

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>
Bibliography:		<i>Axiom Bibliography</i>

Volume 0: Axiom Jenks and Sutor

0.1	Introduction to Axiom	1
0.1.1	Symbolic Computation	1
0.1.2	Numeric Computation	2
0.1.3	Graphics	3
0.1.4	HyperDoc	3
0.1.5	Interactive Programming	4
0.1.6	Data Structures	6
0.1.7	Mathematical Structures	7
0.1.8	Pattern Matching	8
0.1.9	Polymorphic Algorithms	8
0.1.10	Extensibility	9
0.1.11	Types are Defined by Abstract Datatype Programs	10
0.1.12	The Type of Basic Objects is a Domain or Subdomain	11
0.1.13	Domains Have Types Called Categories	11
0.1.14	Operations Can Refer To Abstract Types	12
0.1.15	Categories Form Hierarchies	12
0.1.16	Domains Belong to Categories by Assertion	13
0.1.17	Packages Are Clusters of Polymorphic Operations	13
0.1.18	The Interpreter Builds Domains Dynamically	14
0.1.19	Axiom Code is Compiled	14
0.1.20	Axiom is Extensible	15
0.2	Using Axiom as a Pocket Calculator	15
0.2.1	Basic Arithmetic	16
0.2.2	Type Conversion	17
0.2.3	Useful Functions	19
0.3	Using Axiom as a Symbolic Calculator	22
0.3.1	Expressions Involving Symbols	22
0.3.2	Complex Numbers	24
0.3.3	Number Representations	25
0.3.4	Modular Arithmetic	29
0.4	General Points about Axiom	30
0.4.1	Computation Without Output	30
0.4.2	Accessing Earlier Results	31
0.4.3	Splitting Expressions Over Several Lines	31
0.4.4	Comments and Descriptions	31
0.4.5	Control of Result Types	32
0.5	Data Structures in Axiom	33
0.5.1	Lists	33
0.5.2	Segmented Lists	41
0.5.3	Streams	42
0.5.4	Arrays, Vectors, Strings, and Bits	45
0.5.5	Flexible Arrays	47
0.6	Functions, Choices, and Loops	50
0.6.1	Reading Code from a File	50

0.6.2	Blocks	50
0.6.3	Functions	54
0.6.4	Choices	57
0.6.5	Loops	57
1	An Overview of Axiom	67
1.1	Starting Up and Winding Down	67
1.1.1	Clef	68
1.2	Typographic Conventions	69
1.3	The Axiom Language	69
1.3.1	Arithmetic Expressions	70
1.3.2	Previous Results	70
1.3.3	Some Types	71
1.3.4	Symbols, Variables, Assignments, and Declarations	72
1.3.5	Conversion	75
1.3.6	Calling Functions	76
1.3.7	Some Predefined Macros	77
1.3.8	Long Lines	77
1.3.9	Comments	78
1.4	Numbers	78
1.5	Data Structures	86
1.6	Expanding to Higher Dimensions	93
1.7	Writing Your Own Functions	95
1.8	Polynomials	101
1.9	Limits	102
1.10	Series	104
1.11	Derivatives	106
1.12	Integration	109
1.13	Differential Equations	113
1.14	Solution of Equations	115
1.15	System Commands	117
1.15.1	Undo	118
1.16	Graphics	121
2	Using Types and Modes	123
2.1	The Basic Idea	123
2.1.1	Domain Constructors	125
2.2	Writing Types and Modes	130
2.2.1	Types with No Arguments	131
2.2.2	Types with One Argument	132
2.2.3	Types with More Than One Argument	133
2.2.4	Modes	133
2.2.5	Abbreviations	134
2.3	Declarations	135
2.4	Records	138
2.5	Unions	142

2.5.1	Unions Without Selectors	142
2.5.2	Unions With Selectors	146
2.6	The “Any” Domain	147
2.7	Conversion	148
2.8	Subdomains Again	151
2.9	Package Calling and Target Types	155
2.10	Resolving Types	158
2.11	Exposing Domains and Packages	160
2.12	Commands for Snooping	163
3	Using HyperDoc	167
3.1	Headings	168
3.2	Key Definitions	168
3.3	Scroll Bars	169
3.4	Input Areas	169
3.5	Radio Buttons and Toggles	170
3.6	Search Strings	170
3.6.1	Logical Searches	171
3.7	Example Pages	171
3.8	X Window Resources for HyperDoc	172
4	Input Files and Output Styles	175
4.1	Input Files	175
4.2	The .axiom.input File	176
4.3	Common Features of Using Output Formats	177
4.4	Monospace Two-Dimensional Mathematical Format	178
4.5	TeX Format	179
4.6	IBM Script Formula Format	179
4.7	FORTTRAN Format	180
5	Overview of Interactive Language	185
5.1	Immediate and Delayed Assignments	185
5.2	Blocks	189
5.3	if-then-else	193
5.4	Loops	195
5.4.1	Compiling vs. Interpreting Loops	195
5.4.2	return in Loops	195
5.4.3	break in Loops	196
5.4.4	break vs. => in Loop Bodies	198
5.4.5	More Examples of break	198
5.4.6	iterate in Loops	201
5.4.7	while Loops	201
5.4.8	for Loops	204
5.4.9	for i in n..m repeat	205
5.4.10	for i in n..m by s repeat	206
5.4.11	for i in n.. repeat	207

5.4.12	for x in l repeat	207
5.4.13	“Such that” Predicates	209
5.4.14	Parallel Iteration	209
5.4.15	Mixing Loop Modifiers	212
5.5	Creating Lists and Streams with Iterators	212
5.6	An Example: Streams of Primes	216
6	User-Defined Functions, Macros and Rules	221
6.1	Functions vs. Macros	221
6.2	Macros	222
6.3	Introduction to Functions	225
6.4	Declaring the Type of Functions	227
6.5	One-Line Functions	228
6.6	Declared vs. Undeclared Functions	230
6.7	Functions vs. Operations	232
6.8	Delayed Assignments vs. Functions with No Arguments	233
6.9	How Axiom Determines What Function to Use	234
6.10	Compiling vs. Interpreting	237
6.11	Piece-Wise Function Definitions	238
6.11.1	A Basic Example	238
6.11.2	Picking Up the Pieces	241
6.11.3	Predicates	244
6.12	Caching Previously Computed Results	246
6.13	Recurrence Relations	248
6.14	Making Functions from Objects	250
6.15	Functions Defined with Blocks	254
6.16	Free and Local Variables	258
6.17	Anonymous Functions	264
6.17.1	Some Examples	265
6.17.2	Declaring Anonymous Functions	266
6.18	Example: A Database	269
6.19	Example: A Famous Triangle	271
6.20	Example: Testing for Palindromes	274
6.21	Rules and Pattern Matching	276
7	Graphics	285
7.1	Two-Dimensional Graphics	286
7.1.1	Plotting Two-Dimensional Functions of One Variable	286
7.1.2	Plotting Two-Dimensional Parametric Plane Curves	287
7.1.3	Plotting Plane Algebraic Curves	288
7.1.4	Two-Dimensional Options	289
7.1.5	Color	290
7.1.6	Palette	291
7.1.7	Two-Dimensional Control-Panel	292
7.1.8	Operations for Two-Dimensional Graphics	294
7.1.9	Addendum: Building Two-Dimensional Graphs	297

7.1.10	Addendum: Appending a Graph to a Viewport Window Containing a Graph	304
7.2	Three-Dimensional Graphics	305
7.2.1	Plotting Three-Dimensional Functions of Two Variables	305
7.2.2	Plotting Three-Dimensional Parametric Space Curves	306
7.2.3	Plotting Three-Dimensional Parametric Surfaces	307
7.2.4	Axiom Images	308
7.2.5	Three-Dimensional Options	317
7.2.6	The makeObject Command	320
7.2.7	Building Three-Dimensional Objects From Primitives	321
7.2.8	Coordinate System Transformations	326
7.2.9	Three-Dimensional Clipping	328
7.2.10	Three-Dimensional Control-Panel	329
7.2.11	Operations for Three-Dimensional Graphics	333
7.2.12	Customization using .Xdefaults	336
8	Advanced Problem Solving	339
8.1	Numeric Functions	339
8.2	Polynomial Factorization	349
8.2.1	Integer and Rational Number Coefficients	349
8.2.2	Finite Field Coefficients	350
8.2.3	Simple Algebraic Extension Field Coefficients	350
8.2.4	Factoring Rational Functions	352
8.3	Manipulating Symbolic Roots of a Polynomial	353
8.3.1	Using a Single Root of a Polynomial	353
8.3.2	Using All Roots of a Polynomial	354
8.4	Computation of Eigenvalues and Eigenvectors	356
8.5	Solution of Linear and Polynomial Equations	360
8.5.1	Solution of Systems of Linear Equations	360
8.5.2	Solution of a Single Polynomial Equation	362
8.5.3	Solution of Systems of Polynomial Equations	364
8.6	Limits	367
8.7	Laplace Transforms	370
8.8	Integration	372
8.9	Working with Power Series	376
8.9.1	Creation of Power Series	376
8.9.2	Coefficients of Power Series	378
8.9.3	Power Series Arithmetic	379
8.9.4	Functions on Power Series	381
8.9.5	Converting to Power Series	384
8.9.6	Power Series from Formulas	387
8.9.7	Substituting Numerical Values in Power Series	390
8.9.8	Example: Bernoulli Polynomials and Sums of Powers	391
8.10	Solution of Differential Equations	395
8.10.1	Closed-Form Solutions of Linear Differential Equations	395
8.10.2	Closed-Form Solutions of Non-Linear Differential Equations	399

8.10.3	Power Series Solutions of Differential Equations	403
8.11	Finite Fields	405
8.11.1	Modular Arithmetic and Prime Fields	405
8.11.2	Extensions of Finite Fields	410
8.11.3	Irreducible Modulus Polynomial Representations	411
8.11.4	Cyclic Group Representations	415
8.11.5	Normal Basis Representations	417
8.11.6	Conversion Operations for Finite Fields	420
8.11.7	Utility Operations for Finite Fields	423
8.12	Primary Decomposition of Ideals	430
8.13	Computation of Galois Groups	434
8.14	Non-Associative Algebras and Modelling Genetic Laws	443
9	Some Examples of Domains and Packages	449
9.1	ApplicationProgramInterface	449
9.2	ArrayStack	450
9.3	AssociationList	454
9.4	BalancedBinaryTree	457
9.5	BasicOperator	459
9.6	BinaryExpansion	463
9.7	BinarySearchTree	465
9.8	CardinalNumber	467
9.9	CartesianTensor	471
9.10	Character	482
9.11	CharacterClass	485
9.12	CliffordAlgebra	487
9.12.1	The Complex Numbers as a Clifford Algebra	488
9.12.2	The Quaternion Numbers as a Clifford Algebra	489
9.12.3	The Exterior Algebra on a Three Space	491
9.12.4	The Dirac Spin Algebra	493
9.13	Complex	495
9.14	ContinuedFraction	498
9.15	CycleIndicators	505
9.16	DeRhamComplex	516
9.17	DecimalExpansion	523
9.18	Dequeue	524
9.19	DistributedMultivariatePolynomial	531
9.20	DoubleFloat	533
9.21	EqTable	535
9.22	Equation	536
9.23	EuclideanGroebnerBasisPackage	539
9.24	Exit	540
9.25	Expression	541
9.26	Factored	546
9.26.1	Decomposing Factored Objects	547
9.26.2	Expanding Factored Objects	549

9.26.3	Arithmetic with Factored Objects	549
9.26.4	Creating New Factored Objects	552
9.26.5	Factored Objects with Variables	553
9.27	FactoredFunctions2	554
9.28	File	555
9.29	FileName	558
9.30	FlexibleArray	561
9.31	Float	565
9.31.1	Introduction to Float	565
9.31.2	Conversion Functions	566
9.31.3	Output Functions	569
9.31.4	An Example: Determinant of a Hilbert Matrix	571
9.32	Fraction	573
9.33	FullPartialFractionExpansion	575
9.34	GeneralDistributedMultivariatePolynomial	580
9.35	GeneralSparseTable	582
9.36	GroebnerFactorizationPackage	583
9.37	GroebnerPackage	585
9.38	Heap	586
9.39	HexadecimalExpansion	588
9.40	HomogeneousDistributedMultivariatePolynomial	590
9.41	Integer	592
9.41.1	Basic Functions	592
9.41.2	Primes and Factorization	598
9.41.3	Some Number Theoretic Functions	599
9.42	IntegerLinearDependence	601
9.43	IntegerNumberTheoryFunctions	603
9.44	Kernel	608
9.45	KeyedAccessFile	612
9.46	LexTriangularPackage	616
9.47	LazardSetSolvingPackage	643
9.48	Library	653
9.49	LieExponentials	655
9.50	LiePolynomial	657
9.51	LinearOrdinaryDifferentialOperator	662
9.51.1	Differential Operators with Series Coefficients	662
9.52	LinearOrdinaryDifferentialOperator1	667
9.52.1	Differential Operators with Rational Function Coefficients	667
9.53	LinearOrdinaryDifferentialOperator2	672
9.53.1	Differential Operators with Constant Coefficients	672
9.53.2	Differential Operators with Matrix Coefficients Operating on Vectors	674
9.54	List	678
9.54.1	Creating Lists	678
9.54.2	Accessing List Elements	679
9.54.3	Changing List Elements	681
9.54.4	Other Functions	683

9.54.5 Dot, Dot	684
9.55 LyndonWord	685
9.56 Magma	689
9.57 MakeFunction	693
9.58 MappingPackage1	695
9.59 Matrix	700
9.59.1 Creating Matrices	701
9.59.2 Operations on Matrices	705
9.60 Multiset	709
9.61 MultivariatePolynomial	712
9.62 None	714
9.63 NottinghamGroup	715
9.64 Octonion	716
9.65 OneDimensionalArray	719
9.66 Operator	721
9.67 OrderedVariableList	725
9.68 OrderlyDifferentialPolynomial	726
9.69 PartialFraction	734
9.70 Permanent	737
9.71 Permutation	738
9.72 Polynomial	738
9.73 Quaternion	748
9.74 Queue	751
9.75 RadixExpansion	753
9.76 RealClosure	756
9.77 RealSolvePackage	770
9.78 RegularTriangularSet	772
9.79 RomanNumeral	787
9.80 Segment	789
9.81 SegmentBinding	791
9.82 Set	793
9.83 SingleInteger	796
9.84 SparseTable	799
9.85 SquareMatrix	800
9.86 SquareFreeRegularTriangularSet	802
9.87 Stack	807
9.88 Stream	810
9.89 String	812
9.90 StringTable	819
9.91 Symbol	819
9.92 Table	824
9.93 TextFile	828
9.94 TwoDimensionalArray	830
9.95 TwoDimensionalViewport	835
9.96 UnivariatePolynomial	842
9.97 UnivariateSkewPolynomial	850

9.97.1 A second example	852
9.97.2 A third example	853
9.97.3 A fourth example	854
9.98 UniversalSegment	855
9.99 Vector	857
9.100 Void	859
9.101 WuWenTsunTriangularSet	860
9.102 XPBWPolynomial	864
9.103 XPolynomial	872
9.104 XPolynomialRing	875
9.105 ZeroDimensionalSolvePackage	878
10 Interactive Programming	901
10.1 Drawing Ribbons Interactively	901
10.2 A Ribbon Program	903
10.3 Coloring and Positioning Ribbons	904
10.4 Points, Lines, and Curves	905
10.5 A Bouquet of Arrows	907
10.6 Diversion: When Things Go Wrong	908
10.7 Drawing Complex Vector Fields	908
10.8 Drawing Complex Functions	910
10.9 Functions Producing Functions	911
10.10 Automatic Newton Iteration Formulas	912
11 Packages	915
11.1 Names, Abbreviations, and File Structure	915
11.2 Syntax	916
11.3 Abstract Datatypes	917
11.4 Capsules	917
11.5 Input Files vs. Packages	918
11.6 Compiling Packages	919
11.7 Parameters	920
11.8 Conditionals	921
11.9 Testing	923
11.10 How Packages Work	924
12 Categories	927
12.1 Definitions	928
12.2 Exports	928
12.3 Documentation	929
12.4 Hierarchies	930
12.5 Membership	931
12.6 Defaults	931
12.7 Axioms	932
12.8 Correctness	933
12.9 Attributes	934

