 Curve and Surface Fitting	854
	E04 Minimizing or Maximizing a Function	856
	F01 Matrix Operations - Including Inversion	857
	F02 Eigenvalues and Eigenvectors	858
	F04 Simultaneous Linear Equations	860
	F07 Linear Equations (LAPACK)	862
	S - Approximations of Special Functions	863
3.64	list.ht	866
	List	866
	Creating Lists	867
	Accessing List Elements	869
	Changing List Elements	875
	Other Functions	879
	Dot, Dot	882
3.65	lodo.ht	884
	LinearOrdinaryDifferentialOperator	884
	Differential Operators with Series Coefficients	884
3.66	lodo1.ht	894

	LinearOrdinaryDifferentialOperator1	894
	Differential Operators with Rational Function Coefficients	895
3.67	lodo2.ht	905
	LinearOrdinaryDifferentialOperator2	905
	Differential Operators with Constant Coefficients	906
	Differential Operators with Matrix Coefficients Operating on Vectors	911
3.68	lpoly.ht	919
	LiePolynomial	919
3.69	lword.ht	932
	LyndonWord	932
3.70	magma.ht	942
	Magma	942
3.71	man0.ht	951
	Reference Search	951
	Lisp Functions	952
	Axiom Browser	962
	The Hyperdoc Browse Facility	963
3.72	mapping.ht	964
	Domain Mapping(T,S,...)	964
	Domain Constructor Mapping	965
3.73	mappkg1.ht	965
	MappingPackage1	965
3.74	mset.ht	978
	MultiSet	978
3.75	matrix.ht	984
	Matrix	984
	Creating Matrices	984
	Operations on Matrices	997
3.76	mkfunc.ht	1006
	MakeFunction	1006
3.77	mpoly.ht	1011
	MultivariatePolynomial	1011
3.78	newuser.ht	1018
	No More Help :-(.	1018
	You Tried It!	1018
3.79	none.ht	1019
	None	1019
3.80	numbers.ht	1021
	Axiom Number Types	1021
	Fraction	1023
	Rational Number	1025
	Integers	1029
	Integer Examples	1034
	Integer Example Proof	1036
	Integer Problems	1037
	Integer Problem Proof	1038

	Solution to Problem #1	1038
	Solution to Problem #2	1042
3.81	oct.ht	1044
	Octonion	1044
3.82	odpol.ht	1053
	OrderlyDifferentialPolynomial	1053
3.83	op.ht	1071
	Operator	1071
3.84	ovar.ht	1082
	OrderedVariableList	1082
3.85	perman.ht	1085
	Permanent	1085
3.86	pfr.ht	1088
	PartialFraction	1088
3.87	poly.ht	1095
	Polynomials	1095
	The Specific Polynomial Types	1096
	Basic Operations On Polynomials	1097
	Polynomial Evaluation and Substitution	1104
	Greatest Common Divisors, Resultants, and Discriminants	1108
	Roots of Polynomials	1110
3.88	poly1.ht	1110
	Polynomial	1110
3.89	quat.ht	1134
	Quaternion	1134
3.90	radix.ht	1140
	RadixExpansion	1140
3.91	reclos.ht	1149
	RealClosure	1149
3.92	record.ht	1182
	Domain Record(a:A,...,b:B)	1182
	Domain Constructor Record	1183
3.93	regset.ht	1184
	RegularTriangularSet	1184
3.94	roman.ht	1213
	RomanNumeral	1213
3.95	seg.ht	1218
	Segment	1218
3.96	segbind.ht	1224
	SegmentBinding	1224
3.97	set.ht	1227
	Set	1227
3.98	sint.ht	1237
	SingleInteger	1237
3.99	sqmatrix.ht	1243
	SquareMatrix	1243

3.100sregset.ht	1247
SquareFreeRegularTriangularSet	1247
3.101stbl.ht	1259
SparseTable	1259
3.102stream.ht	1263
Stream	1263
3.103string.ht	1269
String	1269
3.104strtbl.ht	1284
StringTable	1284
3.105symbol.ht	1286
Symbol	1286
3.106table.ht	1298
Table	1298
3.107textfile.ht	1307
TextFile	1307
3.108topics.ht	1313
Axiom Topics	1313
Solving Equations	1315
Linear Algebra	1316
Calculus	1318
3.109type.ht	1319
Category Type	1319
3.110union.ht	1319
Domain Union(a:A,...,b:B)	1319
Domain Constructor Union	1320
Domain Union(A,...,B)	1321
Domain Constructor Union	1322
3.111uniseg.ht	1322
UniversalSegment	1322
3.112up.ht	1327
UnivariatePolynomial	1327
3.113oreup.ht	1345
UnivariateSkewPolynomial	1345
3.114vector.ht	1351
Vector	1351
3.115void.ht	1357
Void	1357
3.116wutset.ht	1360
WuWenTsunTriangularSet	1360
3.117xmpexp.ht	1369
Some Examples of Domains and Packages	1369
3.118xpbwpoly.ht	1374
XPBWPolynomial	1374
3.119xpoly.ht	1395
XPolynomial	1395

<i>CONTENTS</i>	107
3.120xpr.ht	1402
XPolynomialRing	1402
3.121zdsolve.ht	1412
ZeroDimensionalSolvePackage	1412
3.122zlindep.ht	1463
IntegerLinearDependence	1463
4 Users Guide Pages (ug.ht)	1469
Users Guide	1470
5 Users Guide Chapter 0 (ug00.ht)	1473
What's New for May 2008	1473
New polynomial domains and algorithms	1474
Enhancements to HyperDoc and Graphics	1475
Enhancements to NAGLink	1476
Enhancements to the Lisp system	1476
6 Users Guide Chapter 1 (ug01.ht)	1483
An Overview of Axiom	1483
Starting Up and Winding Down	1484
Clef	1487
Typographic Conventions	1488
The Axiom Language	1489
Arithmetic Expressions	1490
Previous Results	1492
Some Types	1494
Symbols, Variables, Assignments, and Declarations	1497
Conversion	1503
Calling Functions	1505
Some Predefined Macros	1508
Long Lines	1509
Comments	1510
Graphics	1510
Numbers	1513
Data Structures	1532
Expanding to Higher Dimensions	1548
Writing Your Own Functions	1553
Polynomials	1566
Limits	1569
Series	1573
Derivatives	1580
Integration	1587
Differential Equations	1595
Solution of Equations	1602
System Commands	1606

7 Users Guide Chapter 2 (ug02.ht)	1613
Using Types and Modes	1613
The Basic Idea	1614
Domain Constructors	1619
Writing Types and Modes	1629
Types with No Arguments	1632
Types with One Argument	1633
Types with More Than One Argument	1636
Modes	1637
Abbreviations	1638
Declarations	1641
Records	1647
Unions	1656
Unions Without Selectors	1657
Unions With Selectors	1664
The “Any” Domain	1668
Conversion	1671
Subdomains Again	1679
Package Calling and Target Types	1686
Resolving Types	1696
Exposing Domains and Packages	1699
Commands for Snooping	1703
8 Users Guide Chapter 3 (ug03.ht)	1707
Using Hyperdoc	1707
Headings	1708
Key Definitions	1709
Scroll Bars	1710
Input Areas	1711
Radio Buttons and Toggles	1713
Search Strings	1714
Logical Searches	1715
Example Pages	1716
X Window Resources for Hyperdoc	1717
9 Users Guide Chapter 4 (ug04.ht)	1721
Input Files and Output Styles	1721
Input Files	1722
The .axiom.input File	1724
Common Features of Using Output Formats	1725
Monospace 2D Mathematical Format	1728
TeX Format	1731
IBM Script Formula Format	1732
FORTRAN Format	1734
HTML Format	1743
Immediate and Delayed Assignments	1745

Blocks	1753
if-then-else	1761
Loops	1765
Compiling vs. Interpreting Loops	1766
return in Loops	1767
break in Loops	1770
break vs. => in Loop Bodies	1773
More Examples of break	1774
iterate in Loops	1782
while Loops	1784
for Loops	1790
for i in n..m repeat	1791
for i in n..m by s repeat	1795
for i in n.. repeat	1797
for x in l repeat	1798
“Such that” Predicates	1800
Parallel Iteration	1802
Creating Lists and Streams with Iterators	1808
An Example: Streams of Primes	1815
10 Users Guide Chapter 6 (ug06.ht)	1823
User-Defined Functions, Macros and Rules	1823
Functions vs. Macros	1825
Macros	1827
Introduction to Functions	1835
Declaring the Type of Functions	1838
One-Line Functions	1841
Declared vs. Undeclared Functions	1846
Functions vs. Operations	1850
Delayed Assignments vs. Functions with No Arguments	1851
How Axiom Determines What Function to Use	1854
Compiling vs. Interpreting	1858
Piece-Wise Function Definitions	1861
A Basic Example	1862
Picking Up the Pieces	1869
Predicates	1876
Caching Previously Computed Results	1880
Recurrence Relations	1883
Making Functions from Objects	1889
Functions Defined with Blocks	1898
Free and Local Variables	1906
Anonymous Functions	1921
Some Examples	1922
Declaring Anonymous Functions	1927
Example: A Database	1932
Example: A Famous Triangle	1939

Example: Testing for Palindromes	1944
Rules and Pattern Matching	1949
11 Users Guide Chapter 7 (ug07.ht)	1967
Graphics	1967
Two-Dimensional Graphics	1968
Plotting Two-Dimensional Functions of One Variable	1969
Plotting 2D Parametric Plane Curves	1972
Plotting Plane Algebraic Curves	1976
Two-Dimensional Options	1978
Color	1983
Palette	1985
Two-Dimensional Control-Panel	1988
Operations for Two-Dimensional Graphics	1991
Addendum: Building Two-Dimensional Graphs	1995
Addendum: Appending a Graph to a Viewport Window Containing a Graph	2015
Three-Dimensional Graphics	2018
Plotting Three-Dimensional Functions of Two Variables	2019
Plotting Three-Dimensional Parametric Space Curves	2022
Plotting 3D Parametric Surfaces	2025
Three-Dimensional Options	2028
The makeObject Command	2038
Building 3D Objects From Primitives	2041
Coordinate System Transformations	2053
Three-Dimensional Clipping	2061
Three-Dimensional Control-Panel	2062
Operations for Three-Dimensional Graphics	2068
Customization using .Xdefaults	2074
12 Users Guide Chapter 8 (ug08.ht)	2077
Advanced Problem Solving	2077
Numeric Functions	2079
Polynomial Factorization	2101
Integer and Rational Number Coefficients	2102
Finite Field Coefficients	2104
Simple Algebraic Extension Field Coefficients	2106
Factoring Rational Functions	2111
Manipulating Symbolic Roots of a Polynomial	2112
Using a Single Root of a Polynomial	2113
Using All Roots of a Polynomial	2117
Computation of Eigenvalues and Eigenvectors	2123
Solution of Linear and Polynomial Equations	2130
Solution of Systems of Linear Equations	2131
Solution of a Single Polynomial Equation	2135
Solution of Systems of Polynomial Equations	2140
Limits	2145

Laplace Transforms	2152
Integration	2157
Working with Power Series	2164
Creation of Power Series	2166
Coefficients of Power Series	2172
Power Series Arithmetic	2175
Functions on Power Series	2178
Converting to Power Series	2186
Power Series from Formulas	2194
Substituting Numerical Values in Power Series	2201
Example: Bernoulli Polynomials and Sums of Powers	2203
Solution of Differential Equations	2211
Closed-Form Solutions of Linear Differential Equations	2212
Closed-Form Solutions of Non-Linear DEs	2220
Power Series Solutions of Differential Equations	2230
Finite Fields	2235
Modular Arithmetic and Prime Fields	2237
Extensions of Finite Fields	2246
Irreducible Mod Polynomial Representations	2249
Cyclic Group Representations	2258
Normal Basis Representations	2264
Conversion Operations for Finite Fields	2272
Utility Operations for Finite Fields	2280
Primary Decomposition of Ideals	2297
Computation of Galois Groups	2306
Non-Associative Algebras and Genetic Laws	2325
13 Users Guide Chapter 10 (ug10.ht)	2337
Interactive Programming	2337
Drawing Ribbons Interactively	2338
A Ribbon Program	2344
Coloring and Positioning Ribbons	2347
Points, Lines, and Curves	2348
A Bouquet of Arrows	2355
Drawing Complex Vector Fields	2357
Drawing Complex Functions	2361
Functions Producing Functions	2364
Automatic Newton Iteration Formulas	2366
14 Users Guide Chapter 11 (ug11.ht)	2375
Packages	2375
Names, Abbreviations, and File Structure	2377
Syntax	2379
Abstract Datatypes	2380
Capsules	2381
Input Files vs. Packages	2382

Compiling Packages	2383
Parameters	2387
Conditionals	2390
Testing	2392
How Packages Work	2399
15 Users Guide Chapter 12 (ug12.ht)	2403
Categories	2403
Definitions	2405
Exports	2407
Documentation	2408
Hierarchies	2410
Membership	2411
Defaults	2412
Axioms	2414
Correctness	2415
Attributes	2416
Parameters	2419
Conditionals	2420
Anonymous Categories	2422
16 Users Guide Chapter 13 (ug13.ht)	2425
Domains	2425
Domains vs. Packages	2426
Definitions	2427
Category Assertions	2429
A Demo	2431
Browse	2435
Representation	2436
Multiple Representations	2437
Add Domain	2438
Defaults	2439
Origins	2441
Short Forms	2442
Example 1: Clifford Algebra	2443
Example 2: Building A Query Facility	2445
A Little Query Language	2447
The Database Constructor	2450
Query Equations	2452
DataLists	2454
Index Cards	2455
Creating a Database	2455
Putting It All Together	2456
Example Queries	2457

17 Users Guide Chapter 14 (ug14.ht)	2471
Browse	2471
The Front Page: Searching the Library	2472
The Constructor Page	2474
Constructor Page Buttons	2476
Cross Reference	2478
Views Of Constructors	2482
Giving Parameters to Constructors	2484
Miscellaneous Features of Browse	2485
The Description Page for Operations	2486
Views of Operations	2487
Capitalization Convention	2490
18 Users Guide Chapter 15 (ug15.ht)	2493
What's New in Axiom Version 2.0	2493
Important Things to Read First	2494
The NAG Library Link	2494
Interpreting NAG Documentation	2495
Using the Link	2498
Providing values for Argument Subprograms	2501
General Fortran-generation utilities in Axiom	2505
Some technical information	2530
Interactive Front-end and Language	2531
Library	2532
HyperDoc	2534
Documentation	2535
19 Users Guide Chapter 16 (ug16.ht)	2537
Axiom System Commands	2538
Introduction	2540
)abbreviation	2542
)boot	2544
)cd	2545
)close	2546
)clear	2547
)compile	2549
)display	2552
)edit	2554
)fin	2555
)frame	2556
)help	2558
)history	2559
)library	2563
)lisp	2565
)load	2566
)ltrace	2566

)pquit	2567
)quit	2569
)read	2570
)set	2571
)show	2573
)spool	2574
)synonym	2575
)system	2576
)trace	2578
)undo	2584
)what	2586

20 Users Guide Chapter 21 (ug21.ht) 2589

Programs for Axiom Images	2589
images1.input	2590
images2.input	2591
images3.input	2591
images5.input	2592
images6.input	2594
images7.input	2595
images8.input	2596
conformal.input	2597
tknot.input	2601
ntube.input	2601
dhtri.input	2604
tetra.input	2605
antoine.input	2607
scherk.input	2608

21 Hypertext Language Pages 2611

Creating Hyperdoc Pages	2611
21.1 htxadvpage1.ht	2612
Input Areas	2612
HTXAdvPage1xPatch1 patch	2613
HTXAdvPage1xPatch1A patch	2613
HTXAdvPage1xPatch2 patch	2614
HTXAdvPage1xPatch2A patch	2614
21.2 htxadvpage2.ht	2615
Radio buttons	2615
21.3 htxadvpage3.ht	2618
Macros	2618
21.4 htxadvpage4.ht	2619
Patch and Paste	2619
patch1 patch	2622
Patch1 patch	2622
Patch2 patch	2623

21.5	htxadvpage5.ht	2623
	Axiom paste-ins	2623
21.6	htxadvpage6.ht	2626
	Miscellaneous	2626
	HTXAdvPage6xPatch1 patch	2628
	HTXAdvPage6xPatch1A patch	2628
	HTXAdvPage6xPatch2 patch	2628
	HTXAdvPage6xPatch2A patch	2629
	HTXAdvPage6xPatch3 patch	2629
	HTXAdvPage6xPatch3A patch	2629
21.7	htxadvtoppage.ht	2630
	Advanced features in Hyperdoc	2630
21.8	htxformatpage1.ht	2631
	Using the special characters	2631
	HTXFormatPage1xPatch1 patch	2632
	HTXFormatPage1xPatch2 patch	2632
21.9	htxformatpage2.ht	2633
	Formatting without commands	2633
	HTXFormatPage2xPatch1 patch	2634
	HTXFormatPage2xPatch2 patch	2635
	HTXFormatPage2xPatch2A patch	2635
	HTXFormatPage2xPatch3 patch	2636
	HTXFormatPage2xPatch3A patch	2636
	HTXFormatPage2xPatch4 patch	2637
	HTXFormatPage2xPatch4A patch	2637
21.10	htxformatpage3.ht	2637
	Using different fonts	2637
	HTXFormatPage3xPatch1 patch	2639
	HTXFormatPage3xPatch2 patch	2640
	HTXFormatPage3xPatch3 patch	2640
	HTXFormatPage3xPatch4 patch	2641
21.11	htxformatpage4.ht	2641
	Indentation	2641
	HTXFormatPage4xPatch1 patch	2644
	HTXFormatPage4xPatch1A patch	2644
	HTXFormatPage4xPatch2 patch	2644
	HTXFormatPage4xPatch2A patch	2645
	HTXFormatPage4xPatch3 patch	2645
	HTXFormatPage4xPatch3A patch	2646
	HTXFormatPage4xPatch4 patch	2646
	HTXFormatPage4xPatch5 patch	2647
	HTXFormatPage4xPatch5A patch	2647
21.12	htxformatpage5.ht	2648
	Creating Lists and Tables	2648
	HTXFormatPage5xPatch1 patch	2650
	HTXFormatPage5xPatch1A patch	2651

HTXFormatPage5xPatch2 patch	2651
HTXFormatPage5xPatch2A patch	2652
HTXFormatPage5xPatch3 patch	2652
HTXFormatPage5xPatch3A patch	2653
21.13htxformatpage6	2653
Boxes and Lines	2653
HTXFormatPage6xPatch1 patch	2654
HTXFormatPage6xPatch2 patch	2655
21.14htxformatpage7	2655
Micro-Spacing	2655
HTXFormatPage7xPatch1 patch	2657
HTXFormatPage7xPatch2 patch	2658
HTXFormatPage7xPatch2A patch	2658
HTXFormatPage7xPatch3 patch	2658
HTXFormatPage7xPatch3A patch	2659
21.15htxformatpage8	2660
Bitmaps and Images	2660
HTXFormatPage8xPatch1 patch	2661
HTXFormatPage8xPatch2 patch	2662
HTXFormatPage8xPatch2A patch	2662
21.16htxformattoppage.ht	2662
Formatting in Hyperdoc	2662
21.17htxintropage1.ht	2663
What Hyperdoc does	2663
21.18htxintropage2.ht	2664
How Hyperdoc does it	2664
21.19htxintropage3.ht	2666
A simple text page	2666
21.20htxintrotoppage.ht	2668
First Steps	2668
21.21htxlinkpage1.ht	2669
Linking to a named page	2669
HTXLinkPage1xPatch1 patch	2671
HTXLinkPage1xPatch1A patch	2671
Test Help Page	2672
21.22htxlinkpage2.ht	2672
Standard Pages	2672
HTXLinkPage2xPatch1 patch	2674
HTXLinkPage2xPatch1A patch	2674
21.23htxlinkpage3.ht	2675
Active Axiom commands	2675
HTXLinkPage3xPatch1 patch	2678
HTXLinkPage3xPatch1A patch	2679
HTXLinkPage3xPatch2 patch	2679
HTXLinkPage3xPatch2A patch	2679
HTXLinkPage3xPatch3 patch	2680

HTXLinkPage3xPatch3A patch	2680
21.24htxlinkpage4.ht	2681
Linking to Lisp	2681
HTXLinkPage4xPatch1 patch	2685
HTXLinkPage4xPatch1A patch	2686
HTXLinkPage4xPatch2 patch	2686
HTXLinkPage4xPatch2A patch	2686
HTXLinkPage4xPatch3 patch	2687
HTXLinkPage4xPatch3A patch	2687
HTXLinkPage4xPatch4 patch	2688
HTXLinkPage4xPatch4A patch	2688
HTXLinkPage4xPatch5 patch	2688
HTXLinkPage4xPatch5A patch	2689
21.25htxlinkpage5.ht	2690
Linking to Unix	2690
HTXLinkPage5xPatch1 patch	2691
HTXLinkPage5xPatch1A patch	2692
HTXLinkPage5xPatch2 patch	2692
HTXLinkPage5xPatch2A patch	2692
21.26htxlinkpage6.ht	2693
How to use your pages with Hyperdoc	2693
HTXLinkPage6xPatch1 patch	2695
HTXLinkPage6xPatch1A patch	2697
HTXLinkPage6xPatch2 patch	2697
HTXLinkPage6xPatch2A patch	2698
21.27htxlinktoppage.ht	2698
Actions in Hyperdoc	2698
21.28htxtoppage.ht	2699
Extending Hyperdoc	2699
21.29htxtrypage.ht	2700
Try out Hyperdoc	2700
22 NAG Library Routines	2703
22.1 nagaux.ht	2703
NAG On-line Documentation	2703
NAG Documentation: summary	2705
NAG Documentation: introduction	2727
NAG Documentation: keyword in context	2744
NAG Documentation: conversion	2842
22.2 nagc.ht	2845
Zeros of Polynomials	2845
Roots of a complex polynomial equation	2849
Roots of a real polynomial equation	2854
Roots of One or More Transcendental Equations	2860
Zero of a continuous function in a given interval	2864
Solution of a system of nonlinear equations	2868

	Solution of a system of nonlinear equations	2872
	Checks the gradients of a set of non-linear functions	2878
	Discrete Fourier transform of real or complex data values	2881
	Discrete Fourier transform of n real data values	2889
	Discrete Fourier transform of a Hermitian sequence	2892
	Discrete Fourier transform of n complex data values	2896
	Circular convolution or correlation of two real vectors	2899
	Discrete Fourier transforms of m sequences	2903
	Discrete Fourier transforms of m Hermitian sequences	2908
	Discrete Fourier transforms of m complex sequences	2912
	Discrete Fourier transform of bivariate complex data	2916
	Summation of Series	2921
	Complex conjugate of a sequence of n data values	2923
	Complex conjugates of m Hermitian sequences	2925
	Form real and imaginary parts of m Hermitian sequences	2927
22.3	nagd.ht	2930
	Quadrature	2930
	Approximation of the integral over a finite interval	2943
	Adaptive integration over a finite interval	2949
	Approximate integration with local singular points	2955
	Approximate integration over a (semi-)infinite interval	2961
	Approximate sine or cosine transform over finite interval	2967
	Adaptive integration of weighted function over an interval	2973
	Hilbert transform over finite interval	2979
	Approximate Sine or Cosine over $[a, \infty]$	2985
	Weights and abscissae for Gaussian quadrature formula	2992
	Multidimensional integrals with finite limits	2998
	Third-order finite-difference integration	3003
	Monte Carlo integration over hyper-rectangular regions	3006
	Ordinary Differential Equations	3011
	First-order ODE over an interval with initial conditions	3018
	First-order ODE with initial conditions and user function	3026
	First-order ODE with variable-order, variable-step	3034
	Stiff First-order ODE with variable order and step	3043
	Two-point boundary-value ODE	3052
	Two-point boundary value ODE with deferred correction	3059
	Eigenevalue of regular singular 2nd-order Sturm-Liouville	3067
	Two-point boundary-value ODE equation systems	3090
	Partial differential equations	3104
	Discrete elliptic PDE on rectangular region	3111
	Discrete 2nd-order elliptic PDE on rectangular regions	3119
	Helmholtz equation in 3 dimensions	3132
22.4	nage.ht	3142
	Interpolation	3142
	Cubic spline interpolant	3147
	Monotonicity-preserving piecewise cubic Hermite interpolant	3152

Piecewise cubic Hermite interpolant	3155
Piecewise cubic Hermite interpolant and 1st deriv	3158
Definite integral of piecewise cubic Hermite interpolant	3161
Bicubic spline interpolated surface	3163
Two-D surface interpolating a set of scattered data points	3170
Evaluate 2D interpolant function from E01SAF	3173
Generate 2D surface interpolating a scattered data points	3176
Evaluate 2D interpolating function from E01SEF	3182
Curve and Surface Fitting	3185
Least-squares polynomial approximations	3210
Evaluate polynomial from Chebyshev-series representation	3216
Constrained weighted least-squares polynomial	3220
Coefficients of polynomial derivative	3228
Find coefficients of indefinite integral of polynomial	3233
Evaluate polynomial in Chebyshev-series representation	3238
Weighted least-squares approx to data points	3243
Evaluates a cubic spline from its B-spline representation	3250
Evaluate cubic spline and 3 derivatives from B-spline	3254
Definite integral of cubic spline from B-spline	3259
Cubic spline approximation to an arbitrary set points	3263
Minimal, weighted least-squares bicubic spline fit	3272
Bicubic spline approximation to a set of data values	3281
Bicubic spline approximation to a set of scattered data	3292
Calculates values of a bicubic spline from B-spline	3304
Calculates values of a bicubic spline from B-spline	3308
Calculates l_1 solution to over-determined system equations	3312
Sorts two-dimensional data into rectangular panels	3318
Minimizing or Maximizing a Function	3322
Minimizes a nonlinear function of several variable	3347
Supply optional parameters to E04DGF from file	3362
Supply individual optional params to E04DGF	3365
Finding an unconstrained minimum of a sum of squares	3367
Finding an unconstrained minimum of a sum of squares	3373
Finding a minimum of a function	3380
Solving linear programming problems	3386
Solving linear or quadratic problems	3395
Minimize an arbitrary smooth constrained function	3415
Supply optional parameters to E04UCF from file	3466
Supply individual optional params to E04UCF	3469
Estimates of elements of the variance-covariance matrix	3472
22.5 nagf.ht	3478
Linear Algebra	3478
Matrix Factorization	3482
Factorizes a real sparse matrix	3485
Factorizes a real sparse matrix	3495
Incomplete Cholesky factorization	3501

Cholesky factor of a symmetric positive-definite matrix	3508
QR factorization of the real m by n matrix A	3513
$B := QB$ or $B := Q^T B$	3518
First $ncolq$ columns of the real m by m orthogonal matrix	3523
QR factorization of the complex m by n matrix A	3527
$B := QB$ or $B := Q^H B$	3532
First $ncolq$ columns of the complex m by m unitary matrix	3538
Eigenvalues and Eigenvectors	3543
Calculates all the eigenvalues of a real symmetric matrix	3549
Eigenvalues and eigenvectors of a real symmetric matrix	3551
Calculates all the eigenvalues of $Ax = \lambda Bx$	3554
Eigenvalues and eigenvectors of $Ax = \lambda Bx$	3557
Calculates all the eigenvalues of a real unsymmetric matrix	3561
Eigenvalues and eigenvectors of a real unsymmetric matrix	3563
Calculates all the eigenvalues of a complex matrix	3566
Eigenvalues and eigenvectors of a complex matrix	3569
Eigenvalues of a complex Hermitian matrix	3572
Eigenvalues/eigenvectors complex Hermitian matrix	3575
Eigenvalues and eigenvectors of a real symmetric matrix	3578
Eigenvalues of generalized eigenproblem $Ax = \lambda Bx$	3582
Eigenvalues and eigenvectors of real sparse symmetric problem	3586
Singular value decomposition of a general real matrix	3600
Singular value decomposition of a general complex matrix	3608
Simultaneous Linear Equations	3615
Approximate solution of a set of complex linear equations	3621
Approximate solution of a set of real linear equations	3624
Real symmetric positive-definite linear equations	3627
Set of real linear equations with a single right-hand side	3630
Solution of a set of real sparse linear equations	3634
Real symmetric positive-definite tridiagonal linear equations	3637
Solution of a linear least-squares problem, $Ax = b$	3642
Sparse symmetric positive-definite system linear equations	3648
Solves a system of real sparse symmetric linear equations	3655
Solution of a system of real linear equations	3666
Solves sparse unsymmetric equations	3671
Linear Algebra Support Routines	3685
Linear Equations (LAPACK)	3718
Computes the LU factorization of a real m by n matrix	3719
Solves a real system of linear equations	3722
Factorization of a real symmetric positive-definite matrix	3726
Real symmetric positive-definite system of linear equations	3730
Sort vector of double precision numbers	3737
Ranks a vector of double precision numbers	3740
Ranks the rows of a matrix of double precision numbers	3742
Ranks the columns of a matrix of double precision numbers	3745
Rearranges a vector of double precision numbers	3748