12.10Parameters	935
12.11Conditionals	935
12.12Anonymous Categories	936
13 Domains	939
13.1 Domains vs. Packages	939
13.2 Definitions	939
13.3 Category Assertions	940
13.4 A Demo	942
13.5 Browse	943
13.6 Representation	943
13.7 Multiple Representations	944
13.8 Add Domain	944
13.9 Defaults	945
13.10Origins	946
13.11Short Forms	946
13.12Example 1: Clifford Algebra	947
13.13Example 2: Building A Query Facility	947
13.13.1 A Little Query Language	949
13.13.2 The Database Constructor	950
13.13.3 Query Equations	951
13.13.4 DataLists	952
13.13.5 Index Cards	953
13.13.6 Creating a Database	953
13.13.7 Putting It All Together	953
13.13.8 Example Queries	954
14 Browse	957
14.1 The Front Page: Searching the Library	957
14.2 The Constructor Page	961
14.2.1 Constructor Page Buttons	963
14.2.2 Cross Reference	968
14.2.3 Views Of Constructors	971
14.2.4 Giving Parameters to Constructors	972
14.3 Miscellaneous Features of Browse	973
14.3.1 The Description Page for Operations	973
14.3.2 Views of Operations	974
14.3.3 Capitalization Convention	979
15 What's New in Axiom Version 2.0	981
15.1 Important Things to Read First	981
15.2 The NAG Library Link	981
15.2.1 Interpreting NAG Documentation	982
15.2.2 Using the Link	983
15.2.3 Providing values for Argument Subprograms	984
15.2.4 General Fortran-generation utilities in Axiom	986

15.2.5	Some technical information	994
15.3	Interactive Front-end and Language	995
15.4	Library	995
15.5	HyperTex	997
15.6	Documentation	997
A	Axiom System Commands	999
A.1	Introduction	999
A.2	)abbreviation	1000
A.3	)browse	1002
A.4	)cd	1002
A.5	)close	1003
A.6	)clear	1003
A.7	)compile	1005
A.8	)display	1007
A.9	)edit	1009
A.10	)fin	1009
A.11	)frame	1010
A.12	)help	1011
A.13	)history	1012
A.14	)include	1014
A.15	)library	1015
A.16	)lisp	1016
A.17	)load	1016
A.18	)regress	1016
A.19	)tangle	1020
A.20	)trace	1020
A.21	)pquit	1020
A.22	)quit	1021
A.23	)read	1022
A.24	)set	1022
A.25	)show	1023
A.26	)spool	1024
A.27	)synonym	1025
A.28	)system	1026
A.29	)trace	1026
A.30	)undo	1030
A.31	)what	1031
B	Categories	1035
C	Domains	1045
D	Packages	1075
E	Operations	1091

F	Programs for AXIOM Images	1193
F.1	images1.input	1193
F.2	images2.input	1194
F.3	images3.input	1194
F.4	images5.input	1194
F.5	images6.input	1196
F.6	images7.input	1196
F.7	images8.input	1197
F.8	conformal.input	1197
F.9	tknot.input	1200
F.10	ntube.input	1201
F.11	dhtri.input	1202
F.12	tetra.input	1203
F.13	antoine.input	1205
F.14	scherk.input	1206
G	Glossary	1209
H	License	1231

Volume 1: Axiom Tutorial

1	Axiom Features	1
1.1	Introduction to Axiom	1
1.1.1	Symbolic Computation	1
1.1.2	Numeric Computation	2
1.1.3	Mathematical Structures	3
1.1.4	HyperDoc	4
1.1.5	Interactive Programming	5
1.1.6	Graphics	6
1.1.7	Data Structures	7
1.1.8	Pattern Matching	8
1.1.9	Polymorphic Algorithms	9
1.1.10	Extensibility	10
1.1.11	Open Source	11
2	Ten Fundamental Ideas	13
2.0.12	Types are Defined by Abstract Datatype Programs	14
2.0.13	The Type of Basic Objects is a Domain or Subdomain	14
2.0.14	Domains Have Types Called Categories	15
2.0.15	Operations Can Refer To Abstract Types	15
2.0.16	Categories Form Hierarchies	15
2.0.17	Domains Belong to Categories by Assertion	16
2.0.18	Packages Are Clusters of Polymorphic Operations	17
2.0.19	The Interpreter Builds Domains Dynamically	17
2.0.20	Axiom Code is Compiled	18
2.0.21	Axiom is Extensible	18
3	Starting Axiom	21
3.1	Starting Up and Winding Down	21
3.1.1	Clef	22
3.1.2	Typographic Conventions	22
3.2	The Axiom Language	23
3.2.1	Arithmetic Expressions	23
3.2.2	Previous Results	24
3.2.3	Some Types	25
3.2.4	Symbols, Variables, Assignments, and Declarations	26
3.2.5	Conversion	28
3.2.6	Calling Functions	29
3.2.7	Some Predefined Macros	30
3.2.8	Long Lines	31
3.2.9	Comments	31
3.3	Using Axiom as a Pocket Calculator	31
3.3.1	Basic Arithmetic	31
3.3.2	Type Conversion	33

3.3.3	Useful Functions	35
3.4	Using Axiom as a Symbolic Calculator	38
3.4.1	Expressions Involving Symbols	38
3.4.2	Complex Numbers	39
3.4.3	Number Representations	41
3.4.4	Modular Arithmetic	45
3.5	General Points about Axiom	46
3.5.1	Computation Without Output	46
3.5.2	Accessing Earlier Results	47
3.5.3	Splitting Expressions Over Several Lines	47
3.5.4	Comments and Descriptions	47
3.5.5	Control of Result Types	48
3.5.6	Using system commands	49
3.5.7	Using undo	50
3.6	Data Structures in Axiom	53
3.6.1	Lists	53
3.6.2	Segmented Lists	61
3.6.3	Streams	62
3.6.4	Arrays, Vectors, Strings, and Bits	64
3.6.5	Flexible Arrays	67
3.7	Functions, Choices, and Loops	70
3.7.1	Reading Code from a File	70
3.7.2	Blocks	70
3.7.3	Functions	74
3.7.4	Choices	77
3.7.5	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
4.0.1	Plotting 2D graphs	128
4.0.2	Palette	133
4.0.3	Two-Dimensional Control-Panel	134
4.0.4	Operations for Two-Dimensional Graphics	137
4.0.5	Building Two-Dimensional Graphs Manually	140
4.0.6	Appending a Graph to a Viewport Window Containing a Graph . . .	149
4.0.7	Plotting 3D Graphs	150

4.0.8	Three-Dimensional Options	152
4.0.9	Three-Dimensional Control-Panel	153
4.0.10	Operations for Three-Dimensional Graphics	158
4.0.11	Customization using .Xdefaults	161
5	Using Types and Modes	163
5.1	The Basic Idea	163
5.1.1	Domain Constructors	165
5.2	Writing Types and Modes	170
5.2.1	Types with No Arguments	171
5.2.2	Types with One Argument	171
5.2.3	Types with More Than One Argument	173
5.2.4	Modes	173
5.2.5	Abbreviations	173
5.3	Declarations	175
5.4	Records	178
5.5	Unions	182
5.5.1	Unions Without Selectors	182
5.5.2	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
6.6.1	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	FORTTRAN 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

0.1	Makefile	1
1	Writing Spad Code	3
1.1	The Description: label and the)describe command	3

Volume 3: Axiom Programmers Guide

0.1 Makefile 1

Volume 4: Axiom Developers Guide

0.1	How Axiom Builds	1
0.1.1	The environment variables	1
0.1.2	The build step	2
0.1.3	Where each output file is created	6
0.2	How Axiom Works	12
0.2.1	Input and Type Selection	12
0.2.2	A simple integral, expansion 1 interpreter	18
0.2.3	A simple integral, expansion 2 integrate	22
0.2.4	A simple integral, expansion 2 internalIntegrate	24
0.2.5	A simple integral, expansion 3 univariate	27
0.2.6	A simple integral, expansion 4 integrate	29
0.2.7	A simple integral, expansion 5 monomialIntegrate	30
0.2.8	A simple integral, expansion 6 HermiteIntegrate	34
0.3	Tools	37
0.3.1	svn	37
0.3.2	git	37
0.3.3	cvs	37
0.4	Common Lisps	41
0.4.1	GCL	41
0.4.2	CCL	42
0.4.3	CMU CL	42
0.4.4	Franz Lisp	42
0.4.5	Lucid Common Lisp	42
0.4.6	Symbolics Common Lisp	43
0.4.7	Golden Common Lisp	43
0.4.8	VM/LISP 370	43
0.4.9	Maclisp	43
0.5	Literate Programming	43
0.5.1	Pamphlet files	43
0.5.2	noweb	44
0.6	Databases	46
0.6.1	libcheck	46
0.6.2	asq	46
0.7	Axiom internal representations	46
0.8	axiom command	49
0.9	help command documentation	49
0.9.1	help documentation for algebra	49
0.9.2	Adding help documentation in Makefile	50
0.9.3	Using help documentation for regression testing	51
0.9.4	help documentation as algebra test files	51
0.10	debugsys	51
0.10.1	debugging hyperdoc	52
0.11	Understanding a compiled function	52
0.12	The axiom.input startup file	61

0.13	Where are Axiom symbols stored?	61
0.14	Translating individual boot files to common lisp	64
0.15	Directories	65
0.15.1	The mnt/linux/bin directory	65
0.15.2	The mnt/linux/doc directory	67
0.15.3	The mnt/linux/algebra directory	70
0.15.4	The mnt/linux/lib directory	71
0.15.5	The mnt/linux/lib directory	73
0.16	The)set command	73
0.16.1	The example bug	78
0.16.2	Operating system level I/O trace (strace)	95
0.17	How to make graphs in algebra books	96
0.18	Adding or Editing pages in Hyperdoc	97
0.19	Graphviz file creation	98
0.20	Adding Algebra	100
0.20.1	Adding algebra to the books	100
0.20.2	Creating a stand-alone pamphlet file	112
0.21	Makefile	112

Volume 5: Axiom Interpreter

1 Credits	1
1.0.1 defvar \$credits	1
2 The Interpreter	5
3 The Fundamental Data Structures	7
3.1 The global variables	7
3.1.1 defvar \$current-directory	7
3.1.2 defvar \$current-directory	7
3.1.3 defvar \$defaultMsgDatabaseName	8
3.1.4 defvar \$defaultMsgDatabaseName	8
3.1.5 defvar \$directory-list	8
3.1.6 defvar \$directory-list	8
3.1.7 defvar \$InitialModemapFrame	9
3.1.8 defvar \$InitialModemapFrame	9
3.1.9 defvar \$library-directory-list	9
3.1.10 defvar \$library-directory-list	9
3.1.11 defvar \$msgDatabaseName	9
3.1.12 defvar \$msgDatabaseName	10
3.1.13 defvar \$openServerIfTrue	10
3.1.14 defvar \$openServerIfTrue	10
3.1.15 defvar \$relative-directory-list	10
3.1.16 defvar \$relative-directory-list	11
3.1.17 defvar \$relative-library-directory-list	11
3.1.18 defvar \$relative-library-directory-list	11
3.1.19 defvar \$spadroot	11
3.1.20 defvar \$spadroot	12
3.1.21 defvar \$SpadServer	12
3.1.22 defvar \$SpadServer	12
3.1.23 defvar \$SpadServerName	12
3.1.24 defvar \$SpadServerName	13
4 Starting Axiom	15
4.1 Variables Used	15
4.2 Data Structures	15
4.3 Functions	15
4.3.1 Set the restart hook	15
4.3.2 restart function (The restart function)	16
4.3.3 defun Non-interactive restarts	18
4.3.4 defun The startup banner messages	19
4.3.5 defun Make a vector of filler characters	20
4.3.6 Starts the interpreter but do not read in profiles	20
4.3.7 defvar \$quitTag	20

4.3.8	defun runspad	21
4.3.9	defun Reset the stack limits	21
5	Handling Terminal Input	23
5.1	Streams	23
5.1.1	defvar \$curinstream	23
5.1.2	defvar \$curoutstream	23
5.1.3	defvar \$errorinstream	23
5.1.4	defvar \$erroroutstream	24
5.1.5	defvar \$*eof*	24
5.1.6	defvar \$*whitespace*	24
5.1.7	defvar \$InteractiveMode	24
5.1.8	defvar \$boot	25
5.1.9	Top-level read-parse-eval-print loop	25
5.1.10	defun ncIntLoop	25
5.1.11	defvar \$intTopLevel	26
5.1.12	defvar \$intRestart	26
5.1.13	defun intloop	26
5.1.14	defvar \$ncMsgList	27
5.1.15	defun SpadInterpretStream	27
5.1.16	defvar \$promptMsg	28
5.1.17	defun GCL cmpnote function	28
5.1.18	defvar \$newcompErrorCount	28
5.1.19	defvar \$nopus	28
5.2	The Read-Eval-Print Loop	30
5.2.1	defun intloopReadConsole	30
5.3	Helper Functions	31
5.3.1	Get the value of an environment variable	31
5.3.2	defvar \$intCoerceFailure	32
5.3.3	defvar \$intSpadReader	32
5.3.4	defun InterpExecuteSpadSystemCommand	32
5.3.5	defun ExecuteInterpSystemCommand	33
5.3.6	defun Handle Synonyms	33
5.3.7	defun Synonym File Reader	33
5.3.8	defun init-memory-config	34
5.3.9	Set spadroot to be the AXIOM shell variable	35
5.3.10	Does the string start with this prefix?	36
5.3.11	defun Interpret a line of lisp code	36
5.3.12	Get the current directory	36
5.3.13	Prepend the absolute path to a filename	36
5.3.14	Make the initial modemap frame	37
5.3.15	defun nclloopEscaped	37
5.3.16	defun intloopProcessString	37
5.3.17	defun nclloopParse	38
5.3.18	defun next	38
5.3.19	defun next1	38

5.3.20	defun incString	39
5.3.21	Call the garbage collector	39
5.3.22	defun reroot	40
5.3.23	defun setCurrentLine	41
5.3.24	Show the Axiom prompt	42
5.3.25	defvar \$frameAlist	43
5.3.26	defvar \$frameNumber	43
5.3.27	defvar \$currentFrameNum	43
5.3.28	defvar \$EndServerSession	43
5.3.29	defvar \$NeedToSignalSessionManager	44
5.3.30	defvar \$sockBufferLength	44
5.3.31	READ-LINE in an Axiom server system	44
5.3.32	defun protectedEVAL	47
5.3.33	defvar \$QuietCommand	47
5.3.34	defun executeQuietCommand	47
5.3.35	defun parseAndInterpret	48
5.3.36	defun parseFromString	48
5.3.37	defvar \$interpOnly	49
5.3.38	defvar \$minivectorNames	49
5.3.39	defvar \$domPvar	49
5.3.40	defun processInteractive	49
5.3.41	defvar \$ProcessInteractiveValue	52
5.3.42	defvar \$HTCompanionWindowID	52
5.3.43	defun processInteractive1	52
5.3.44	defun interpretTopLevel	53
5.3.45	defvar \$genValue	53
5.3.46	defun Type analyzes and evaluates expression x, returns object	54
5.3.47	defun Dispatcher for the type analysis routines	54
5.3.48	defun interpret2	55
5.3.49	defun Result Output Printing	56
5.3.50	defun printStatisticsSummary	57
5.3.51	defun printStorage	58
5.3.52	defun printTypeAndTime	58
5.3.53	defun printTypeAndTimeNormal	59
5.3.54	defun printTypeAndTimeSaturn	60
5.3.55	defun printAsTeX	61
5.3.56	defun sameUnionBranch	61
5.3.57	defun msgText	61
5.3.58	defun Right-justify the Type output	62
5.3.59	defun Destructively fix quotes in strings	62
5.3.60	Include a file into the stream	63
5.3.61	defun intloopInclude0	63
5.3.62	defun intloopProcess	64
5.3.63	defun intloopSpadProcess	64
5.3.64	defun intloopSpadProcess,interp	65
5.3.65	defun phParse	66