	Inverts a permutation	3751
22.6	nags.ht	3754
	Approximations of Special Functions	3754
	Exponential function e^z , for complex z	3767
	Returns the value of the exponential integral $E(x)$	3770
	Returns the value of the cosine integral	3773
	Returns the value of the sine integral	3776
	Returns the value of the Gamma function	3779
	Returns a value for the logarithm of the Gamma function	3782
	Incomplete gamma functions $P(a,x)$ and $Q(a,x)$	3786
	Returns the value of the complementary error function	3789
	Returns the value of the error function erfx	3793
	Returns the value of the Bessel Function $Y_0(x)$	3795
	Returns the value of the Bessel Function $Y_1(x)$	3799
	Returns the value of the Bessel Function $J_0(x)$	3804
	Returns the value of the Bessel Function $J_1(x)$	3807
	Returns a value for the Airy function, $Ai(x)$	3811
	Returns a value of the Airy function, $Bi(x)$	3816
	Value of the derivative of the Airy function $Ai(x)$	3820
	Value for the derivative of the Airy function $Bi(x)$	3824
	Values for the Bessel functions $Y_{\nu+n}(z)$	3828
	Values for the Bessel functions $J_{\nu+n}(z)$	3833
	Value of the Airy function $Ai(z)$ or derivative $Ai'(z)$	3838
	Value of the Airy function $Bi(z)$ or derivative $Bi'(z)$	3842
	Returns a sequence of values for the Hankel functions	3846
	Returns the value of the modified Bessel Function $K_0(x)$	3852
	Returns the value of the modified Bessel Function $K_1(x)$	3855
	Returns the value of the modified Bessel Function $I_0(x)$	3859
	Returns a value for the modified Bessel Function $I_1(x)$	3863
	Sequence of values for the modified Bessel $K_{\nu_n}(z)$	3866
	Sequence of values for the modified Bessel $I_{\nu+n}$	3871
	Returns a value for the Kelvin function $\operatorname{ber} x$	3875
	Returns a value for the Kelvin function $\operatorname{bei} x$	3879
	Returns a value for the Kelvin function $\operatorname{ker} x$	3882
	Returns a value for the Kelvin function keix	3886
	Returns a value for the Fresnel Integral $S(x)$	3890
	Returns a value for the Fresnel Integral $C(x)$	3894
	Returns a value of an elementary integral	3898
	Value of the symmetrised elliptic integral of first kind	3902
	Value of the symmetrised elliptic integral of second kind	3906
	Value of the symmetrised elliptic integral of third kind	3911
22.7	nagx.ht	3916
	Mathematical Constants	3916
	Machine Constants	3917
	Input/Output Utilities	3924
	Value of the current error message unit number	3926

Value of the current advisory message unit number	3928
Print a real matrix stored in a two-dimensional array	3931
Print a complex matrix stored in a 2D array	3934
Date and Time Utilities	3938
Returns the current date and time	3940
From seven-integer format time and date to character string	3941
Compares two date/time character strings	3944
Amount of processor time used	3947
23 NAG ASP Example Code	3949
23.1 aspex.ht	3949
Asp1 Example Code	3949
Asp10 Example Code	3949
Asp12 Example Code	3950
Asp19 Example Code	3950
Asp20 Example Code	3953
Asp24 Example Code	3953
Asp27 Example Code	3954
Asp28 Example Code	3954
Asp29 Example Code	3957
Asp30 Example Code	3958
Asp31 Example Code	3959
Asp33 Example Code	3959
Asp34 Example Code	3960
Asp35 Example Code	3960
Asp4 Example Code	3961
Asp41 Example Code	3961
Asp42 Example Code	3962
Asp49 Example Code	3963
Asp50 Example Code	3964
Asp55 Example Code	3965
Asp6 Example Code	3966
Asp7 Example Code	3966
Asp73 Example Code	3967
Asp74 Example Code	3967
Asp77 Example Code	3968
Asp78 Example Code	3969
Asp8 Example Code	3969
Asp80 Example Code	3970
Asp9 Example Code	3970
24 NAG ANNA Expert System	3973
24.1 annaex.ht	3973
Axiom/NAG Expert System	3973
Integration	3974
Ordinary Differential Equations	3975

Optimization	3975
Partial Differential Equations	3976
Examples Using the Axiom/NAG Expert System	3977
Examples Using the Axiom/NAG Expert System	3978
Examples Using the Axiom/NAG Expert System	3979
Examples Using the Axiom/NAG Expert System	3981
About the Axiom/NAG Expert System	3982
Introduction to the Axiom/NAG Expert System	3983
Example using the Axiom/NAG Expert System	3984
Example using the Axiom/NAG Expert System	3989
Example using the Axiom/NAG Expert System	3990
Decision Agents	3991
Inference Mechanisms	3992
Method Domains	3993
Measure Functions	3994
Computational Agents	3995
25 ANNA Algebra Code	3997
26 Page hierarchy layout	3999
27 Makefile	4033

Volume 8: Axiom Graphics

1	Overview	1
1.1	Environment Settings	1
	X11 .Xdefaults	1
	Shell Variables	2
1.2	Pre-release change history	3
2	Graphics File Formats	9
2.1	The viewFile data file format	9
	The viewType	9
	The title	9
	The window boundaries	10
	The graph specifications	10
2.2	The graph file format	12
	The bounding values	12
2.3	The parabola	14
2.4	3D graph information	16
3	include	19
3.1	actions.h	19
3.2	colors.h	22
3.3	component.h	23
3.4	g.h	25
3.5	nox10.h	26
3.6	override.h	27
3.7	rgb.h	28
3.8	spadcolors.h	28
3.9	tube.h	29
3.10	view2d.h	32
3.11	view3d.h	34
3.12	viewcommand.h	36
3.13	view.h	36
3.14	write.h	37
3.15	xdefs.h	38
4	viewman	41
4.1	viewman Call Graph	41
4.2	Constants and Headers	43
	defines	43
	System includes	44
	Local includes	44
	extern references	45
	forward references	45
	global variables	46

4.3	Code	47
	endChild	47
	rmViewMgr	47
	closeChildViewport	49
	goodbye	49
	funView2D	49
	forkView2D	51
	sendGraphToView2D	54
	funView3D	55
	forkView3D	58
	makeView2DFromSpadData	61
	makeView3DFromSpadData	62
	makeGraphFromSpadData	64
	discardGraph	65
	readViewport	66
	superSelect	66
	brokenPipe	67
	main	67
5	viewalone	71
5.1	viewalone Call Graph	71
5.2	Constants and Headers	73
	System includes	73
	Local includes	73
	defines	73
	extern references	74
	global variables	74
5.3	Code	75
	sendGraphToView2D	75
	makeView2DFromFileData	76
	makeView3DFromFileData	80
	spoonView2D	82
	spoonView3D	83
	main	86
6	view2d	87
6.1	view2d Call Graph	87
6.2	Constants and Headers	96
	System includes	96
	local includes	96
	static variables	97
	structs	97
	defines	99
	extern references	104
	forward references	105
	global variables	107

6.3	Code	109
	initButtons	109
	writeControlTitle	121
	makeMessageFromData	122
	writeControlMessage	123
	drawControlPanel	123
	getControlXY	127
	makeControlPanel	128
	putControlPanelSomewhere	130
	clearControlMessage	131
	getGraphFromViewman	131
	freeGraph	133
	mergeDatabases	133
	getPotValue	134
	doPick	135
	doDrop	135
	clickedOnGraphSelect	136
	drawControlPushButton	137
	buttonAction	137
	processEvents	143
	clickedOnGraph	149
	readViewman	150
	spadAction	151
	absolute	155
	goodbye	155
	writeTitle	156
	drawTheViewport	156
	makeViewport	164
	makeView2D	166
	writeViewport	167
	main	170
7	view3d	177
7.1	view3d Call Graph	177
7.2	Constants and Headers	190
	System includes	190
	Local includes	190
	defines	191
	static variables	205
	structs	206
	extern references	209
	forward references	211
	global variables	215
7.3	Code	219
	initButtons	219
	closeViewport	226

scaleComponents	227
makeTriangle	228
triangulate	229
readComponentsFromViewman	231
calcNormData	232
make3DComponents	233
draw3DComponents	235
drawColorMap	242
writeControlTitle	244
clearControlMessage	244
writeControlMessage	244
drawControlPanel	245
getControlXY	256
makeControlPanel	257
putControlPanelSomewhere	259
phong	260
hueValue	261
getHue	261
Value	261
hlsTOrgb	262
initLightButtons	262
makeLightingPanel	264
drawLightingAxes	266
drawLightTransArrow	268
drawLightingPanel	269
theHandler	274
mergeDatabases	274
getMeshNormal	275
normalizeVector	275
dotProduct	276
merge	277
msort	278
getPotValue	278
getLinearPotValue	279
buttonAction	279
processEvents	293
project	308
projectAPoint	309
projectAllPoints	309
projectAllPolys	310
projectAPoly	311
projectStuff	313
makeQuitPanel	314
drawQuitPanel	315
initQuitButtons	316
makeSavePanel	316

drawSavePanel	318
initSaveButtons	318
getCBufferAxes	319
putCBufferAxes	320
getCBufferIndx	320
putCBufferIndx	320
putZBuffer	321
getZBuffer	321
putImageX	321
drawPhongSpan	321
scanPhong	323
boxTObuffer	325
clipboxTObuffer	327
axesTObuffer	328
scanLines	330
freePolyList	333
showAxesLabels	333
makeTriangle	334
drawPhong	336
readViewman	339
scalePoint	339
spadAction	339
traverse	345
absolute	345
getRandom	346
normDist	346
goodbye	346
drawLineComponent	347
drawOpaquePolygon	348
copyPolygons	349
minMaxPolygons	351
polyCompare	352
makeTriangle	352
makeTriangle	352
freePointReservoir	355
freeListOfPolygons	356
drawPolygons	356
lessThan	359
greaterThan	359
isNaN	360
isNaNPoint	360
equal	360
matrixMultiply4x4	360
vectorMatrix4	361
ROTATE	362
ROTATE1	362

SCALE	363
TRANSLATE	363
writeTitle	363
drawPreViewport	364
drawTheViewport	369
makeViewport	371
postMakeViewport	376
keepDrawingViewport	377
initVolumeButtons	378
makeVolumePanel	381
drawClipXBut	382
drawClipYBut	383
drawClipZBut	385
drawClipVolume	385
drawHitherControl	387
drawEyeControl	388
drawFrustrum	389
drawVolumePanel	389
writeViewport	392
main	395
8 gdraws	403
Gdraw	403
To use G Functions	404
8.1 gfun.c	405
filecopy	406
PSCreateFile	406
GdrawsDrawFrame	408
GdrawsSetDimension	408
GDrawImageString	409
GDrawArc	410
GDrawLine	411
GDrawLines	412
GDrawPoint	413
GDrawRectangle	413
GDraw3DButtonIn	414
GDraw3DButtonIn	415
GDrawPushButton	415
GDrawString	416
GFillArc	417
PSGlobalInit	417
PSInit	420
PSCreateContext	420
PSfindGC	421
GSetForeground	422
GSetBackground	423

	GSetLineAttributes	423
	PSClose	425
	centerX	425
	centerY	426
	PSColorPolygon	426
	PSColorwOutline	427
	PSDrawColor	428
	PSFillPolygon	428
	PSFillwOutline	429
	TrivEqual	430
	TrivHashCode	430
	XCreateAssocTable	430
	XMakeAssoc	431
	XLookUpAssoc	431
	XDeleteAssoc	431
8.2	The postscript command definitions	432
	colorpoly	432
	colorwol	432
	drawarc	433
	drawcolor	434
	drawIstr	434
	drawline	436
	drawlines	436
	drawpoint	437
	draw	437
	drawrect	438
	drawstr	438
	drwfilled	439
	end	440
	fillarc	440
	fillpoly	441
	fillwol	441
	header	442
	setup	446
9	The APIs	447
9.1	Graphics API	447
	XDrawString	447
	XDrawPoint	448
	XDrawLine	448
	XDrawImageString	449
	XFillArc	450
	XDrawArc	451
	XSetForeground	452
	XSetBackground	452
	XSetLineAttributes	452

<i>CONTENTS</i>	131
DefaultScreen	453
RootWindow	453
XCreateAssocTable	453
XOpenDisplay	453
9.2 X11 API calls	454
10 Makefile	461

Volume 8.1: Axiom Gallery

1	General examples	1
1.1	Two dimensional functions	1
	A Simple Sine Function	2
	A Simple Sine Function, Non-adaptive plot	3
	A Simple Sine Function, Drawn to Scale	4
	A Simple Sine Function, Polar Plot	5
	A Simple Tangent Function, Clipping On	6
	A Simple Tangent Function, Clipping On	7
	Tangent and Sine	8
	A 2D Sine Function in BiPolar Coordinates	9
	A 2D Sine Function in Elliptic Coordinates	10
	A 2D Sine Wave in Polar Coordinates	11
1.2	Two dimensional curves	11
	A Line in Parabolic Coordinates	12
	Lissajous Curve	13
	A Parametric Curve	14
	A Parametric Curve in Polar Coordinates	15
1.3	Three dimensional functions	15
	A 3D Constant Function in Elliptic Coordinates	16
	A 3D Constant Function in Oblate Spheroidal	17
	A 3D Constant in Polar Coordinates	18
	A 3D Constant in Prolate Spheroidal Coordinates	19
	A 3D Constant in Spherical Coordinates	20
	A 2-Equation Space Function	21
1.4	Three dimensional curves	21
	A Parametric Space Curve	22
	A Tube around a Parametric Space Curve	23
	A 2-Equation Cylindrical Curve	24
1.5	Three dimensional surfaces	24
	A Icosahedron	25
	A 3D figure 8 immersion (Klein bagel)	27
	A 2-Equation bipolarCylindrical Surface	28
	A 3-Equation Parametric Space Surface	29
	A 3D Vector of Points in Elliptic Cylindrical	30
	A 3D Constant Function in BiPolar Coordinates	31
	A Swept in Parabolic Coordinates	32
	A Swept Cone in Parabolic Cylindrical Coordinates	33
	A Truncated Cone in Toroidal Coordinates	34
	A Swept Surface in Paraboloidal Coordinates	35
2	Jenks Book images	37
	The Complex Gamma Function	38
	The Complex Arctangent Function	39

3	Hyperdoc examples	41
3.1	Two dimensional examples	41
	A function of one variable	42
	A Parametric function	43
	A Polynomial in 2 variables	44
3.2	Three dimensional examples	44
	A function of two variables	45
	A parametrically defined curve	46
	A parametrically defined surface	47
4	CRC Standard Curves and Surfaces [?]	49
4.1	Standard Curves and Surfaces	49
4.2	CRC graphs	50
	Functions with $x^{n/m}$	50
	Functions with x^n and $(a + bx)^m$	61
	Functions with $a^2 + x^2$ and x^m	104
	Functions with $a^2 - x^2$ and x^m	114
	Functions with $a^3 + x^3$ and x^m	125
	Functions with $a^3 - x^3$ and x^m	133
	Functions with $a^4 + x^4$ and x^m	140
	Functions with $a^4 - x^4$ and x^m	148
	Functions with $(a + bx)^{1/2}$ and x^m	156
5	Pasta by Design[?]	171
5.1	Acini Di Pepe	172
5.2	Agnolotti	173
5.3	Anellini	174
5.4	Bucatini	175
5.5	Buccoli	176
5.6	Calamaretti	177
5.7	Cannelloni	178
5.8	Cannolicchi Rigati	179
5.9	Capellini	180
5.10	Cappelletti	181
5.11	Casarecce	182
5.12	Castellane	183
5.13	Cavatappi	184
5.14	Cavatelli	185
5.15	Chifferi Rigati	186
5.16	Colonne Pompeii	187
5.17	Conchiglie Rigate	189
5.18	Conchigliette Lisce	190
5.19	Conchiglioni Rigate	191
5.20	Corallini Lisci	192
5.21	Creste Di Galli	193
5.22	Couretti	194

5.23 Ditali Rigati	195
5.24 Fagottini	196
5.25 Farfalle	197
5.26 Farfalline	199
5.27 Farfalloni	200
5.28 Festonati	202
5.29 Fettuccine	203
5.30 Fiocchi Rigati	204
5.31 Fisarmoniche	205
5.32 Funghini	206
5.33 Fusilli	207
5.34 Fusilli al Ferretto	208
5.35 Fusilli Capri	209
5.36 Fusilli Lunghi Bucati	210
5.37 Galletti	212
5.38 Garganelli	213
5.39 Gemelli	214
5.40 Gigli	215
5.41 Giglio Ondulato	216
5.42 Gnocchetti Sardi	217
5.43 Gnocchi	218
5.44 Gramigna	219
5.45 Lancette	220
5.46 Lasagna Larga Doppia Riccia	221
5.47 Linguine	222
5.48 Lumaconi Rigati	223
5.49 Maccheroni	224
5.50 Maccheroni Alla Chitarra	225
5.51 Mafaldine	226
5.52 Manicotti	227
5.53 Orecchiette	229
5.54 Paccheri	230
5.55 Pappardelle	231
5.56 Penne Rigate	232
5.57 Pennoni Lisci	233
5.58 Pennoni Rigati	234
5.59 Puntalette	235
5.60 Quadrefiore	236
5.61 Quadretti	237
5.62 Racchette	238
5.63 Radiatori	240
5.64 Ravioli Quadrati	241
5.65 Ravioli Tondi	242
5.66 Riccioli	243
5.67 Riccioli al Cinque Saperi	244
5.68 Rigatoni	245

5.69 Rombi	246
5.70 Rotelle	247
5.71 Saccottini	248
5.72 Sagnarelli	249
5.73 Sagne Incannulate	250
5.74 Scialatielli	251
5.75 Spaccatelle	252
5.76 Spaghetti	253
5.77 Spiralli	254
5.78 Stelletta	255
5.79 Stortini	256
5.80 Strozzapreti	258
5.81 Tagliatelle	259
5.82 Taglierini	260
5.83 Tagliolini	261
5.84 Torchietti	263
5.85 Tortellini	265
5.86 Tortiglioni	266
5.87 Trenne	267
5.88 Tripoline	269
5.89 Trofie	270
5.90 Trottole	271
5.91 Tubetti Rigati	273
5.92 Ziti	274

Volume 9: Axiom Compiler

1	The Axiom Compiler	1
1.1	Makefile	1
2	Overview	3
2.1	The Input	4
2.2	The Output, the EQ.nrlib directory	8
2.3	The code.lsp and EQ.lsp files	9
2.4	The code.o file	23
2.5	The info file	23
2.6	The EQ.fn file	26
2.7	The index.kaf file	31
	The index offset byte	33
	The “loadTimeStuff”	33
	The “compilerInfo”	35
	The “constructorForm”	42
	The “constructorKind”	42
	The “constructorModemap”	42
	The “constructorCategory”	44
	The “sourceFile”	45
	The “modemaps”	45
	The “operationAlist”	47
	The “superDomain”	49
	The “signaturesAndLocals”	49
	The “attributes”	49
	The “predicates”	49
	The “abbreviation”	50
	The “parents”	50
	The “ancestors”	51
	The “documentation”	51
	The “slotInfo”	53
	The “index”	55
3	Compiler top level	57
3.1	Global Data Structures	57
3.2	Pratt Parsing	57
3.3	)compile	58
	Spad compiler	61
3.4	Operator Precedence Table Initialization	62
	LED and NUD Tables	62
3.5	Gliph Table	65
	Rename Token Table	65
	Generic function table	66
3.6	Giant steps, Baby steps	66

4	The Parser	67
4.1	EQ.spad	67
4.2	boot transformations	71
	defun string2BootTree	71
	defun new2OldLisp	72
	defun new2OldTran	72
	defun newIf2Cond	73
	defun newDef2Def	74
	defun new2OldDefForm	74
	defun newConstruct	74
4.3	preparse	75
	defvar \$index	75
	defvar \$linelist	75
	defvar \$echolinestack	75
	defvar \$preparse-last-line	76
4.4	Parsing routines	76
	defun initialize-preparse	76
	defun preparse	80
	defun Build the lines from the input for piles	84
	defun parsepiles	87
	defun add-parens-and-semis-to-line	88
	defun preparseReadLine	89
	defun skip-ifblock	89
	defun preparseReadLine1	90
	defun expand-tabs	91
4.5	I/O Handling	92
	defun preparse-echo	92
	Parsing stack	92
	defstruct \$stack	92
	defun stack-load	92
	defun stack-clear	93
	defmacro stack-/empty	93
	defun stack-push	93
	defun stack-pop	94
	Parsing token	94
	defstruct \$token	94
	defvar \$prior-token	94
	defvar \$nonblank	95
	defvar \$current-token	95
	defvar \$next-token	95
	defvar \$valid-tokens	95
	defun token-install	96
	defun token-print	96
	Parsing reduction	96
	defstruct \$reduction	96

5	Parse Transformers	97
5.1	Direct called parse routines	97
	defun parseTransform	97
	defun parseTran	97
	defun parseAtom	98
	defun parseTranList	99
	defplist parseConstruct	99
	defun parseConstruct	99
5.2	Indirect called parse routines	100
	defplist parseAnd	101
	defun parseAnd	101
	defplist parseAtSign	101
	defun parseAtSign	102
	defun parseType	102
	defplist parseCategory	102
	defun parseCategory	103
	defun parseDropAssertions	103
	defplist parseCoerce	103
	defun parseCoerce	104
	defplist parseColon	104
	defun parseColon	104
	defplist parseDEF	105
	defun parseDEF	105
	defun parseLhs	106
	defun transIs	106
	defun transIs1	106
	defun isListConstructor	107
	defplist parseDollarGreaterthan	107
	defun parseDollarGreaterthan	108
	defplist parseDollarGreaterEqual	108
	defun parseDollarGreaterEqual	108
	defun parseDollarLessEqual	109
	defplist parseDollarNotEqual	109
	defun parseDollarNotEqual	109
	defplist parseEquivalence	110
	defun parseEquivalence	110
	defplist parseExit	110
	defun parseExit	110
	defplist parseGreaterEqual	111
	defun parseGreaterEqual	111
	defplist parseGreaterthan	111
	defun parseGreaterthan	112
	defplist parseHas	112
	defun parseHas	112
	defun parseHasRhs	114
	defun loadIfNecessary	114

defun loadLibIfNecessary	115
defun updateCategoryFrameForConstructor	116
defun convertOpAlist2compilerInfo	116
defun updateCategoryFrameForCategory	117
defplist parseIf	117
defun parseIf	118
defun parseIf,ifTran	118
defplist parseImplies	120
defun parseImplies	120
defplist parseIn	121
defun parseIn	121
defplist parseInBy	122
defun parseInBy	122
defplist parseIs	123
defun parseIs	123
defplist parseIsnt	123
defun parseIsnt	123
defplist parseJoin	124
defun parseJoin	124
defplist parseLeave	124
defun parseLeave	125
defplist parseLessEqual	125
defun parseLessEqual	125
defplist parseLET	126
defun parseLET	126
defplist parseLETD	126
defun parseLETD	127
defplist parseMDEF	127
defun parseMDEF	127
defplist parseNot	128
defun parseNot	128
defplist parseNotEqual	129
defun parseNotEqual	129
defplist parseOr	129
defun parseOr	129
defplist parsePretend	130
defun parsePretend	130
defplist parseReturn	131
defun parseReturn	131
defplist parseSegment	131
defun parseSegment	131
defplist parseSeq	132
defun parseSeq	132
defplist parseVCONS	132
defun parseVCONS	133

defplist parseWhere	133
defun parseWhere	133
6 Compile Transformers	135
defun compExpression	135
6.1 Handline Category DEF forms	138
defplist compDefine plist	140
defun compDefine	140
defun compDefine1	141
defun compDefineAddSignature	143
defun compDefineFunctor	144
defun compDefineFunctor1	144
defun compDefineCapsuleFunction	151
defun compInternalFunction	155
defun compDefWhereClause	155
defun compDefineCategory	158
defun compDefineCategory1	158
defun compDefineCategory2	159
defun compDefineLisplib	163
defun compileDocumentation	165
defun compArgumentConditions	166
defun compileCases	167
defun compFunctorBody	168
defun compile	169
defvar \$NoValueMode	172
defvar \$EmptyMode	172
defun hasFullSignature	172
defun addEmptyCapsuleIfNecessary	173
defun getTargetFromRhs	173
defun giveFormalParametersValues	174
defun macroExpandInPlace	174
defun macroExpand	174
defun macroExpandList	175
defun makeCategoryPredicates	175
defun mkCategoryPackage	176
defun mkEvalableCategoryForm	178
defun encodeFunctionName	179
defun mkRepetitionAssoc	180
defun splitEncodedFunctionName	180
defun encodeItem	181
defun getCaps	181
defun constructMacro	182
defun spadCompileOrSetq	182
defun compileConstructor	183
defun compileConstructor1	184
defun compAndDefine	185

defun putInLocalDomainReferences	185
defun NRTputInTail	185
defun NRTputInHead	186
defun getArgumentModeOrMoan	187
defun augLisplibModemapsFromCategory	187
defun mkAlistOfExplicitCategoryOps	189
defun flattenSignatureList	190
defun interactiveModemapForm	191
defun replaceVars	192
defun fixUpPredicate	192
defun orderPredicateItems	193
defun signatureTran	193
defun orderPredTran	194
defun isDomainSubst	196
defun moveORsOutside	197
defun substVars	198
defun modemapPattern	199
defun evalAndRwriteLispForm	200
defun rwriteLispForm	200
defun mkConstructor	201
defun unloadOneConstructor	201
defun lisplibDoRename	201
defun initializeLisplib	202
defun writeLib1	203
defun finalizeLisplib	203
defun getConstructorOpsAndAtts	205
defun getCategoryOpsAndAtts	205
defun getSlotFromCategoryForm	206
defun transformOperationAlist	206
defun getFunctorOpsAndAtts	208
defun getSlotFromFunctor	208
defun compMakeCategoryObject	208
defun mergeSignatureAndLocalVarAlists	209
defun lisplibWrite	209
defun isCategoryPackageName	210
defun NRTgetLookupFunction	210
defun NRTgetLocalIndex	211
defun augmentLisplibModemapsFromFunctor	212
defun allLASSOCs	213
defun formal2Pattern	214
defun mkDatabasePred	214
defun disallowNilAttribute	214
defun bootStrapError	215
defun reportOnFunctorCompilation	215
defun displayMissingFunctions	216
defun makeFunctorArgumentParameters	217

	defun genDomainViewList0	219
	defun genDomainViewList	219
	defun genDomainView	219
	defun genDomainOps	220
	defun mkOpVec	221
	defun AssocBarGensym	222
	defun orderByDependency	222
6.2	Code optimization routines	223
	defun optimizeFunctionDef	223
	defun optimize	225
	defun optXLAMCond	226
	defun optCONDtail	226
	defvar \$BasicPredicates	227
	defun optPredicateIfTrue	227
	defun optIF2COND	227
	defun subrname	228
	Special case optimizers	228
	defplist optCall	229
	defun Optimize “call” expressions	229
	defun optPackageCall	230
	defun optCallSpecially	231
	defun optSpecialCall	232
	defun compileTimeBindingOf	233
	defun optCallEval	233
	defplist optSEQ	234
	defun optSEQ	234
	defplist optEQ	235
	defun optEQ	236
	defplist optMINUS	236
	defun optMINUS	236
	defplist optQSMINUS	237
	defun optQSMINUS	237
	defplist opt-	237
	defun opt-	238
	defplist optLESSP	238
	defun optLESSP	238
	defplist optSPADCALL	239
	defun optSPADCALL	239
	defplist optSuchthat	240
	defun optSuchthat	240
	defplist optCatch	240
	defun optCatch	240
	defplist optCond	242
	defun optCond	242
	defun EqualBarGensym	244
	defplist optMkRecord	245

	defun optMkRecord	245
	defplist optRECORDELT	245
	defun optRECORDELT	245
	defplist optSETRECORDELT	246
	defun optSETRECORDELT	246
	defplist optRECORDCOPY	247
	defun optRECORDCOPY	247
6.3	Functions to manipulate modemaps	248
	defun addDomain	248
	defun unknownTypeError	249
	defun isFunctor	249
	defun getDomainsInScope	250
	defun putDomainsInScope	250
	defun isSuperDomain	251
	defun addNewDomain	251
	defun augModemapsFromDomain	252
	defun augModemapsFromDomain1	252
	defun substituteCategoryArguments	253
	defun addConstructorModemaps	254
	defun getModemap	254
	defun compApplyModemap	255
	defun compMapCond	256
	defun compMapCond'	257
	defun compMapCond''	257
	defun compMapCondFun	258
	defun getUniqueSignature	259
	defun getUniqueModemap	259
	defun getModemapList	259
	defun getModemapListFromDomain	260
	defun domainMember	260
	defun augModemapsFromCategory	260
	defun addEltModemap	261
	defun mkNewModemapList	262
	defun insertModemap	263
	defun mergeModemap	263
	defun TruthP	264
	defun evalAndSub	265
	defun getOperationAlist	265
	defvar \$FormalMapVariableList	266
	defun substNames	266
	defun augModemapsFromCategoryRep	267
6.4	Maintaining Modemaps	268
	defun addModemapKnown	268
	defun addModemap	269
	defun addModemap0	269
	defun addModemap1	270