5.3.66	defun phIntReportMsgs	66
5.3.67	defun phInterpret	67
5.3.68	defun intInterpretPform	67
5.3.69	defun zeroOneTran	68
5.3.70	defun ncConversationPhase	68
5.3.71	defun ncConversationPhase,wrapup	68
5.3.72	defun ncError	69
5.3.73	defun intloopEchoParse	69
5.3.74	defun nclloopPrintLines	70
5.3.75	defun mkLineList	70
5.3.76	defun nonBlank	71
5.3.77	defun nclloopDQlines	71
5.3.78	defun poGlobalLinePosn	72
5.3.79	defun streamChop	72
5.3.80	defun nclloopInclude0	73
5.3.81	defun incStream	73
5.3.82	defun incRenumber	74
5.3.83	defun incZip	74
5.3.84	defun incZip1	74
5.3.85	defun incIgen	75
5.3.86	defun incIgen1	75
5.3.87	defun incRenumberLine	75
5.3.88	defun incRenumberItem	76
5.3.89	defun incHandleMessage	76
5.3.90	defun incLude	76
5.3.91	defmacro Rest	77
5.3.92	defvar \$Top	77
5.3.93	defvar \$IfSkipToEnd	77
5.3.94	defvar \$IfKeepPart	77
5.3.95	defvar \$IfSkipPart	78
5.3.96	defvar \$ElseifSkipToEnd	78
5.3.97	defvar \$ElseifKeepPart	78
5.3.98	defvar \$ElseifSkipPart	78
5.3.99	defvar \$ElseSkipToEnd	78
5.3.100	defvar \$ElseKeepPart	79
5.3.101	defvar \$Top?	79
5.3.102	defvar \$If?	79
5.3.103	defvar \$Elseif?	79
5.3.104	defvar \$Else?	80
5.3.105	defvar \$SkipEnd?	80
5.3.106	defvar \$KeepPart?	80
5.3.107	defvar \$SkipPart?	81
5.3.108	defvar \$Skipping?	81
5.3.109	defun incLude1	81
5.3.110	defun xlPrematureEOF	86
5.3.111	defun xlMsg	86

5.3.112 defun xLOK	86
5.3.113 defun xLOK1	86
5.3.114 defun incAppend	87
5.3.115 defun incAppend1	87
5.3.116 defun incLine	87
5.3.117 defun incLine1	88
5.3.118 defun inclmsgPrematureEOF	88
5.3.119 defun theorigin	88
5.3.120 defun porigin	88
5.3.121 defun ifCond	89
5.3.122 defun xLSkip	89
5.3.123 defun xLSay	89
5.3.124 defun inclmsgSay	90
5.3.125 defun theid	90
5.3.126 defun xLNoSuchFile	90
5.3.127 defun inclmsgNoSuchFile	91
5.3.128 defun thefname	91
5.3.129 defun pfname	91
5.3.130 defun xLCannotRead	91
5.3.131 defun inclmsgCannotRead	92
5.3.132 defun xLFileCycle	92
5.3.133 defun inclmsgFileCycle	92
5.3.134 defun xLConActive	93
5.3.135 defun inclmsgConActive	93
5.3.136 defun xLConStill	94
5.3.137 defun inclmsgConStill	94
5.3.138 defun xLConsole	94
5.3.139 defun inclmsgConsole	94
5.3.140 defun xLSkippingFin	95
5.3.141 defun inclmsgFinSkipped	95
5.3.142 defun xLPrematureFin	95
5.3.143 defun inclmsgPrematureFin	95
5.3.144 defun assertCond	96
5.3.145 defun xLIfSyntax	96
5.3.146 defun inclmsgIfSyntax	97
5.3.147 defun xLIfBug	97
5.3.148 defun inclmsgIfBug	97
5.3.149 defun xLCmdBug	98
5.3.150 defun inclmsgCmdBug	98
5.3.151 defvar \$incCommands	98
5.3.152 defvar \$pfMacros	98
5.3.153 defun incClassify	99
5.3.154 defun incCommand?	100
5.3.155 defun incPrefix?	100
5.3.156 defun incCommandTail	101
5.3.157 defun incDrop	101

5.3.158 defun inclFname	102
5.3.159 defun incFileInput	102
5.3.160 defun incConsoleInput	102
5.3.161 defun incNConsoles	103
5.3.162 defun incActive?	103
5.3.163 defun incRgen	103
5.3.164 defun Delay	103
5.3.165 defvar \$StreamNil	104
5.3.166 defvar \$StreamNil	104
5.3.167 defun incRgen1	104
6 The Token Scanner	105
6.0.168 defvar \$SPACE	105
6.0.169 defvar \$ESCAPE	105
6.0.170 defvar \$STRINGCHAR	105
6.0.171 defvar \$PLUSCOMMENT	106
6.0.172 defvar \$MINUSCOMMENT	106
6.0.173 defvar \$RADIXCHAR	106
6.0.174 defvar \$DOT	106
6.0.175 defvar \$EXPONENT1	107
6.0.176 defvar \$EXPONENT2	107
6.0.177 defvar \$CLOSEPAREN	107
6.0.178 defvar \$QUESTION	107
6.0.179 defvar \$scanKeyWords	108
6.0.180 defvar \$infgeneric	110
6.0.181 defun lineoftoks	111
6.0.182 defun nextline	112
6.0.183 defun scanIgnoreLine	113
6.0.184 defun constoken	113
6.0.185 defun scanToken	114
6.0.186 defun lfid	115
6.0.187 defun startsComment?	115
6.0.188 defun scanComment	116
6.0.189 defun lfcomment	116
6.0.190 defun startsNegComment?	117
6.0.191 defun scanNegComment	117
6.0.192 defun lfnegcomment	118
6.0.193 defun punctuation?	118
6.0.194 defun scanPunct	118
6.0.195 defun subMatch	119
6.0.196 defun substringMatch	119
6.0.197 defun scanKeyTr	120
6.0.198 defun keyword	121
6.0.199 defun keyword?	121
6.0.200 defun scanPossFloat	121
6.0.201 defun digit?	122

6.0.202 defun lfkey	122
6.0.203 defun spleI	122
6.0.204 defun spleI1	122
6.0.205 defun scanEsc	123
6.0.206 defvar \$scanCloser	125
6.0.207 defun scanCloser?	125
6.0.208 defun scanWord	126
6.0.209 defun scanExponent	126
6.0.210 defun lffloat	127
6.0.211 defmacro idChar?	128
6.0.212 defun scanW	128
6.0.213 defun posend	129
6.0.214 defun scanSpace	129
6.0.215 defun lfspaces	130
6.0.216 defun scanString	130
6.0.217 defun lfstring	130
6.0.218 defun scanS	131
6.0.219 defun scanTransform	132
6.0.220 defun scanNumber	132
6.0.221 defun rdigit?	133
6.0.222 defun lfinteger	133
6.0.223 defun lfrinteger	134
6.0.224 defun scanCheckRadix	134
6.0.225 defun scanEscape	135
6.0.226 defun scanError	135
6.0.227 defun lferror	135
6.0.228 defvar \$scanKeyTable	136
6.0.229 defun scanKeyTableCons	136
6.0.230 defvar \$scanDict	137
6.0.231 defun scanDictCons	137
6.0.232 defun scanInsert	138
6.0.233 defvar \$scanPun	139
6.0.234 defun scanPunCons	139
7 Input Stream Parser	141
7.0.235 defun Input Stream Parser	141
7.0.236 defun npItem	142
7.0.237 defun npItem1	142
7.0.238 defun npFirstTok	143
7.0.239 defun Push one item onto \$stack	143
7.0.240 defun Pop one item off \$stack	144
7.0.241 defun Pop the second item off \$stack	144
7.0.242 defun Pop the third item off \$stack	144
7.0.243 defun npQualDef	145
7.0.244 defun Advance over a keyword	145
7.0.245 defun Advance the input stream	145

7.0.246 defun npComma	146
7.0.247 defun npTuple	146
7.0.248 defun npCommaBackSet	146
7.0.249 defun npQualifiedDefinition	147
7.0.250 defun npQualified	147
7.0.251 defun npDefinitionOrStatement	147
7.0.252 defun npBackTrack	148
7.0.253 defun npGives	148
7.0.254 defun npLambda	148
7.0.255 defun npType	149
7.0.256 defun npMatch	150
7.0.257 defun npSuch	150
7.0.258 defun npWith	150
7.0.259 defun npCompMissing	151
7.0.260 defun npMissing	151
7.0.261 defun npRestore	152
7.0.262 defun Peek for keyword s, no advance of token stream	152
7.0.263 defun npCategoryL	152
7.0.264 defun npCategory	153
7.0.265 defun npSCategory	153
7.0.266 defun npSignature	154
7.0.267 defun npSigItemList	154
7.0.268 defun npListing	155
7.0.269 defun Always produces a list, fn is applied to it	155
7.0.270 defun npSigItem	156
7.0.271 defun npTypeVariable	156
7.0.272 defun npSignatureDefinee	156
7.0.273 defun npTypeVariablelist	157
7.0.274 defun npSigDecl	157
7.0.275 defun npPrimary	157
7.0.276 defun npPrimary2	158
7.0.277 defun npADD	158
7.0.278 defun npAdd	159
7.0.279 defun npAtom2	159
7.0.280 defun npInfixOperator	160
7.0.281 defun npInfixOp	161
7.0.282 defun npPrefixColon	161
7.0.283 defun npApplication	162
7.0.284 defun npDotted	162
7.0.285 defun npAnyNo	162
7.0.286 defun npSelector	163
7.0.287 defun npApplication2	163
7.0.288 defun npPrimary1	164
7.0.289 defun npMacro	164
7.0.290 defun npMdef	164
7.0.291 defun npMDEF	165

7.0.292 defun npMDEFinition	165
7.0.293 defun npFix	166
7.0.294 defun npLet	166
7.0.295 defun npLetQualified	166
7.0.296 defun npDefinition	167
7.0.297 defun npDefinitionItem	167
7.0.298 defun npTyping	168
7.0.299 defun npDefaultItemList	168
7.0.300 defun npSDefaultItem	169
7.0.301 defun npDefaultItem	169
7.0.302 defun npDefaultDecl	170
7.0.303 defun npStatement	170
7.0.304 defun npExport	171
7.0.305 defun npLocalItemList	171
7.0.306 defun npSLocalItem	172
7.0.307 defun npLocalItem	172
7.0.308 defun npLocalDecl	172
7.0.309 defun npLocal	173
7.0.310 defun npFree	173
7.0.311 defun npInline	174
7.0.312 defun npIterate	174
7.0.313 defun npBreak	174
7.0.314 defun npLoop	175
7.0.315 defun npIterators	175
7.0.316 defun npIterator	176
7.0.317 defun npSuchThat	176
7.0.318 defun Apply argument 0 or more times	177
7.0.319 defun npWhile	177
7.0.320 defun npForIn	177
7.0.321 defun npReturn	178
7.0.322 defun npVoid	179
7.0.323 defun npExpress	179
7.0.324 defun npExpress1	179
7.0.325 defun npConditionalStatement	180
7.0.326 defun npImport	180
7.0.327 defun npQualTypelist	180
7.0.328 defun npSQualTypelist	181
7.0.329 defun npQualType	181
7.0.330 defun npAndOr	181
7.0.331 defun npEncAp	182
7.0.332 defun npEncl	182
7.0.333 defun npAtom1	183
7.0.334 defun npPDefinition	183
7.0.335 defun npDollar	183
7.0.336 defun npConstTok	184
7.0.337 defun npBDefinition	185

7.0.338 defun npBracketed	185
7.0.339 defun npParened	185
7.0.340 defun npBracked	186
7.0.341 defun npBraced	186
7.0.342 defun npAngleBared	186
7.0.343 defun npDefn	187
7.0.344 defun npDef	187
7.0.345 defun npBPILEDefinition	188
7.0.346 defun npPileBracketed	188
7.0.347 defun npPileDefinitionlist	189
7.0.348 defun npListAndRecover	189
7.0.349 defun npRecoverTrap	190
7.0.350 defun npMoveTo	191
7.0.351 defun syIgnoredFromTo	191
7.0.352 defun syGeneralErrorHere	192
7.0.353 defun sySpecificErrorHere	192
7.0.354 defun sySpecificErrorAtToken	192
7.0.355 defun npDefinitionlist	193
7.0.356 defun npSemiListing	193
7.0.357 defun npSemiBackSet	193
7.0.358 defun npRule	193
7.0.359 defun npSingleRule	194
7.0.360 defun npDefTail	194
7.0.361 defun npDefaultValue	194
7.0.362 defun npWConditional	195
7.0.363 defun npConditional	195
7.0.364 defun npElse	196
7.0.365 defun npBacksetElse	197
7.0.366 defun npLogical	197
7.0.367 defun npDisjand	197
7.0.368 defun npDiscrim	197
7.0.369 defun npQuiver	198
7.0.370 defun npRelation	198
7.0.371 defun npSynthetic	198
7.0.372 defun npBy	199
7.0.373 defun	199
7.0.374 defun npSegment	200
7.0.375 defun npArith	200
7.0.376 defun npSum	201
7.0.377 defun npTerm	201
7.0.378 defun npRemainder	201
7.0.379 defun npProduct	202
7.0.380 defun npPower	202
7.0.381 defun npAmpersandFrom	202
7.0.382 defun npFromdom	202
7.0.383 defun npFromdom1	203

7.0.384	defun npAmpersand	204
7.0.385	defun npName	204
7.0.386	defvar \$npPParg	204
7.0.387	defun npId	204
7.0.388	defun npSymbolVariable	205
7.0.389	defun npRightAssoc	206
7.0.390	defun p o p o p o p = (((p o p) o p) o p)	206
7.0.391	defun npInfGeneric	207
7.0.392	defun npDDInfKey	208
7.0.393	defun npInfKey	208
7.0.394	defun npPushId	209
7.0.395	defvar \$npPParg	209
7.0.396	defun npPP	209
7.0.397	defun npPPff	210
7.0.398	defun npPPg	210
7.0.399	defun npPPf	211
7.0.400	defun npEnclosed	211
7.0.401	defun npState	212
7.0.402	defun npTrap	212
7.0.403	defun npTrapForm	212
7.0.404	defun npVariable	213
7.0.405	defun npVariablelist	213
7.0.406	defun npVariableName	213
7.0.407	defun npDecl	214
7.0.408	defun npParenthesized	214
7.0.409	defun npParenthesize	215
7.0.410	defun npMissingMate	215
7.0.411	defun npExit	215
7.0.412	defun npPileExit	216
7.0.413	defun npAssign	216
7.0.414	defun npAssignment	217
7.0.415	defun npAssignVariable	217
7.0.416	defun npColon	217
7.0.417	defun npTagged	218
7.0.418	defun npTypedForm1	218
7.0.419	defun npTypified	218
7.0.420	defun npTypeStyle	219
7.0.421	defun npPretend	219
7.0.422	defun npColonQuery	219
7.0.423	defun npCoerceTo	220
7.0.424	defun npTypedForm	220
7.0.425	defun npRestrict	220
7.0.426	defun npListofFun	221
7.1	Macro handling	221
7.1.1	defun phMacro	221
7.1.2	defun macroExpanded	222

7.1.3	defun macExpand	222
7.1.4	defun macApplication	223
7.1.5	defun mac0MLambdaApply	223
7.1.6	defun mac0ExpandBody	224
7.1.7	defun mac0InfiniteExpansion	225
7.1.8	defun mac0InfiniteExpansion,name	226
7.1.9	defun mac0GetName	226
7.1.10	defun macId	227
7.1.11	defun mac0Get	228
7.1.12	defun macWhere	228
7.1.13	defun macWhere,mac	228
7.1.14	defun macLambda	228
7.1.15	defun macLambda,mac	229
7.1.16	defun Add appropriate definition the a Macro pform	229
7.1.17	defun Add a macro to the global pfMacros list	230
7.1.18	defun macSubstituteOuter	230
7.1.19	defun mac0SubstituteOuter	231
7.1.20	defun macLambdaParameterHandling	231
7.1.21	defun macSubstituteId	232
8	Pftrees	233
8.1	Abstract Syntax Trees Overview	233
8.2	Structure handlers	235
8.2.1	defun pfGlobalLinePosn	235
8.2.2	defun pfCharPosn	235
8.2.3	defun pfLinePosn	235
8.2.4	defun pfFileName	236
8.2.5	defun pfCopyWithPos	236
8.2.6	defun pfMapParts	236
8.2.7	defun pf0ApplicationArgs	237
8.2.8	defun pf0FlattenSyntacticTuple	237
8.2.9	defun pfSourcePosition	238
8.2.10	defun Convert a Sequence node to a list	238
8.2.11	defun pfSpread	239
8.2.12	defun Deconstruct nodes to lists	239
8.2.13	defun pfCheckMacroOut	240
8.2.14	defun pfCheckArg	241
8.2.15	defun pfCheckId	241
8.2.16	defun pfFlattenApp	241
8.2.17	defun pfCollect1?	242
8.2.18	defun pfCollectVariable1	242
8.2.19	defun pfPushMacroBody	243
8.2.20	defun pfSourceStok	243
8.2.21	defun pfTransformArg	244
8.2.22	defun pfTaggedToTyped1	244
8.2.23	defun pfSuch	244