6.5	Indirect called comp routines	270
	defplist compAdd plist	271
	defun compAdd	271
	defun compTuple2Record	273
	defplist compCapsule plist	273
	defun compCapsule	274
	defun compCapsuleInner	274
	defun processFunctor	275
	defun compCapsuleItems	275
	defun compSingleCapsuleItem	276
	defun doIt	276
	defun doItIf	281
	defun isMacro	282
	defplist compCase plist	283
	defun compCase	283
	defun compCase1	284
	defplist compCat plist	284
	defplist compCat plist	285
	defplist compCat plist	285
	defun compCat	285
	defplist compCategory plist	286
	defun compCategory	286
	defun compCategoryItem	287
	defun mkExplicitCategoryFunction	288
	defun mustInstantiate	289
	defun wrapDomainSub	290
	defplist compColon plist	290
	defun compColon	290
	defun makeCategoryForm	293
	defplist compCons plist	294
	defun compCons	294
	defun compCons1	294
	defplist compConstruct plist	295
	defun compConstruct	295
	defplist compConstructorCategory plist	296
	defplist compConstructorCategory plist	296
	defplist compConstructorCategory plist	297
	defplist compConstructorCategory plist	297
	defun compConstructorCategory	297
	defun getAbbreviation	298
	defun mkAbbrev	298
	defun addSuffix	299
	defun alistSize	299
	defun getSignatureFromMode	299
	defun getSpecialCaseAssoc	300
	defun addArgumentConditions	300

defun stripOffSubdomainConditions	301
defun stripOffArgumentConditions	302
defun getSignature	302
defun checkAndDeclare	304
defun hasSigInTargetCategory	304
defun getArgumentMode	305
defplist compElt plist	306
defun compElt	306
defplist compExit plist	307
defun compExit	308
defplist compHas plist	308
defun compHas	309
defun compHasFormat	309
defun mkList	310
defplist compIf plist	310
defun compIf	311
defun compFromIf	312
defun canReturn	312
defun compBoolean	314
defun getSuccessEnvironment	314
defun getInverseEnvironment	316
defun getUnionMode	317
defun isUnionMode	317
defplist compImport plist	318
defun compImport	318
defplist compIs plist	318
defun compIs	318
defplist compJoin plist	319
defun compJoin	319
defun compForMode	321
defplist compLambda plist	321
defun compLambda	321
defplist compLeave plist	322
defun compLeave	323
defplist compMacro plist	323
defun compMacro	323
defplist compPretend plist	324
defun compPretend	324
defplist compQuote plist	325
defun compQuote	326
defplist compReduce plist	326
defun compReduce	326
defun compReduce1	326
defplist compRepeatOrCollect plist	328
defplist compRepeatOrCollect plist	328
defun compRepeatOrCollect	329

defplist compReturn plist	331
defun compReturn	331
defplist compSeq plist	332
defun compSeq	332
defun compSeq1	332
defun replaceExitEtc	333
defun convertOrCroak	334
defun compSeqItem	334
defplist compSetq plist	335
defplist compSetq plist	335
defun compSetq	335
defun compSetq1	335
defun uncons	336
defun setqMultiple	337
defun setqMultipleExplicit	339
defun setqSetelt	340
defun setqSingle	340
defun NRTassocIndex	342
defun assignError	342
defun outputComp	343
defun maxSuperType	344
defun isDomainForm	344
defun isDomainConstructorForm	344
defplist compString plist	345
defun compString	345
defplist compSubDomain plist	346
defun compSubDomain	346
defun compSubDomain1	346
defun lispize	347
defplist compSubsetCategory plist	348
defun compSubsetCategory	348
defplist compSuchthat plist	348
defun compSuchthat	349
defplist compVector plist	349
defun compVector	349
defplist compWhere plist	350
defun compWhere	350
6.6 Functions for coercion	351
defun coerce	351
defun coerceEasy	352
defun coerceSubset	353
defun coerceHard	354
defun coerceExtraHard	355
defun hasType	356
defun coerceable	356
defun coerceExit	357

defplist compAtSign plist	357
defun compAtSign	357
defplist compCoerce plist	358
defun compCoerce	358
defun compCoerce1	359
defun coerceByModemap	359
defun autoCoerceByModemap	360
defun resolve	361
defun mkUnion	362
defun This orders Unions	362
defun modeEqualSubst	363
7 Post Transformers	365
7.1 Direct called postparse routines	365
defun postTransform	365
defun postTran	366
defun postOp	367
defun postAtom	367
defun postTranList	368
defun postScriptsForm	368
defun postTranScripts	368
defun postTransformCheck	369
defun postcheck	369
defun postError	370
defun postForm	370
7.2 Indirect called postparse routines	371
defplist postAdd plist	372
defun postAdd	372
defun postCapsule	373
defun postBlockItemList	373
defun postBlockItem	373
defplist postAtSign plist	374
defun postAtSign	374
defun postType	375
defplist postBigFloat plist	375
defun postBigFloat	376
defplist postBlock plist	376
defun postBlock	376
defplist postCategory plist	377
defun postCategory	377
defun postCollect,finish	377
defun postMakeCons	378
defplist postCollect plist	379
defun postCollect	379
defun postIteratorList	380
defplist postColon plist	380

defun postColon	381
defplist postColonColon plist	381
defun postColonColon	381
defplist postComma plist	382
defun postComma	382
defun comma2Tuple	382
defun postFlatten	382
defplist postConstruct plist	383
defun postConstruct	383
defun postTranSegment	384
defplist postDef plist	384
defun postDef	384
defun postDefArgs	386
defplist postExit plist	386
defun postExit	387
defplist postIf plist	387
defun postIf	387
defplist postIn plist	388
defun postIn	388
defun postInSeq	388
defplist postIn plist	389
defun postIn	389
defplist postJoin plist	389
defun postJoin	390
defplist postMapping plist	390
defun postMapping	390
defplist postMDef plist	391
defun postMDef	391
defplist postPretend plist	392
defun postPretend	392
defplist postQUOTE plist	392
defun postQUOTE	393
defplist postReduce plist	393
defun postReduce	393
defplist postRepeat plist	394
defun postRepeat	394
defplist postScripts plist	394
defun postScripts	394
defplist postSemiColon plist	395
defun postSemiColon	395
defun postFlattenLeft	395
defplist postSignature plist	396
defun postSignature	396
defun removeSuperfluousMapping	396
defun killColons	397
defplist postSlash plist	397

	defun postSlash	397
	defplist postTuple plist	398
	defun postTuple	398
	defplist postTupleCollect plist	398
	defun postTupleCollect	398
	defplist postWhere plist	399
	defun postWhere	399
	defplist postWith plist	399
	defun postWith	400
7.3	Support routines	400
	defun setDefOp	400
	defun aplTran	401
	defun aplTran1	401
	defun aplTranList	403
	defun hasAplExtension	403
	defun deepestExpression	404
	defun containsBang	404
	defun getScriptName	404
	defun decodeScripts	405
8	DEF forms	407
	defvar \$defstack	407
	defvar \$is-spill	407
	defvar \$is-spill-list	407
	defvar \$vl	408
	defvar \$is-gensymlist	408
	defvar \$initial-gensym	408
	defvar \$is-eqlist	408
	defun hackforis	408
	defun hackforis1	409
	defun unTuple	409
	defun errhuh	409
9	PARSE forms	411
9.1	The original meta specification	411
9.2	The PARSE code	416
	defvar \$tmptok	416
	defvar \$tok	416
	defvar \$ParseMode	417
	defvar \$definition-name	417
	defvar \$lablasoc	417
	defun PARSE-NewExpr	417
	defun PARSE-Command	418
	defun PARSE-SpecialKeyWord	418
	defun PARSE-SpecialCommand	419
	defun PARSE-TokenCommandTail	419

defun PARSE-TokenOption	420
defun PARSE-TokenList	420
defun PARSE-CommandTail	421
defun PARSE-PrimaryOrQM	421
defun PARSE-Option	422
defun PARSE-Statement	422
defun PARSE-InfixWith	423
defun PARSE-With	423
defun PARSE-Category	423
defun PARSE-Expression	425
defun PARSE-Import	425
defun PARSE-Expr	426
defun PARSE-LedPart	426
defun PARSE-NudPart	426
defun PARSE-Operation	427
defun PARSE-leftBindingPowerOf	427
defun PARSE-rightBindingPowerOf	428
defun PARSE-getSemanticForm	428
defun PARSE-Prefix	428
defun PARSE-Infix	429
defun PARSE-TokTail	430
defun PARSE-Qualification	430
defun PARSE-Reduction	431
defun PARSE-ReductionOp	431
defun PARSE-Form	431
defun PARSE-Application	432
defun PARSE-Label	433
defun PARSE-Selector	433
defun PARSE-PrimaryNoFloat	434
defun PARSE-Primary	434
defun PARSE-Primary1	434
defun PARSE-Float	435
defun PARSE-FloatBase	436
defun PARSE-FloatBasePart	436
defun PARSE-FloatExponent	437
defun PARSE-Enclosure	438
defun PARSE-IntegerTok	438
defun PARSE-FormalParameter	439
defun PARSE-FormalParameterTok	439
defun PARSE-Quad	439
defun PARSE-String	439
defun PARSE-VarForm	440
defun PARSE-Scripts	440
defun PARSE-ScriptItem	441
defun PARSE-Name	441
defun PARSE-Data	442

defun PARSE-Sexpr	442
defun PARSE-Sexpr1	442
defun PARSE-NBGlyphTok	443
defun PARSE-GlyphTok	444
defun PARSE-AnyId	444
defun PARSE-Sequence	445
defun PARSE-Sequence1	445
defun PARSE-OpenBracket	446
defun PARSE-OpenBrace	446
defun PARSE-IteratorTail	447
defun PARSE-Iterator	447
The PARSE implicit routines	448
defun PARSE-Suffix	448
defun PARSE-SemiColon	449
defun PARSE-Return	449
defun PARSE-Exit	449
defun PARSE-Leave	450
defun PARSE-Seg	450
defun PARSE-Conditional	451
defun PARSE-ElseClause	451
defun PARSE-Loop	452
defun PARSE-LabelExpr	452
defun PARSE-FloatTok	453
9.3 The PARSE support routines	453
String grabbing	454
defun match-string	454
defun skip-blanks	454
defun token-lookahead-type	455
defun match-advance-string	455
defun initial-substring-p	456
defun quote-if-string	456
defun escape-keywords	457
defun isTokenDelimiter	457
defun underscore	458
Token Handling	458
defun getToken	458
defun unget-tokens	458
defun match-current-token	459
defun match-token	460
defun match-next-token	460
defun current-symbol	460
defun make-symbol-of	460
defun current-token	461
defun try-get-token	461
defun next-token	462
defun advance-token	462

defvar \$XTokenReader	463
defun get-token	463
Character handling	463
defun current-char	463
defun next-char	463
defun char-eq	464
defun char-ne	464
Error handling	464
defvar \$meta-error-handler	464
defun meta-syntax-error	465
Floating Point Support	465
defun floatexpid	465
Dollar Translation	465
defun dollarTran	465
Applying metagrammatical elements of a production (e.g., Star).	466
defmacro Bang	466
defmacro must	466
defun action	467
defun optional	467
defmacro star	467
Stacking and retrieving reductions of rules.	468
defvar \$reduce-stack	468
defmacro reduce-stack-clear	468
defun push-reduction	468
10 Comment Recording	469
10.1 Comment Recording Layer 0 – API	470
defun recordSignatureDocumentation	470
defun recordAttributeDocumentation	470
10.2 Comment Recording Layer 1	471
defun recordDocumentation	471
10.3 Comment Recording Layer 2	471
defun collectComBlock	471
10.4 Comment Recording Layer 3	472
defun recordHeaderDocumentation	472
defun collectAndDeleteAssoc	472
11 Category handling	475
defun getConstructorExports	475
12 Building libdb.text	477
defun extendLocalLibdb	477
defun buildLibdb	478
defun buildLibdbString	480
defun dbReadLines	481
defun purgeNewConstructorLines	481

defun dbWriteLines	481
defun buildLibdbConEntry	482
defun buildLibOps	484
defun buildLibOp	484
defun buildLibAttrs	485
defun buildLibAttr	485
defun screenLocalLine	486
13 Comment Syntax Checking	487
13.1 Comment Checking Layer 0 – API	492
defun finalizeDocumentation	492
13.2 Comment Checking Layer 1	495
defun transDocList	495
13.3 Comment Checking Layer 2	496
defun transDoc	496
13.4 Comment Checking Layer 3	497
defun transformAndRecheckComments	497
13.5 Comment Checking Layer 4	498
defun checkComments	498
defun checkRewrite	499
13.6 Comment Checking Layer 5	501
defun checkArguments	501
defun checkBalance	501
13.7 Comment Checking Layer 6	502
defun checkBeginEnd	502
defun checkDecorate	504
defun checkDecorateForHt	506
defun checkDocError1	507
defun checkFixCommonProblem	508
defun checkGetLispFunctionName	508
defun checkHTargs	509
defun checkRecordHash	509
defun checkTexht	512
defun checkTransformFirsts	513
defun checkTrim	516
13.8 Comment Checking Layer 7	517
defun checkDocError	517
defun checkRemoveComments	518
defun checkSkipToken	518
defun checkSplit2Words	518
13.9 Comment Checking Layer 8	519
defun checkAddIndented	519
defun checkDocMessage	519
defun checkExtract	520
defun checkGetArgs	521
defun checkGetMargin	522

defun checkGetParse	522
defun checkGetStringBeforeRightBrace	523
defun checkIeEg	523
defun checkIndentedLines	524
defun checkSkipIdentifierToken	525
defun checkSkipOpToken	525
defun checkSplitBrace	525
defun checkTrimCommented	526
defun newString2Words	527
13.10 Comment Checking Layer 9	527
defun checkAddBackSlashes	527
defun checkAddMacros	528
defun checkAddPeriod	529
defun checkAddSpaceSegments	529
defun checkAddSpaces	530
defun checkAlphabetic	531
defun checkIeEgfun	531
defun checkIsValidType	532
defun checkLookForLeftBrace	533
defun checkLookForRightBrace	533
defun checkNumOfArgs	534
defun checkSayBracket	534
defun checkSkipBlanks	534
defun checkSplitBackslash	535
defun checkSplitOn	536
defun checkSplitPunctuation	537
defun firstNonBlankPosition	538
defun getMatchingRightPren	538
defun hasNoVowels	539
defun htcharPosition	539
defun newWordFrom	540
defun removeBackslashes	541
defun whoOwns	541
14 Utility Functions	543
defun translablel	543
defun translablel1	543
defun displayPreCompilationErrors	544
defun bumperrorcount	545
defun parseTranCheckForRecord	545
defun makeSimplePredicateOrNil	546
defun parse-spadstring	546
defun parse-string	546
defun parse-identifier	547
defun parse-number	547
defun parse-keyword	548

defun parse-argument-designator	548
defun print-package	549
defun checkWarning	549
defun tuple2List	549
defmacro pop-stack-1	550
defmacro pop-stack-2	550
defmacro pop-stack-3	551
defmacro pop-stack-4	551
defmacro nth-stack	551
defun Pop-Reduction	552
defun addclose	552
defun blankp	552
defun drop	553
defun escaped	553
defvar \$comblocklist	553
defun fincomblock	553
defun indent-pos	554
defun infixtok	555
defun is-console	555
defun next-tab-loc	555
defun nonblankloc	555
defun parseprint	556
defun skip-to-endif	556
15 The Compiler	557
defvar \$newConlist	557
15.1 Compiling EQ.spad	557
15.2 The top level compiler command	560
defun compiler	562
defun compileSpad2Cmd	565
defun compileSpadLispCmd	568
compilerDoitWithScreenedLisplib	569
defun compilerDoit	570
defun /rq	571
defun /rf	571
defun /RQ,LIB	572
defun /rf-1	572
defun spad	573
defun Interpreter interface to the compiler	576
defun compTopLevel	586
defun print-defun	587
defun def-rename	587
defun compOrCroak	588
defun compOrCroak1	589
defun comp	590
defun compNoStacking	590

defun compNoStacking1	591
defun comp2	591
defun comp3	592
defun applyMapping	593
defun compApply	595
defun compTypeOf	596
defun compColonInside	596
defun compAtom	597
defun compAtomWithModemap	598
defun transImplementation	599
defun convert	600
defun primitiveType	600
defun compSymbol	600
defun compList	602
defun compForm	602
defun compForm1	603
defun compToApply	605
defun compApplication	605
defun getFormModemaps	607
defun eltModemapFilter	608
defun seteltModemapFilter	609
defun compExpressionList	609
defun compForm2	610
defun compForm3	612
defun compFocompFormWithModemap	613
defun substituteIntoFunctorModemap	614
defun compFormPartiallyBottomUp	615
defun compFormMatch	615
defun compUniquely	616
defun compArgumentsAndTryAgain	616
defun compWithMappingMode	617
defun compWithMappingMode1	617
defun extractCodeAndConstructTriple	622
defun hasFormalMapVariable	623
defun argsToSig	623
defun compMakeDeclaration	624
defun modifyModeStack	625
defun Create a list of unbound symbols	625
defun compOrCroak1,compactify	626
defun Compiler/Interpreter interface	627
defun recompile-lib-file-if-necessary	627
defun spad-fixed-arg	627
defun compile-lib-file	628
defun compileFileQuietly	628
defvar \$byConstructors	629
defvar \$constructorsSeen	629

16 Level 1	631
defvar \$current-fragment	631
defun read-a-line	631
17 Level 0	633
17.1 Line Handling	633
Line Buffer	633
defstruct \$line	633
defvar \$current-line	634
defmacro line-clear	634
defun line-print	634
defun line-at-end-p	634
defun line-past-end-p	635
defun line-next-char	635
defun line-advance-char	635
defun line-current-segment	636
defun line-new-line	636
defun next-line	636
defun Advance-Char	637
defun storeblanks	637
defun initial-substring	637
defun get-a-line	638
18 The Chunks	639
19 Index	657

Volume 10: Axiom Algebra: Implementation

1	The Algebra Makefile	1
1.1	Adding new algebra	1
1.2	Adding the algebra to the proper book	2
	Adding a Category	2
	Adding a Domain	2
	Adding a Package	9
	Adding Numerics	9
1.3	Rebuilding the algebra from scratch	9
1.4	The Algebra Lattice Layers	10
	Layer 0 Bootstrap	10
	Layer 0	12
	Layer 1	16
	Layer 2	26
	Layer 3	36
	Layer 4	41
	Layer 5	43
	Layer6	47
	Layer7	57
	Layer8	86
	Layer9	102
	Layer10	108
	Layer11	122
	Layer12	196
	Layer13	204
	Layer14	210
	Layer15	219
	Layer16	223
	Layer17	264
	Layer18	320
	Layer19	336
	Layer20	342
	Layer21	343
	Layer22	346
	Layer23	347
	Order	348
1.5	Cliques	348
1.6	Broken Files	350
1.7	The Environment	350
	The working directories	350
	The depsys variable	351
	The intersys variable	351
	The shell variable	352
1.8	The Makefile Stanzas	352

1.9	Generic Make Rules	354
1.10	Pamphlet file structure	356
	Finding the algebra code	357
	Write the Makefile stanzas for the algebra files	357
	Find the algebra bootstrap code	359
	Write the Makefile stanzas for the bootstrap files	359
1.11	Stage markers	360
	Regression testing	363
1.12	The Makefile	388
2	Implementation	391
2.1	Elementary Functions[?]	391
	Rationale for Branch Cuts and Identities	391
	Inverse trigonometric functions	393
	Inverse hyperbolic functions	394

Volume 10.1: Axiom Algebra: Theory

1	Interval Arithmetic	1
1.1	Addition	2
1.2	Sign Change	2
1.3	Subtraction	2
1.4	Multiplication	2
1.5	Multiplication by a positive number	3
1.6	Multiplication of Two Positive Numbers	3
1.7	Division	3
1.8	Reciprocal	4
1.9	Absolute Value	4
1.10	Square	4
1.11	Square Root	4
2	Integration [?]	7
2.1	Rational Functions	8
	The full partial-fraction algorithm	8
	The Hermite reduction	9
	The Rothstein-Trager and Lazard-Rioboo-Trager algorithms	10
2.2	Algebraic Functions	11
	The Hermite reduction	12
	Simple radical extensions	16
	Liouville's Theorem	18
	The integral part	18
	The logarithmic part	19
2.3	Elementary Functions	22
	Differential algebra	22
	The Hermite reduction	24
	The polynomial reduction	25
	The residue criterion	26
	The transcendental logarithmic case	28
	The transcendental exponential case	29
	The transcendental tangent case	30
	The algebraic logarithmic case	30
	The algebraic exponential case	33
3	Singular Value Decomposition [?]	37
3.1	Singular Value Decomposition Tutorial	37
4	Quaternions	43
	Preface	43
4.1	Quaternions	44
4.2	Vectors, and their Composition	44
4.3	Examples To Chapter 1.	71

<i>CONTENTS</i>	161
4.4 Products And Quotients of Vectors	73
4.5 Examples To Chapter 2.	99
4.6 Interpretations And Transformations	100
4.7 Examples to Chapter 3	130
4.8 Axiom Examples	136
5 Clifford Algebra [?]	139
5.1 Introduction	139
5.2 Clifford Basis Matrix Theory	140
5.3 Calculation of the inverse of a Clifford number	142
Example 1: Clifford (2)	143
Example 2: Clifford (3)	143
Example 3: Clifford (2,2)	145
Conclusion	148
6 Package for Algebraic Function Fields	149
7 Interpolation Formulas	151
8 Groebner Basis	155
9 Greatest Common Divisor	157
10 Polynomial Factorization	159
11 Cylindrical Algebraic Decomposition	161
12 Pade approximant	163
13 Schwartz-Zippel lemma and testing polynomial identities	165
14 Chinese Remainder Theorem	167
15 Gaussian Elimination	169
16 Diophantine Equations	171
17 Index	177

Volume 10.2: Axiom Algebra: Categories

1	Categories	1
2	Category Layer 1	3
	Category (CATEGORY)	3
	AdditiveValuationAttribute (ATADDVA)	5
	ApproximateAttribute (ATAPPRO)	7
	ArbitraryExponentAttribute (ATARBEX)	9
	ArbitraryPrecisionAttribute (ATARBPR)	11
	ArcHyperbolicFunctionCategory (AHYP)	13
	ArcTrigonometricFunctionCategory (ATRIG)	15
	AttributeRegistry (ATTREG)	18
	BasicType (BASTYPE)	23
	CanonicalAttribute (ATCANON)	25
	CanonicalClosedAttribute (ATCANCL)	27
	CanonicalUnitNormalAttribute (ATCUNOR)	29
	CentralAttribute (ATCENRL)	31
	CoercibleTo (KOERCE)	33
	CombinatorialFunctionCategory (CFCAT)	36
	CommutativeStarAttribute (ATCS)	39
	ConvertibleTo (KONVERT)	41
	ElementaryFunctionCategory (ELEMFUN)	45
	Eltable (ELTAB)	48
	FiniteAggregateAttribute (ATFINAG)	51
	HyperbolicFunctionCategory (HYPCAT)	53
	InnerEvaluable (IEVALAB)	56
	JacobiIdentityAttribute (ATJACID)	59
	LazyRepresentationAttribute (ATLR)	61
	LeftUnitaryAttribute (ATLUNIT)	63
	ModularAlgebraicGcdOperations (MAGCDOC)	65
	MultiplicativeValuationAttribute (ATMULVA)	68
	NotherianAttribute (ATNOTHR)	70
	NoZeroDivisorsAttribute (ATNZDIV)	72
	NullSquareAttribute (ATNULSQ)	74
	OpenMath (OM)	76
	PartiallyOrderedSetAttribute (ATPOSET)	79
	PartialTranscendentalFunctions (PTRANFN)	81
	Patternable (PATAB)	86
	PrimitiveFunctionCategory (PRIMCAT)	89
	RadicalCategory (RADCAT)	92
	RetractableTo (RETRACT)	95
	RightUnitaryAttribute (ATRUNIT)	99
	ShallowlyMutableAttribute (ATSHMUT)	101
	SpecialFunctionCategory (SPFCAT)	103

TrigonometricFunctionCategory (TRIGCAT)	106
Type (TYPE)	109
UnitsKnownAttribute (ATUNIKN)	111
3 Category Layer 2	115
Aggregate (AGG)	115
CombinatorialOpsCategory (COMBOPC)	119
Comparable (COMPAR)	123
EltableAggregate (ELTAGG)	125
Evaluable (EVALAB)	129
FortranProgramCategory (FORTCAT)	133
FullyRetractableTo (FRETRCT)	136
FullyPatternMatchable (FPATMAB)	141
Logic (LOGIC)	145
PlottablePlaneCurveCategory (PPCURVE)	148
PlottableSpaceCurveCategory (PSCURVE)	151
RealConstant (REAL)	155
SegmentCategory (SEGCAT)	158
SetCategory (SETCAT)	162
TranscendentalFunctionCategory (TRANFUN)	166
4 Category Layer 3	173
AbelianSemiGroup (ABELSG)	173
BlowUpMethodCategory (BLMETCT)	177
DesingTreeCategory (DSTRCAT)	181
FortranFunctionCategory (FORTFN)	186
FortranMatrixCategory (FMC)	191
FortranMatrixFunctionCategory (FMFUN)	195
FortranVectorCategory (FVC)	200
FortranVectorFunctionCategory (FVFUN)	204
FullyEvaluableOver (FEVALAB)	209
FileCategory (FILECAT)	213
Finite (FINITE)	218
FileNameCategory (FNCAT)	222
GradedModule (GRMOD)	226
LeftOreRing (LORER)	231
HomogeneousAggregate (HOAGG)	233
IndexedDirectProductCategory (IDPC)	240
LiouvillianFunctionCategory (LFCAT)	244
Monad (MONAD)	249
NumericalIntegrationCategory (NUMINT)	254
NumericalOptimizationCategory (OPTCAT)	259
OrdinaryDifferentialEquationsSolverCategory (ODECAT)	264
OrderedSet (ORDSET)	269
PartialDifferentialEquationsSolverCategory (PDECAT)	274
PatternMatchable (PATMAB)	279

RealRootCharacterizationCategory (RRCC)	283
SegmentExpansionCategory (SEGXCAT)	288
SemiGroup (SGROUP)	292
SetCategoryWithDegree (SETCATD)	296
SExpressionCategory (SEXCAT)	299
StepThrough (STEP)	305
ThreeSpaceCategory (SPACEC)	309
5 Category Layer 4	321
AbelianMonoid (ABELMON)	321
AffineSpaceCategory (AFSPCAT)	326
BagAggregate (BGAGG)	331
CachableSet (CACHSET)	337
Collection (CLAGG)	341
DifferentialVariableCategory (DVARCAT)	348
ExpressionSpace (ES)	355
GradedAlgebra (GRALG)	367
IndexedAggregate (IXAGG)	372
MonadWithUnit (MONADWU)	380
Monoid (MONOID)	386
OrderedFinite (ORDFIN)	391
PlacesCategory (PLACESC)	395
ProjectiveSpaceCategory (PRSPCAT)	400
RecursiveAggregate (RCAGG)	406
TwoDimensionalArrayCategory (ARR2CAT)	412
6 Category Layer 5	425
BinaryRecursiveAggregate (BRAGG)	426
CancellationAbelianMonoid (CABMON)	434
DictionaryOperations (DIOPS)	439
DoublyLinkedAggregate (DLAGG)	446
Group (GROUP)	452
LinearAggregate (LNAGG)	458
MatrixCategory (MATCAT)	466
OrderedAbelianSemiGroup (OASGP)	511
OrderedMonoid (ORDMON)	516
PolynomialSetCategory (PSETCAT)	520
PriorityQueueAggregate (PRQAGG)	534
QueueAggregate (QUAGG)	540
SetAggregate (SETAGG)	546
StackAggregate (SKAGG)	554
UnaryRecursiveAggregate (URAGG)	560

7 Category Layer 6	573
AbelianGroup (ABELGRP)	574
BinaryTreeCategory (BTCAT)	579
Dictionary (DIAGG)	586
DequeueAggregate (DQAGG)	593
ExtensibleLinearAggregate (ELAGG)	600
FiniteLinearAggregate (FLAGG)	608
FreeAbelianMonoidCategory (FAMONC)	617
MultiDictionary (MDAGG)	623
OrderedAbelianMonoid (OAMON)	629
PermutationCategory (PERMCAT)	633
StreamAggregate (STAGG)	639
TriangularSetCategory (TSETCAT)	649
8 Category Layer 7	669
FiniteDivisorCategory (FDIVCAT)	670
FiniteSetAggregate (FSAGG)	675
KeyedDictionary (KDAGG)	684
LazyStreamAggregate (LZSTAGG)	691
LeftModule (LMODULE)	710
ListAggregate (LSAGG)	714
MultisetAggregate (MSETAGG)	728
NonAssociativeRng (NARNG)	734
OneDimensionalArrayAggregate (A1AGG)	739
OrderedCancellationAbelianMonoid (OCAMON)	751
RegularTriangularSetCategory (RSETCAT)	755
RightModule (RMODULE)	771
Rng (RNG)	775
9 Category Layer 8	781
BiModule (BMODULE)	782
BitAggregate (BTAGG)	787
NonAssociativeRing (NASRING)	796
NormalizedTriangularSetCategory (NTSCAT)	801
OrderedAbelianGroup (OAGROUP)	811
OrderedAbelianMonoidSup (OAMONS)	815
OrderedMultisetAggregate (OMSAGG)	819
Ring (RING)	826
SquareFreeRegularTriangularSetCategory (SFRTCAT)	831
StringAggregate (SRAGG)	841
TableAggregate (TBAGG)	852
VectorCategory (VECTCAT)	863

10 Category Layer 9	873
AssociationListAggregate (ALAGG)	873
CharacteristicNonZero (CHARNZ)	887
CharacteristicZero (CHARZ)	892
CommutativeRing (COMRING)	896
DifferentialRing (DIFRING)	902
EntireRing (ENTIRER)	907
FreeModuleCat (FMCAT)	912
LeftAlgebra (LALG)	918
LinearlyExplicitRingOver (LINEXP)	923
Module (MODULE)	928
OrderedRing (ORDRING)	933
PartialDifferentialRing (PDRING)	939
PointCategory (PTCAT)	946
RectangularMatrixCategory (RMATCAT)	954
SquareFreeNormalizedTriangularSetCategory (SNTSCAT)	963
StringCategory (STRICAT)	972
UnivariateSkewPolynomialCategory (OREPCAT)	982
XAlgebra (XALG)	994
11 Category Layer 10	999
Algebra (ALGEBRA)	999
DifferentialExtension (DIFEXT)	1005
FullyLinearlyExplicitRingOver (FLINEXP)	1012
LieAlgebra (LIECAT)	1018
LinearOrdinaryDifferentialOperatorCategory (LODOCAT)	1023
NonAssociativeAlgebra (NAALG)	1032
VectorSpace (VSPACE)	1038
XFreeAlgebra (XFALG)	1042
12 Category Layer 11	1051
DirectProductCategory (DIRPCAT)	1051
DivisionRing (DIVRING)	1063
FiniteRankNonAssociativeAlgebra (FINAALG)	1069
FreeLieAlgebra (FLALG)	1091
IntegralDomain (INTDOM)	1097
MonogenicLinearOperator (MLO)	1103
OctonionCategory (OC)	1109
QuaternionCategory (QUATCAT)	1120
SquareMatrixCategory (SMATCAT)	1131
XPolynomialsCat (XPOLYC)	1144

13 Category Layer 12	1151
AbelianMonoidRing (AMR)	1151
FortranMachineTypeCategory (FMTC)	1158
FramedNonAssociativeAlgebra (FRNAALG)	1165
GcdDomain (GCDDOM)	1179
OrderedIntegralDomain (OINTDOM)	1185
14 Category Layer 13	1191
FiniteAbelianMonoidRing (FAMR)	1191
IntervalCategory (INTCAT)	1200
PowerSeriesCategory (PSCAT)	1208
PrincipalIdealDomain (PID)	1216
UniqueFactorizationDomain (UFD)	1222
15 Category Layer 14	1229
DivisorCategory (DIVCAT)	1229
EuclideanDomain (EUCDOM)	1235
MultivariateTaylorSeriesCategory (MTSCAT)	1243
PolynomialFactorizationExplicit (PFECAT)	1253
UnivariatePowerSeriesCategory (UPSCAT)	1260
16 Category Layer 15	1271
Field (FIELD)	1271
IntegerNumberSystem (INS)	1278
LocalPowerSeriesCategory (LOCPOWC)	1289
PAdicIntegerCategory (PADICCT)	1299
PolynomialCategory (POLYCAT)	1305
UnivariateTaylorSeriesCategory (UTSCAT)	1327
17 Category Layer 16	1343
AlgebraicallyClosedField (ACF)	1343
DifferentialPolynomialCategory (DPOLCAT)	1356
FieldOfPrimeCharacteristic (FPC)	1374
FiniteRankAlgebra (FINRALG)	1380
FunctionSpace (FS)	1387
InfinitelyClosePointCategory (INFCLCT)	1415
PseudoAlgebraicClosureOfPerfectFieldCategory (PACPERC)	1420
QuotientFieldCategory (QFCAT)	1427
RealClosedField (RCFIELD)	1441
RealNumberSystem (RNS)	1451
RecursivePolynomialCategory (RPOLCAT)	1459
UnivariateLaurentSeriesCategory (ULSCAT)	1499
UnivariatePuisseuxSeriesCategory (UPXSCAT)	1511
UnivariatePolynomialCategory (UPOLYC)	1522

18 Category Layer 17	1547
AlgebraicallyClosedFunctionSpace (ACFS)	1547
ExtensionField (XF)	1562
FiniteFieldCategory (FFIELDC)	1570
FloatingPointSystem (FPS)	1582
FramedAlgebra (FRAMALG)	1591
PseudoAlgebraicClosureOfFiniteFieldCategory (PACFFC)	1598
UnivariateLaurentSeriesConstructorCategory (ULSCCAT)	1606
UnivariatePuisseuxSeriesConstructorCategory (UPXSCCA)	1623
19 Category Layer 18	1635
FiniteAlgebraicExtensionField (FAXF)	1635
MonogenicAlgebra (MONOGEN)	1651
PseudoAlgebraicClosureOfRationalNumberCategory (PACRATC)	1663
20 Category Layer 19	1671
ComplexCategory (COMPCAT)	1671
FunctionFieldCategory (FFCAT)	1693
PseudoAlgebraicClosureOfAlgExtOfRationalNumberCategory (PACEXTC)	1717
21 The bootstrap code	1727
21.1 ABELGRP.lsp BOOTSTRAP	1727
21.2 ABELGRP-.lsp BOOTSTRAP	1728
21.3 ABELMON.lsp BOOTSTRAP	1730
21.4 ABELMON-.lsp BOOTSTRAP	1731
21.5 ABELSG.lsp BOOTSTRAP	1732
21.6 ABELSG-.lsp BOOTSTRAP	1733
21.7 ALAGG.lsp BOOTSTRAP	1735
21.8 CABMON.lsp BOOTSTRAP	1736
21.9 CLAGG.lsp BOOTSTRAP	1737
21.10CLAGG-.lsp BOOTSTRAP	1739
21.11COMRING.lsp BOOTSTRAP	1743
21.12DIFRING.lsp BOOTSTRAP	1744
21.13DIFRING-.lsp BOOTSTRAP	1745
21.14DIVRING.lsp BOOTSTRAP	1747
21.15DIVRING-.lsp BOOTSTRAP	1748
21.16ES.lsp BOOTSTRAP	1750
21.17ES-.lsp BOOTSTRAP	1752
21.18EUCDOM.lsp BOOTSTRAP	1768
The Lisp Implementation	1768
21.19EUCDOM-.lsp BOOTSTRAP	1771
The Lisp Implementation	1771
21.20ENTIRER.lsp BOOTSTRAP	1784
21.21FFIELDC.lsp BOOTSTRAP	1785
21.22FFIELDC-.lsp BOOTSTRAP	1786
21.23FPS.lsp BOOTSTRAP	1797

21.24FPS-.lsp BOOTSTRAP	1799
21.25GCDDOM.lsp BOOTSTRAP	1801
21.26GCDDOM-.lsp BOOTSTRAP	1802
21.27HOAGG.lsp BOOTSTRAP	1806
21.28HOAGG-.lsp BOOTSTRAP	1808
21.29INS.lsp BOOTSTRAP	1814
21.30INS-.lsp BOOTSTRAP	1816
21.31INTDOM.lsp BOOTSTRAP	1824
21.32INTDOM-.lsp BOOTSTRAP	1825
21.33LNAGG.lsp BOOTSTRAP	1827
21.34LNAGG-.lsp BOOTSTRAP	1829
21.35LSAGG.lsp BOOTSTRAP	1831
21.36LSAGG-.lsp BOOTSTRAP	1832
21.37MONOID.lsp BOOTSTRAP	1849
21.38MONOID-.lsp BOOTSTRAP	1850
21.39MTSCAT.lsp BOOTSTRAP	1852
21.40OINTDOM.lsp BOOTSTRAP	1854
21.41ORDRING.lsp BOOTSTRAP	1855
21.42ORDRING-.lsp BOOTSTRAP	1856
21.43POLYCAT.lsp BOOTSTRAP	1858
21.44POLYCAT-.lsp BOOTSTRAP	1860
21.45PSETCAT.lsp BOOTSTRAP	1891
21.46PSETCAT-.lsp BOOTSTRAP	1894
21.47QFCAT.lsp BOOTSTRAP	1911
21.48QFCAT-.lsp BOOTSTRAP	1912
21.49RCAGG.lsp BOOTSTRAP	1921
21.50RCAGG-.lsp BOOTSTRAP	1922
21.51RING.lsp BOOTSTRAP	1924
21.52RING-.lsp BOOTSTRAP	1925
21.53RNG.lsp BOOTSTRAP	1926
21.54RNS.lsp BOOTSTRAP	1926
21.55RNS-.lsp BOOTSTRAP	1928
21.56SETAGG.lsp BOOTSTRAP	1932
21.57SETAGG-.lsp BOOTSTRAP	1934
21.58SETCAT.lsp BOOTSTRAP	1935
21.59SETCAT-.lsp BOOTSTRAP	1936
21.60STAGG.lsp BOOTSTRAP	1937
21.61STAGG-.lsp BOOTSTRAP	1939
21.62TSETCAT.lsp BOOTSTRAP	1945
21.63TSETCAT-.lsp BOOTSTRAP	1948
21.64UFD.lsp BOOTSTRAP	1968
21.65UFD-.lsp BOOTSTRAP	1969
21.66ULSCAT.lsp BOOTSTRAP	1972
21.67UPOLYC.lsp BOOTSTRAP	1974
21.68UPOLYC-.lsp BOOTSTRAP	1976
21.69URAGG.lsp BOOTSTRAP	1998

21.70URAGG-.lsp BOOTSTRAP	2000
22 Chunk collections	2015

Volume 10.3: Axiom Algebra: Domains

1 Chapter Overview	1
2 Chapter A	3
domain AFFPL AffinePlane	3
AffinePlane (AFFPL)	4
domain AFFPLPS AffinePlaneOverPseudoAlgebraicClosureOfFiniteField	5
AffinePlaneOverPseudoAlgebraicClosureOfFiniteField (AFFPLPS)	7
domain AFFSP AffineSpace	8
AffineSpace (AFFSP)	9
domain ALGSC AlgebraGivenByStructuralConstants	12
AlgebraGivenByStructuralConstants (ALGSC)	14
domain ALGFF AlgebraicFunctionField	23
AlgebraicFunctionField (ALGFF)	27
domain AN AlgebraicNumber	32
AlgebraicNumber (AN)	35
domain ANON AnonymousFunction	37
AnonymousFunction (ANON)	38
domain ANTISYM AntiSymm	39
AntiSymm (ANTISYM)	40
domain ANY Any	45
Any (ANY)	50
domain ASTACK ArrayStack	52
ArrayStack (ASTACK)	65
domain ASP1 Asp1	69
Asp1 (ASP1)	71
domain ASP10 Asp10	73
Asp10 (ASP10)	75
domain ASP12 Asp12	78
Asp12 (ASP12)	80
domain ASP19 Asp19	81
Asp19 (ASP19)	85
domain ASP20 Asp20	91
Asp20 (ASP20)	92
domain ASP24 Asp24	96
Asp24 (ASP24)	98
domain ASP27 Asp27	100
Asp27 (ASP27)	102
domain ASP28 Asp28	104
Asp28 (ASP28)	108
domain ASP29 Asp29	113
Asp29 (ASP29)	114
domain ASP30 Asp30	116
Asp30 (ASP30)	118

domain ASP31 Asp31	121
Asp31 (ASP31)	122
domain ASP33 Asp33	126
Asp33 (ASP33)	127
domain ASP34 Asp34	129
Asp34 (ASP34)	130
domain ASP35 Asp35	133
Asp35 (ASP35)	134
domain ASP4 Asp4	138
Asp4 (ASP4)	140
domain ASP41 Asp41	142
Asp41 (ASP41)	144
domain ASP42 Asp42	149
Asp42 (ASP42)	151
domain ASP49 Asp49	157
Asp49 (ASP49)	158
domain ASP50 Asp50	162
Asp50 (ASP50)	164
domain ASP55 Asp55	167
Asp55 (ASP55)	169
domain ASP6 Asp6	174
Asp6 (ASP6)	176
domain ASP7 Asp7	179
Asp7 (ASP7)	181
domain ASP73 Asp73	184
Asp73 (ASP73)	185
domain ASP74 Asp74	189
Asp74 (ASP74)	191
domain ASP77 Asp77	195
Asp77 (ASP77)	196
domain ASP78 Asp78	200
Asp78 (ASP78)	201
domain ASP8 Asp8	204
Asp8 (ASP8)	206
domain ASP80 Asp80	209
Asp80 (ASP80)	211
domain ASP9 Asp9	214
Asp9 (ASP9)	216
domain JORDAN AssociatedJordanAlgebra	219
AssociatedJordanAlgebra (JORDAN)	222
domain LIE AssociatedLieAlgebra	225
AssociatedLieAlgebra (LIE)	228
domain ALIST AssociationList	231
AssociationList (ALIST)	235
domain ATTRIBUT AttributeButtons	237
AttributeButtons (ATTRIBUT)	239

domain AUTOMOR Automorphism	244
Automorphism (AUTOMOR)	245
3 Chapter B	249
domain BBTREE BalancedBinaryTree	249
BalancedBinaryTree (BBTREE)	252
domain BPADIC BalancedPAdicInteger	256
BalancedPAdicInteger (BPADIC)	258
domain BPADICRT BalancedPAdicRational	259
BalancedPAdicRational (BPADICRT)	262
domain BFUNCT BasicFunctions	264
BasicFunctions (BFUNCT)	265
domain BOP BasicOperator	267
BasicOperator (BOP)	273
domain BSD BasicStochasticDifferential	278
BasicStochasticDifferential (BSD)	285
domain BINARY BinaryExpansion	288
BinaryExpansion (BINARY)	292
domain BINFILE BinaryFile	293
BinaryFile (BINFILE)	295
domain BSTREE BinarySearchTree	297
BinarySearchTree (BSTREE)	302
domain BTOURN BinaryTournament	304
BinaryTournament (BTOURN)	306
domain BTREE BinaryTree	308
BinaryTree (BTREE)	310
domain BITS Bits	312
Bits (BITS)	314
domain BLHN BlowUpWithHamburgerNoether	315
BlowUpWithHamburgerNoether (BLHN)	317
domain BLQT BlowUpWithQuadTrans	318
BlowUpWithQuadTrans (BLQT)	319
domain BOOLEAN Boolean	321
Boolean (BOOLEAN)	322
4 Chapter C	325
domain CARD CardinalNumber	325
CardinalNumber (CARD)	332
domain CARTEN CartesianTensor	336
CartesianTensor (CARTEN)	356
domain CHAR Character	368
Character (CHAR)	373
domain CCLASS CharacterClass	376
CharacterClass (CCLASS)	381
domain CLIF CliffordAlgebra[?, ?]	384
Vector (linear) spaces	384

Quadratic Forms[?]	386
Quadratic spaces, Clifford Maps[?, ?]	386
Universal Clifford algebras[?]	386
Real Clifford algebras $\mathbb{R}_{p,q}$ [?]	386
Notation for integer sets	387
Frames for Clifford algebras[?, ?, ?]	387
Real frame groups[?, ?]	387
Canonical products[?, ?, ?]	388
Clifford algebra of frame group[?, ?, ?, ?]	388
Neutral matrix representations[?, ?, ?]	388
CliffordAlgebra (CLIF)	401
domain COLOR Color	406
Color (COLOR)	407
domain COMM Commutator	409
Commutator (COMM)	411
domain COMPLEX Complex	412
Complex (COMPLEX)	418
domain CDFMAT ComplexDoubleFloatMatrix	421
ComplexDoubleFloatMatrix (CDFMAT)	426
domain CDFVEC ComplexDoubleFloatVector	428
ComplexDoubleFloatVector (CDFVEC)	432
domain CONTFRAC ContinuedFraction	434
ContinuedFraction (CONTFRAC)	445
5 Chapter D	453
domain DBASE Database	453
Database (DBASE)	454
domain DLIST DataList	456
DataList (DLIST)	459
domain DECIMAL DecimalExpansion	461
DecimalExpansion (DECIMAL)	465
Denavit-Hartenberg Matrices	466
Homogeneous Transformations	466
Notation	467
Vectors	468
Planes	469
Transformations	471
Translation Transformation	471
Rotation Transformations	473
Coordinate Frames	476
Relative Transformations	477
Objects	478
Inverse Transformations	478
General Rotation Transformation	479
Equivalent Angle and Axis of Rotation	482
Example 1.1	485

Stretching and Scaling	486
Perspective Transformations	487
Transform Equations	489
Summary	489
DenavitHartenbergMatrix (DHMATRIX)	491
domain DEQUEUE Dequeue	494
Dequeue (DEQUEUE)	512
domain DERHAM DeRhamComplex	518
DeRhamComplex (DERHAM)	530
domain DSTREE DesingTree	533
DesingTree (DSTREE)	534
domain DSMP DifferentialSparseMultivariatePolynomial	537
DifferentialSparseMultivariatePolynomial (DSMP)	541
domain DIRPROD DirectProduct	543
DirectProduct (DIRPROD)	547
domain DPMM DirectProductMatrixModule	549
DirectProductMatrixModule (DPMM)	552
domain DPMO DirectProductModule	554
DirectProductModule (DPMO)	557
domain DIRRING DirichletRing	558
DirichletRing (DIRRING)	563
domain DMP DistributedMultivariatePolynomial	567
DistributedMultivariatePolynomial (DMP)	571
domain DIV Divisor	573
Divisor (DIV)	575
domain DFLOAT DoubleFloat	578
DoubleFloat (DFLOAT)	586
domain DFMAT DoubleFloatMatrix	595
DoubleFloatMatrix (DFMAT)	599
domain DFVEC DoubleFloatVector	601
DoubleFloatVector (DFVEC)	605
domain DROPT DrawOption	606
DrawOption (DROPT)	608
domain D01AJFA d01ajfAnnaType	613
d01ajfAnnaType (D01AJFA)	614
domain D01AKFA d01akfAnnaType	615
d01akfAnnaType (D01AKFA)	617
domain D01ALFA d01alfAnnaType	618
d01alfAnnaType (D01ALFA)	620
domain D01AMFA d01amfAnnaType	622
d01amfAnnaType (D01AMFA)	623
domain D01ANFA d01anfAnnaType	625
d01anfAnnaType (D01ANFA)	626
domain D01APFA d01apfAnnaType	628
d01apfAnnaType (D01APFA)	629
domain D01AQFA d01aqfAnnaType	631

d01aqfAnnaType (D01AQFA)	633
domain D01ASFA d01asfAnnaType	635
d01asfAnnaType (D01ASFA)	636
domain D01FCFA d01fcfAnnaType	638
d01fcfAnnaType (D01FCFA)	639
domain D01GBFA d01gbfAnnaType	641
d01gbfAnnaType (D01GBFA)	643
domain D01TRNS d01TransformFunctionType	645
d01TransformFunctionType (D01TRNS)	646
domain D02BBFA d02bbfAnnaType	649
d02bbfAnnaType (D02BBFA)	651
domain D02BHFA d02bhfAnnaType	653
d02bhfAnnaType (D02BHFA)	654
domain D02CJFA d02cjfAnnaType	657
d02cjfAnnaType (D02CJFA)	658
domain D02EJFA d02ejfAnnaType	660
d02ejfAnnaType (D02EJFA)	661
domain D03EEFA d03eefAnnaType	664
d03eefAnnaType (D03EEFA)	665
domain D03FAFA d03fafAnnaType	667
d03fafAnnaType (D03FAFA)	668
6 Chapter E	671
domain EFULS ElementaryFunctionsUnivariateLaurentSeries	671
ElementaryFunctionsUnivariateLaurentSeries (EFULS)	672
domain EFUPXS ElementaryFunctionsUnivariatePuisseuxSeries	680
ElementaryFunctionsUnivariatePuisseuxSeries (EFUPXS)	681
domain EQ Equation	687
Equation (EQ)	691
domain EQTBL EqTable	696
EqTable (EQTBL)	698
domain EMR EuclideanModularRing	699
EuclideanModularRing (EMR)	701
domain EXIT Exit	704
Exit (EXIT)	707
domain EXPEXPAN ExponentialExpansion	708
ExponentialExpansion (EXPEXPAN)	711
domain EXPR Expression	715
Expression (EXPR)	723
domain EXPUPXS ExponentialOfUnivariatePuisseuxSeries	735
ExponentialOfUnivariatePuisseuxSeries (EXPUPXS)	739
domain EAB ExtAlgBasis	742
ExtAlgBasis (EAB)	743
domain E04DGFA e04dgmAnnaType	745
e04dgmAnnaType (E04DGFA)	747
domain E04FDFA e04fdfAnnaType	749

e04fdfAnnaType (E04FDFA)	750
domain E04GCFA e04gcfAnnaType	753
e04gcfAnnaType (E04GCFA)	754
domain E04JAFA e04jafAnnaType	757
e04jafAnnaType (E04JAFA)	758
domain E04MBFA e04mbfAnnaType	760
e04mbfAnnaType (E04MBFA)	762
domain E04NAFA e04nafAnnaType	764
e04nafAnnaType (E04NAFA)	765
domain E04UCFA e04ucfAnnaType	767
e04ucfAnnaType (E04UCFA)	769

7 Chapter F 773

domain FR Factored	773
Factored (FR)	786
domain FILE File	797
File (FILE)	802
domain FNAME FileName	804
FileName (FNAME)	810
domain FDIV FiniteDivisor	811
FiniteDivisor (FDIV)	813
domain FF FiniteField	816
FiniteField (FF)	819
domain FFCG FiniteFieldCyclicGroup	821
FiniteFieldCyclicGroup (FFCG)	824
domain FFCGX FiniteFieldCyclicGroupExtension	826
FiniteFieldCyclicGroupExtension (FFCGX)	829
domain FF CGP FiniteFieldCyclicGroupExtensionByPolynomial	831
FiniteFieldCyclicGroupExtensionByPolynomial (FFCGP)	834
domain FFX FiniteFieldExtension	842
FiniteFieldExtension (FFX)	845
domain FFP FiniteFieldExtensionByPolynomial	847
FiniteFieldExtensionByPolynomial (FFP)	850
domain FFNB FiniteFieldNormalBasis	856
FiniteFieldNormalBasis (FFNB)	859
domain FFNBX FiniteFieldNormalBasisExtension	861
FiniteFieldNormalBasisExtension (FFNBX)	865
domain FFNB P FiniteFieldNormalBasisExtensionByPolynomial	867
FiniteFieldNormalBasisExtensionByPolynomial (FFNB P)	871
domain FARRAY FlexibleArray	880
FlexibleArray (FARRAY)	885
domain FLOAT Float	887
Float (FLOAT)	908
domain FC FortranCode	929
FortranCode (FC)	931
domain FEXPR FortranExpression	943

FortranExpression (FEXPR)	946
domain FORTRAN FortranProgram	954
FortranProgram (FORTRAN)	955
domain FST FortranScalarType	960
FortranScalarType (FST)	962
domain FTEM FortranTemplate	965
FortranTemplate (FTEM)	967
domain FT FortranType	969
FortranType (FT)	971
domain FCOMP FourierComponent	973
FourierComponent (FCOMP)	975
domain FSERIES FourierSeries	976
FourierSeries (FSERIES)	978
domain FRAC Fraction	980
Fraction (FRAC)	985
domain FRIDEAL FractionalIdeal	993
FractionalIdeal (FRIDEAL)	994
domain FRMOD FramedModule	998
FramedModule (FRMOD)	1000
domain FAGROUP FreeAbelianGroup	1002
FreeAbelianGroup (FAGROUP)	1004
domain FAMONOID FreeAbelianMonoid	1006
FreeAbelianMonoid (FAMONOID)	1007
domain FGROUPE FreeGroup	1008
FreeGroup (FGROUPE)	1010
domain FM FreeModule	1012
FreeModule (FM)	1013
domain FM1 FreeModule1	1015
FreeModule1 (FM1)	1016
domain FMONOID FreeMonoid	1019
FreeMonoid (FMONOID)	1021
domain FNLA FreeNilpotentLie	1025
FreeNilpotentLie (FNLA)	1027
domain FPARFRAC FullPartialFractionExpansion	1030
FullPartialFractionExpansion (FPARFRAC)	1040
domain FUNCTION FunctionCalled	1044
FunctionCalled (FUNCTION)	1045
8 Chapter G	1047
domain GDMP GeneralDistributedMultivariatePolynomial	1047
GeneralDistributedMultivariatePolynomial (GDMP)	1052
domain GMODPOL GeneralModulePolynomial	1058
GeneralModulePolynomial (GMODPOL)	1059
domain GCNAALG GenericNonAssociativeAlgebra	1061
GenericNonAssociativeAlgebra (GCNAALG)	1064
domain GPOLSET GeneralPolynomialSet	1072