8.3	Special Nodes	245
8.3.1	defun Create a Listof node	245
8.3.2	defun pfNothing	245
8.3.3	defun Is this a Nothing node?	245
8.4	Leaves	246
8.4.1	defun Create a Document node	246
8.4.2	defun Construct an Id node	246
8.4.3	defun Is this an Id node?	246
8.4.4	defun Construct an Id leaf node	246
8.4.5	defun Return the Id part	247
8.4.6	defun Construct a Leaf node	247
8.4.7	defun Is this a leaf node?	247
8.4.8	defun Return the token position of a leaf node	248
8.4.9	defun Return the Leaf Token	248
8.4.10	defun Is this a Literal node?	248
8.4.11	defun Create a LiteralClass node	248
8.4.12	defun Return the LiteralString	249
8.4.13	defun Return the parts of a tree node	249
8.4.14	defun Return the argument unchanged	249
8.4.15	defun pfPushBody	249
8.4.16	defun An S-expression which people can read.	250
8.4.17	defun Create a human readable S-expression	250
8.4.18	defun Construct a Symbol or Expression node	251
8.4.19	defun Construct a Symbol leaf node	251
8.4.20	defun Is this a Symbol node?	252
8.4.21	defun Return the Symbol part	252
8.5	Trees	252
8.5.1	defun Construct a tree node	252
8.5.2	defun Construct an Add node	252
8.5.3	defun Construct an And node	253
8.5.4	defun pfAttribute	253
8.5.5	defun Return an Application node	253
8.5.6	defun Return the Arg part of an Application node	254
8.5.7	defun Return the Op part of an Application node	254
8.5.8	defun Is this an And node?	254
8.5.9	defun Return the Left part of an And node	254
8.5.10	defun Return the Right part of an And node	255
8.5.11	defun Flatten a list of lists	255
8.5.12	defun Is this an Application node?	255
8.5.13	defun Create an Assign node	255
8.5.14	defun Is this an Assign node?	256
8.5.15	defun Return the parts of an LhsItem of an Assign node	256
8.5.16	defun Return the LhsItem of an Assign node	256
8.5.17	defun Return the RHS of an Assign node	256
8.5.18	defun Construct an application node for a brace	257
8.5.19	defun Construct an Application node for brace-bars	257

8.5.20	defun Construct an Application node for a bracket	257
8.5.21	defun Construct an Application node for bracket-bars	257
8.5.22	defun Create a Break node	258
8.5.23	defun Is this a Break node?	258
8.5.24	defun Return the From part of a Break node	258
8.5.25	defun Construct a Coerceto node	259
8.5.26	defun Is this a CoerceTo node?	259
8.5.27	defun Return the Expression part of a CoerceTo node	259
8.5.28	defun Return the Type part of a CoerceTo node	259
8.5.29	defun Return the Body of a Collect node	260
8.5.30	defun Return the Iterators of a Collect node	260
8.5.31	defun Create a Collect node	260
8.5.32	defun Is this a Collect node?	260
8.5.33	defun pfDefinition	261
8.5.34	defun Return the Lhs of a Definition node	261
8.5.35	defun Return the Rhs of a Definition node	261
8.5.36	defun Is this a Definition node?	261
8.5.37	defun Return the parts of a Definition node	262
8.5.38	defun Create a Do node	262
8.5.39	defun Is this a Do node?	262
8.5.40	defun Return the Body of a Do node	262
8.5.41	defun Construct a Sequence node	263
8.5.42	defun Construct an Exit node	263
8.5.43	defun Is this an Exit node?	263
8.5.44	defun Return the Cond part of an Exit	263
8.5.45	defun Return the Expression part of an Exit	264
8.5.46	defun Create an Export node	264
8.5.47	defun Construct an Expression leaf node	264
8.5.48	defun pfFirst	264
8.5.49	defun Create an Application Fix node	265
8.5.50	defun Create a Free node	265
8.5.51	defun Is this a Free node?	265
8.5.52	defun Return the parts of the Items of a Free node	266
8.5.53	defun Return the Items of a Free node	266
8.5.54	defun Construct a Forin node	266
8.5.55	defun Is this a ForIn node?	266
8.5.56	defun Return all the parts of the LHS of a ForIn node	267
8.5.57	defun Return the LHS part of a ForIn node	267
8.5.58	defun Return the Whole part of a ForIn node	267
8.5.59	defun pfFromDom	267
8.5.60	defun Construct a Fromdom node	268
8.5.61	defun Is this a Fromdom mode?	268
8.5.62	defun Return the What part of a Fromdom node	268
8.5.63	defun Return the Domain part of a Fromdom node	269
8.5.64	defun Construct a Hide node	269
8.5.65	defun pfIf	269

8.5.66	defun Is this an If node?	269
8.5.67	defun Return the Cond part of an If	270
8.5.68	defun Return the Then part of an If	270
8.5.69	defun pfIfThenOnly	270
8.5.70	defun Return the Else part of an If	270
8.5.71	defun Construct an Import node	271
8.5.72	defun Construct an Iterate node	271
8.5.73	defun Is this an Iterate node?	271
8.5.74	defun Handle an infix application	271
8.5.75	defun Create an Inline node	272
8.5.76	defun pfLam	272
8.5.77	defun pfLambda	273
8.5.78	defun Return the Body part of a Lambda node	273
8.5.79	defun Return the Rets part of a Lambda node	273
8.5.80	defun Is this a Lambda node?	273
8.5.81	defun Return the Args part of a Lambda node	274
8.5.82	defun Return the Args of a Lambda Node	274
8.5.83	defun Construct a Local node	274
8.5.84	defun Is this a Local node?	274
8.5.85	defun Return the parts of Items of a Local node	275
8.5.86	defun Return the Items of a Local node	275
8.5.87	defun Construct a Loop node	275
8.5.88	defun pfLoop1	275
8.5.89	defun Is this a Loop node?	276
8.5.90	defun Return the Iterators of a Loop node	276
8.5.91	defun pf0LoopIterators	276
8.5.92	defun pfLp	276
8.5.93	defun Create a Macro node	277
8.5.94	defun Is this a Macro node?	277
8.5.95	defun Return the Lhs of a Macro node	277
8.5.96	defun Return the Rhs of a Macro node	277
8.5.97	defun Construct an MLambda node	278
8.5.98	defun Is this an MLambda node?	278
8.5.99	defun Return the Args of an MLambda	278
8.5.100	defun Return the parts of an MLambda argument	278
8.5.101	defun pfMLambdaBody	279
8.5.102	defun Is this a Not node?	279
8.5.103	defun Return the Arg part of a Not node	279
8.5.104	defun Construct a NoValue node	279
8.5.105	defun Is this a Novalue node?	280
8.5.106	defun Return the Expr part of a Novalue node	280
8.5.107	defun Construct an Or node	280
8.5.108	defun Is this an Or node?	280
8.5.109	defun Return the Left part of an Or node	281
8.5.110	defun Return the Right part of an Or node	281
8.5.111	defun Return the part of a parenthesised expression	281

8.5.112 defun pfPretend	281
8.5.113 defun Is this a Pretend node?	282
8.5.114 defun Return the Expression part of a Pretend node	282
8.5.115 defun Return the Type part of a Pretend node	282
8.5.116 defun Construct a QualType node	282
8.5.117 defun Construct a Restrict node	283
8.5.118 defun Is this a Restrict node?	283
8.5.119 defun Return the Expr part of a Restrict node	283
8.5.120 defun Return the Type part of a Restrict node	283
8.5.121 defun Construct a RetractTo node	284
8.5.122 defun Construct a Return node	284
8.5.123 defun Is this a Return node?	284
8.5.124 defun Return the Expr part of a Return node	284
8.5.125 defun pfReturnNoName	285
8.5.126 defun Construct a ReturnTyped node	285
8.5.127 defun Construct a Rule node	285
8.5.128 defun Return the Lhs of a Rule node	286
8.5.129 defun Return the Rhs of a Rule node	286
8.5.130 defun Is this a Rule node?	286
8.5.131 defun pfSecond	286
8.5.132 defun Construct a Sequence node	287
8.5.133 defun Return the Args of a Sequence node	287
8.5.134 defun Is this a Sequence node?	287
8.5.135 defun Return the parts of the Args of a Sequence node	287
8.5.136 defun Create a Suchthat node	288
8.5.137 defun Is this a SuchThat node?	288
8.5.138 defun Return the Cond part of a SuchThat node	288
8.5.139 defun Create a Tagged node	288
8.5.140 defun Is this a Tagged node?	289
8.5.141 defun Return the Expression portion of a Tagged node	289
8.5.142 defun Return the Tag of a Tagged node	289
8.5.143 defun pfTaggedToTyped	289
8.5.144 defun pfTweakIf	290
8.5.145 defun Construct a Typed node	290
8.5.146 defun Is this a Typed node?	291
8.5.147 defun Return the Type of a Typed node	291
8.5.148 defun Return the Id of a Typed node	291
8.5.149 defun Construct a Typing node	291
8.5.150 defun Return a Tuple node	292
8.5.151 defun Return a Tuple from a List	292
8.5.152 defun Is this a Tuple node?	292
8.5.153 defun Return the Parts of a Tuple node	293
8.5.154 defun Return the parts of a Tuple	293
8.5.155 defun Return a list from a Sequence node	293
8.5.156 defun The comment is attached to all signatutres	293
8.5.157 defun Construct a WDeclare node	294

8.5.158 defun Construct a Where node	294
8.5.159 defun Is this a Where node?	294
8.5.160 defun Return the parts of the Context of a Where node	295
8.5.161 defun Return the Context of a Where node	295
8.5.162 defun Return the Expr part of a Where node	295
8.5.163 defun Construct a While node	295
8.5.164 defun Is this a While node?	296
8.5.165 defun Return the Cond part of a While node	296
8.5.166 defun Construct a With node	296
8.5.167 defun Create a Wrong node	296
8.5.168 defun Is this a Wrong node?	297
9 Pftree to s-expression translation	299
9.0.169 defun Pftree to s-expression translation	299
9.0.170 defun Pftree to s-expression translation inner function	300
9.0.171 defun Convert a Literal to an S-expression	304
9.0.172 defun Convert a float to an S-expression	305
9.0.173 defun Change an Application node to an S-expression	305
9.0.174 defun Convert a SuchThat node to an S-expression	307
9.0.175 defun pfOp2Sex	308
9.0.176 defun pmDontQuote?	309
9.0.177 defun hasOptArgs?	309
9.0.178 defun Convert a Sequence node to an S-expression	310
9.0.179 defun pfSequence2Sex0	310
9.0.180 defun Convert a loop node to an S-expression	311
9.0.181 defun Change a Collect node to an S-expression	314
9.0.182 defun Convert a Definition node to an S-expression	315
9.0.183 defun Convert a Lambda node to an S-expression	316
9.0.184 defun pfCollectArgTran	317
9.0.185 defun Convert a Lambda node to an S-expression	317
9.0.186 defun Convert a Rule node to an S-expression	318
9.0.187 defun Convert the Lhs of a Rule to an S-expression	318
9.0.188 defun Convert the Rhs of a Rule to an S-expression	319
9.0.189 defun Convert a Rule predicate to an S-expression	319
9.0.190 defun patternVarsOf	321
9.0.191 defun patternVarsOf1	321
9.0.192 defun pvarPredTran	322
9.0.193 defun Convert the Lhs of a Rule node to an S-expression	322
9.0.194 defvar \$dotdot	323
9.0.195 defun Translate ops into internal symbols	323
10 Keyed Message Handling	325
10.0.196 defvar \$cacheMessages	326
10.0.197 defvar \$msgAlist	326
10.0.198 defvar \$msgDatabaseName	326
10.0.199 defvar \$testingErrorPrefix	327

10.0.200	defvar \$texFormatting	327
10.0.201	defvar \$*msghash*	327
10.0.202	defvar \$msgdbPrims	327
10.0.203	defvar \$msgdbPunct	327
10.0.204	defvar \$msgdbNoBlanksBeforeGroup	328
10.0.205	defvar \$msgdbNoBlanksAfterGroup	328
10.0.206	defun Fetch a message from the message database	328
10.0.207	defun Cache messages read from message database	329
10.0.208	defun getKeyedMsg	329
10.0.209	defun Say a message using a keyed lookup	329
10.0.210	defun Handle msg formatting and print to file	330
10.0.211	defun Break a message into words	330
10.0.212	defun Write a msg into spadmsg.listing file	331
10.0.213	defun sayMSG	331
11	Stream Utilities	333
11.0.214	defun npNull	333
11.0.215	defun StreamNull	333
12	Code Piles	335
12.0.216	defun insertpile	335
12.0.217	defun pilePlusComment	336
12.0.218	defun pilePlusComments	336
12.0.219	defun pileTree	337
12.0.220	defun pileColumn	337
12.0.221	defun pileForests	337
12.0.222	defun pileForest	338
12.0.223	defun pileForest1	338
12.0.224	defun eqpileTree	339
12.0.225	defun pileCtree	340
12.0.226	defun pileCforest	340
12.0.227	defun enPile	340
12.0.228	defun firstTokPosn	341
12.0.229	defun lastTokPosn	341
12.0.230	defun separatePiles	341
13	Dequeue Functions	343
13.0.231	defun dqUnit	343
13.0.232	defun dqConcat	343
13.0.233	defun dqAppend	344
13.0.234	defun dqToList	344

14 Message Handling	345
14.1 The Line Object	345
14.1.1 defun Line object creation	345
14.1.2 defun Line element 0; Extra blanks	345
14.1.3 defun Line element 1; String	345
14.1.4 defun Line element 2; Global number	346
14.1.5 defun Line element 2; Set Global number	346
14.1.6 defun Line element 3; Local number	346
14.1.7 defun Line element 4; Place of origin	346
14.1.8 defun Line element 4; Is it a filename?	347
14.1.9 defun Line element 4; Is it a filename?	347
14.1.10 defun Line element 4; Get filename	347
14.2 Messages	347
14.2.1 defun msgCreate	347
14.2.2 defun getMsgPosTagOb	348
14.2.3 defun getMsgKey	348
14.2.4 defun getMsgArgL	349
14.2.5 defun getMsgPrefix	349
14.2.6 defun setMsgPrefix	349
14.2.7 defun getMsgText	349
14.2.8 defun setMsgText	349
14.2.9 defun getMsgPrefix?	350
14.2.10 defun getMsgTag	350
14.2.11 defun getMsgTag?	350
14.2.12 defun line?	351
14.2.13 defun leader?	351
14.2.14 defun toScreen?	351
14.2.15 defun ncSoftError	351
14.2.16 defun ncHardError	352
14.2.17 defun desiredMsg	352
14.2.18 defun processKeyedError	353
14.2.19 defun msgOutputter	353
14.2.20 defun listOutputter	354
14.2.21 defun getStFromMsg	354
14.2.22 defvar \$preLength	355
14.2.23 defun getPreStL	355
14.2.24 defun getPosStL	356
14.2.25 defun ppos	357
14.2.26 defun remFile	357
14.2.27 defun showMsgPos?	357
14.2.28 defvar \$imPrGuys	358
14.2.29 defun msgImPr?	358
14.2.30 defun getMsgCatAttr	358
14.2.31 defun getMsgPos	359
14.2.32 defun getMsgFTTag?	359
14.2.33 defun decideHowMuch	359

14.2.34 defun poNopos?	360
14.2.35 defun poPosImmediate?	360
14.2.36 defun poFileName	360
14.2.37 defun poGetLineObject	361
14.2.38 defun poLinePosn	361
14.2.39 defun listDecideHowMuch	361
14.2.40 defun remLine	362
14.2.41 defun getMsgKey?	362
14.2.42 defun getMsgLitSym	362
14.2.43 defun tabbing	362
14.2.44 defvar \$toWhereGuys	363
14.2.45 defun getMsgToWhere	363
14.2.46 defun toFile?	363
14.2.47 defun alreadyOpened?	363
14.2.48 defun setMsgForcedAttrList	364
14.2.49 defun setMsgForcedAttr	364
14.2.50 defvar \$attrCats	364
14.2.51 defun whichCat	365
14.2.52 defun setMsgCatlessAttr	365
14.2.53 defun putDatabaseStuff	365
14.2.54 defun getMsgInfoFromKey	366
14.2.55 defun setMsgUnforcedAttrList	366
14.2.56 defun setMsgUnforcedAttr	367
14.2.57 defvar \$imPrTagGuys	367
14.2.58 defun initImPr	367
14.2.59 defun initToWhere	368
14.2.60 defun ncBug	368
14.2.61 defun processMsgList	369
14.2.62 defun erMsgSort	369
14.2.63 defun erMsgCompare	370
14.2.64 defun compareposns	370
14.2.65 defun erMsgSep	370
14.2.66 defun makeMsgFromLine	371
14.2.67 defun rep	371
14.2.68 defun getLinePos	372
14.2.69 defun getLineText	372
14.2.70 defun queueUpErrors	372
14.2.71 defun thisPosIsLess	374
14.2.72 defun thisPosIsEqual	374
14.2.73 defun redundant	374
14.2.74 defvar \$repGuys	375
14.2.75 defun msgNoRep?	375
14.2.76 defun sameMsg?	376
14.2.77 defun processChPosesForOneLine	376
14.2.78 defun poCharPosn	377
14.2.79 defun makeLeaderMsg	377

14.2.80 defun posPointers	378
14.2.81 defun getMsgPos2	378
14.2.82 defun insertPos	379
14.2.83 defun putFTText	379
14.2.84 defun From	380
14.2.85 defun To	380
14.2.86 defun FromTo	380
15 The Interpreter Syntax	383
15.1 syntax assignment	383
15.2 syntax blocks	386
15.3 system clef	388
15.4 syntax collection	389
15.5 syntax for	391
15.6 syntax if	395
15.7 syntax iterate	397
15.8 syntax leave	398
15.9 syntax parallel	399
15.10 syntax repeat	402
15.11 syntax suchthat	406
15.12 syntax syntax	407
15.13 syntax while	407
16 Abstract Syntax Trees (ptrees)	411
16.0.1 defun Construct a leaf token	411
16.0.2 defun Return a part of a node	412
16.0.3 defun Compare a part of a node	412
16.0.4 defun pfNoPosition?	412
16.0.5 defun poNoPosition?	413
16.0.6 defun tokType	413
16.0.7 defun tokPart	413
16.0.8 defun tokPosn	413
16.0.9 defun pfNoPosition	414
16.0.10 defun poNoPosition	414
17 Attributed Structures	415
17.0.11 defun ncTag	415
17.0.12 defun ncAlist	415
17.0.13 defun ncEltQ	416
17.0.14 defun ncPutQ	416
18 Function Selection	419
18.0.15 defun ofCategory	419
18.0.16 defun isPartialMode	420
18.0.17 defun hasCaty	420
18.0.18 defun domArg	422

18.0.19 defun domArg2	422
18.0.20 defun hasSig	423
18.0.21 defun hasAtt	424
18.0.22 defun hasSigAnd	425
18.0.23 defun hasSigOr	426
18.0.24 defun hasAttSig	426
18.0.25 defun hasCatel	427
18.0.26 defun hasCatExpression	427
18.0.27 defun unifyStruct	428
18.0.28 defun unifyStructVar	429
18.0.29 defun containsVars	430
18.0.30 defun containsVars1	431
18.0.31 defun hasCaty1	431
18.0.32 defun mkDomPvar	432
18.0.33 defun hasCate	433
18.0.34 defun constructSubst	434
18.0.35 defun hasCateSpecial	434
18.0.36 defun hasCateSpecialNew	435
18.0.37 defun defaultTargetFE	437
18.0.38 defun isEqualOrSubDomain	438
19 System Command Handling	439
19.1 Variables Used	441
19.1.1 defvar \$systemCommands	441
19.1.2 defvar \$syscommands	442
19.1.3 defvar \$noParseCommands	442
19.2 Functions	443
19.2.1 defun handleNoParseCommands	443
19.2.2 defun Handle a top level command	444
19.2.3 defun Split block into option block	445
19.2.4 defun Tokenize a system command	445
19.2.5 defun Handle system commands	446
19.2.6 defun Select commands matching this user level	446
19.2.7 defun No command begins with this string	447
19.2.8 defun No option begins with this string	447
19.2.9 defvar \$oldline	447
19.2.10 defun No command/option begins with this string	447
19.2.11 defun Option not available at this user level	448
19.2.12 defun Command not available at this user level	448
19.2.13 defun Command not available error message	448
19.2.14 defun satisfiesUserLevel	449
19.2.15 defun hasOption	449
19.2.16 defun terminateSystemCommand	450
19.2.17 defun Terminate a system command	450
19.2.18 defun commandAmbiguityError	450
19.2.19 defun getParserMacroNames	451

19.2.20 defun clearParserMacro	451
19.2.21 defun displayMacro	451
19.2.22 defun displayWorkspaceNames	452
19.2.23 defun getWorkspaceNames	453
19.2.24 defun fixObjectForPrinting	454
19.2.25 defun displayProperties,sayFunctionDeps	454
19.2.26 defun displayValue	457
19.2.27 defun displayType	458
19.2.28 defun getAndSay	459
19.2.29 defun displayProperties	459
19.2.30 defun displayParserMacro	462
19.2.31 defun displayCondition	463
19.2.32 defun interpFunctionDepAlists	463
19.2.33 defun displayModemap	464
19.2.34 defun displayMode	464
19.2.35 defun Split into tokens delimited by spaces	465
19.2.36 defun Convert string tokens to their proper type	465
19.2.37 defun Is the argument string an integer?	466
19.2.38 defun Handle parsed system commands	466
19.2.39 defun Parse a system command	467
19.2.40 defun Get first word in a string	467
19.2.41 defun Unabbreviate keywords in commands	467
19.2.42 defun The command is ambiguous error	468
19.2.43 defun Remove the spaces surrounding a string	469
19.2.44 defun Remove the lisp command prefix	469
19.2.45 defun Handle the)lisp command	470
19.2.46 defun The)boot command is no longer supported	470
19.2.47 defun Handle the)system command	470
19.2.48 defun Handle the)synonym command	471
19.2.49 defun Handle the synonym system command	471
19.2.50 defun printSynonyms	472
19.2.51 defun Print a list of each matching synonym	472
19.2.52 defvar \$tokenCommands	473
19.2.53 defvar \$InitialCommandSynonymAlist	474
19.2.54 defun Print the current version information	474
19.2.55 defvar \$CommandSynonymAlist	476
19.2.56 defun nclloopCommand	476
19.2.57 defun nclloopPrefix?	477
19.2.58 defun selectOptionLC	477
19.2.59 defun selectOption	477
20)abbreviations help page Command	479
20.1 abbreviations help page man page	479
20.2 Functions	481
20.2.1 defun abbreviations	481
20.2.2 defun abbreviationsSpad2Cmd	481

20.2.3	defun listConstructorAbbreviations	482
21	)boot help page Command	485
21.1	boot help page man page	485
21.2	Functions	486
22	)browse help page Command	487
22.1	browse help page man page	487
22.2	Overview	487
22.3	Browsers, MathML, and Fonts	488
22.4	The axServer/multiServ loop	489
22.5	The)browse command	490
22.6	Variables Used	491
22.7	Functions	491
22.8	The server support code	491
23	)cd help page Command	493
23.1	cd help page man page	493
23.2	Variables Used	494
23.3	Functions	494
24	)clear help page Command	495
24.1	clear help page man page	495
24.2	Variables Used	497
24.2.1	defvar \$clearOptions	497
24.3	Functions	497
24.3.1	defun clear	497
24.3.2	defvar \$clearExcept	497
24.3.3	defun clearSpad2Cmd	498
24.3.4	defun clearCmdSortedCaches	499
24.3.5	defun compiledLookupCheck	499
24.3.6	defvar \$functionTable	500
24.3.7	defun clearCmdCompletely	500
24.3.8	defun clearCmdAll	501
24.3.9	defun clearMacroTable	502
24.3.10	defun clearCmdExcept	502
24.3.11	defun clearCmdParts	503
25	)close help page Command	507
25.1	close help page man page	507
25.2	Functions	508
25.2.1	defun queryClients	508
25.2.2	defun close	508

26)compile help page Command	511
26.1 compile help page man page	511
26.2 Functions	513
26.2.1 defvar \$/editfile	513
27)copyright help page Command	515
27.1 copyright help page man page	515
27.2 Functions	520
27.2.1 defun copyright	520
27.2.2 defun trademark	521
28)credits help page Command	523
28.1 credits help page man page	523
28.2 Variables Used	523
28.3 Functions	523
28.3.1 defun credits	523
29)describe help page Command	525
29.1 describe help page man page	525
29.1.1 defvar \$describeOptions	526
29.2 Functions	526
29.2.1 defun Print comment strings from algebra libraries	526
29.2.2 defun describeSpad2Cmd	526
29.2.3 defun cleanline	527
29.2.4 defun flatten	529
30)display help page Command	531
30.1 display help page man page	531
30.1.1 defvar \$displayOptions	533
30.2 Functions	533
30.2.1 defun display	533
30.2.2 displaySpad2Cmd	533
30.2.3 defun abbQuery	534
30.2.4 defun displayOperations	535
30.2.5 defun yesanswer	535
30.2.6 defun displayMacros	536
30.2.7 defun sayExample	537
30.2.8 defun cleanupLine	538
31)edit help page Command	541
31.1 edit help page man page	541
31.2 Functions	542
31.2.1 defun edit	542
31.2.2 defun editSpad2Cmd	542
31.2.3 defun Implement the)edit command	543
31.2.4 defun updateSourceFiles	544

32)fin help page Command	545
32.1 fin help page man page	545
32.1.1 defun Exit from the interpreter to lisp	546
32.2 Functions	546
33)frame help page Command	547
33.1 frame help page man page	547
33.2 Variables Used	549
33.2.1 Primary variables	549
33.2.2 Used variables	550
33.3 Data Structures	550
33.3.1 Frames and the Interpreter Frame Ring	550
33.4 Accessor Functions	550
33.4.1 0th Frame Component – frameName	550
33.4.2 defun frameName	550
33.4.3 1st Frame Component – frameInteractive	551
33.4.4 2nd Frame Component – frameIOIndex	551
33.4.5 3rd Frame Component – frameHiFiAccess	551
33.4.6 4th Frame Component – frameHistList	551
33.4.7 5th Frame Component – frameHistListLen	552
33.4.8 6th Frame Component – frameHistListAct	552
33.4.9 7th Frame Component – frameHistRecord	552
33.4.10 8th Frame Component – frameHistoryTable	552
33.4.11 9th Frame Component – frameExposureData	553
33.5 Functions	553
33.5.1 Initializing the Interpreter Frame Ring	553
33.5.2 Creating a List of all of the Frame Names	554
33.5.3 Get Named Frame Environment (aka Interactive)	554
33.5.4 Create a new, empty Interpreter Frame	554
33.5.5 Collecting up the Environment into a Frame	555
33.5.6 Update from the Current Frame	556
33.5.7 Find a Frame in the Frame Ring by Name	557
33.5.8 Update the Current Interpreter Frame	557
33.5.9 Move to the next Interpreter Frame in Ring	558
33.5.10 Change to the Named Interpreter Frame	558
33.5.11 Move to the previous Interpreter Frame in Ring	559
33.5.12 Add a New Interpreter Frame	559
33.5.13 Close an Interpreter Frame	560
33.5.14 Display the Frame Names	561
33.5.15 Import items from another frame	561
33.5.16 The top level frame command	563
33.5.17 The top level frame command handler	564
33.6 Frame File Messages	565

34)help help page Command	567
34.1 help help page man page	567
34.2 Functions	570
34.2.1 The top level help command	570
34.2.2 The top level help command handler	570
34.2.3 defun newHelpSpad2Cmd	570
35)history help page Command	573
35.1 history help page man page	573
35.2 Initialized history variables	576
35.2.1 defvar \$oldHistoryFileName	576
35.2.2 defvar \$historyFileType	577
35.2.3 defvar \$historyDirectory	577
35.2.4 defvar \$useInternalHistoryTable	577
35.3 Data Structures	577
35.4 Functions	577
35.4.1 defun makeHistFileName	577
35.4.2 defun oldHistFileName	578
35.4.3 defun histFileName	578
35.4.4 defun histInputFileName	578
35.4.5 defun initHist	579
35.4.6 defun initHistList	579
35.4.7 The top level history command	580
35.4.8 The top level history command handler	580
35.4.9 defun setHistoryCore	582
35.4.10 defvar \$sunderbar	584
35.4.11 defun writeInputLines	585
35.4.12 defun resetInCoreHist	586
35.4.13 defun changeHistListLen	587
35.4.14 defun updateHist	587
35.4.15 defun updateInCoreHist	588
35.4.16 defun putHist	588
35.4.17 defun recordNewValue	589
35.4.18 defun recordNewValue0	589
35.4.19 defun recordOldValue	590
35.4.20 defun recordOldValue0	590
35.4.21 defun undoInCore	590
35.4.22 defun undoChanges	591
35.4.23 defun undoFromFile	592
35.4.24 defun saveHistory	593
35.4.25 defun restoreHistory	595
35.4.26 defun setIOindex	597
35.4.27 defun showInput	597
35.4.28 defun showInOut	598
35.4.29 defun fetchOutput	598
35.4.30 Read the history file using index n	599

35.4.31	Write information of the current step to history file	600
35.4.32	Disable history if an error occurred	601
35.4.33	defun writeHistModesAndValues	601
35.5	Lisplib output transformations	602
35.5.1	defun spadrrwrite0	602
35.5.2	defun Random write to a stream	602
35.5.3	defun spadrrwrite	603
35.5.4	defun spadrrread	603
35.5.5	defun Random read a key from a stream	603
35.5.6	defun unwritable?	604
35.5.7	defun writifyComplain	604
35.5.8	defun safeWritify	604
35.5.9	defun writify,writifyInner	605
35.5.10	defun writify	608
35.5.11	defun spadClosure?	609
35.5.12	defvar \$NonNullStream	609
35.5.13	defvar \$NullStream	609
35.5.14	defun dewritify,dewritifyInner	610
35.5.15	defun dewritify	613
35.5.16	defun ScanOrPairVec,ScanOrInner	613
35.5.17	defun ScanOrPairVec	614
35.5.18	defun gensymInt	614
35.5.19	defun charDigitVal	615
35.5.20	defun histFileErase	615
35.6	History File Messages	616
36	)include help page Command	619
36.1	include help page man page	619
36.2	Functions	619
36.2.1	defun nclloopInclude1	619
36.2.2	Returns the first non-blank substring of the given string	620
36.2.3	Open the include file and read it in	620
36.2.4	Return the include filename	620
36.2.5	Return the next token	621
37	)library help page Command	623
37.1	library help page man page	623
38	)lisp help page Command	625
38.1	lisp help page man page	625
38.2	Functions	626
39	)load help page Command	627
39.1	load help page man page	627
39.1.1	defun The)load command (obsolete)	627

40)ltrace help page Command	629
40.1 ltrace help page man page	629
40.1.1 defun The top level)ltrace function	630
40.2 Variables Used	630
40.3 Functions	630
41)pquit help page Command	631
41.1 pquit help page man page	631
41.2 Functions	632
41.2.1 The top level pquit command	632
41.2.2 The top level pquit command handler	632
42)quit help page Command	635
42.1 quit help page man page	635
42.2 Functions	636
42.2.1 The top level quit command	636
42.2.2 The top level quit command handler	636
42.2.3 Leave the Axiom interpreter	637
43)read help page Command	639
43.1 read help page man page	639
43.1.1 defun The)read command	640
43.1.2 defun Implement the)read command	640
43.1.3 defun /read	642
44)regress help page Command	643
44.1 regress help page man page	643
45)savesystem help page Command	647
45.1 savesystem help page man page	647
45.1.1 defun The)savesystem command	648
46)set help page Command	649
46.1 set help page man page	649
46.2 Overview	650
46.3 Variables Used	651
46.4 Functions	651
46.4.1 Initialize the set variables	651
46.4.2 Reset the workspace variables	652
46.4.3 Display the set option information	653
46.4.4 Display the set variable settings	655
46.4.5 Translate options values to t or nil	656
46.4.6 Translate t or nil to option values	657
46.5 The list structure	657
46.6 breakmode	658
46.6.1 defvar \$BreakMode	659