GeneralPolynomialSet (GPOLSET)	1074
domain GSTBL GeneralSparseTable	1076
GeneralSparseTable (GSTBL)	1078
domain GTSET GeneralTriangularSet	1080
GeneralTriangularSet (GTSET)	1082
domain GSERIES GeneralUnivariatePowerSeries	1086
GeneralUnivariatePowerSeries (GSERIES)	1089
domain GRIMAGE GraphImage	1093
GraphImage (GRIMAGE)	1094
domain GOPT GuessOption	1103
GuessOption (GOPT)	1104
domain GOPT0 GuessOptionFunctions0	1108
GuessOptionFunctions0 (GOPT0)	1110
9 Chapter H	1117
domain HASHTBL HashTable	1117
HashTable (HASHTBL)	1120
domain HEAP Heap	1121
Heap (HEAP)	1134
domain HEXADEC HexadecimalExpansion	1139
HexadecimalExpansion (HEXADEC)	1142
package HTMLFORM HTMLFormat	1144
Overview	1144
Why output to HTML?	1145
Using the formatter	1145
Form of the output	1146
Matrix Formatting	1146
Programmers Guide	1146
Future Developments	1147
HTMLFormat (HTMLFORM)	1152
domain HDP HomogeneousDirectProduct	1169
HomogeneousDirectProduct (HDP)	1172
domain HDMP HomogeneousDistributedMultivariatePolynomial	1174
HomogeneousDistributedMultivariatePolynomial (HDMP)	1179
domain HELLDIV HyperellipticFiniteDivisor	1181
HyperellipticFiniteDivisor (HELLDIV)	1183
10 Chapter I	1189
domain ICP InfClsPt	1189
InfClsPt (ICP)	1190
domain ICARD IndexCard	1192
IndexCard (ICARD)	1193
domain IBITS IndexedBits	1195
IndexedBits (IBITS)	1199
domain IDPAG IndexedDirectProductAbelianGroup	1201
IndexedDirectProductAbelianGroup (IDPAG)	1202

domain IDPAM IndexedDirectProductAbelianMonoid	1204
IndexedDirectProductAbelianMonoid (IDPAM)	1205
domain IDPO IndexedDirectProductObject	1208
IndexedDirectProductObject (IDPO)	1209
domain IDPOAM IndexedDirectProductOrderedAbelianMonoid	1210
IndexedDirectProductOrderedAbelianMonoid (IDPOAM)	1212
domain IDPOAMS IndexedDirectProductOrderedAbelianMonoidSup	1213
IndexedDirectProductOrderedAbelianMonoidSup (IDPOAMS)	1214
domain INDE IndexedExponents	1216
IndexedExponents (INDE)	1217
domain IFARRAY IndexedFlexibleArray	1218
IndexedFlexibleArray (IFARRAY)	1222
domain ILIST IndexedList	1227
IndexedList (ILIST)	1231
domain IMATRIX IndexedMatrix	1235
IndexedMatrix (IMATRIX)	1238
domain IARRAY1 IndexedOneDimensionalArray	1240
IndexedOneDimensionalArray (IARRAY1)	1243
domain ISTRING IndexedString	1246
IndexedString (ISTRING)	1249
domain IARRAY2 IndexedTwoDimensionalArray	1254
IndexedTwoDimensionalArray (IARRAY2)	1256
domain IVECTOR IndexedVector	1257
IndexedVector (IVECTOR)	1260
domain ITUPLE InfiniteTuple	1261
InfiniteTuple (ITUPLE)	1262
domain INFCLSPT InfinitelyClosePoint	1263
InfinitelyClosePoint (INFCLSPT)	1265
domain INFCLSPS InfinitelyClosePointOverPseudoAlgebraicClosureOffiniteField	1269
InfinitelyClosePointOverPseudoAlgebraicClosureOffiniteField (INFCLSPS)	1271
domain IAN InnerAlgebraicNumber	1272
InnerAlgebraicNumber (IAN)	1276
domain IFF InnerFiniteField	1280
InnerFiniteField (IFF)	1283
domain IFAMON InnerFreeAbelianMonoid	1285
InnerFreeAbelianMonoid (IFAMON)	1286
domain IIARRAY2 InnerIndexedTwoDimensionalArray	1288
InnerIndexedTwoDimensionalArray (IIARRAY2)	1290
domain IPADIC InnerPAdicInteger	1292
InnerPAdicInteger (IPADIC)	1294
domain IPF InnerPrimeField	1300
InnerPrimeField (IPF)	1303
domain ISUPS InnerSparseUnivariatePowerSeries	1307
InnerSparseUnivariatePowerSeries (ISUPS)	1310
domain INTABL InnerTable	1333
InnerTable (INTABL)	1335

domain ITAYLOR InnerTaylorSeries	1336
InnerTaylorSeries (ITAYLOR)	1338
domain INFORM InputForm	1341
InputForm (INFORM)	1343
domain INT Integer	1347
Integer (INT)	1361
domain ZMOD IntegerMod	1366
IntegerMod (ZMOD)	1367
domain INTFTBL IntegrationFunctionsTable	1370
IntegrationFunctionsTable (INTFTBL)	1371
domain IR IntegrationResult	1373
IntegrationResult (IR)	1375
domain INTRVL Interval	1379
Interval (INTRVL)	1384
11 Chapter J	1395
12 Chapter K	1397
domain KERNEL Kernel	1397
Kernel (KERNEL)	1404
domain KAFILe KeyedAccessFile	1407
KeyedAccessFile (KAFILe)	1413
13 Chapter L	1419
domain LAUPOL LaurentPolynomial	1419
LaurentPolynomial (LAUPOL)	1421
domain LIB Library	1425
Library (LIB)	1428
domain LEXP LieExponentials	1430
LieExponentials (LEXP)	1435
domain LPOLY LiePolynomial	1438
LiePolynomial (LPOLY)	1446
domain LSQM LieSquareMatrix	1451
LieSquareMatrix (LSQM)	1455
domain LODO LinearOrdinaryDifferentialOperator	1458
LinearOrdinaryDifferentialOperator (LODO)	1469
domain LODO1 LinearOrdinaryDifferentialOperator1	1470
LinearOrdinaryDifferentialOperator1 (LODO1)	1479
domain LODO2 LinearOrdinaryDifferentialOperator2	1480
LinearOrdinaryDifferentialOperator2 (LODO2)	1491
domain LIST List	1492
List (LIST)	1504
domain LMOPS ListMonoidOps	1507
ListMonoidOps (LMOPS)	1509
domain LMDICT ListMultiDictionary	1513
ListMultiDictionary (LMDICT)	1515

domain LA LocalAlgebra	1518
LocalAlgebra (LA)	1520
domain LO Localize	1521
Localize (LO)	1522
domain LWORD LyndonWord	1524
LyndonWord (LWORD)	1531
14 Chapter M	1537
domain MCMPLX MachineComplex	1537
MachineComplex (MCMPLX)	1542
domain MFLOAT MachineFloat	1545
MachineFloat (MFLOAT)	1547
domain MINT MachineInteger	1554
MachineInteger (MINT)	1557
domain MAGMA Magma	1559
Magma (MAGMA)	1565
domain MKCHSET MakeCachableSet	1568
MakeCachableSet (MKCHSET)	1570
domain MMLFORM MathMLFormat	1571
Introduction to Mathematical Markup Language	1572
Displaying MathML	1572
Test Cases	1573
)set output mathml on	1574
File src/interp/setvars.boot.pamphlet	1574
File setvart.boot.pamphlet	1574
File src/algebra/Makefile.pamphlet	1575
File src/algebra/exposed.lsp.pamphlet	1575
File src/algebra/Lattice.pamphlet	1575
File src/doc/axiom.bib.pamphlet	1576
File interp/i-output.boot.pamphlet	1576
Public Declarations	1576
Private Constant Declarations	1578
Private Function Declarations	1579
Public Function Definitions	1581
Private Function Definitions	1582
Mathematical Markup Language Form	1599
MathMLForm (MMLFORM)	1603
domain MATRIX Matrix	1603
Matrix (MATRIX)	1622
domain MODMON ModMonic	1627
ModMonic (MODMON)	1631
domain MODFIELD ModularField	1636
ModularField (MODFIELD)	1638
domain MODRING ModularRing	1639
ModularRing (MODRING)	1641
domain MODMONOM ModuleMonomial	1643

ModuleMonomial (MODMONOM)	1644
domain MODOP ModuleOperator	1645
ModuleOperator (MODOP)	1647
domain MOEBIUS MoebiusTransform	1652
MoebiusTransform (MOEBIUS)	1654
domain MRING MonoidRing	1656
MonoidRing (MRING)	1658
domain MSET Multiset	1665
Multiset (MSET)	1670
domain MPOLY MultivariatePolynomial	1676
MultivariatePolynomial (MPOLY)	1681
domain MYEXPR MyExpression	1683
MyExpression (MYEXPR)	1687
domain MYUP MyUnivariatePolynomial	1689
MyUnivariatePolynomial (MYUP)	1694

15 Chapter N 1697

domain NSDPS NeitherSparseOrDensePowerSeries	1697
NeitherSparseOrDensePowerSeries (NSDPS)	1701
domain NSMP NewSparseMultivariatePolynomial	1709
NewSparseMultivariatePolynomial (NSMP)	1713
domain NSUP NewSparseUnivariatePolynomial	1723
NewSparseUnivariatePolynomial (NSUP)	1728
domain NONE None	1735
None (NONE)	1737
domain NNI NonNegativeInteger	1738
NonNegativeInteger (NNI)	1739
domain NOTTING NottinghamGroup	1740
NottinghamGroup (NOTTING)	1744
domain NIPROB NumericalIntegrationProblem	1745
NumericalIntegrationProblem (NIPROB)	1746
domain ODEPROB NumericalODEProblem	1748
NumericalODEProblem (ODEPROB)	1750
domain OPTPROB NumericalOptimizationProblem	1751
NumericalOptimizationProblem (OPTPROB)	1753
domain PDEPROB NumericalPDEProblem	1754
NumericalPDEProblem (PDEPROB)	1756

16 Chapter O 1759

domain OCT Octonion	1759
Octonion (OCT)	1765
domain ODEIFTBL ODEIntensityFunctionsTable	1767
ODEIntensityFunctionsTable (ODEIFTBL)	1768
domain ARRAY1 OneDimensionalArray	1770
OneDimensionalArray (ARRAY1)	1774
domain ONECOMP OnePointCompletion	1775

OnePointCompletion (ONECOMP)	1777
domain OMCONN OpenMathConnection	1780
OpenMathConnection (OMCONN)	1781
domain OMDEV OpenMathDevice	1782
OpenMathDevice (OMDEV)	1784
domain OMENC OpenMathEncoding	1788
OpenMathEncoding (OMENC)	1789
domain OMERR OpenMathError	1790
OpenMathError (OMERR)	1792
domain OMERRK OpenMathErrorKind	1793
OpenMathErrorKind (OMERRK)	1794
domain OP Operator	1796
Operator (OP)	1804
domain OMLO OppositeMonogenicLinearOperator	1805
OppositeMonogenicLinearOperator (OMLO)	1806
domain ORDCOMP OrderedCompletion	1807
OrderedCompletion (ORDCOMP)	1809
domain ODP OrderedDirectProduct	1813
OrderedDirectProduct (ODP)	1816
domain OFMONOID OrderedFreeMonoid	1817
OrderedFreeMonoid (OFMONOID)	1829
domain OVAR OrderedVariableList	1834
OrderedVariableList (OVAR)	1836
domain ODPOL OrderlyDifferentialPolynomial	1837
OrderlyDifferentialPolynomial (ODPOL)	1851
domain ODVAR OrderlyDifferentialVariable	1853
OrderlyDifferentialVariable (ODVAR)	1855
domain ODR OrdinaryDifferentialRing	1856
OrdinaryDifferentialRing (ODR)	1858
domain OWP OrdinaryWeightedPolynomials	1859
OrdinaryWeightedPolynomials (OWP)	1861
domain OSI OrdSetInts	1862
OrdSetInts (OSI)	1864
domain OUTFORM OutputForm	1865
OutputForm (OUTFORM)	1867
17 Chapter P	1879
domain PADIC PAdicInteger	1879
PAdicInteger (PADIC)	1881
domain PADICRAT PAdicRational	1882
PAdicRational (PADICRAT)	1885
domain PADICRC PAdicRationalConstructor	1887
PAdicRationalConstructor (PADICRC)	1890
domain PALETTE Palette	1895
Palette (PALETTE)	1896
domain PARPCURV ParametricPlaneCurve	1898

ParametricPlaneCurve (PARPCURV)	1899
domain PARSCURV ParametricSpaceCurve	1900
ParametricSpaceCurve (PARSCURV)	1901
domain PARSURF ParametricSurface	1903
ParametricSurface (PARSURF)	1904
domain PFR PartialFraction	1905
PartialFraction (PFR)	1913
domain PRITITION Partition	1921
Partition (PRITITION)	1923
domain PATTERN Pattern	1926
Pattern (PATTERN)	1928
domain PATLRES PatternMatchListResult	1936
PatternMatchListResult (PATLRES)	1937
domain PATRES PatternMatchResult	1939
PatternMatchResult (PATRES)	1940
domain PENDTREE PendantTree	1942
PendantTree (PENDTREE)	1944
domain PERM Permutation	1946
Permutation (PERM)	1949
domain PERMGRP PermutationGroup	1958
PermutationGroup (PERMGRP)	1959
domain HACKPI Pi	1975
Pi (HACKPI)	1977
domain ACPLLOT PlaneAlgebraicCurvePlot	1979
PlaneAlgebraicCurvePlot (ACPLLOT)	1992
domain PLACES Places	2017
Places (PLACES)	2019
domain PLACESPS PlacesOverPseudoAlgebraicClosureOfFiniteField	2020
PlacesOverPseudoAlgebraicClosureOfFiniteField (PLACESPS)	2021
domain PLCS Plcs	2022
Plcs (PLCS)	2023
domain PLOT Plot	2027
Plot (PLOT)	2029
domain PLOT3D Plot3D	2041
Plot3D (PLOT3D)	2042
domain PBWLB PoincareBirkhoffWittLyndonBasis	2052
PoincareBirkhoffWittLyndonBasis (PBWLB)	2054
domain POINT Point	2056
Point (POINT)	2059
domain POLY Polynomial	2061
Polynomial (POLY)	2077
domain IDEAL PolynomialIdeals	2079
PolynomialIdeals (IDEAL)	2081
domain PR PolynomialRing	2090
PolynomialRing (PR)	2092
domain PI PositiveInteger	2098

PositiveInteger (PI)	2100
domain PF PrimeField	2101
PrimeField (PF)	2104
domain PRIMARR PrimitiveArray	2106
PrimitiveArray (PRIMARR)	2109
domain PRODUCT Product	2110
Product (PRODUCT)	2112
domain PROJPL ProjectivePlane	2115
ProjectivePlane (PROJPL)	2117
domain PROJPLPS ProjectivePlaneOverPseudoAlgebraicClosureOfFiniteField	2118
ProjectivePlaneOverPseudoAlgebraicClosureOfFiniteField (PROJPLPS)	2119
domain PROJSP ProjectiveSpace	2120
ProjectiveSpace (PROJSP)	2121
domain PACEXT PseudoAlgebraicClosureOfAlgExtOfRationalNumber	2125
PseudoAlgebraicClosureOfAlgExtOfRationalNumber (PACEXT)	2126
domain PACOFF PseudoAlgebraicClosureOfFiniteField	2132
PseudoAlgebraicClosureOfFiniteField (PACOFF)	2135
domain PACRAT PseudoAlgebraicClosureOfRationalNumber	2143
PseudoAlgebraicClosureOfRationalNumber (PACRAT)	2146
18 Chapter Q	2153
domain QFORM QuadraticForm	2153
QuadraticForm (QFORM)	2154
domain QALGSET QuasiAlgebraicSet	2155
QuasiAlgebraicSet (QALGSET)	2157
domain QUAT Quaternion	2161
Quaternion (QUAT)	2167
domain QEQUAT QueryEquation	2168
QueryEquation (QEQUAT)	2169
domain QUEUE Queue	2170
Queue (QUEUE)	2184
19 Chapter R	2189
domain RADFF RadicalFunctionField	2189
RadicalFunctionField (RADFF)	2193
domain RADIX RadixExpansion	2199
RadixExpansion (RADIX)	2205
domain RECLOS RealClosure	2211
RealClosure (RECLOS)	2236
domain RMATRIX RectangularMatrix	2243
RectangularMatrix (RMATRIX)	2245
domain REF Reference	2248
Reference (REF)	2249
domain RGCHAIN RegularChain	2250
RegularChain (RGCHAIN)	2254
domain REGSET RegularTriangularSet	2257

RegularTriangularSet (REGSET)	2285
domain RESRING ResidueRing	2294
ResidueRing (RESRING)	2296
domain RESULT Result	2297
Result (RESULT)	2300
domain RULE RewriteRule	2302
RewriteRule (RULE)	2305
domain ROIRC RightOpenIntervalRootCharacterization	2308
RightOpenIntervalRootCharacterization (ROIRC)	2310
domain ROMAN RomanNumeral	2320
RomanNumeral (ROMAN)	2326
domain ROUTINE RoutinesTable	2327
RoutinesTable (ROUTINE)	2330
domain RULECOLD RuleCalled	2339
RuleCalled (RULECOLD)	2340
domain RULESET Ruleset	2341
Ruleset (RULESET)	2342

20 Chapter S**2345**

domain FORMULA ScriptFormulaFormat	2345
ScriptFormulaFormat (FORMULA)	2346
domain SEG Segment	2355
Segment (SEG)	2359
domain SEGBIND SegmentBinding	2361
SegmentBinding (SEGBIND)	2364
domain SET Set	2365
Set (SET)	2372
domain SETMN SetOfMIntegersInOneToN	2376
SetOfMIntegersInOneToN (SETMN)	2377
domain SDPOL SequentialDifferentialPolynomial	2381
SequentialDifferentialPolynomial (SDPOL)	2385
domain SDVAR SequentialDifferentialVariable	2387
SequentialDifferentialVariable (SDVAR)	2389
domain SEX SExpression	2390
SExpression (SEX)	2391
domain SEXOF SExpressionOf	2392
SExpressionOf (SEXOF)	2394
domain SAE SimpleAlgebraicExtension	2396
SimpleAlgebraicExtension (SAE)	2399
domain SFORT SimpleFortranProgram	2404
SimpleFortranProgram (SFORT)	2405
domain SINT SingleInteger	2407
SingleInteger (SINT)	2411
domain SAOS SingletonAsOrderedSet	2416
SingletonAsOrderedSet (SAOS)	2418
domain SMP SparseMultivariatePolynomial	2419

SparseMultivariatePolynomial (SMP)	2422
domain SMTS SparseMultivariateTaylorSeries	2435
SparseMultivariateTaylorSeries (SMTS)	2440
domain STBL SparseTable	2447
SparseTable (STBL)	2450
domain SULS SparseUnivariateLaurentSeries	2451
SparseUnivariateLaurentSeries (SULS)	2456
domain SUP SparseUnivariatePolynomial	2462
SparseUnivariatePolynomial (SUP)	2466
domain SUPEXPR SparseUnivariatePolynomialExpressions	2475
SparseUnivariatePolynomialExpressions (SUPEXPR)	2480
domain SUPXS SparseUnivariatePuisseuxSeries	2483
SparseUnivariatePuisseuxSeries (SUPXS)	2487
domain ORESUP SparseUnivariateSkewPolynomial	2489
SparseUnivariateSkewPolynomial (ORESUP)	2492
domain SUTS SparseUnivariateTaylorSeries	2493
SparseUnivariateTaylorSeries (SUTS)	2496
domain SHDP SplitHomogeneousDirectProduct	2505
SplitHomogeneousDirectProduct (SHDP)	2508
domain SPLNODE SplittingNode	2510
SplittingNode (SPLNODE)	2512
domain SPLTREE SplittingTree	2515
SplittingTree (SPLTREE)	2518
domain SREGSET SquareFreeRegularTriangularSet	2525
SquareFreeRegularTriangularSet (SREGSET)	2534
domain SQMATRIX SquareMatrix	2544
SquareMatrix (SQMATRIX)	2547
domain STACK Stack	2551
Stack (STACK)	2563
domain SD StochasticDifferential	2567
StochasticDifferential (SD)	2572
domain STREAM Stream	2577
Stream (STREAM)	2581
domain STRING String	2596
String (STRING)	2606
domain STRTBL StringTable	2608
StringTable (STRTBL)	2610
domain SUBSPACE SubSpace	2611
SubSpace (SUBSPACE)	2614
domain COMPPROP SubSpaceComponentProperty	2623
SubSpaceComponentProperty (COMPPROP)	2624
domain SUCH SuchThat	2626
SuchThat (SUCH)	2627
domain SWITCH Switch	2628
Switch (SWITCH)	2629
domain SYMBOL Symbol	2632

Symbol (SYMBOL)	2640
domain SYMTAB SymbolTable	2646
SymbolTable (SYMTAB)	2648
domain SYMPOLY SymmetricPolynomial	2652
SymmetricPolynomial (SYMPOLY)	2654
21 Chapter T	2657
domain TABLE Table	2657
Table (TABLE)	2663
domain TABLEAU Tableau	2665
Tableau (TABLEAU)	2666
domain TS TaylorSeries	2667
TaylorSeries (TS)	2670
domain TEX TexFormat	2672
product(product(i*j,i=a..b),j=c..d) fix	2672
TexFormat (TEX)	2676
domain TEXTFILE TextFile	2688
TextFile (TEXTFILE)	2692
domain SYMS TheSymbolTable	2694
TheSymbolTable (SYMS)	2696
domain M3D ThreeDimensionalMatrix	2700
ThreeDimensionalMatrix (M3D)	2702
domain VIEW3D ThreeDimensionalViewport	2708
ThreeDimensionalViewport (VIEW3D)	2710
domain SPACE3 ThreeSpace	2729
ThreeSpace (SPACE3)	2731
domain TREE Tree	2739
Tree (TREE)	2740
domain TUBE TubePlot	2748
TubePlot (TUBE)	2749
domain TUPLE Tuple	2751
Tuple (TUPLE)	2752
domain ARRAY2 TwoDimensionalArray	2753
TwoDimensionalArray (ARRAY2)	2763
domain VIEW2D TwoDimensionalViewport	2764
TwoDimensionalViewport (VIEW2D)	2769
22 Chapter U	2785
domain UFPS UnivariateFormalPowerSeries	2785
UnivariateFormalPowerSeries (UFPS)	2788
domain ULS UnivariateLaurentSeries	2790
UnivariateLaurentSeries (ULS)	2795
domain ULSCONS UnivariateLaurentSeriesConstructor	2798
UnivariateLaurentSeriesConstructor (ULSCONS)	2803
domain UP UnivariatePolynomial	2814
UnivariatePolynomial (UP)	2827

domain UPXS UnivariatePuisseuxSeries	2829
UnivariatePuisseuxSeries (UPXS)	2833
domain UPXSCONS UnivariatePuisseuxSeriesConstructor	2837
UnivariatePuisseuxSeriesConstructor (UPXSCONS)	2841
domain UPXSsing UnivariatePuisseuxSeriesWithExponentialSingularity	2849
UnivariatePuisseuxSeriesWithExponentialSingularity (UPXSsing)	2852
domain OREUP UnivariateSkewPolynomial	2858
UnivariateSkewPolynomial (OREUP)	2872
domain UTS UnivariateTaylorSeries	2873
UnivariateTaylorSeries (UTS)	2876
domain UTSZ UnivariateTaylorSeriesCZero	2883
UnivariateTaylorSeriesCZero (UTSZ)	2886
domain UNISEG UniversalSegment	2892
UniversalSegment (UNISEG)	2896
domain U8MAT U8Matrix	2899
U8Matrix (U8MAT)	2901
domain U16MAT U16Matrix	2903
U16Matrix (U16MAT)	2906
domain U32MAT U32Matrix	2908
U32Matrix (U32MAT)	2910
domain U8VEC U8Vector	2912
U8Vector (U8VEC)	2917
domain U16VEC U16Vector	2919
U16Vector (U16VEC)	2924
domain U32VEC U32Vector	2926
U32Vector (U32VEC)	2931
23 Chapter V	2935
domain VARIABLE Variable	2935
Variable (VARIABLE)	2936
domain VECTOR Vector	2937
Vector (VECTOR)	2941
domain VOID Void	2943
Void (VOID)	2945
24 Chapter W	2947
domain WP WeightedPolynomials	2947
WeightedPolynomials (WP)	2949
domain WUTSET WuWenTsunTriangularSet	2951
WuWenTsunTriangularSet (WUTSET)	2958
25 Chapter X	2965
domain XDPOLY XDistributedPolynomial	2965
XDistributedPolynomial (XDPOLY)	2967
domain XPBWPOLY XPBWPolynomial	2970
XPBWPolynomial (XPBWPOLY)	2987

<i>CONTENTS</i>	191
domain XPOLY XPolynomial	2992
XPolynomial (XPOLY)	2998
domain XPR XPolynomialRing	2999
XPolynomialRing (XPR)	3007
domain XRPOLY XRecursivePolynomial	3011
XRecursivePolynomial (XRPOLY)	3013
26 Chapter Y	3021
27 Chapter Z	3023
28 The bootstrap code	3025
BOOLEAN.lsp	3025
CHAR.lsp BOOTSTRAP	3030
DFLOAT.lsp BOOTSTRAP	3034
ILIST.lsp BOOTSTRAP	3050
INT.lsp BOOTSTRAP	3062
ISTRING.lsp BOOTSTRAP	3073
LIST.lsp BOOTSTRAP	3091
NNI.lsp BOOTSTRAP	3097
OUTFORM.lsp BOOTSTRAP	3100
PI.lsp BOOTSTRAP	3114
PRIMARR.lsp BOOTSTRAP	3116
REF.lsp BOOTSTRAP	3119
SINT.lsp BOOTSTRAP	3122
SYMBOL.lsp BOOTSTRAP	3135
VECTOR.lsp BOOTSTRAP	3151
29 Chunk collections	3155
30 Index	3165