46.7 debug	659
46.8 debug lambda type	660
46.8.1 defvar \$lambdtype	660
46.9 debug dalymode	660
46.9.1 defvar \$dalymode	661
46.10 compile	661
46.11 compile output	662
46.12 Variables Used	662
46.13 Functions	662
46.13.1 The set output command handler	662
46.13.2 Describe the set output library arguments	663
46.13.3 defvar \$output-library	663
46.13.4 Open the output library	664
46.14 compile input	664
46.15 Variables Used	665
46.16 Functions	665
46.16.1 The set input library command handler	665
46.16.2 Describe the set input library arguments	666
46.16.3 Add the input library to the list	666
46.16.4 defvar \$input-libraries	666
46.16.5 Drop an input library from the list	667
46.17 expose	667
46.18 Variables Used	668
46.18.1 defvar \$globalExposureGroupAlist	668
46.18.2 defvar \$localExposureDataDefault	694
46.18.3 defvar \$localExposureData	694
46.19 Functions	694
46.19.1 The top level set expose command handler	694
46.19.2 The top level set expose add command handler	695
46.19.3 Expose a group	696
46.19.4 The top level set expose add constructor handler	698
46.19.5 The top level set expose drop handler	699
46.19.6 The top level set expose drop group handler	700
46.19.7 The top level set expose drop constructor handler	701
46.19.8 Display exposed groups	702
46.19.9 Display exposed constructors	702
46.19.10 Display hidden constructors	703
46.20 functions	703
46.21 functions cache	704
46.22 Variables Used	705
46.22.1 defvar \$cacheAlist	705
46.23 Functions	705
46.23.1 The top level set functions cache handler	705
46.23.2 defvar \$compileDontDefineFunctions	709
46.24 functions recurrence	709
46.24.1 defvar \$compileRecurrence	710

46.25	fortran	710
46.25.1	ints2floats	711
46.25.2	defvar \$fortInts2Floats	712
46.25.3	fortindent	712
46.25.4	defvar \$fortIndent	712
46.25.5	fortlength	713
46.25.6	defvar \$fortLength	713
46.25.7	typedecs	713
46.25.8	defvar \$printFortranDecs	714
46.25.9	defaulttype	714
46.25.10	defvar \$defaultFortranType	715
46.25.11	precision	715
46.25.12	defvar \$fortranPrecision	715
46.25.13	intrinsic	716
46.25.14	defvar \$useIntrinsicFunctions	716
46.25.15	explength	717
46.25.16	defvar \$maximumFortranExpressionLength	717
46.25.17	segment	717
46.25.18	defvar \$fortranSegment	718
46.25.19	optlevel	718
46.25.20	defvar \$fortranOptimizationLevel	718
46.25.21	startindex	719
46.25.22	defvar \$fortranArrayStartingIndex	719
46.25.23	calling	719
46.25.24	defvar \$fortranTmpDir	720
46.25.25	The top level set fortran calling tempfile handler	721
46.25.26	Validate the output directory	722
46.25.27	Describe the set fortran calling tempfile	722
46.25.28	defvar \$fortranDirectory	723
46.25.29	defun setFortDir	723
46.25.30	defun describeSetFortDir	724
46.25.31	defvar \$fortranLibraries	725
46.25.32	defun setLinkerArgs	726
46.25.33	defun describeSetLinkerArgs	726
46.26	hyperdoc	727
46.26.1	fullscreen	727
46.26.2	defvar \$fullScreenSysVars	727
46.26.3	mathwidth	728
46.26.4	defvar \$historyDisplayWidth	728
46.27	help	729
46.27.1	fullscreen	729
46.27.2	defvar \$useFullScreenHelp	729
46.28	history	730
46.28.1	defvar \$HiFiAccess	730
46.29	messages	731
46.29.1	any	732

46.29.2	defvar \$printAnyIfTrue	732
46.29.3	autoload	733
46.29.4	defvar \$printLoadMsgs	733
46.29.5	bottomup	734
46.29.6	defvar \$reportBottomUpFlag	734
46.29.7	coercion	734
46.29.8	defvar \$reportCoerceIfTrue	735
46.29.9	dropmap	735
46.29.10	defvar \$displayDroppedMap	736
46.29.11	expose	736
46.29.12	defvar \$giveExposureWarning	736
46.29.13	file	737
46.29.14	defvar \$printMsgsToFile	737
46.29.15	frame	738
46.29.16	defvar \$frameMessages	738
46.29.17	highlighting	738
46.29.18	defvar \$highlightAllowed	739
46.29.19	instant	739
46.29.20	defvar \$reportInstantiations	740
46.29.21	insteach	740
46.29.22	defvar \$reportEachInstantiation—	740
46.29.23	interponly	741
46.29.24	defvar \$reportInterpOnly	741
46.29.25	naglink	742
46.29.26	defvar \$nagMessages	742
46.29.27	number	742
46.29.28	defvar \$displayMsgNumber	743
46.29.29	prompt	743
46.29.30	defvar \$inputPromptType	744
46.29.31	selection	744
46.29.32	set	745
46.29.33	defvar \$displaySetValue	745
46.29.34	startup	746
46.29.35	defvar \$displayStartMsgs	746
46.29.36	summary	746
46.29.37	defvar \$printStatisticsSummaryIfTrue	747
46.29.38	testing	747
46.29.39	defvar \$testingSystem	748
46.29.40	time	748
46.29.41	defvar \$printTimeIfTrue	748
46.29.42	type	749
46.29.43	defvar \$printTypeIfTrue	749
46.29.44	void	750
46.29.45	defvar \$printVoidIfTrue	750
46.30	naglink	750
46.30.1	host	751

46.30.2	defvar \$nagHost	751
46.30.3	defun setNagHost	752
46.30.4	defun describeSetNagHost	752
46.30.5	persistence	753
46.30.6	defvar \$fortPersistence	753
46.30.7	defun setFortPers	754
46.30.8	defun describeFortPersistence	754
46.30.9	messages	755
46.30.10	double	755
46.30.11	defvar \$nagEnforceDouble	756
46.31	output	756
46.31.1	abbreviate	757
46.31.2	defvar \$abbreviateTypes	758
46.31.3	algebra	758
46.31.4	defvar \$algebraFormat	759
46.31.5	defvar \$algebraOutputFile	759
46.31.6	defvar \$algebraOutputStream	760
46.31.7	defun setOutputAlgebra	760
46.31.8	defun describeSetOutputAlgebra	762
46.31.9	characters	763
46.31.10	defun setOutputCharacters	764
46.31.11	fortran	765
46.31.12	defvar \$fortranFormat	766
46.31.13	defvar \$fortranOutputFile	766
46.31.14	defun setOutputFortran	767
46.31.15	defun describeSetOutputFortran	769
46.31.16	fraction	770
46.31.17	defvar \$fractionDisplayType	771
46.31.18	length	771
46.31.19	defvar \$margin	771
46.31.20	defvar \$linelength	771
46.31.21	mathml	772
46.31.22	defvar \$mathmlFormat	773
46.31.23	defvar \$mathmlOutputFile	773
46.31.24	defun setOutputMathml	774
46.31.25	defun describeSetOutputMathml	776
46.31.26	html	777
46.31.27	defvar \$htmlFormat	777
46.31.28	defvar \$htmlOutputFile	777
46.31.29	defun setOutputHtml	778
46.31.30	defun describeSetOutputHtml	780
46.31.31	openmath	781
46.31.32	defvar \$openMathFormat	782
46.31.33	defvar \$openMathOutputFile	782
46.31.34	defun setOutputOpenMath	783
46.31.35	defun describeSetOutputOpenMath	785

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

47)show help page Command 811

47.1	show help page man page	811
47.1.1	defun The)show command	812
47.1.2	defun The internal)show command	812
47.1.3	defun reportOperations	813
47.1.4	defun reportOpsFromLisplib0	815
47.1.5	defun reportOpsFromLisplib1	815
47.1.6	defun reportOpsFromLisplib	816
47.1.7	defun isExposedConstructor	818

47.1.8 defun displayOperationsFromLisplib	818
47.1.9 defun reportOpsFromUnitDirectly0	819
47.1.10 defun reportOpsFromUnitDirectly	819
47.1.11 defun getOplistForConstructorForm	822
47.1.12 defun getOplistWithUniqueSignatures	823
47.1.13 defun reportOpsFromUnitDirectly1	823
47.1.14 defun sayShowWarning	824
48)spool help page Command	825
48.1 spool help page man page	825
49)summary help page Command	827
49.1 summary help page man page	827
49.1.1 defun summary	828
50)synonym help page Command	829
50.1 synonym help page man page	829
50.1.1 defun The)synonym command	830
50.1.2 defun The)synonym command implementation	830
50.1.3 defun Return a sublist of applicable synonyms	831
50.1.4 defun Get the system command from the input line	831
50.1.5 defun Remove system keyword	832
50.1.6 defun processSynonymLine	833
51)system help page Command	835
51.1 system help page man page	835
52)tangle help page Command	837
52.1 tangle help page man page	837
53)trace help page Command	839
53.1 trace help page man page	839
53.1.1 The trace global variables	843
53.1.2 defvar \$traceNoisely	844
53.1.3 defvar \$reportSpadTrace	844
53.1.4 defvar \$optionAlist	844
53.1.5 defvar \$tracedMapSignatures	844
53.1.6 defvar \$traceOptionList	844
53.1.7 defun trace	845
53.1.8 defun traceSpad2Cmd	845
53.1.9 defun trace1	846
53.1.10 defun getTraceOptions	850
53.1.11 defun saveMapSig	851
53.1.12 defun getMapSig	851
53.1.13 defun getTraceOption,hn	851
53.1.14 defun getTraceOption	852

53.1.15 defun traceOptionError	855
53.1.16 defun resetTimers	856
53.1.17 defun resetSpacers	856
53.1.18 defun resetCounters	856
53.1.19 defun ptimers	857
53.1.20 defun pspacers	857
53.1.21 defun pcounters	858
53.1.22 defun transOnlyOption	858
53.1.23 defun stackTraceOptionError	859
53.1.24 defun removeOption	859
53.1.25 defun domainToGenvar	859
53.1.26 defun genDomainTraceName	860
53.1.27 defun untrace	860
53.1.28 defun transTraceItem	861
53.1.29 defun removeTracedMapSigs	862
53.1.30 defun coerceTraceArgs2E	862
53.1.31 defun coerceSpadArgs2E	863
53.1.32 defun subTypes	864
53.1.33 defun coerceTraceFunValue2E	865
53.1.34 defun coerceSpadFunValue2E	866
53.1.35 defun isListOfIdentifiers	866
53.1.36 defun isListOfIdentifiersOrStrings	867
53.1.37 defun getMapSubNames	867
53.1.38 defun getPreviousMapSubNames	868
53.1.39 defun lassocSub	869
53.1.40 defun rassocSub	869
53.1.41 defun isUncompiledMap	869
53.1.42 defun isInterpOnlyMap	870
53.1.43 defun augmentTraceNames	870
53.1.44 defun isSubForRedundantMapName	871
53.1.45 defun untraceMapSubNames	871
53.1.46 defun funfind,LAM	872
53.1.47 defmacro funfind	872
53.1.48 defun isDomainOrPackage	873
53.1.49 defun isTraceGensym	873
53.1.50 defun spadTrace,g	873
53.1.51 defun spadTrace,isTraceable	873
53.1.52 defun spadTrace	874
53.1.53 defun traceDomainLocalOps	878
53.1.54 defun untraceDomainLocalOps	878
53.1.55 defun traceDomainConstructor	878
53.1.56 defun untraceDomainConstructor,keepTraced?	880
53.1.57 defun untraceDomainConstructor	881
53.1.58 defun flattenOperationAlist	881
53.1.59 defun mapLetPrint	882
53.1.60 defun letPrint	883

53.1.61 defun Identifier beginning with a sharpsign-number?	884
53.1.62 defun Identifier beginning with a sharpsign?	884
53.1.63 defun isgenvar	884
53.1.64 defun letPrint2	885
53.1.65 defun letPrint3	886
53.1.66 defun getAliasIfTracedMapParameter	887
53.1.67 defun getBpiNameIfTracedMap	888
53.1.68 defun hasPair	889
53.1.69 defun shortenForPrinting	889
53.1.70 defun spadTraceAlias	889
53.1.71 defun getOption	890
53.1.72 defun reportSpadTrace	890
53.1.73 defun orderBySlotNumber	891
53.1.74 defun /tracereply	892
53.1.75 defun spadReply,printName	892
53.1.76 defun spadReply	893
53.1.77 defun spadUntrace	893
53.1.78 defun remover	895
53.1.79 defun prTraceNames,fn	896
53.1.80 defun prTraceNames	896
53.1.81 defvar \$constructors	897
53.1.82 defun traceReply	897
53.1.83 defun addTraceItem	900
53.1.84 defun ?t	900
53.1.85 defun tracelet	902
53.1.86 defun breaklet	903
53.1.87 defun stupidIsSpadFunction	904
53.1.88 defun break	904
53.1.89 defun compileBoot	905
54)undo help page Command	907
54.1 undo help page man page	907
54.2 Evaluation	908
54.2.1 defun evalDomain	911
54.2.2 defun mkEvalable	911
54.2.3 defun mkEvalableUnion	913
54.2.4 defun mkEvalableRecord	913
54.2.5 defun mkEvalableMapping	913
54.2.6 defun evaluateType	914
54.2.7 defun Eval args passed to a constructor	915
54.2.8 defvar \$noEvalTypeMsg	917
54.2.9 defun throwEvalTypeMsg	917
54.2.10 defun makeOrdinal	918
54.2.11 defun evaluateSignature	918
54.3 Data Structures	918
54.4 Functions	919

54.4.1	Initial Undo Variables	919
54.4.2	defvar \$undoFlag	919
54.4.3	defvar \$frameRecord	919
54.4.4	defvar \$previousBindings	919
54.4.5	defvar \$reportUndo	920
54.4.6	defun undo	920
54.4.7	defun recordFrame	921
54.4.8	defun diffAlist	922
54.4.9	defun reportUndo	925
54.4.10	defun clearFrame	927
54.4.11	Undo previous n commands	927
54.4.12	defun undoSteps	928
54.4.13	defun undoSingleStep	929
54.4.14	defun undoLocalModemapHack	931
54.4.15	Remove undo lines from history write	931
55	)what help page Command	935
55.1	what help page man page	935
55.1.1	defvar \$whatOptions	937
55.1.2	defun what	937
55.1.3	defun whatSpad2Cmd,fixpat	937
55.1.4	defun whatSpad2Cmd	938
55.1.5	defun Show keywords for)what command	939
55.1.6	defun The)what commands implementation	939
55.1.7	defun Find all names contained in a pattern	940
55.1.8	defun Find function of names contained in pattern	941
55.1.9	defun satisfiesRegularExpressions	941
55.1.10	defun filterAndFormatConstructors	942
55.1.11	defun whatConstructors	943
55.1.12	Display all operation names containing the fragment	943
56	)with help page Command	945
56.1	with help page man page	945
56.1.1	defun with	945
57	)workfiles help page Command	947
57.1	workfiles help page man page	947
57.1.1	defun workfiles	947
57.1.2	defun workfilesSpad2Cmd	947
58	)zsystemdevelopment help page Command	951
58.1	zsystemdevelopment help page man page	951
58.1.1	defun zsystemdevelopment	951
58.1.2	defun zsystemDevelopmentSpad2Cmd	951
58.1.3	defun zsystemdevelopment1	952