Volume 10.4: Axiom Algebra: Packages

1 Chapter Overview	1
2 Chapter A	3
package AFALGGRO AffineAlgebraicSetComputeWithGroebnerBasis	3
AffineAlgebraicSetComputeWithGroebnerBasis (AFALGGRO)	4
package AFALGRES AffineAlgebraicSetComputeWithResultant	8
AffineAlgebraicSetComputeWithResultant (AFALGRES)	9
package AF AlgebraicFunction	13
AlgebraicFunction (AF)	14
package INTHERAL AlgebraicHermiteIntegration	19
AlgebraicHermiteIntegration (INTHERAL)	19
package INTALG AlgebraicIntegrate	22
AlgebraicIntegrate (INTALG)	23
package INTAF AlgebraicIntegration	30
AlgebraicIntegration (INTAF)	31
package ALGMANIP AlgebraicManipulations	33
AlgebraicManipulations (ALGMANIP)	34
package ALGMFACT AlgebraicMultFact	38
AlgebraicMultFact (ALGMFACT)	39
package ALGPKG AlgebraPackage	41
AlgebraPackage (ALGPKG)	42
package ALGFACT AlgFactor	51
AlgFactor (ALGFACT)	52
package INTPACK AnnaNumericalIntegrationPackage	55
AnnaNumericalIntegrationPackage (INTPACK)	56
package OPTPACK AnnaNumericalOptimizationPackage	66
AnnaNumericalOptimizationPackage (OPTPACK)	67
package ODEPACK AnnaOrdinaryDifferentialEquationPackage	76
AnnaOrdinaryDifferentialEquationPackage (ODEPACK)	77
package PDEPACK AnnaPartialDifferentialEquationPackage	85
AnnaPartialDifferentialEquationPackage (PDEPACK)	86
package ANY1 AnyFunctions1	92
AnyFunctions1 (ANY1)	93
package API ApplicationProgramInterface	94
ApplicationProgramInterface (API)	101
package APPRULE ApplyRules	103
ApplyRules (APPRULE)	104
package APPLYORE ApplyUnivariateSkewPolynomial	107
ApplyUnivariateSkewPolynomial (APPLYORE)	108
package ASSOCEQ AssociatedEquations	109
AssociatedEquations (ASSOCEQ)	110
package PMPRED AttachPredicates	112
AttachPredicates (PMPRED)	113

package AXSERV AxiomServer	114
AxiomServer (AXSERV)	115
3 Chapter B	133
package BALFACT BalancedFactorisation	133
BalancedFactorisation (BALFACT)	134
package BOP1 BasicOperatorFunctions1	135
BasicOperatorFunctions1 (BOP1)	136
package BEZIER Bezier	139
Bezier (BEZIER)	157
package BEZOUT BezoutMatrix	158
BezoutMatrix (BEZOUT)	159
package BLUPACK BlowUpPackage	163
BlowUpPackage (BLUPACK)	164
package BOUNDZRO BoundIntegerRoots	169
BoundIntegerRoots (BOUNDZRO)	170
package BRILL BrillhartTests	172
BrillhartTests (BRILL)	174
4 Chapter C	177
package CARTEN2 CartesianTensorFunctions2	177
CartesianTensorFunctions2 (CARTEN2)	178
package CHVAR ChangeOfVariable	179
ChangeOfVariable (CHVAR)	180
package CPIMA CharacteristicPolynomialInMonogenicalAlgebra	183
CharacteristicPolynomialInMonogenicalAlgebra (CPIMA)	184
package CHARPOL CharacteristicPolynomialPackage	185
CharacteristicPolynomialPackage (CHARPOL)	186
package IBACHIN ChineseRemainderToolsForIntegralBases	187
ChineseRemainderToolsForIntegralBases (IBACHIN)	188
package CVMP CoerceVectorMatrixPackage	192
CoerceVectorMatrixPackage (CVMP)	193
package COMBF CombinatorialFunction	194
CombinatorialFunction (COMBF)	198
package CDEN CommonDenominator	210
CommonDenominator (CDEN)	211
package COMMONOP CommonOperators	212
CommonOperators (COMMONOP)	213
package COMMUPC CommuteUnivariatePolynomialCategory	218
CommuteUnivariatePolynomialCategory (COMMUPC)	219
package COMPFAC ComplexFactorization	220
ComplexFactorization (COMPFAC)	221
package COMPLEX2 ComplexFunctions2	223
ComplexFunctions2 (COMPLEX2)	224
package CINTSLPE ComplexIntegerSolveLinearPolynomialEquation	225
ComplexIntegerSolveLinearPolynomialEquation (CINTSLPE)	226

package COMPLPAT ComplexPattern	227
ComplexPattern (COMPLPAT)	228
package CPMATCH ComplexPatternMatch	229
ComplexPatternMatch (CPMATCH)	230
package CRFP ComplexRootFindingPackage	231
ComplexRootFindingPackage (CRFP)	233
package CMPLXRT ComplexRootPackage	245
ComplexRootPackage (CMPLXRT)	246
package CTRIGMNP ComplexTrigonometricManipulations	247
ComplexTrigonometricManipulations (CTRIGMNP)	248
package ODECONST ConstantLODE	251
ConstantLODE (ODECONST)	252
package COORDSYS CoordinateSystems	254
CoordinateSystems (COORDSYS)	255
package CRAPACK CRAPackage	259
CRAPackage (CRAPACK)	260
package CYCLES CycleIndicators	262
CycleIndicators (CYCLES)	281
package CSTTOOLS CyclicStreamTools	286
CyclicStreamTools (CSTTOOLS)	287
package CYCLOTOM CyclotomicPolynomialPackage	289
CyclotomicPolynomialPackage (CYCLOTOM)	290
5 Chapter D	293
package DFINTTLS DefiniteIntegrationTools	293
DefiniteIntegrationTools (DFINTTLS)	294
package DEGRED DegreeReductionPackage	299
DegreeReductionPackage (DEGRED)	300
package DTP DesingTreePackage	302
DesingTreePackage (DTP)	303
package DIOSP DiophantineSolutionPackage	312
DiophantineSolutionPackage (DIOSP)	313
package DIRPROD2 DirectProductFunctions2	317
DirectProductFunctions2 (DIRPROD2)	318
package DLP DiscreteLogarithmPackage	320
DiscreteLogarithmPackage (DLP)	321
package DISPLAY DisplayPackage	323
DisplayPackage (DISPLAY)	324
package DDFACT DistinctDegreeFactorize	326
DistinctDegreeFactorize (DDFACT)	327
package DFSFUN DoubleFloatSpecialFunctions	333
DoubleFloatSpecialFunctions (DFSFUN)	348
The Exponential Integral	352
En:(PI,R)→OPR	358
The Ei Function	358
The Fresnel Integral[?, ?]	385

package DBLRESP DoubleResultantPackage	389
DoubleResultantPackage (DBLRESP)	390
package DRAWCX DrawComplex	391
DrawComplex (DRAWCX)	392
package DRAWHACK DrawNumericHack	396
DrawNumericHack (DRAWHACK)	397
package DROPT0 DrawOptionFunctions0	398
DrawOptionFunctions0 (DROPT0)	399
package DROPT1 DrawOptionFunctions1	403
DrawOptionFunctions1 (DROPT1)	404
package D01AGNT d01AgentsPackage	405
d01AgentsPackage (D01AGNT)	406
package D01WGTS d01WeightsPackage	412
d01WeightsPackage (D01WGTS)	413
package D02AGNT d02AgentsPackage	419
d02AgentsPackage (D02AGNT)	420
package D03AGNT d03AgentsPackage	426
d03AgentsPackage (D03AGNT)	427

6 Chapter E 431

package EP EigenPackage	431
EigenPackage (EP)	432
package EF ElementaryFunction	437
ElementaryFunction (EF)	449
package DEFINTEF ElementaryFunctionDefiniteIntegration	467
ElementaryFunctionDefiniteIntegration (DEFINTEF)	468
package LODEEF ElementaryFunctionLODESolver	473
ElementaryFunctionLODESolver (LODEEF)	474
package ODEEF ElementaryFunctionODESolver	480
ElementaryFunctionODESolver (ODEEF)	481
package SIGNEF ElementaryFunctionSign	486
ElementaryFunctionSign (SIGNEF)	487
package EFSTRUC ElementaryFunctionStructurePackage	492
ElementaryFunctionStructurePackage (EFSTRUC)	493
package INTEF ElementaryIntegration	501
ElementaryIntegration (INTEF)	502
package RDEEF ElementaryRischDE	511
ElementaryRischDE (RDEEF)	512
package RDEEFS ElementaryRischDESystem	520
ElementaryRischDESystem (RDEEFS)	521
package ELFUTS EllipticFunctionsUnivariateTaylorSeries	523
EllipticFunctionsUnivariateTaylorSeries (ELFUTS)	524
package EQ2 EquationFunctions2	526
EquationFunctions2 (EQ2)	527
package ERROR ErrorFunctions	527
ErrorFunctions (ERROR)	529

package GBEUCLID EuclideanGroebnerBasisPackage	531
EuclideanGroebnerBasisPackage (GBEUCLID)	555
package EVALCYC EvaluateCycleIndicators	566
EvaluateCycleIndicators (EVALCYC)	567
package ESCONT ExpertSystemContinuityPackage	568
ExpertSystemContinuityPackage (ESCONT)	569
package ESCONT1 ExpertSystemContinuityPackage1	575
ExpertSystemContinuityPackage1 (ESCONT1)	576
package ESTOOLS ExpertSystemToolsPackage	577
ExpertSystemToolsPackage (ESTOOLS)	578
package ESTOOLS1 ExpertSystemToolsPackage1	586
ExpertSystemToolsPackage1 (ESTOOLS1)	587
package ESTOOLS2 ExpertSystemToolsPackage2	588
ExpertSystemToolsPackage2 (ESTOOLS2)	589
package EXPR2 ExpressionFunctions2	590
ExpressionFunctions2 (EXPR2)	591
package EXPRSOL ExpressionSolve	592
Bugs	592
ExpressionSolve (EXPRSOL)	593
package ES1 ExpressionSpaceFunctions1	595
ExpressionSpaceFunctions1 (ES1)	596
package ES2 ExpressionSpaceFunctions2	597
ExpressionSpaceFunctions2 (ES2)	598
package EXPRODE ExpressionSpaceODESolver	599
ExpressionSpaceODESolver (EXPRODE)	600
package OMEXPR ExpressionToOpenMath	605
ExpressionToOpenMath (OMEXPR)	606
package EXPR2UPS ExpressionToUnivariatePowerSeries	612
ExpressionToUnivariatePowerSeries (EXPR2UPS)	613
package EXPRTUBE ExpressionTubePlot	620
ExpressionTubePlot (EXPRTUBE)	621
package EXP3D Export3D	625
Export3D (EXP3D)	626
package E04AGNT e04AgentsPackage	628
e04AgentsPackage (E04AGNT)	629
7 Chapter F	637
package FACTFUNC FactoredFunctions	637
FactoredFunctions (FACTFUNC)	638
package FR2 FactoredFunctions2	639
FactoredFunctions2 (FR2)	642
package FRUTIL FactoredFunctionUtilities	643
FactoredFunctionUtilities (FRUTIL)	644
package FACUTIL FactoringUtilities	645
FactoringUtilities (FACUTIL)	646

package FACTEXT FactorisationOverPseudoAlgebraicClosureOfAlgExtOfRational- Number	649
FactorisationOverPseudoAlgebraicClosureOfAlgExtOfRationalNumber (FAC- TEXT)	650
package FACTRN FactorisationOverPseudoAlgebraicClosureOfRationalNumber . .	653
FactorisationOverPseudoAlgebraicClosureOfRationalNumber (FACTRN) . .	654
package FGLMICPK FGLMIfCanPackage	657
FGLMIfCanPackage (FGLMICPK)	658
package FORDER FindOrderFinite	661
FindOrderFinite (FORDER)	662
package FAMR2 FiniteAbelianMonoidRingFunctions2	663
FiniteAbelianMonoidRingFunctions2 (FAMR2)	664
package FDIV2 FiniteDivisorFunctions2	665
FiniteDivisorFunctions2 (FDIV2)	666
package FFFACTOR FiniteFieldFactorization	667
FiniteFieldFactorization (FFFACTOR)	668
package FFFACTSE FiniteFieldFactorizationWithSizeParseBySideEffect	673
FiniteFieldFactorizationWithSizeParseBySideEffect (FFFACTSE)	674
package FFF FiniteFieldFunctions	679
FiniteFieldFunctions (FFF)	680
package FFHOM FiniteFieldHomomorphisms	685
FiniteFieldHomomorphisms (FFHOM)	686
package FFPOLY FiniteFieldPolynomialPackage	694
FiniteFieldPolynomialPackage (FFPOLY)	695
package FFPOLY2 FiniteFieldPolynomialPackage2	715
FiniteFieldPolynomialPackage2 (FFPOLY2)	716
package FFSLPE FiniteFieldSolveLinearPolynomialEquation	719
FiniteFieldSolveLinearPolynomialEquation (FFSLPE)	720
package FFSQFR FiniteFieldSquareFreeDecomposition	721
FiniteFieldSquareFreeDecomposition (FFSQFR)	722
package FLAGG2 FiniteLinearAggregateFunctions2	725
FiniteLinearAggregateFunctions2 (FLAGG2)	726
package FLASORT FiniteLinearAggregateSort	728
FiniteLinearAggregateSort (FLASORT)	729
package FSAGG2 FiniteSetAggregateFunctions2	732
FiniteSetAggregateFunctions2 (FSAGG2)	733
package FLOATCP FloatingComplexPackage	734
FloatingComplexPackage (FLOATCP)	735
package FLOATRP FloatingRealPackage	738
FloatingRealPackage (FLOATRP)	739
package FCPAK1 FortranCodePackage1	742
FortranCodePackage1 (FCPAK1)	743
package FOP FortranOutputStackPackage	746
FortranOutputStackPackage (FOP)	747
package FORT FortranPackage	749
FortranPackage (FORT)	750

package FRIDEAL2 FractionalIdealFunctions2	752
FractionalIdealFunctions2 (FRIDEAL2)	753
package FFFG FractionFreeFastGaussian	754
FractionFreeFastGaussian (FFFG)	756
package FFFGF FractionFreeFastGaussianFractions	766
FractionFreeFastGaussianFractions (FFFGF)	767
package FRAC2 FractionFunctions2	770
FractionFunctions2 (FRAC2)	771
package FRNAAF2 FramedNonAssociativeAlgebraFunctions2	772
FramedNonAssociativeAlgebraFunctions2 (FRNAAF2)	773
package FSPECF FunctionalSpecialFunction	774
FunctionalSpecialFunction (FSPECF)	775
differentiation of special functions	781
package FFCAT2 FunctionFieldCategoryFunctions2	783
FunctionFieldCategoryFunctions2 (FFCAT2)	784
package FFINTBAS FunctionFieldIntegralBasis	785
FunctionFieldIntegralBasis (FFINTBAS)	786
package PMASSFS FunctionSpaceAssertions	789
FunctionSpaceAssertions (PMASSFS)	790
package PMPREDFS FunctionSpaceAttachPredicates	792
FunctionSpaceAttachPredicates (PMPREDFS)	793
package FSCINT FunctionSpaceComplexIntegration	795
FunctionSpaceComplexIntegration (FSCINT)	796
package FS2 FunctionSpaceFunctions2	798
FunctionSpaceFunctions2 (FS2)	799
package FSINT FunctionSpaceIntegration	800
FunctionSpaceIntegration (FSINT)	801
package FSPRMELT FunctionSpacePrimitiveElement	804
FunctionSpacePrimitiveElement (FSPRMELT)	805
package FSRED FunctionSpaceReduce	808
FunctionSpaceReduce (FSRED)	809
package SUMFS FunctionSpaceSum	810
FunctionSpaceSum (SUMFS)	811
package FS2EXPXP FunctionSpaceToExponentialExpansion	813
FunctionSpaceToExponentialExpansion (FS2EXPXP)	814
package FS2UPS FunctionSpaceToUnivariatePowerSeries	825
FunctionSpaceToUnivariatePowerSeries (FS2UPS)	826
package FSUPFACT FunctionSpaceUnivariatePolynomialFactor	842
FunctionSpaceUnivariatePolynomialFactor (FSUPFACT)	843
8 Chapter G	847
package GALFACTU GaloisGroupFactorizationUtilities	847
GaloisGroupFactorizationUtilities (GALFACTU)	848
package GALFACT GaloisGroupFactorizer	851
GaloisGroupFactorizer (GALFACT)	852
package GALPOLYU GaloisGroupPolynomialUtilities	869

GaloisGroupPolynomialUtilities (GALPOLYU)	870
package GALUTIL GaloisGroupUtilities	872
GaloisGroupUtilities (GALUTIL)	873
package GAUSSFAC GaussianFactorizationPackage	876
GaussianFactorizationPackage (GAUSSFAC)	877
package GHENSEL GeneralHenselPackage	881
GeneralHenselPackage (GHENSEL)	882
package GENMFACT GeneralizedMultivariateFactorize	885
GeneralizedMultivariateFactorize (GENMFACT)	886
package GPAFF GeneralPackageForAlgebraicFunctionField	887
GeneralPackageForAlgebraicFunctionField (GPAFF)	889
package GENPGCD GeneralPolynomialGcdPackage	903
GeneralPolynomialGcdPackage (GENPGCD)	904
package GENUPS GenerateUnivariatePowerSeries	917
GenerateUnivariatePowerSeries (GENUPS)	918
package GENEEZ GenExEuclid	923
GenExEuclid (GENEEZ)	924
package GENUFACT GenUFactorize	928
GenUFactorize (GENUFACT)	929
package INTG0 GenusZeroIntegration	931
GenusZeroIntegration (INTG0)	932
package GDRAW GnuDraw	938
GnuDraw (GDRAW)	939
package GOSPER GosperSummationMethod	941
GosperSummationMethod (GOSPER)	942
package GRDEF GraphicsDefaults	947
GraphicsDefaults (GRDEF)	948
package GRAY GrayCode	950
GrayCode (GRAY)	951
package GBF GroebnerFactorizationPackage	953
GroebnerFactorizationPackage (GBF)	957
package GBINTERN GroebnerInternalPackage	964
GroebnerInternalPackage (GBINTERN)	965
package GB GroebnerPackage	975
GroebnerPackage (GB)	1002
package GROEBSOL GroebnerSolve	1005
GroebnerSolve (GROEBSOL)	1006
package GUESS Guess	1011
Guess (GUESS)	1012
package GUESSAN GuessAlgebraicNumber	1047
GuessAlgebraicNumber (GUESSAN)	1048
package GUESSF GuessFinite	1049
GuessFinite (GUESSF)	1050
package GUESSF1 GuessFiniteFunctions	1050
GuessFiniteFunctions (GUESSF1)	1051
package GUESSINT GuessInteger	1052

GuessInteger (GUESSINT)	1053
package GUESSP GuessPolynomial	1054
GuessPolynomial (GUESSP)	1055
package GUESSUP GuessUnivariatePolynomial	1056
GuessUnivariatePolynomial (GUESSUP)	1057
9 Chapter H	1063
package HB HallBasis	1063
HallBasis (HB)	1064
package HEUGCD HeuGcd	1066
HeuGcd (HEUGCD)	1067
10 Chapter I	1073
package IDECOMP IdealDecompositionPackage	1073
IdealDecompositionPackage (IDECOMP)	1074
package INCRMAPS IncrementingMaps	1082
IncrementingMaps (INCRMAPS)	1083
package INFPROD0 InfiniteProductCharacteristicZero	1084
InfiniteProductCharacteristicZero (INFPROD0)	1085
package INPRODF InFiniteProductFiniteField	1086
InfiniteProductFiniteField (INPRODF)	1087
package INPRODPF InFiniteProductPrimeField	1090
InfiniteProductPrimeField (INPRODPF)	1091
package ITFUN2 InfiniteTupleFunctions2	1092
InfiniteTupleFunctions2 (ITFUN2)	1093
package ITFUN3 InfiniteTupleFunctions3	1094
InfiniteTupleFunctions3 (ITFUN3)	1095
package INFINITY Infinity	1096
Infinity (INFINITY)	1097
package IALGFACT InnerAlgFactor	1098
InnerAlgFactor (IALGFACT)	1099
package ICDEN InnerCommonDenominator	1101
InnerCommonDenominator (ICDEN)	1102
package IMATLIN InnerMatrixLinearAlgebraFunctions	1104
InnerMatrixLinearAlgebraFunctions (IMATLIN)	1105
package IMATQF InnerMatrixQuotientFieldFunctions	1110
InnerMatrixQuotientFieldFunctions (IMATQF)	1111
package INMODGCD InnerModularGcd	1112
InnerModularGcd (INMODGCD)	1113
package INNMFACt InnerMultFact	1119
InnerMultFact (INNMFACt)	1120
package INBFF InnerNormalBasisFieldFunctions	1129
InnerNormalBasisFieldFunctions (INBFF)	1130
package INEP InnerNumericEigenPackage	1137
InnerNumericEigenPackage (INEP)	1138
package INFSP InnerNumericFloatSolvePackage	1143

InnerNumericFloatSolvePackage (INFSP)	1144
package INPSIGN InnerPolySign	1148
InnerPolySign (INPSIGN)	1149
package ISUMP InnerPolySum	1150
InnerPolySum (ISUMP)	1151
package ITRIGMNP InnerTrigonometricManipulations	1153
InnerTrigonometricManipulations (ITRIGMNP)	1154
package INFORM1 InputFormFunctions1	1158
InputFormFunctions1 (INFORM1)	1159
package INTERGB InterfaceGroebnerPackage	1160
InterfaceGroebnerPackage (INTERGB)	1161
IntegerBits (INTBIT)	1164
package COMBINAT IntegerCombinatoricFunctions	1165
IntegerCombinatoricFunctions (COMBINAT)	1167
package INTFACT IntegerFactorizationPackage	1171
IntegerFactorizationPackage (INTFACT)	1172
squareFree	1173
PollardSmallFactor	1173
BasicSieve	1176
BasicMethod	1176
factor	1177
package ZLINDEP IntegerLinearDependence	1179
IntegerLinearDependence (ZLINDEP)	1182
package INTTHEORY IntegerNumberTheoryFunctions	1183
IntegerNumberTheoryFunctions (INTTHEORY)	1197
package PRIMES IntegerPrimesPackage	1202
IntegerPrimesPackage (PRIMES)	1203
smallPrimes	1205
primes	1209
rabinProvesCompositeSmall	1210
rabinProvesComposite	1210
prime?	1211
nextPrime	1212
prevPrime	1213
package INTRET IntegerRetractions	1213
IntegerRetractions (INTRET)	1214
package IROOT IntegerRoots	1215
IntegerRoots (IROOT)	1216
perfectSquare?	1217
perfectNthPower?	1217
perfectNthRoot	1218
approxNthRoot	1218
perfectNthRoot	1219
perfectSqrt	1219
approxSqrt	1219
package INTSLPE IntegerSolveLinearPolynomialEquation	1220

IntegerSolveLinearPolynomialEquation (INTSLPE)	1221
package IBATool IntegralBasisTools	1222
IntegralBasisTools (IBATool)	1223
package IBPTOOLS IntegralBasisPolynomialTools	1226
IntegralBasisPolynomialTools (IBPTOOLS)	1227
package IR2 IntegrationResultFunctions2	1229
IntegrationResultFunctions2 (IR2)	1230
package IRRF2F IntegrationResultRFToFunction	1232
IntegrationResultRFToFunction (IRRF2F)	1233
package IR2F IntegrationResultToFunction	1235
IntegrationResultToFunction (IR2F)	1236
package INTTOOLS IntegrationTools	1241
IntegrationTools (INTTOOLS)	1242
package IPRNTPK InternalPrintPackage	1245
InternalPrintPackage (IPRNTPK)	1246
package IRURPK InternalRationalUnivariateRepresentationPackage	1247
InternalRationalUnivariateRepresentationPackage (IRURPK)	1248
package INTFRSP InterpolateFormsPackage	1252
InterpolateFormsPackage (INTFRSP)	1253
package INTDIVP IntersectionDivisorPackage	1260
IntersectionDivisorPackage (INTDIVP)	1261
package IRREDFFX IrredPolyOverFiniteField	1263
IrredPolyOverFiniteField (IRREDFFX)	1264
package IRSN IrrRepSymNatPackage	1266
IrrRepSymNatPackage (IRSN)	1267
package INVLAPLA InverseLaplaceTransform	1274
InverseLaplaceTransform (INVLAPLA)	1275
11 Chapter J	1279
12 Chapter K	1281
package KERNEL2 KernelFunctions2	1281
KernelFunctions2 (KERNEL2)	1282
package KOVACIC Kovacic	1283
Kovacic (KOVACIC)	1284
13 Chapter L	1287
package LAPLACE LaplaceTransform	1287
LaplaceTransform (LAPLACE)	1288
package LAZM3PK LazardSetSolvingPackage	1293
LazardSetSolvingPackage (LAZM3PK)	1313
package LEADCDET LeadingCoefDetermination	1316
LeadingCoefDetermination (LEADCDET)	1317
package LEXTRIPK LexTriangularPackage	1320
LexTriangularPackage (LEXTRIPK)	1390
package LINDEP LinearDependence	1395

LinearDependence (LINDEP)	1396
package LODOF LinearOrdinaryDifferentialOperatorFactorizer	1398
LinearOrdinaryDifferentialOperatorFactorizer (LODOF)	1399
package LODOOPS LinearOrdinaryDifferentialOperatorsOps	1402
LinearOrdinaryDifferentialOperatorsOps (LODOOPS)	1403
package LPEFRAC LinearPolynomialEquationByFractions	1405
LinearPolynomialEquationByFractions (LPEFRAC)	1406
package LISYSER LinearSystemFromPowerSeriesPackage	1408
LinearSystemFromPowerSeriesPackage (LISYSER)	1409
package LSMP LinearSystemMatrixPackage	1411
LinearSystemMatrixPackage (LSMP)	1412
package LSMP1 LinearSystemMatrixPackage1	1414
LinearSystemMatrixPackage1 (LSMP1)	1415
package LSPP LinearSystemPolynomialPackage	1417
LinearSystemPolynomialPackage (LSPP)	1418
package LGROBP LinGroebnerPackage	1419
LinGroebnerPackage (LGROBP)	1420
package LOP LinesOpPack	1427
LinesOpPack (LOP)	1428
package LF LiouvillianFunction	1431
LiouvillianFunction (LF)	1432
package LIST2 ListFunctions2	1436
ListFunctions2 (LIST2)	1437
package LIST3 ListFunctions3	1439
ListFunctions3 (LIST3)	1440
package LIST2MAP ListToMap	1441
ListToMap (LIST2MAP)	1442
package LPARSPT LocalParametrizationOfSimplePointPackage	1444
LocalParametrizationOfSimplePointPackage (LPARSPT)	1445

14 Chapter M**1453**

package MKBCFUNC MakeBinaryCompiledFunction	1453
MakeBinaryCompiledFunction (MKBCFUNC)	1454
package MKFLCFN MakeFloatCompiledFunction	1455
MakeFloatCompiledFunction (MKFLCFN)	1456
package MKFUNC MakeFunction	1459
MakeFunction (MKFUNC)	1464
package MKRECORD MakeRecord	1465
MakeRecord (MKRECORD)	1466
package MKUCFUNC MakeUnaryCompiledFunction	1467
MakeUnaryCompiledFunction (MKUCFUNC)	1468
package MAPHACK1 MappingPackageInternalHacks1	1469
MappingPackageInternalHacks1 (MAPHACK1)	1470
package MAPHACK2 MappingPackageInternalHacks2	1471
MappingPackageInternalHacks2 (MAPHACK2)	1472
package MAPHACK3 MappingPackageInternalHacks3	1473

MappingPackageInternalHacks3 (MAPHACK3)	1474
package MAPPKG1 MappingPackage1	1475
MappingPackage1 (MAPPKG1)	1484
package MAPPKG2 MappingPackage2	1486
MappingPackage2 (MAPPKG2)	1494
package MAPPKG3 MappingPackage3	1496
MappingPackage3 (MAPPKG3)	1505
package MAPPKG4 MappingPackage4	1507
MappingPackage4 (MAPPKG4)	1512
package MATCAT2 MatrixCategoryFunctions2	1514
MatrixCategoryFunctions2 (MATCAT2)	1515
package MCDEN MatrixCommonDenominator	1516
MatrixCommonDenominator (MCDEN)	1517
package MATLIN MatrixLinearAlgebraFunctions	1519
MatrixLinearAlgebraFunctions (MATLIN)	1520
package MAMA MatrixManipulation	1527
MatrixManipulation (MAMA)	1542
package MTHING MergeThing	1549
MergeThing (MTHING)	1550
package MESH MeshCreationRoutinesForThreeDimensions	1551
MeshCreationRoutinesForThreeDimensions (MESH)	1552
package MDDFACT ModularDistinctDegreeFactorizer	1555
ModularDistinctDegreeFactorizer (MDDFACT)	1556
package MHROWRED ModularHermitianRowReduction	1561
ModularHermitianRowReduction (MHROWRED)	1562
package MRF2 MonoidRingFunctions2	1567
MonoidRingFunctions2 (MRF2)	1568
package MONOTOOL MonomialExtensionTools	1569
MonomialExtensionTools (MONOTOOL)	1570
package MSYSCMD MoreSystemCommands	1572
MoreSystemCommands (MSYSCMD)	1573
package MPCPF MPolyCatPolyFactorizer	1574
MPolyCatPolyFactorizer (MPCPF)	1575
package MPRFF MPolyCatRationalFunctionFactorizer	1577
MPolyCatRationalFunctionFactorizer (MPRFF)	1578
package MPC2 MPolyCatFunctions2	1581
MPolyCatFunctions2 (MPC2)	1582
package MPC3 MPolyCatFunctions3	1583
MPolyCatFunctions3 (MPC3)	1584
package MRATFAC MRationalFactorize	1585
MRationalFactorize (MRATFAC)	1586
package MFINFACT MultFiniteFactorize	1588
MultFiniteFactorize (MFINFACT)	1589
package MMAP MultipleMap	1599
MultipleMap (MMAP)	1600
package MCALCFN MultiVariableCalculusFunctions	1601

MultiVariableCalculusFunctions (MCALCFN)	1602
package MULTFACT MultivariateFactorize	1606
MultivariateFactorize (MULTFACT)	1607
package MLIFT MultivariateLifting	1608
package MULTSQFR MultivariateSquareFree	1614
MultivariateSquareFree (MULTSQFR)	1615

15 Chapter N**1623**

package NAGF02 NagEigenPackage	1623
NagEigenPackage (NAGF02)	1690
package NAGE02 NagFittingPackage	1702
NagFittingPackage (NAGE02)	1832
package NAGF04 NagLinearEquationSolvingPackage	1845
NagLinearEquationSolvingPackage (NAGF04)	1910
package NAGSP NAGLinkSupportPackage	1919
NAGLinkSupportPackage (NAGSP)	1920
package NAGD01 NagIntegrationPackage	1922
NagIntegrationPackage (NAGD01)	1999
package NAGE01 NagInterpolationPackage	2008
NagInterpolationPackage (NAGE01)	2047
package NAGF07 NagLapack	2054
NagLapack (NAGF07)	2068
package NAGF01 NagMatrixOperationsPackage	2071
NagMatrixOperationsPackage (NAGF01)	2128
package NAGE04 NagOptimisationPackage	2135
NagOptimisationPackage (NAGE04)	2287
package NAGD02 NagOrdinaryDifferentialEquationsPackage	2296
NagOrdinaryDifferentialEquationsPackage (NAGD02)	2386
package NAGD03 NagPartialDifferentialEquationsPackage	2396
NagPartialDifferentialEquationsPackage (NAGD03)	2433
package NAGC02 NagPolynomialRootsPackage	2436
NagPolynomialRootsPackage (NAGC02)	2451
package NAGC05 NagRootFindingPackage	2453
NagRootFindingPackage (NAGC05)	2470
package NAGC06 NagSeriesSummationPackage	2473
NagSeriesSummationPackage (NAGC06)	2518
package NAGS NagSpecialFunctionsPackage	2524
NagSpecialFunctionsPackage (NAGS)	2671
package NSUP2 NewSparseUnivariatePolynomialFunctions2	2687
NewSparseUnivariatePolynomialFunctions2 (NSUP2)	2688
package NEWTON NewtonInterpolation	2689
NewtonInterpolation (NEWTON)	2690
package NPOLYGON NewtonPolygon	2691
NewtonPolygon (NPOLYGON)	2692
package NCODIV NonCommutativeOperatorDivision	2697
NonCommutativeOperatorDivision (NCODIV)	2698

package NONE1 NoneFunctions1	2700
NoneFunctions1 (NONE1)	2701
package NODE1 NonLinearFirstOrderODESolver	2702
NonLinearFirstOrderODESolver (NODE1)	2703
package NLINSOL NonLinearSolvePackage	2707
NonLinearSolvePackage (NLINSOL)	2708
package NORMPK NormalizationPackage	2710
NormalizationPackage (NORMPK)	2711
package NORMMA NormInMonogenicAlgebra	2715
NormInMonogenicAlgebra (NORMMA)	2716
package NORMRETR NormRetractPackage	2718
NormRetractPackage (NORMRETR)	2719
package NPCOEF NPCoef	2720
NPCoef (NPCOEF)	2721
package NFINTBAS NumberFieldIntegralBasis	2725
NumberFieldIntegralBasis (NFINTBAS)	2726
package NUMFMT NumberFormats	2731
NumberFormats (NUMFMT)	2732
package NTPOLFN NumberTheoreticPolynomialFunctions	2736
NumberTheoreticPolynomialFunctions (NTPOLFN)	2737
package NUMERIC Numeric	2739
Numeric (NUMERIC)	2740
package NUMODE NumericalOrdinaryDifferentialEquations	2749
NumericalOrdinaryDifferentialEquations (NUMODE)	2752
package NUMQUAD NumericalQuadrature	2760
NumericalQuadrature (NUMQUAD)	2762
package NCEP NumericComplexEigenPackage	2773
NumericComplexEigenPackage (NCEP)	2774
package NCNTFRAC NumericContinuedFraction	2776
NumericContinuedFraction (NCNTFRAC)	2777
package NREP NumericRealEigenPackage	2778
NumericRealEigenPackage (NREP)	2779
package NUMTUBE NumericTubePlot	2781
NumericTubePlot (NUMTUBE)	2782
16 Chapter O	2787
package OCTCT2 OctonionCategoryFunctions2	2787
OctonionCategoryFunctions2 (OCTCT2)	2788
package ODEINT ODEIntegration	2789
ODEIntegration (ODEINT)	2790
package ODETOOLS ODETools	2792
ODETools (ODETOOLS)	2793
package ARRAY12 OneDimensionalArrayFunctions2	2795
OneDimensionalArrayFunctions2 (ARRAY12)	2796
package ONECOMP2 OnePointCompletionFunctions2	2798
OnePointCompletionFunctions2 (ONECOMP2)	2799

package OMPKG OpenMathPackage	2800
OpenMathPackage (OMPKG)	2801
package OMSERVER OpenMathServerPackage	2803
OpenMathServerPackage (OMSERVER)	2804
package OPQUERY OperationsQuery	2805
OperationsQuery (OPQUERY)	2806
package ORDCOMP2 OrderedCompletionFunctions2	2807
OrderedCompletionFunctions2 (ORDCOMP2)	2808
package ORDFUNS OrderingFunctions	2809
OrderingFunctions (ORDFUNS)	2810
package ORTHPOL OrthogonalPolynomialFunctions	2812
OrthogonalPolynomialFunctions (ORTHPOL)	2813
package OUT OutputPackage	2815
OutputPackage (OUT)	2816

17 Chapter P**2819**

package PAFF PackageForAlgebraicFunctionField	2819
PackageForAlgebraicFunctionField (PAFF)	2821
package PAFFFF PackageForAlgebraicFunctionFieldOverFiniteField	2827
PackageForAlgebraicFunctionFieldOverFiniteField (PAFFFF)	2829
package PFORP PackageForPoly	2837
PackageForPoly (PFORP)	2838
package PADEPAC PadeApproximantPackage	2845
PadeApproximantPackage (PADEPAC)	2846
package PADE PadeApproximants	2847
PadeApproximants (PADE)	2848
package PWFFINTB PAdicWildFunctionFieldIntegralBasis	2852
PAdicWildFunctionFieldIntegralBasis (PWFFINTB)	2853
package YSTREAM ParadoxicalCombinatorsForStreams	2858
ParadoxicalCombinatorsForStreams (YSTREAM)	2859
package PLEQN ParametricLinearEquations	2860
ParametricLinearEquations (PLEQN)	2862
package PARPC2 ParametricPlaneCurveFunctions2	2875
ParametricPlaneCurveFunctions2 (PARPC2)	2876
package PARSC2 ParametricSpaceCurveFunctions2	2877
ParametricSpaceCurveFunctions2 (PARSC2)	2878
package PARSU2 ParametricSurfaceFunctions2	2878
ParametricSurfaceFunctions2 (PARSU2)	2879
package PARAMP ParametrizationPackage	2880
ParametrizationPackage (PARAMP)	2881
package PFRPAC PartialFractionPackage	2883
PartialFractionPackage (PFRPAC)	2886
package PARTPERM PartitionsAndPermutations	2887
PartitionsAndPermutations (PARTPERM)	2888
package PATTERN1 PatternFunctions1	2891
PatternFunctions1 (PATTERN1)	2892

package PATTERN2 PatternFunctions2	2894
PatternFunctions2 (PATTERN2)	2895
package PATMATCH PatternMatch	2896
PatternMatch (PATMATCH)	2897
package PMASS PatternMatchAssertions	2899
PatternMatchAssertions (PMASS)	2900
package PMFS PatternMatchFunctionSpace	2901
PatternMatchFunctionSpace (PMFS)	2902
package PMINS PatternMatchIntegerNumberSystem	2904
PatternMatchIntegerNumberSystem (PMINS)	2905
package INTPM PatternMatchIntegration	2907
PatternMatchIntegration (INTPM)	2908
package PMKERNEL PatternMatchKernel	2915
PatternMatchKernel (PMKERNEL)	2916
package PMLSAGG PatternMatchListAggregate	2918
PatternMatchListAggregate (PMLSAGG)	2919
package PMPLCAT PatternMatchPolynomialCategory	2921
PatternMatchPolynomialCategory (PMPLCAT)	2922
package PMDOWN PatternMatchPushDown	2924
PatternMatchPushDown (PMDOWN)	2925
package PMQFCAT PatternMatchQuotientFieldCategory	2927
PatternMatchQuotientFieldCategory (PMQFCAT)	2928
package PATRES2 PatternMatchResultFunctions2	2929
PatternMatchResultFunctions2 (PATRES2)	2930
package PMSYM PatternMatchSymbol	2931
PatternMatchSymbol (PMSYM)	2932
package PMTOOLS PatternMatchTools	2933
PatternMatchTools (PMTOOLS)	2934
package PERMAN Permanent	2938
Permanent (PERMAN)	2940
package PGE PermutationGroupExamples	2944
PermutationGroupExamples (PGE)	2945
package PICOERCE PiCoercions	2953
PiCoercions (PICOERCE)	2954
package PLOT1 PlotFunctions1	2955
PlotFunctions1 (PLOT1)	2956
package PLOTTOOL PlotTools	2957
PlotTools (PLOTTOOL)	2958
package PRJALGPK ProjectiveAlgebraicSetPackage	2960
ProjectiveAlgebraicSetPackage (PRJALGPK)	2961
package PTFUNC2 PointFunctions2	2965
PointFunctions2 (PTFUNC2)	2966
package PTPACK PointPackage	2967
PointPackage (PTPACK)	2968
package PFO PointsOfFiniteOrder	2970
PointsOfFiniteOrder (PFO)	2971

package PFOQ PointsOfFiniteOrderRational	2977
PointsOfFiniteOrderRational (PFOQ)	2978
package PFOTOOLS PointsOfFiniteOrderTools	2980
PointsOfFiniteOrderTools (PFOTOOLS)	2981
package PLPKCRV PolynomialPackageForCurve	2983
PolynomialPackageForCurve (PLPKCRV)	2984
package POLTOPOL PolToPol	2986
PolToPol (POLTOPOL)	2987
package PGROEB PolyGroebner	2989
PolyGroebner (PGROEB)	2990
package PAN2EXPR PolynomialAN2Expression	2992
PolynomialAN2Expression (PAN2EXPR)	2993
package POLYLIFT PolynomialCategoryLifting	2994
PolynomialCategoryLifting (POLYLIFT)	2995
package POLYCATQ PolynomialCategoryQuotientFunctions	2996
PolynomialCategoryQuotientFunctions (POLYCATQ)	2997
package PCOMP PolynomialComposition	3000
PolynomialComposition (PCOMP)	3001
package PDECOMP PolynomialDecomposition	3002
PolynomialDecomposition (PDECOMP)	3003
package PFBR PolynomialFactorizationByRecursion	3005
PolynomialFactorizationByRecursion (PFBR)	3006
package PFBRU PolynomialFactorizationByRecursionUnivariate	3012
PolynomialFactorizationByRecursionUnivariate (PFBRU)	3013
package POLY2 PolynomialFunctions2	3019
PolynomialFunctions2 (POLY2)	3020
package PGCD PolynomialGcdPackage	3021
PolynomialGcdPackage (PGCD)	3022
package PINTERP PolynomialInterpolation	3032
PolynomialInterpolation (PINTERP)	3033
package PINTERPA PolynomialInterpolationAlgorithms	3034
PolynomialInterpolationAlgorithms (PINTERPA)	3035
package PNTHEORY PolynomialNumberTheoryFunctions	3036
PolynomialNumberTheoryFunctions (PNTHEORY)	3037
package POLYROOT PolynomialRoots	3041
PolynomialRoots (POLYROOT)	3042
package PSETPK PolynomialSetUtilitiesPackage	3045
PolynomialSetUtilitiesPackage (PSETPK)	3046
package SOLVEFOR PolynomialSolveByFormulas	3063
PolynomialSolveByFormulas (SOLVEFOR)	3064
package PSQFR PolynomialSquareFree	3070
PolynomialSquareFree (PSQFR)	3071
package POLY2UP PolynomialToUnivariatePolynomial	3074
PolynomialToUnivariatePolynomial (POLY2UP)	3075
package LIMITPS PowerSeriesLimitPackage	3076
PowerSeriesLimitPackage (LIMITPS)	3077

package PREASSOC PrecomputedAssociatedEquations	3088
PrecomputedAssociatedEquations (PREASSOC)	3089
package PRIMARR2 PrimitiveArrayFunctions2	3091
PrimitiveArrayFunctions2 (PRIMARR2)	3092
package PRIMELT PrimitiveElement	3094
PrimitiveElement (PRIMELT)	3095
package ODEPRIM PrimitiveRatDE	3097
PrimitiveRatDE (ODEPRIM)	3098
package ODEPRRIC PrimitiveRatRicDE	3102
PrimitiveRatRicDE (ODEPRRIC)	3103
package PRINT PrintPackage	3109
PrintPackage (PRINT)	3110
package PSEUDLIN PseudoLinearNormalForm	3111
PseudoLinearNormalForm (PSEUDLIN)	3112
package PRS PseudoRemainderSequence	3115
PseudoRemainderSequence (PRS)	3116
package INTPAF PureAlgebraicIntegration	3136
PureAlgebraicIntegration (INTPAF)	3137
package ODEPAL PureAlgebraicLODE	3145
PureAlgebraicLODE (ODEPAL)	3146
package PUSHVAR PushVariables	3147
PushVariables (PUSHVAR)	3148
18 Chapter Q	3151
package QALGSET2 QuasiAlgebraicSet2	3151
QuasiAlgebraicSet2 (QALGSET2)	3152
package QCMPACK QuasiComponentPackage	3155
QuasiComponentPackage (QCMPACK)	3156
package QFCAT2 QuotientFieldCategoryFunctions2	3164
QuotientFieldCategoryFunctions2 (QFCAT2)	3165
package QUATCT2 QuaternionCategoryFunctions2	3166
QuaternionCategoryFunctions2 (QUATCT2)	3168
19 Chapter R	3171
package REP RadicalEigenPackage	3171
RadicalEigenPackage (REP)	3172
package SOLVERAD RadicalSolvePackage	3176
RadicalSolvePackage (SOLVERAD)	3189
package RADUTIL RadixUtilities	3196
RadixUtilities (RADUTIL)	3197
package RDIST RandomDistributions	3198
RandomDistributions (RDIST)	3199
package RFDIST RandomFloatDistributions	3200
RandomFloatDistributions (RFDIST)	3201
package RIDIST RandomIntegerDistributions	3203
RandomIntegerDistributions (RIDIST)	3204

package RANDSRC RandomNumberSource	3206
RandomNumberSource (RANDSRC)	3207
package RATFACT RationalFactorize	3208
RationalFactorize (RATFACT)	3209
package RF RationalFunction	3211
RationalFunction (RF)	3212
package DEFINTRF RationalFunctionDefiniteIntegration	3214
RationalFunctionDefiniteIntegration (DEFINTRF)	3215
package RFFACT RationalFunctionFactor	3217
RationalFunctionFactor (RFFACT)	3218
package RFFACTOR RationalFunctionFactorizer	3219
RationalFunctionFactorizer (RFFACTOR)	3220
package INTRF RationalFunctionIntegration	3222
RationalFunctionIntegration (INTRF)	3223
package LIMITRF RationalFunctionLimitPackage	3224
RationalFunctionLimitPackage (LIMITRF)	3225
package SIGNRF RationalFunctionSign	3229
RationalFunctionSign (SIGNRF)	3230
package SUMRF RationalFunctionSum	3232
RationalFunctionSum (SUMRF)	3238
package INTRAT RationalIntegration	3240
RationalIntegration (INTRAT)	3241
package RINTERP RationalInterpolation	3243
Introduction	3243
Questions and Outlook	3243
RationalInterpolation (RINTERP)	3244
package ODERAT RationalLODE	3247
RationalLODE (ODERAT)	3248
package RATRET RationalRetractions	3253
RationalRetractions (RATRET)	3254
package ODERTRIC RationalRicDE	3255
RationalRicDE (ODERTRIC)	3256
package RURPK RationalUnivariateRepresentationPackage	3262
RationalUnivariateRepresentationPackage (RURPK)	3263
package POLUTIL RealPolynomialUtilitiesPackage	3266
RealPolynomialUtilitiesPackage (POLUTIL)	3268
package REALSOLV RealSolvePackage	3270
RealSolvePackage (REALSOLV)	3274
package REAL0 RealZeroPackage	3276
RealZeroPackage (REAL0)	3277
package REAL0Q RealZeroPackageQ	3283
RealZeroPackageQ (REAL0Q)	3284
package RMCAT2 RectangularMatrixCategoryFunctions2	3286
RectangularMatrixCategoryFunctions2 (RMCAT2)	3287
package RECOP RecurrenceOperator	3288
RecurrenceOperator (RECOP)	3289

Defining new operators	3291
Recurrences	3293
Functional Equations	3297
package RDIV ReducedDivisor	3300
ReducedDivisor (RDIV)	3301
package ODERED ReduceLODE	3303
ReduceLODE (ODERED)	3304
package REDORDER ReductionOfOrder	3305
ReductionOfOrder (REDORDER)	3306
package RSDCMPK RegularSetDecompositionPackage	3308
RegularSetDecompositionPackage (RSDCMPK)	3310
package RSETGCD RegularTriangularSetGcdPackage	3316
RegularTriangularSetGcdPackage (RSETGCD)	3317
package REPDB RepeatedDoubling	3324
RepeatedDoubling (REPDB)	3325
package REPSQ RepeatedSquaring	3326
RepeatedSquaring (REPSQ)	3328
package REP1 RepresentationPackage1	3329
RepresentationPackage1 (REP1)	3330
package REP2 RepresentationPackage2	3337
RepresentationPackage2 (REP2)	3338
package RESLATC ResolveLatticeCompletion	3354
ResolveLatticeCompletion (RESLATC)	3355
package RETSOL RetractSolvePackage	3356
RetractSolvePackage (RETSOL)	3357
package RFP RootsFindingPackage	3359
RootsFindingPackage (RFP)	3360
20 Chapter S	3365
package SAERFFC SAERationalFunctionAlgFactor	3365
SAERationalFunctionAlgFactor (SAERFFC)	3366
package FORMULA1 ScriptFormulaFormat1	3367
ScriptFormulaFormat1 (FORMULA1)	3368
package SEGBIND2 SegmentBindingFunctions2	3369
SegmentBindingFunctions2 (SEGBIND2)	3370
package SEG2 SegmentFunctions2	3371
SegmentFunctions2 (SEG2)	3372
package SAEFACT SimpleAlgebraicExtensionAlgFactor	3373
SimpleAlgebraicExtensionAlgFactor (SAEFACT)	3374
package SIMPAN SimplifyAlgebraicNumberConvertPackage	3375
SimplifyAlgebraicNumberConvertPackage (SIMPAN)	3376
package SMITH SmithNormalForm	3377
SmithNormalForm (SMITH)	3378
package SCACHE SortedCache	3383
SortedCache (SCACHE)	3384
package SORTPAK SortPackage	3386

SortPackage (SORTPAK)	3387
package SUP2 SparseUnivariatePolynomialFunctions2	3388
SparseUnivariatePolynomialFunctions2 (SUP2)	3389
package SPECOUT SpecialOutputPackage	3390
SpecialOutputPackage (SPECOUT)	3391
package SFQCMPIK SquareFreeQuasiComponentPackage	3393
SquareFreeQuasiComponentPackage (SFQCMPIK)	3394
package SRDCMPIK SquareFreeRegularSetDecompositionPackage	3403
SquareFreeRegularSetDecompositionPackage (SRDCMPIK)	3404
package SFRGCD SquareFreeRegularTriangularSetGcdPackage	3410
SquareFreeRegularTriangularSetGcdPackage (SFRGCD)	3411
package MATSTOR StorageEfficientMatrixOperations	3421
StorageEfficientMatrixOperations (MATSTOR)	3422
package STREAM1 StreamFunctions1	3426
StreamFunctions1 (STREAM1)	3427
package STREAM2 StreamFunctions2	3428
StreamFunctions2 (STREAM2)	3429
package STREAM3 StreamFunctions3	3431
StreamFunctions3 (STREAM3)	3432
package STINPROD StreamInfiniteProduct	3433
StreamInfiniteProduct (STINPROD)	3434
package STTAYLOR StreamTaylorSeriesOperations	3436
StreamTaylorSeriesOperations (STTAYLOR)	3437
package STNSR StreamTensor	3446
StreamTensor (STNSR)	3447
package STTF StreamTranscendentalFunctions	3448
StreamTranscendentalFunctions (STTF)	3449
package STTFNC StreamTranscendentalFunctionsNonCommutative	3459
StreamTranscendentalFunctionsNonCommutative (STTFNC)	3460
package SCPKG StructuralConstantsPackage	3465
StructuralConstantsPackage (SCPKG)	3466
package SHP SturmHabichtPackage	3469
SturmHabichtPackage (SHP)	3470
package SUBRESP SubResultantPackage	3478
SubResultantPackage (SUBRESP)	3479
package SUPFRACF SupFractionFactorizer	3482
SupFractionFactorizer (SUPFRACF)	3483
package ODESYS SystemODESolver	3484
SystemODESolver (ODESYS)	3485
package SYSSOLP SystemSolvePackage	3491
SystemSolvePackage (SYSSOLP)	3492
package SGCF SymmetricGroupCombinatoricFunctions	3497
SymmetricGroupCombinatoricFunctions (SGCF)	3498
package SYMFUNC SymmetricFunctions	3508
SymmetricFunctions (SYMFUNC)	3509

21 Chapter T	3511
package TABLBUMP TableauxBumpers	3511
TableauxBumpers (TABLBUMP)	3512
package TBCMPPK TabulatedComputationPackage	3515
TabulatedComputationPackage (TBCMPPK)	3516
package TANEXP TangentExpansions	3519
TangentExpansions (TANEXP)	3520
package UTSSOL TaylorSolve	3521
TaylorSolve (UTSSOL)	3523
package TEMUTL TemplateUtilities	3526
TemplateUtilities (TEMUTL)	3527
package TEX1 TexFormat1	3528
TexFormat1 (TEX1)	3529
package TOOLSIGN ToolsForSign	3530
ToolsForSign (TOOLSIGN)	3531
package DRAW TopLevelDrawFunctions	3532
TopLevelDrawFunctions (DRAW)	3533
package DRAWCURV TopLevelDrawFunctionsForAlgebraicCurves	3540
TopLevelDrawFunctionsForAlgebraicCurves (DRAWCURV)	3541
package DRAWCFUN TopLevelDrawFunctionsForCompiledFunctions	3544
TopLevelDrawFunctionsForCompiledFunctions (DRAWCFUN)	3545
package DRAWPT TopLevelDrawFunctionsForPoints	3558
TopLevelDrawFunctionsForPoints (DRAWPT)	3559
package TOPSP TopLevelThreeSpace	3561
TopLevelThreeSpace (TOPSP)	3562
package INHERTR TranscendentalHermiteIntegration	3563
TranscendentalHermiteIntegration (INHERTR)	3564
package INTTR TranscendentalIntegration	3566
TranscendentalIntegration (INTTR)	3567
package TRMANIP TranscendentalManipulations	3576
TranscendentalManipulations (TRMANIP)	3577
The htrigs function	3585
package RDETR TranscendentalRischDE	3591
TranscendentalRischDE (RDETR)	3592
package RDETRS TranscendentalRischDESystem	3596
TranscendentalRischDESystem (RDETRS)	3597
package SOLVETRA TransSolvePackage	3602
TransSolvePackage (SOLVETRA)	3608
package SOLVESER TransSolvePackageService	3619
TransSolvePackageService (SOLVESER)	3620
package TRIMAT TriangularMatrixOperations	3623
TriangularMatrixOperations (TRIMAT)	3624
package TRIGMNIP TrigonometricManipulations	3626
TrigonometricManipulations (TRIGMNIP)	3627
package TUBETOOL TubePlotTools	3630
TubePlotTools (TUBETOOL)	3631

package CLIP TwoDimensionalPlotClipping	3634
TwoDimensionalPlotClipping (CLIP)	3635
package TWOFACT TwoFactorize	3641
TwoFactorize (TWOFACT)	3642

22 Chapter U 3649

package UNIFACT UnivariateFactorize	3649
UnivariateFactorize (UNIFACT)	3650
package UFPS1 UnivariateFormalPowerSeriesFunctions	3657
UnivariateFormalPowerSeriesFunctions (UFPS1)	3658
package ULS2 UnivariateLaurentSeriesFunctions2	3659
UnivariateLaurentSeriesFunctions2 (ULS2)	3660
package UPOLYC2 UnivariatePolynomialCategoryFunctions2	3661
UnivariatePolynomialCategoryFunctions2 (UPOLYC2)	3662
package UPCDEN UnivariatePolynomialCommonDenominator	3663
UnivariatePolynomialCommonDenominator (UPCDEN)	3664
package UPDECOMP UnivariatePolynomialDecompositionPackage	3665
UnivariatePolynomialDecompositionPackage (UPDECOMP)	3666
package UPDIVP UnivariatePolynomialDivisionPackage	3669
UnivariatePolynomialDivisionPackage (UPDIVP)	3670
package UP2 UnivariatePolynomialFunctions2	3671
UnivariatePolynomialFunctions2 (UP2)	3672
package UPMP UnivariatePolynomialMultiplicationPackage	3673
UnivariatePolynomialMultiplicationPackage (UPMP)	3674
package UPSQFREE UnivariatePolynomialSquareFree	3677
UnivariatePolynomialSquareFree (UPSQFREE)	3678
package UPXS2 UnivariatePuisseuxSeriesFunctions2	3680
UnivariatePuisseuxSeriesFunctions2 (UPXS2)	3681
package OREPCTO UnivariateSkewPolynomialCategoryOps	3683
UnivariateSkewPolynomialCategoryOps (OREPCTO)	3684
package UTS2 UnivariateTaylorSeriesFunctions2	3687
UnivariateTaylorSeriesFunctions2 (UTS2)	3688
package UTSODE UnivariateTaylorSeriesODESolver	3689
UnivariateTaylorSeriesODESolver (UTSODE)	3690
package UNISEG2 UniversalSegmentFunctions2	3693
UniversalSegmentFunctions2 (UNISEG2)	3694
package UDPO UserDefinedPartialOrdering	3695
UserDefinedPartialOrdering (UDPO)	3696
package UDVO UserDefinedVariableOrdering	3698
UserDefinedVariableOrdering (UDVO)	3699
package UTSODETL UTSodetools	3700
UTSodetools (UTSODETL)	3701
package POLYVEC U32VectorPolynomialOperations	3703
U32VectorPolynomialOperations (POLYVEC)	3704

23 Chapter V	3717
package VECTOR2 VectorFunctions2	3717
VectorFunctions2 (VECTOR2)	3718
package VIEWDEF ViewDefaultsPackage	3719
ViewDefaultsPackage (VIEWDEF)	3720
package VIEW ViewportPackage	3725
ViewportPackage (VIEW)	3726
24 Chapter W	3731
package WEIER WeierstrassPreparation	3731
WeierstrassPreparation (WEIER)	3732
package WFFINTBS WildFunctionFieldIntegralBasis	3735
WildFunctionFieldIntegralBasis (WFFINTBS)	3736
25 Chapter X	3743
package XEXPPKG XExponentialPackage	3743
XExponentialPackage (XEXPPKG)	3744
26 Chapter Y	3747
27 Chapter Z	3749
package ZDSOLVE ZeroDimensionalSolvePackage	3749
ZeroDimensionalSolvePackage (ZDSOLVE)	3812
28 Chunk collections	3823
29 Index	3835