59 Handlers for Special Forms	955
59.0.4 defun getAndEvalConstructorArgument	956
59.0.5 defun replaceSharps	956
59.0.6 defun isDomainValuedVariable	957
59.0.7 defun evalCategory	957
60 Handling input files	959
60.0.8 defun Handle .axiom.input file	959
60.0.9 defvar \$boot-line-stack	959
60.0.10 defvar \$in-stream	959
60.0.11 defvar \$out-stream	960
60.0.12 defvar \$file-closed	960
60.0.13 defvar \$echo-meta	960
60.0.14 defvar \$noSubsumption	960
60.0.15 defvar \$envHashTable	961
60.0.16 defun Dynamically add bindings to the environment	961
60.0.17 defun Fetch a property list for a symbol from CategoryFrame	962
60.0.18 defun Search for a binding in the environment list	962
60.0.19 defun Search for a binding in the current environment	962
60.0.20 defun searchTailEnv	963
61 File Parsing	965
61.0.21 defun Bind a variable in the interactive environment	965
61.0.22 defvar \$line-handler	965
61.0.23 defvar \$spad-errors	965
61.0.24 defvar \$xtokenreader	966
61.0.25 defun Initialize the spad reader	966
61.0.26 defun spad-syntax-error	967
61.0.27 defun spad-long-error	967
61.0.28 defun spad-short-error	968
61.0.29 defun spad-error-loc	968
61.0.30 defun iostat	968
61.0.31 defun next-lines-show	969
61.0.32 defun token-stack-show	969
61.0.33 defun ioclear	970
61.0.34 defun Set boot-line-stack to nil	970
62 Handling output	973
62.1 Special Character Tables	973
62.1.1 defvar \$defaultSpecialCharacters	973
62.1.2 defvar \$plainSpecialCharacters0	974
62.1.3 defvar \$plainSpecialCharacters1	974
62.1.4 defvar \$plainSpecialCharacters2	975
62.1.5 defvar \$plainSpecialCharacters3	975
62.1.6 defvar \$plainRTspecialCharacters	976
62.1.7 defvar \$RTspecialCharacters	976

62.1.8 defvar \$specialCharacters	977
62.1.9 defvar \$specialCharacterAlist	977
62.1.10 defun Look up a special character code for a symbol	978
63 Stream and File Handling	979
63.0.11 defun make-instream	979
63.0.12 defun make-outstream	979
63.0.13 defun make-appendstream	980
63.0.14 defun defiostream	980
63.0.15 defun shut	980
63.0.16 defun eofp	981
63.0.17 defun makeStream	981
63.0.18 defun Construct a new input file name	981
63.0.19 defun getDirectoryList	982
63.0.20 defun probeName	982
63.0.21 defun makeFullNamestring	983
63.0.22 defun Replace a file by erase and rename	983
64 The Spad Server Mechanism	985
64.0.23 defun openserver	985
65 Axiom Build-time Functions	987
65.0.24 defun spad-save	987
66 Exposure Groups	989
67 Databases	991
67.1 Database structure	991
67.1.1 kaf File Format	991
67.1.2 Database Files	992
67.1.3 defstruct \$database	994
67.1.4 defvar \$*defaultdomain-list*	995
67.1.5 defvar \$*operation-hash*	995
67.1.6 defvar \$*hasCategory-hash*	995
67.1.7 defvar \$*miss*	996
67.1.8 Database streams	996
67.1.9 defvar \$*compressvector*	996
67.1.10 defvar \$*compressVectorLength*	996
67.1.11 defvar \$*compress-stream*	997
67.1.12 defvar \$*compress-stream-stamp*	997
67.1.13 defvar \$*interp-stream*	997
67.1.14 defvar \$*interp-stream-stamp*	997
67.1.15 defvar \$*operation-stream*	997
67.1.16 defvar \$*operation-stream-stamp*	998
67.1.17 defvar \$*browse-stream*	998
67.1.18 defvar \$*browse-stream-stamp*	998

67.1.19 defvar <code>\$*category-stream*</code>	998
67.1.20 defvar <code>\$*category-stream-stamp*</code>	999
67.1.21 defvar <code>\$*allconstructors*</code>	999
67.1.22 defvar <code>\$*allOperations*</code>	999
67.1.23 defun Reset all hash tables before saving system	999
67.1.24 defun Preload algebra into saved system	1000
67.1.25 defun Open the interp database	1002
67.1.26 defun Open the browse database	1004
67.1.27 defun Open the category database	1005
67.1.28 defun Open the operations database	1006
67.1.29 defun Add operations from newly compiled code	1006
67.1.30 defun Show all database attributes of a constructor	1007
67.1.31 defun Set a value for a constructor key in the database	1008
67.1.32 defun Delete a value for a constructor key in the database	1009
67.1.33 defun Get constructor information for a database key	1009
67.1.34 defun The <code>)library</code> top level command	1013
67.1.35 defun Read a local filename and update the hash tables	1013
67.1.36 defun Update the database from an <code>nrllib index.kaf</code> file	1015
67.1.37 defun <code>updateDatabase</code>	1017
67.1.38 defun Make new databases	1017
67.1.39 defun <code>saveDependentsHashTable</code>	1021
67.1.40 defun <code>saveUsersHashTable</code>	1022
67.1.41 defun Construct the proper database full pathname	1022
67.1.42 <code>compress.daase</code>	1023
67.1.43 defun Set up compression vectors for the databases	1023
67.1.44 defvar <code>\$*attributes*</code>	1024
67.1.45 defun Write out the compress database	1024
67.1.46 defun Compress an expression using the compress vector	1025
67.1.47 defun Uncompress an expression using the compress vector	1026
67.1.48 Building the <code>interp.daase</code> from hash tables	1026
67.1.49 defun Write the interp database	1030
67.1.50 Building the <code>browse.daase</code> from hash tables	1032
67.1.51 defun Write the browse database	1032
67.1.52 Building the <code>category.daase</code> from hash tables	1033
67.1.53 defun Write the category database	1033
67.1.54 Building the <code>operation.daase</code> from hash tables	1034
67.1.55 defun Write the operations database	1034
67.1.56 Database support operations	1035
67.1.57 defun Data preloaded into the image at build time	1035
67.1.58 defun Return all constructors	1035
67.1.59 defun Return all operations	1035

68 System Statistics	1037
68.1 Lisp Library Handling	1037
68.1.1 defun loadLib	1037
68.1.2 defun isSystemDirectory	1038
68.1.3 defun loadLibNoUpdate	1039
68.1.4 defun loadFunctor	1040
69 Special Lisp Functions	1041
69.1 Axiom control structure macros	1041
69.1.1 defun put	1041
69.1.2 defmacro while	1041
69.1.3 defmacro whileWithResult	1042
69.2 Filename Handling	1042
69.2.1 defun namestring	1042
69.2.2 defun pathnameName	1042
69.2.3 defun pathnameType	1042
69.2.4 defun pathnameTypeId	1043
69.2.5 defun mergePathnames	1043
69.2.6 defun pathnameDirectory	1043
69.2.7 defun Axiom pathnames	1044
69.2.8 defun makePathname	1044
69.2.9 defun Delete a file	1044
69.2.10 defun wrap	1045
69.2.11 defun lotsof	1045
69.2.12 defmacro startsId?	1046
69.2.13 defun hput	1046
69.2.14 defmacro hget	1046
69.2.15 defun hkeys	1046
69.2.16 defun digitp	1047
69.2.17 defun pname	1047
69.2.18 defun size	1047
69.2.19 defun strpos	1047
69.2.20 defun strposl	1048
69.2.21 defun qenum	1048
69.2.22 defmacro identp	1048
69.2.23 defun concat	1049
69.2.24 defun functionp	1049
69.2.25 defun brightprint	1049
69.2.26 defun brightprint-0	1050
69.2.27 defun member	1050
69.2.28 defun messageprint	1050
69.2.29 defun messageprint-1	1051
69.2.30 defun messageprint-2	1051
69.2.31 defun sayBrightly1	1051
69.2.32 defmacro assq	1052

70 Record, Union, Mapping, and Enumeration	1053
71 Common Lisp Algebra Support	1055
71.1 InputForm	1055
71.1.1 defun unparseInputForm	1055
71.2 Void	1056
71.2.1 defun voidValue	1056
71.3 U32Vector	1056
71.3.1 defun getrefv32	1056
71.3.2 defmacro qv32len	1056
71.3.3 defmacro elt32	1057
71.3.4 defmacro setelt32	1057
71.4 DirectProduct	1057
71.4.1 defun vec2list	1057
71.5 AlgebraicFunction	1057
71.5.1 defun retract	1057
71.6 Any	1059
71.6.1 defun spad2BootCoerce	1059
71.7 ParametricLinearEquations	1059
71.7.1 defun algCoerceInteractive	1059
71.8 NumberFormats	1060
71.8.1 defun ncParseFromString	1060
71.9 SingleInteger	1060
71.9.1 defun qsquotient	1060
71.9.2 defun qsremainder	1060
71.9.3 defmacro qsdifference	1061
71.9.4 defmacro qslessp	1061
71.9.5 defmacro qsadd1	1061
71.9.6 defmacro qssub1	1061
71.9.7 defmacro qsminus	1062
71.9.8 defmacro qsplus	1062
71.9.9 defmacro qstimes	1062
71.9.10 defmacro qsabsval	1062
71.9.11 defmacro qsoddp	1063
71.9.12 defmacro qszerop	1063
71.9.13 defmacro qsmax	1063
71.9.14 defmacro qsmin	1063
71.10 Boolean	1064
71.10.1 defun The Boolean = function support	1064
71.11 IndexedBits	1064
71.11.1 defmacro truth-to-bit	1064
71.11.2 defun IndexedBits new function support	1064
71.11.3 defmacro bit-to-truth	1065
71.11.4 defmacro bvec-elt	1065
71.11.5 defmacro bvec-setelt	1065
71.11.6 defmacro bvec-size	1065

71.11.7 defun IndexedBits concat function support	1065
71.11.8 defun IndexedBits copy function support	1066
71.11.9 defun IndexedBits = function support	1066
71.11.10 defun IndexedBits < function support	1066
71.11.11 defun IndexedBits And function support	1066
71.11.12 defun IndexedBits Or function support	1067
71.11.13 defun IndexedBits xor function support	1067
71.11.14 defun IndexedBits nand function support	1067
71.11.15 defun IndexedBits nor function support	1067
71.11.16 defun IndexedBits not function support	1068
71.12 KeyedAccessFile	1068
71.12.1 defun KeyedAccessFile defstream function support	1068
71.12.2 defun KeyedAccessFile defstream function support	1068
71.13 Table	1069
71.13.1 defun Table InnerTable support	1069
71.13.2 defun compiledLookup	1069
71.13.3 defun basicLookup	1069
71.13.4 defun lookupInDomainVector	1071
71.13.5 defun basicLookupCheckDefaults	1072
71.13.6 defun oldCompLookup	1072
71.13.7 defun NRTevalDomain	1073
71.14 Plot3d	1073
71.14.1 defvar \$numericFailure	1073
71.14.2 defvar \$oldBreakMode	1074
71.14.3 defmacro trapNumericErrors	1074
71.15 DoubleFloatVector	1074
71.15.1 defmacro dlen	1074
71.15.2 defmacro make-double-vector	1075
71.15.3 defmacro make-double-vector1	1075
71.15.4 defmacro delt	1075
71.15.5 defmacro dsetelt	1075
71.16 ComplexDoubleFloatVector	1076
71.16.1 defmacro make-cdouble-vector	1076
71.16.2 defmacro cdelt	1076
71.16.3 defmacro cdsetelt	1076
71.16.4 defmacro cdlen	1077
71.17 DoubleFloatMatrix	1077
71.17.1 defmacro make-double-matrix	1077
71.17.2 defmacro make-double-matrix1	1077
71.17.3 defmacro daref2	1078
71.17.4 defmacro dsetaref2	1078
71.17.5 defmacro danrows	1078
71.17.6 defmacro dancols	1078
71.18 ComplexDoubleFloatMatrix	1079
71.18.1 defmacro make-cdouble-matrix	1079
71.18.2 defmacro cdaref2	1079

71.18.3 defmacro cdsetaref2	1079
71.18.4 defmacro cdanrows	1080
71.18.5 defmacro cdancols	1080
71.19 Integer	1080
71.19.1 defun Integer divide function support	1080
71.19.2 defun Integer quo function support	1081
71.19.3 defun Integer quo function support	1081
71.19.4 defun Integer random function support	1081
71.20 IndexCard	1082
71.20.1 defun IndexCard origin function support	1082
71.20.2 defun IndexCard origin function support	1082
71.20.3 defun IndexCard elt function support	1082
71.21 OperationsQuery	1083
71.21.1 defun OperationQuery getDatabase function support	1083
71.22 Database	1084
71.22.1 defun Database elt function support	1084
71.23 FileName	1084
71.23.1 defun FileName filename function implementation	1084
71.23.2 defun FileName filename support function	1084
71.23.3 defun FileName directory function implementation	1085
71.23.4 defun FileName directory function support	1085
71.23.5 defun FileName name function implementation	1085
71.23.6 defun FileName extension function implementation	1085
71.23.7 defun FileName exists? function implementation	1086
71.23.8 defun FileName readable? function implementation	1086
71.23.9 defun FileName writeable? function implementation	1086
71.23.10 defun FileName writeable? function support	1086
71.23.11 defun FileName new function implementation	1087
71.24 DoubleFloat	1087
71.24.1 defmacro DFLessThan	1087
71.24.2 defmacro DFUnaryMinus	1088
71.24.3 defmacro DFMinusp	1088
71.24.4 defmacro DFZerop	1088
71.24.5 defmacro DFAdd	1088
71.24.6 defmacro DFSubtract	1089
71.24.7 defmacro DFMultiply	1089
71.24.8 defmacro DFIntegerMultiply	1089
71.24.9 defmacro DFMax	1089
71.24.10 defmacro DFMin	1090
71.24.11 defmacro DFEql	1090
71.24.12 defmacro DFDivide	1090
71.24.13 defmacro DFIntegerDivide	1090
71.24.14 defmacro DFSqrt	1091
71.24.15 defmacro DFLogE	1091
71.24.16 defmacro DFLog	1091
71.24.17 defmacro DFIntegerExpt	1091

71.24.18	defmacro DFExpt	1092
71.24.19	defmacro DFExp	1092
71.24.20	defmacro DFSin	1092
71.24.21	defmacro DFCos	1092
71.24.22	defmacro DFTan	1093
71.24.23	defmacro DFAsin	1093
71.24.24	defmacro DFAcos	1093
71.24.25	defmacro DFAtan	1093
71.24.26	defmacro DFAtan2	1094
71.24.27	defmacro DFSinh	1094
71.24.28	defmacro DFCosh	1094
71.24.29	defmacro DFTanh	1095
71.24.30	defmacro DFAsinh	1095
71.24.31	defmacro DFAcosh	1095
71.24.32	defmacro DFAtanh	1096
71.24.33	defun Machine specific float numerator	1096
71.24.34	defun Machine specific float denominator	1096
71.24.35	defun Machine specific float sign	1097
71.24.36	defun Machine specific float bit length	1097
71.24.37	defun Decode floating-point values	1097
71.24.38	defun The cotangent routine	1097
71.24.39	defun The inverse cotangent function	1098
71.24.40	defun The secant function	1098
71.24.41	defun The inverse secant function	1098
71.24.42	defun The cosecant function	1099
71.24.43	defun The inverse cosecant function	1099
71.24.44	defun The hyperbolic cosecant function	1099
71.24.45	defun The hyperbolic cotangent function	1100
71.24.46	defun The hyperbolic secant function	1100
71.24.47	defun The inverse hyperbolic cosecant function	1100
71.24.48	defun The inverse hyperbolic cotangent function	1100
71.24.49	defun The inverse hyperbolic secant function	1101
72 OpenMath		1103
72.1	A Technical Overview[?]	1103
72.1.1	The OpenMath Architecture	1103
72.1.2	OpenMath Encodings	1105
72.1.3	Content Dictionaries	1106
72.1.4	OpenMath in Action	1108
72.2	Technical Details[?]	1109
72.3	The Structure of the API	1109
72.4	OpenMath Expressions	1110
72.4.1	Expressions	1110
72.4.2	Symbols	1110
72.4.3	Encoding and Decoding OpenMath Expressions	1110
72.5	Big Integers	1111