Volume 10.5: Axiom Algebra: Numerics

1	Numerical Analysis [?]	1
2	Chapter Overview	3
3	Algebra Cover Code	7
	package BLAS1 BlasLevelOne	7
	BlasLevelOne (BLAS1)	42
	dcabs1 BLAS	48
	lsame BLAS	53
	daxpy BLAS	69
	dcopy BLAS	81
	ddot BLAS	91
	dnrm2 BLAS	99
	drotg BLAS	105
	drot BLAS	117
	dscal BLAS	134
	dswap BLAS	141
	dzasum BLAS	149
	dznrm2 BLAS	154
	icamax BLAS	162
	idamax BLAS	170
	isamax BLAS	177
	izamax BLAS	185
	zaxpy BLAS	192
	zcopy BLAS	208
	zdotc BLAS	212
	zdotu BLAS	216
	zdscal BLAS	219
	zrotg BLAS	222
	zscal BLAS	226
	zswap BLAS	229
4	BLAS Level 2	235
	dgbmv BLAS	235
	dgemv BLAS	248
	dger BLAS	258
	dsbmv BLAS	265
	dspmv BLAS	278
	dspr2 BLAS	290
	dspr BLAS	301
	dsymv BLAS	310
	dsyr2 BLAS	322
	dsyr BLAS	333

dtbmv BLAS	341
dtbsv BLAS	358
dtpmv BLAS	375
dtpsv BLAS	391
dtrmv BLAS	407
dtrsv BLAS	421
zgbmv BLAS	435
zgemv BLAS	450
zgerc BLAS	462
zgeru BLAS	468
zhbmv BLAS	474
zhemv BLAS	488
zher2 BLAS	500
zher BLAS	515
zhpmv BLAS	526
zhpr2 BLAS	539
zhpr BLAS	554
ztbmv BLAS	566
ztbsv BLAS	586
ztpmv BLAS	607
ztpsv BLAS	626
ztrmv BLAS	646
ztrsv BLAS	664
5 BLAS Level 3	683
dgemm BLAS	683
dsymm BLAS	696
dsyr2k BLAS	710
dsyrk BLAS	725
dtrmm BLAS	739
dtrsm BLAS	757
zgemm BLAS	776
zhemm BLAS	796
zher2k BLAS	811
zherk BLAS	831
zsymm BLAS	849
zsyr2k BLAS	863
zsyrk BLAS	878
ztrmm BLAS	891
ztrsm BLAS	912
6 LAPACK	937
dbdsdc LAPACK	937
dbdsqr LAPACK	957
ddisna LAPACK	995
dgebak LAPACK	1003

dgebal LAPACK	1010
dgebd2 LAPACK	1022
dgebrd LAPACK	1032
dgeev LAPACK	1042
dgeevx LAPACK	1062
dgehd2 LAPACK	1086
dgehrd LAPACK	1092
dgelq2 LAPACK	1102
dgelqf LAPACK	1106
dgeqr2 LAPACK	1114
dgeqrf LAPACK	1118
dgesdd LAPACK	1125
dgesvd LAPACK	1193
dgesv LAPACK	1391
dgetf2 LAPACK	1395
dgetrf LAPACK	1400
dgetrs LAPACK	1407
dhseqr LAPACK	1412
disnan LAPACK	1432
dlabad LAPACK	1434
dlabrd LAPACK	1436
dlacon LAPACK	1454
dlacpy LAPACK	1462
dladiv LAPACK	1466
dlaed6 LAPACK	1468
dlaexc LAPACK	1481
dlahqr LAPACK	1499
dlahrd LAPACK	1522
dlaisnan LAPACK	1531
dlaln2 LAPACK	1533
dlamch LAPACK	1559
dlamc1 LAPACK	1564
dlamc2 LAPACK	1571
dlamc3 LAPACK	1582
dlamc4 LAPACK	1584
dlamc5 LAPACK	1588
dlamrg LAPACK	1594
dlange LAPACK	1599
dlanhs LAPACK	1605
dlanst LAPACK	1611
dlanv2 LAPACK	1616
dlapy2 LAPACK	1624
dlapy3 LAPACK	1626
dlqtr LAPACK	1629
dlarfb LAPACK	1666
dlarfg LAPACK	1691

dlarf LAPACK	1696
dlarft LAPACK	1700
dlarfx LAPACK	1710
dlartg LAPACK	1765
dlas2 LAPACK	1771
dlascl LAPACK	1775
dlasd0 LAPACK	1787
dlasd1 LAPACK	1798
dlasd2 LAPACK	1806
dlasd3 LAPACK	1827
dlasd4 LAPACK	1846
dlasd5 LAPACK	1895
dlasd6 LAPACK	1904
dlasd7 LAPACK	1914
dlasd8 LAPACK	1932
dlasda LAPACK	1945
dlasdq LAPACK	1964
dlasdt LAPACK	1977
dlaset LAPACK	1983
dlasq1 LAPACK	1987
dlasq2 LAPACK	1994
dlasq3 LAPACK	2021
dlasq4 LAPACK	2040
dlasq5 LAPACK	2058
dlasq6 LAPACK	2072
dlasr LAPACK	2084
dlasrt LAPACK	2103
dlasq LAPACK	2113
dlasv2 LAPACK	2117
dlaswp LAPACK	2125
dlasy2 LAPACK	2131
dorg2r LAPACK	2154
dorgbr LAPACK	2159
dorghr LAPACK	2169
dorgl2 LAPACK	2175
dorglq LAPACK	2181
dorgqr LAPACK	2189
dorm2r LAPACK	2198
dormbr LAPACK	2205
dorml2 LAPACK	2215
dormlq LAPACK	2222
dormqr LAPACK	2232
dtrevc LAPACK	2242
dtrexc LAPACK	2302
dtrsna LAPACK	2317
ieeck LAPACK	2340

ilaenv LAPACK	2346
ilazlc LAPACK	2367
ilazlr LAPACK	2370
zgebak LAPACK	2374
zgebal LAPACK	2383
zgeev LAPACK	2397
zgehd2 LAPACK	2417
zgehrd LAPACK	2424
zhseqr LAPACK	2436
zlacgv LAPACK	2451
zlacpy LAPACK	2455
zladiw LAPACK	2459
zlahqr LAPACK	2462
zlahr2 LAPACK	2485
zlange LAPACK	2499
zlaqr0 LAPACK	2505
zlaqr1 LAPACK	2531
zlaqr2 LAPACK	2537
zlaqr3 LAPACK	2557
zlaqr4 LAPACK	2579
zlaqr5 LAPACK	2604
zlarfb LAPACK	2654
zlarf LAPACK	2689
zlarfg LAPACK	2696
zlarft LAPACK	2701
zlartg LAPACK	2715
zlascl LAPACK	2723
zlaset LAPACK	2735
zlassq LAPACK	2740
zlatrs LAPACK	2745
zrot LAPACK	2779
ztrevc LAPACK	2784
ztrexcl LAPACK	2803
zung2r LAPACK	2810
zunghr LAPACK	2816
zungqr LAPACK	2824
zunm2r LAPACK	2834
zunmhr LAPACK	2842
zunmqr LAPACK	2850
7 LAPACK tests	2863
8 Chunk collections	2879
9 Index	2891

Volume 11: Axiom Browser

Overview	1
1.1 Build Instructions	1
1.2 The Makefile	1
1.3 Building new pages	2
Communicating with Axiom	3
Handling statements with no free variables	3
Handling statements with free variables	3
Handling domain database lookups	4
Handling)show domain	4
Handling lisp expressions	4
Handling expressions that have no output	4
1.4 Defined Pages	5
1.5 The Standard Layout	16
1.6 Cascading Style Sheet	17
Standard Style Sheet	17
Menu style sheet	19
1.7 standard head	23
1.8 Javascript functions	24
Show only mathml	24
Show Full Answer	24
Handle Free Variables	25
axiom talker	27
1.9 Pages	28
axiomfonts.xhtml	41
aldorusersguidepage.xhtml	88
algebrapage.xhtml	89
alggrouptheory.xhtml	89
alggrouptheorygroup.xhtml	90
alggrouptheoryrepa6.xhtml	91
alggrouptheoryreptheory.xhtml	95
algnumberttheory.xhtml	95
algnumberttheorygalois.xhtml	96
basiccommand.xhtml	103
basiclimit.xhtml	104
bcexpand.xhtml	105
bcmatrix.xhtml	106
calculus.xhtml	111
calculuspage.xhtml	111
calderivatives.xhtml	113
calintegrals.xhtml	116
callaplace.xhtml	119
callimits.xhtml	121
calmoreintegrals.xhtml	124

calseries.xhtml	128
calseries1.xhtml	129
calseries2.xhtml	132
calseries3.xhtml	133
calseries4.xhtml	134
calseries5.xhtml	137
calseries6.xhtml	140
calseries7.xhtml	143
calseries8.xhtml	144
cats.xhtml	148
commandline.xhtml	149
complexlimit.xhtml	164
conversionfunctions.xhtml	165
cryptopage.xhtml	168
cryptoclass1.xhtml	169
cryptoclass2.xhtml	174
cryptoclass3.xhtml	177
cryptoclass4.xhtml	181
cryptoclass5.xhtml	185
cryptoclass6.xhtml	188
cryptoclass7.xhtml	190
cryptoclass8.xhtml	194
cryptoclass9.xhtml	198
cryptoclass10.xhtml	201
cryptoclass11.xhtml	203
dbopbinary.xhtml	206
dbcharacteristic.xhtml	206
dbcomplexcomplex.xhtml	207
dbcomplexconjugate.xhtml	207
dbcomplexfactor.xhtml	207
dbcomplexdoublefloat.xhtml	208
dbcomplexfloat.xhtml	208
dbcompleximag.xhtml	208
dbcomplexnorm.xhtml	209
dbcomplexreal.xhtml	209
dbcomplexinteger.xhtml	209
dbexpressioninteger.xhtml	209
dbfractioninteger.xhtml	210
dbfractionpolynomialinteger.xhtml	210
dblookup.xhtml	210
dbopacos.xhtml	211
dbopacosh.xhtml	211
dbopacot.xhtml	211
dbopacoth.xhtml	212
dbopacsc.xhtml	212
dbopacsch.xhtml	212

dbopaddmod.xhtml	212
dbopairyai.xhtml	213
dbopairybi.xhtml	213
dbopapproximants.xhtml	213
dbopasin.xhtml	214
dbopasinh.xhtml	214
dbopasec.xhtml	214
dbopasech.xhtml	215
dbopatan.xhtml	215
dbopatanh.xhtml	215
dbopbernoullib.xhtml	215
dbopbesseli.xhtml	216
dbopbesselj.xhtml	216
dbopbesselk.xhtml	216
dbopbessely.xhtml	217
dbopbeta.xhtml	217
dbopcardinalnumber.xhtml	217
dbopchebyshevt.xhtml	218
dbopchebyshevu.xhtml	218
dbopcoefficient.xhtml	218
dbopcoefficients.xhtml	218
dbopcoerce.xhtml	219
dbopcolumn.xhtml	219
dbopcompactfraction.xhtml	219
dbopcomplexeigenvectors.xhtml	220
dbopcomplexelementary.xhtml	220
dbopcomplexintegrate.xhtml	220
dbopcomplexlimit.xhtml	221
dbopcomplexsolve.xhtml	221
dbopcontent.xhtml	221
dbopcontinuedfraction.xhtml	221
dbopconvergents.xhtml	222
dbopconvert.xhtml	222
dbopcopy.xhtml	222
dbopcos.xhtml	223
dbopcosh.xhtml	223
dbopcot.xhtml	223
dbopcoth.xhtml	224
dbopcount.xhtml	224
dbopcountableq.xhtml	224
dbopcreate3space.xhtml	224
dbopcsc.xhtml	225
dbopcsch.xhtml	225
dbopcurve.xhtml	225
dbopcyclagits.xhtml	226
dbopcyclotomic.xhtml	226

dbopd.xhtml	226
dbopdecimal.xhtml	227
dbopdefiningpolynomial.xhtml	227
dbopdegree.xhtml	227
dbopdenom.xhtml	227
dbopdraw.xhtml	228
dbopdeterminant.xhtml	228
dbopdiagonalmatrix.xhtml	228
dbopdigamma.xhtml	229
dbopdigits.xhtml	229
dbopdimension.xhtml	229
dbopdivide.xhtml	230
dbopdivisors.xhtml	230
dbopei.xhtml	230
dboeigenmatrix.xhtml	230
dboeigenvalues.xhtml	231
dboeigenvector.xhtml	231
dboeigenvectors.xhtml	231
dbopelt.xhtml	232
dboequal.xhtml	232
dboeulere.xhtml	232
dboeulerphi.xhtml	233
dboeval.xhtml	233
dboevenq.xhtml	233
dbopexp.xhtml	233
dbopexquo.xhtml	234
dbopfactor.xhtml	234
dbopfactorfraction.xhtml	234
dbopfibonacci.xhtml	235
dbopfiniteq.xhtml	235
dbopfirstdenom.xhtml	235
dbopfirstnumer.xhtml	236
dbopfracragits.xhtml	236
dbopfractionpart.xhtml	236
dbopgamma.xhtml	236
dbopgcd.xhtml	237
dbophermiteh.xhtml	237
dbophex.xhtml	237
dbophorizconcat.xhtml	238
dbophtrigs.xhtml	238
dbophypergeometric0f1.xhtml	238
dbopinteger.xhtml	239
dbopintegrate.xhtml	239
dbopinverse.xhtml	239
dbopinvmmod.xhtml	239
dbopjacobi.xhtml	240

dboplagerrel.xhtml	240
dboplaurent.xhtml	240
dboplcm.xhtml	241
dbopleadingcoefficient.xhtml	241
dbopleadingmonomial.xhtml	241
dboplegendre.xhtml	242
dboplenth.xhtml	242
dboplimit.xhtml	242
dboplog.xhtml	242
dboploggamma.xhtml	243
dbopmainvariable.xhtml	243
dbopmakegraphimage.xhtml	243
dbopmakeobject.xhtml	244
dbopmakeviewport3d.xhtml	244
dbopmap.xhtml	244
dbopmapbang.xhtml	245
dbopmatrix.xhtml	245
dbopmax.xhtml	245
dbopmemberq.xhtml	245
dbopmin.xhtml	246
dbopminimumdegree.xhtml	246
dbopminus.xhtml	246
dbopmoebiusmu.xhtml	247
dbopmonicdivide.xhtml	247
dbopmulmod.xhtml	247
dbopncols.xhtml	248
dbopnegativeq.xhtml	248
dbopnew.xhtml	248
dbopnextprime.xhtml	248
dbopnorm.xhtml	249
dbopnrows.xhtml	249
dbopnthfractionalterm.xhtml	249
dbopnthroot.xhtml	250
dbopnumer.xhtml	250
dbopnumeric.xhtml	250
dbopoddq.xhtml	251
dboponedimensionalarray.xhtml	251
dbopoperator.xhtml	251
dboporthonormalbasis.xhtml	251
dbopoutputfixed.xhtml	252
dbopoutputfloating.xhtml	252
dbopoutputgeneral.xhtml	252
dbopoutputspacing.xhtml	253
dboppadicfraction.xhtml	253
dbopnullity.xhtml	253
dbopnullspace.xhtml	254

dbopnumberoffractionalterms.xhtml	254
dboppartialfraction.xhtml	254
dboppartialquotients.xhtml	254
dbopplus.xhtml	255
dboppattern.xhtml	255
dboppermanent.xhtml	255
dboppi.xhtml	256
dboppolygamma.xhtml	256
dboppositiveq.xhtml	256
dboppositiveremainder.xhtml	257
dbopprefixagits.xhtml	257
dbopprevprime.xhtml	257
dbopprimefactor.xhtml	257
dbopprimeq.xhtml	258
dbopprimes.xhtml	258
dboppuiseux.xhtml	258
dbopqelt.xhtml	259
dbopqseteltbang.xhtml	259
dbopquatern.xhtml	259
dbopradicaleigenvectors.xhtml	260
dbopradicalsolve.xhtml	260
dboprank.xhtml	260
dbopratdenom.xhtml	260
dboprealeigenvectors.xhtml	261
dboprealelementary.xhtml	261
dbopreduce.xhtml	261
dbopreductum.xhtml	262
dboprem.xhtml	262
dbopquo.xhtml	262
dbopresetvariableorder.xhtml	263
dbopresultant.xhtml	263
dboprootof.xhtml	263
dboprootsimp.xhtml	263
dboprootsof.xhtml	264
dbopseries.xhtml	264
dbopround.xhtml	264
dboprow.xhtml	265
dboprowechelon.xhtml	265
dbopsetcolumnbang.xhtml	265
dbopseteltbang.xhtml	266
dbopsetrowbang.xhtml	266
dbopsetelt.xhtml	266
dbopsetsubmatrixbang.xhtml	266
dbopsign.xhtml	267
dbopsimplify.xhtml	267
dbopseriesolve.xhtml	267

dbopsin.xhtml	268
dbopsingleintegerand.xhtml	268
dbopsingleintegernot.xhtml	268
dbopsingleintegeror.xhtml	269
dbopsingleintegerxor.xhtml	269
dbopsec.xhtml	269
dbopsech.xhtml	269
dbopsetvariableorder.xhtml	270
dbopsinh.xhtml	270
dbopsolve.xhtml	270
dbopsqrt.xhtml	271
dbopstar.xhtml	271
dbopstarstar.xhtml	271
dbopsubmatrix.xhtml	272
dbopsubmod.xhtml	272
dbopsurface.xhtml	272
dbopsumofkthpowerdivisors.xhtml	272
dboptan.xhtml	273
dboptanh.xhtml	273
dboptaylor.xhtml	273
dboptimes.xhtml	274
dboptotaldegree.xhtml	274
dboptrace.xhtml	274
dboptranspose.xhtml	275
dboptrigs.xhtml	275
dboptruncate.xhtml	275
dbopvariables.xhtml	275
dbopvectorise.xhtml	276
dbopvectorspace.xhtml	276
dbopwrite.xhtml	276
dbopzeroof.xhtml	277
dbopzerosof.xhtml	277
dbopzeroq.xhtml	277
dbopvertconcat.xhtml	278
dbopwholepart.xhtml	278
dbpolynomialinteger.xhtml	278
dbpolynomialfractioninteger.xhtml	278
dbopwholeragits.xhtml	279
definiteintegral.xhtml	279
determinantofhilbert.xhtml	280
differentiate.xhtml	282
dlnf.xhtml	283
dlnfapproximations.xhtml	284
dlnfasymptoticexpansions.xhtml	294
dlnfbarnesgfunction.xhtml	342
dlnfbetafunction.xhtml	359

dlmfcontinuedfractions.xhtml	388
dlmfdefinitions.xhtml	395
dlmffunctionrelations.xhtml	404
dlmfgraphics.xhtml	422
dlmfinequalities.xhtml	427
dlmfinfiniteproducts.xhtml	442
dlmfintegrals.xhtml	452
dlmfintegralrepresentations.xhtml	470
dlmfmathematicalapplications.xhtml	508
dlmfmethodsofcomputation.xhtml	518
dlmfmultidimensionalintegral.xhtml	520
dlmfnotation.xhtml	548
dlmfphysicalapplications.xhtml	556
dlmfpolygammafunctions.xhtml	568
dlmfqgammaandbetafunctions.xhtml	578
dlmfseriesexpansions.xhtml	596
dlmfsums.xhtml	613
dlmfsoftware.xhtml	616
dlmfspecialvaluesandextrema.xhtml	616
dlmftables.xhtml	642
draw.xhtml	692
draw2donevariable.xhtml	694
draw2ddefinedcurve.xhtml	696
draw2dpolynomialequation.xhtml	697
draw3dtwovariable.xhtml	699
draw3ddefinedtube.xhtml	700
draw3ddefinedsurface.xhtml	702
equidifferential.xhtml	704
equidifferentiallinear.xhtml	705
equidifferentialnonlinear.xhtml	708
equidifferentialpowerseries.xhtml	712
equationpage.xhtml	715
equsystemlinear.xhtml	716
examplesexposedpage.xhtml	718
factored.xhtml	719
foundationlibrarydocpage.xhtml	719
funalgebraicfunctions.xhtml	719
funelementaryfunctions.xhtml	721
funoperatoralgebra.xhtml	722
functionpage.xhtml	727
funpatternmatching.xhtml	728
funrationalfunctions.xhtml	736
funsimplication.xhtml	737
glossarypage.xhtml	740
graphexamples.xhtml	774
graphexamplesassorted.xhtml	774

graphexamplesimplicit.xhtml	776
graphexampleslistofpoints.xhtml	777
graphexamplesonevariable.xhtml	779
graphexamplesparametric.xhtml	780
graphexamplespolar.xhtml	781
graphexamplesthreed.xhtml	782
graphicspage.xhtml	784
graphviewports.xhtml	785
graph2d.xhtml	786
graph2dimplicit.xhtml	787
graph2dlistsofpoints.xhtml	788
graph2donevariable.xhtml	790
graph2dparametric.xhtml	792
graph2dpolar.xhtml	793
graph3d.xhtml	795
graph3dobjects.xhtml	795
graph3dparametric.xhtml	799
graph3dsurfaces.xhtml	800
graph3dtubeplots.xhtml	802
graph3dtwovariables.xhtml	804
htxtoppage.xhtml	805
indefiniteintegral.xhtml	806
introtofloat.xhtml	806
jenks.xhtml	807
laurentseries.xhtml	809
linalgpage.xhtml	811
linconversion.xhtml	813
lincreate.xhtml	816
lineigen.xhtml	821
linhilbert.xhtml	824
linintro.xhtml	826
linoperations.xhtml	828
linpermaent.xhtml	832
linsquarematrices.xhtml	833
linvectors.xhtml	835
lin1darrays.xhtml	838
lin2darrays.xhtml	840
man0page.xhtml	845
menualgebraadjointmatrix.xhtml	847
menualgebraapplytolist.xhtml	848
menualgebracharacteristicpolynomial.xhtml	848
menualgebradeterminant.xhtml	848
menualgebraeigenvalues.xhtml	849
menualgebraeigenvectors.xhtml	849
menualgebraentermatrix.xhtml	849
menualgebrainvertmatrix.xhtml	849

menualgebrageneratematrix.xhtml	850
menualgebramakelist.xhtml	850
menualgebramaptolist.xhtml	850
menualgebramaptomatrix.xhtml	851
menualgebrareducelist.xhtml	851
menualgebratransposematrix.xhtml	851
menuaxiomaddtopath.xhtml	852
menuaxiomclearmemory.xhtml	852
menuaxiomdeletefunction.xhtml	852
menuaxiomdeletevariable.xhtml	852
menuaxiominterrupt.xhtml	853
menuaxiomrestart.xhtml	853
menuaxiomshowdefinition.xhtml	853
menuaxiomdisplay.xhtml	854
menuaxiomset.xhtml	854
menuaxiomshowfunctions.xhtml	854
menuaxiomshowvariables.xhtml	855
menuaxiomtoggletimedisplay.xhtml	855
menucalculuscalculusum.xhtml	855
menucalculuscalculusproduct.xhtml	855
menucalculuschangevariable.xhtml	856
menucalculuscontinuedfractions.xhtml	856
menucalculusdifferentiate.xhtml	856
menucalculusdividepolynomials.xhtml	857
menucalculusfindlimit.xhtml	857
menucalculusgetseries.xhtml	857
menucalculusgreatestcommondivisor.xhtml	858
menucalculusleastcommonmultiple.xhtml	858
menucalculusintegrate.xhtml	858
menucalculusinverselaplace transform.xhtml	858
menucalculuslaplace transform.xhtml	859
menucalculuslevel3.xhtml	859
menucalculuslevel3a.xhtml	859
menucalculuslevel3b.xhtml	860
menucalculuslevel3c.xhtml	860
menucalculuspadeapproximation.xhtml	860
menucalculuspartialfractions.xhtml	861
menucalculusrischintegrate.xhtml	861
menueditcopy.xhtml	861
menueditcopyasimage.xhtml	861
menueditcopytex.xhtml	862
menueditcopytext.xhtml	862
menueditcut.xhtml	862
menueditpaste.xhtml	863
menueditdeleteselection.xhtml	863
menueditselectiontoimage.xhtml	863

menueditselectiontoinput.xhtml	864
menuequationsrealrootsofpolynomial.xhtml	864
menuequationsatvalue.xhtml	864
menuequationsboundaryvalueproblem.xhtml	864
menuequationsinitialvalueproblem1.xhtml	865
menuequationsinitialvalueproblem2.xhtml	865
menuequationssolvealgebraicsystem.xhtml	865
menuequationseliminatevariable.xhtml	866
menuequationssolveinearsystem.xhtml	866
menuequationssolveode.xhtml	866
menuequationssolveodewithlaplace.xhtml	867
menuequationsrootsofpolynomial.xhtml	867
menuequationssolve.xhtml	867
menuequationssolvenumerically.xhtml	867
menufileexit.xhtml	868
menufileinputfile.xhtml	868
menufileloadlibrary.xhtml	868
menufileopen.xhtml	869
menufileprint.xhtml	869
menufileread.xhtml	869
menufilesave.xhtml	870
menufilesaveas.xhtml	870
menufiletogglespool.xhtml	870
menunumericsetprecision.xhtml	870
menunumerictobigfloat.xhtml	871
menunumerictofloat.xhtml	871
menunumerictogglenumericoutput.xhtml	871
menusimplifyaddalgebraicequality.xhtml	872
menusimplifycomplexsimplification.xhtml	872
menusimplifycontractlogarithms.xhtml	872
menusimplifyevalutenounform.xhtml	873
menusimplifyexpandexpression.xhtml	873
menusimplifyexpandlogarithms.xhtml	873
menusimplifyfactorialsandgamma.xhtml	873
menusimplifyfactorcomplex.xhtml	874
menusimplifyfactorexpression.xhtml	874
menusimplifymoduluscomputation.xhtml	874
menusimplifysimplifyexpression.xhtml	875
menusimplifysubstitute.xhtml	875
menusimplifysimplifyradicals.xhtml	875
menusimplifytogglealgebraicflag.xhtml	876
menusimplifytrigsimplification.xhtml	876
numbasicfunctions.xhtml	876
numberspage.xhtml	882
numcardinalnumbers.xhtml	884
numcomplexnumbers.xhtml	888

numcontinuedfractions.xhtml	892
numexamples.xhtml	898
numfactorization.xhtml	899
numfinitefields.xhtml	901
numfloat.xhtml	903
numfractions.xhtml	904
numfunctions.xhtml	905
numgeneralinfo.xhtml	911
numintegerfractions.xhtml	912
numintegers.xhtml	912
nummachinefloats.xhtml	914
nummachinesizedintegers.xhtml	917
numnumbertheoreticfunctions.xhtml	920
numnumericfunctions.xhtml	922
numoctonions.xhtml	933
numotherbases.xhtml	936
numpartialfractions.xhtml	939
numproblems.xhtml	943
numquaternions.xhtml	946
numquotientfields.xhtml	948
numrationalnumbers.xhtml	952
numrepeatingbinaryexpansions.xhtml	953
numrepeatingdecimals.xhtml	955
numrepeatinghexexpansions.xhtml	957
numromannumerals.xhtml	958
ocwmit18085.xhtml	961
ocwmit18085lecture1.xhtml	962
ocwmit18085lecture2.xhtml	970
operations.xhtml	970
outputfunctions.xhtml	971
pagelist.xhtml	973
pagematrix.xhtml	973
pageonedimensionalarray.xhtml	973
pageset.xhtml	973
pagetable.xhtml	974
pagepermanent.xhtml	974
pagesquarematrix.xhtml	974
pagetwodimensionalarray.xhtml	975
pagevector.xhtml	979
polybasicfunctions.xhtml	980
polyfactorization.xhtml	983
polyfactorization1.xhtml	984
polyfactorization2.xhtml	985
polyfactorization3.xhtml	986
polyfactorization4.xhtml	988
polygcdandfriends.xhtml	989

polynomialpage.xhtml	990
polyroots.xhtml	991
polyroots1.xhtml	993
polyroots2.xhtml	995
polyroots3.xhtml	997
polyroots4.xhtml	999
polyspecifictypes.xhtml	1001
polyspecifictypes1.xhtml	1003
polyspecifictypes2.xhtml	1013
polyspecifictypes3.xhtml	1021
polyspecifictypes4.xhtml	1024
polysubstitutions.xhtml	1026
puiseuxseries.xhtml	1028
reallimit.xhtml	1030
refsearchpage.xhtml	1031
releasenotes.xhtml	1032
rootpage.xhtml	1033
series.xhtml	1035
seriesexpand.xhtml	1036
solve.xhtml	1037
solve-linearequations.xhtml	1038
solve-linear-matrix.xhtml	1041
solve-single-polynomial.xhtml	1046
solve-system-polynomials.xhtml	1047
summation.xhtml	1047
systemvariables.xhtml	1048
taylorseries.xhtml	1048
topexamplepage.xhtml	1050
topicspage.xhtml	1050
topreferencepage.xhtml	1051
topsettingspage.xhtml	1053
tutorial.xhtml	1053
uglangpage.xhtml	1054
ugsyscmdpage.xhtml	1054
usersguidepage.xhtml	1054
rcm3720.input	1054
signatures.txt	1055
strang.input	1056
bitmaps/axiom1.bitmap	1057
1.10 License	1063

Volume 12: Axiom Crystal

Axiom Crystal Design	1
1.1 Book presentation	1
Book spines	1
Linking information	2
Experiments	3
1.2 Hide/Show a div element	3
1.3 Hide/Show a nested div element	4
1.4 Hide/Show a ring of elements	5
Other work	7
1.5 Understanding the Dynamics of Complex Lisp Programs [?]	7

Volume 13: Proving Axiom Correct

1	Here is a problem	3
1.1	Approaches	4
2	Theory	7
3	Software Details	9
3.1	Installed Software	9
3.2	Coq Spad proofs	11
3.3	ACL2 Lisp proofs	11
3.4	Lisp to Hardware	11

Bibliography: Axiom Bibliography

1.1	Axiom Citations in the Literature	3
1.2	Axiom Citations of External Sources	42
1.3	Special Topics	72
	Solving Systems of Equations	72
	Numerical Algorithms	72
	Special Functions	73
	Polynomial GCD	74
	Category Theory	76
	Proving Axiom Correct	77
	Interval Arithmetic	83
	Numerics	84
	Advanced Documentation	84
	Differential Equations	85
	Expression Simplification	89
	Integration	89
	Partial Fraction Decomposition	95
	Ore Rings	95