72.6 Functions Dealing with OpenMath Devices	1111
72.7 Functions to Write OpenMath Expressions to Devices	1112
72.7.1 Beginning and Ending Objects	1112
72.7.2 Writing Basic Objects	1113
72.7.3 Writing Structured Objects	1113
72.8 Functions to Extract OpenMath Expressions from Devices	1114
72.8.1 Testing the type of the current token	1114
72.8.2 Extracting the current token	1115
72.9 Comments in the SGML/XML Encodings	1118
72.10 I/O Functions for Devices	1119
72.11 Communications	1119
72.11.1 Functions to Initiate an OMconn	1120
72.12 Parameters	1121
72.13 Miscellaneous Functions and Variables	1121
72.14 The OM.h header file	1122
72.15 Axiom OpenMath stub functions	1131
72.15.1 Axiom specific functions	1131
72.15.2 defun om-Read	1131
72.15.3 defun om-listCDs	1132
72.15.4 defun om-listSymbols	1132
72.15.5 defun om-supportsCD	1132
72.15.6 defun om-supportsSymbol	1132
72.15.7 Lisp conversion functions	1133
72.15.8 defun om-setDevEncoding	1133
72.15.9 Device manipulation functions	1133
72.15.10 defun om-openFileDev	1133
72.15.11 defun om-openStringDev	1134
72.15.12 defun om-closeDev	1134
72.15.13 Connection manipulation functions	1134
72.15.14 defun om-makeConn	1134
72.15.15 defun om-closeConn	1134
72.15.16 defun om-getConnInDev	1135
72.15.17 defun om-getConnOutDev	1135
72.15.18 Client/Server functions	1135
72.15.19 defun om-bindTCP	1135
72.15.20 defun om-connectTCP	1136
72.15.21 Device input/output functions	1136
72.15.22 defun om-getApp	1137
72.15.23 defun om-getAtp	1138
72.15.24 defun om-getAttr	1138
72.15.25 defun om-getBind	1138
72.15.26 defun om-getBVar	1138
72.15.27 defun om-getByteArray	1139
72.15.28 defun om-getEndApp	1139
72.15.29 defun om-getEndAtp	1139
72.15.30 defun om-getEndAttr	1139

72.15.31	defun om-getEndBind	1140
72.15.32	defun om-getEndBVar	1140
72.15.33	defun om-getEndError	1140
72.15.34	defun om-getEndObject	1140
72.15.35	defun om-getError	1141
72.15.36	defun om-getFloat	1141
72.15.37	defun om-getInt	1141
72.15.38	defun om-getObject	1141
72.15.39	defun om-getString	1142
72.15.40	defun om-getSymbol	1142
72.15.41	defun om-getType	1142
72.15.42	defun om-getVar	1142
72.15.43	defun om-putApp	1143
72.15.44	defun om-putAtp	1143
72.15.45	defun om-putAttr	1143
72.15.46	defun om-putBind	1143
72.15.47	defun om-putBVar	1144
72.15.48	defun om-putByteArray	1144
72.15.49	defun om-putEndApp	1144
72.15.50	defun om-putEndAtp	1144
72.15.51	defun om-putEndAttr	1145
72.15.52	defun om-putEndBind	1145
72.15.53	defun om-putEndBVar	1145
72.15.54	defun om-putEndError	1145
72.15.55	defun om-putEndObject	1146
72.15.56	defun om-putError	1146
72.15.57	defun om-putFloat	1146
72.15.58	defun om-putInt	1146
72.15.59	defun om-putObject	1147
72.15.60	defun om-putString	1147
72.15.61	defun om-putSymbol	1147
72.15.62	defun om-putVar	1147
72.15.63	defun om-stringToStringPtr	1148
72.15.64	defun om-stringPtrToString	1148
73 NRLIB code.lisp support code		1149
73.0.65	defun makeByteWordVec2	1149
73.0.66	defmacro spadConstant	1149
74 Monitoring execution		1151
74.0.67	defvar \$*monitor-domains*	1157
74.0.68	defvar \$*monitor-nrlibs*	1157
74.0.69	defvar \$*monitor-table*	1158
74.0.70	defstruct \$monitor-data	1158
74.0.71	defstruct \$libstream	1158
74.0.72	defun Initialize the monitor statistics hashtable	1158

74.0.73 defun	End the monitoring process, we cannot restart	1159
74.0.74 defun	Return a list of the monitor-data structures	1159
74.0.75 defun	Add a function to be monitored	1160
74.0.76 defun	Remove a function being monitored	1160
74.0.77 defun	Enable all (or optionally one) function for monitoring	1160
74.0.78 defun	Disable all (optionally one) function for monitoring	1161
74.0.79 defun	Reset the table count for the table (or a function)	1161
74.0.80 defun	Incr the count of fn by 1	1162
74.0.81 defun	Decr the count of fn by 1	1162
74.0.82 defun	Return the monitor information for a function	1163
74.0.83 defun	Hang a monitor call on all of the defuns in a file	1163
74.0.84 defun	Return a list of the functions with zero count fields	1163
74.0.85 defun	Return a list of functions with non-zero counts	1164
74.0.86 defun	Write out a list of symbols or structures to a file	1164
74.0.87 defun	Save the *monitor-table* in loadable form	1165
74.0.88 defun	restore a checkpointed file	1165
74.0.89 defun	Printing help documentation	1166
74.0.90	Monitoring algebra files	1168
74.0.91 defun	Monitoring algebra code.lsp files	1168
74.0.92 defun	Monitor autoloaded files	1168
74.0.93 defun	Monitor an nrlib	1169
74.0.94 defun	Given a monitor-data item, extract the nrlib name	1169
74.0.95 defun	Is this an exposed algebra function?	1170
74.0.96 defun	Monitor exposed domains	1170
74.0.97 defun	Generate a report of the monitored domains	1171
74.0.98 defun	Parse an)abbrev expression for the domain name	1172
74.0.99 defun	Given a spad file, report all nrlibs it creates	1172
74.0.100 defun	Print percent of functions tested	1173
74.0.101 defun	Find all monitored symbols containing the string	1173

75 The Interpreter 1175

76 The Global Variables 1209

76.1	Star Global Variables	1209
76.1.1	*eof*	1209
76.1.2	*features*	1209
76.1.3	*package*	1209
76.1.4	*standard-input*	1210
76.1.5	*standard-output*	1210
76.1.6	*top-level-hook*	1210
76.2	Dollar Global Variables	1212
76.2.1	\$boot	1213
76.2.2	coerceFailure	1213
76.2.3	\$currentLine	1213
76.2.4	\$displayStartMsgs	1213
76.2.5	\$e	1213

76.2.6	\$erMsgToss	1213
76.2.7	\$fn	1213
76.2.8	\$frameRecord	1213
76.2.9	\$HiFiAccess	1214
76.2.10	\$HistList	1214
76.2.11	\$HistListAct	1214
76.2.12	\$HistListLen	1214
76.2.13	\$HistRecord	1214
76.2.14	\$historyFileType	1215
76.2.15	\$internalHistoryTable	1215
76.2.16	\$interpreterFrameName	1215
76.2.17	\$interpreterFrameRing	1215
76.2.18	\$InteractiveFrame	1215
76.2.19	\$intRestart	1215
76.2.20	\$intTopLevel	1215
76.2.21	\$IOindex	1216
76.2.22	\$lastPos	1216
76.2.23	\$libQuiet	1216
76.2.24	\$msgDatabaseName	1216
76.2.25	\$ncMsgList	1216
76.2.26	\$newcompErrorCount	1216
76.2.27	\$newspad	1216
76.2.28	\$nopus	1216
76.2.29	\$oldHistoryFileName	1217
76.2.30	\$okToExecuteMachineCode	1217
76.2.31	\$options	1217
76.2.32	\$previousBindings	1217
76.2.33	\$PrintCompilerMessageIfTrue	1217
76.2.34	\$reportUndo	1217
76.2.35	\$spad	1217
76.2.36	\$SpadServer	1218
76.2.37	\$SpadServerName	1218
76.2.38	\$systemCommandFunction	1218
76.2.39	top_level	1218
76.2.40	\$quitTag	1218
76.2.41	\$useInternalHistoryTable	1218
76.2.42	\$undoFlag	1218

Volume 6: Axiom Command

1	Overview	1
2	The axiom Command	3
2.0.1	[-ht | -noht]	3
2.0.2	[-gr | -nogr]	4
2.0.3	[-clef | -noclef]	4
2.0.4	[-nonag | -nag]	5
2.0.5	[-noiw | -iw]	5
2.0.6	[-ihere | -noihere]	6
2.0.7	[-nox]	6
2.0.8	[-go | -nogo]	7
2.0.9	[-ws wsname]	7
2.0.10	[-list]	7
2.0.11	[-grprog fname]	7
2.0.12	[-nagprog fname]	8
2.0.13	[-htprog fname]	8
2.0.14	[-clefprog fname]	8
2.0.15	[-sessionprog fname]	8
2.0.16	[-clientprog fname]	8
2.0.17	[-h]	8
3	The sman program	17
3.1	sman.h	17
3.2	sman	18
3.2.1	includes	18
3.2.2	variables	18
3.2.3	process_arguments	20
3.2.4	should_L_clef	23
3.2.5	in_X	23
3.2.6	set_up_defaults	23
3.2.7	process_options	24
3.2.8	death_handler	24
3.2.9	nagman_handler	24
3.2.10	sman_catch_signals	25
3.2.11	fix_env	26
3.2.12	init_term_io	26
3.2.13	strPrefix	27
3.2.14	check_spad_proc	27
3.2.15	clean_up_old_sockets	28
3.2.16	fork_you	28
3.2.17	exec_command_env	29
3.2.18	spawn_of_hell	29
3.2.19	start_the_spadclient	30

3.2.20	start_the_local_spadclient	30
3.2.21	start_the_nagman	31
3.2.22	start_the_session_manager	31
3.2.23	start_the_hypertext	32
3.2.24	start_the_graphics	32
3.2.25	fork_Axiom	32
3.2.26	start_the_Axiom	34
3.2.27	clean_up_sockets	35
3.2.28	read_from_spad_io	35
3.2.29	read_from_manager	36
3.2.30	manage_spad_io	37
3.2.31	init_spad_process_list	38
3.2.32	print_spad_process_list	38
3.2.33	find_child	38
3.2.34	kill_all_children	39
3.2.35	clean_up_terminal	39
3.2.36	monitor_children	39
3.2.37	main sman	41
3.2.38	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
6.2.1	includes	50
6.2.2	variables	51
6.2.3	term	52
6.2.4	size_of_file	53
6.2.5	rpcloop	53
6.2.6	catchSignals	59
6.2.7	main nagman	60
6.2.8	nagman	61
7	The hypertext program	63
8	The clef program	65
9	The session program	67
9.1	session	67
9.1.1	includes	67
9.1.2	variables	68
9.1.3	usr1_handler	68

9.1.4	usr2_handler	68
9.1.5	term_handler	69
9.1.6	pr	69
9.1.7	close_client	70
9.1.8	read_SpadServer_command	71
9.1.9	test_sock_for_process	72
9.1.10	read_menu_client_command	72
9.1.11	read_from_spad_io	73
9.1.12	kill_spad	74
9.1.13	accept_session_connection	74
9.1.14	read_from_session	76
9.1.15	manage_sessions	77
9.1.16	main sessionmanager	78
9.1.17	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
4.0.1	BeStruct	87
4.1	Shared Code for file handling	87
4.1.1	strpostfix	87
4.1.2	extendHT	88
4.1.3	buildHtFilename	88
4.1.4	pathname	90
4.1.5	htFileOpen	91
4.1.6	dbFileOpen	91
4.1.7	tempFileOpen	93
4.2	Shared Code for Hash Table Handling	93
4.2.1	halloc	93
4.2.2	hashInit	94
4.2.3	freeHash	94
4.2.4	hashInsert	95
4.2.5	hashFind	95
4.2.6	hashReplace	95
4.2.7	hashDelete	96
4.2.8	hashMap	96
4.2.9	hashCopyEntry	97
4.2.10	hashCopyTable	97
4.2.11	stringHash	97
4.2.12	stringEqual	98
4.2.13	allocString	98
4.3	Shared Code for Error Handling	98
4.3.1	jump	98
4.3.2	dumpToken	99
4.3.3	printPageAndFilename	99
4.3.4	printNextTenTokens	100

4.3.5	printToken	100
4.3.6	tokenName	101
4.3.7	htperror	102
4.4	Shared Code for Lexical Analyzer	103
4.4.1	parserInit	104
4.4.2	initScanner	104
4.4.3	saveScannerState	105
4.4.4	restoreScannerState	105
4.4.5	ungetChar	106
4.4.6	getChar	106
4.4.7	getChar1	107
4.4.8	ungetToken	109
4.4.9	getToken	109
4.4.10	pushBeStack	112
4.4.11	checkAndPopBeStack	113
4.4.12	clearBeStack	113
4.4.13	beType	114
4.4.14	beginType	115
4.4.15	endType	116
4.4.16	keywordType	117
4.4.17	getExpectedToken	118
4.4.18	spadErrorHandler	118
4.4.19	resetConnection	119
4.4.20	spadBusy	119
4.4.21	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
6.2.1	System includes	142
6.2.2	Local includes	142
6.3	externs	143
6.4	local variables	143
6.5	Code	144
6.5.1	spadbufInterHandler	144
6.5.2	spadbufFunctionChars	144
6.5.3	interpIO	145
6.5.4	. . . . .	146
6.5.5	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
7.3.1	System includes	150
7.3.2	Local includes	151
7.4	defines	151
7.5	local variables	151
7.6	Code	151
7.6.1	allocString	151
7.6.2	strPrefix	152
7.6.3	getExTitle	152
7.6.4	exToHt	153
7.6.5	emitHeader	154
7.6.6	emitFooter	154
7.6.7	emitMenuEntry	154
7.6.8	emitSpadCommand	155
7.6.9	openCoverPage	155
7.6.10	closeCoverPage	156
7.6.11	closeCoverFile	156
7.6.12	emitCoverLink	156
7.6.13	addFile	157
7.6.14	main	157
8	The htadd command	159
8.1	htadd Call Graph	159
8.2	Constants and Headers	164
8.2.1	System includes	164
8.2.2	structs	164
8.2.3	Local includes	164
8.2.4	extern references	165
8.2.5	defines	165
8.2.6	forward declarations	166
8.2.7	local variables	166
8.3	The Shared Code	167
8.4	Code	167
8.4.1	parseArgs	167
8.4.2	writable	168
8.4.3	buildDBFilename	168
8.4.4	addfile	170
8.4.5	updateDB	171
8.4.6	addNewPages	172
8.4.7	copyFile	173
8.4.8	getFilename	174
8.4.9	deleteFile	175
8.4.10	deleteDB	175

8.4.11	main	176
9	The hthits function	179
9.1	hthits Call Graph	179
9.2	Constants and Headers	181
9.2.1	System includes	181
9.2.2	defines	181
9.2.3	structs	181
9.2.4	Local includes	182
9.2.5	local variables	182
9.2.6	cmdline	182
9.2.7	handleHtdb	182
9.2.8	handleFile	183
9.2.9	handleFilePages	185
9.2.10	handlePage	185
9.2.11	searchPage	186
9.2.12	squirt	187
9.2.13	splitpage	187
9.2.14	untexbuf	188
9.2.15	badDB	189
9.2.16	regerr	189
9.2.17	main	189
10	The hypertext command	191
10.1	Constants and Headers	191
10.1.1	System includes	191
10.2	structs	192
10.2.1	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
10.8.1	sigusr2Handler	209
10.8.2	sigcldHandler	209
10.8.3	cleanSocket	209
10.8.4	initHash	210
10.8.5	initPageStructs	210
10.8.6	checkArguments	210
10.8.7	makeServerConnections	212
10.9	Condition Handling	213
10.9.1	insertCond	213
10.9.2	changeCond	214
10.9.3	checkMemostack	214
10.9.4	checkCondition	215

10.10	Dialog Handling	216
10.10.1	redrawWin	216
10.10.2	mystrncpy	216
10.10.3	incLineNumbers	216
10.10.4	decLineNumbers	217
10.10.5	decreaseLineNumbers	217
10.10.6	overwriteBuffer	217
10.10.7	moveSymForward	219
10.10.8	clearCursorline	220
10.10.9	insertBuffer	220
10.10.10	addBufferToSym	222
10.10.11	drawInputsymbol	223
10.10.12	updateInputsymbol	224
10.10.13	drawCursor	224
10.10.14	moveCursorHome	225
10.10.15	moveCursorEnd	226
10.10.16	void moveCursorForward	226
10.10.17	moveCursorDown	227
10.10.18	moveCursorUp	227
10.10.19	clearCursor	228
10.10.20	moveCursorBackward	229
10.10.21	moveRestBack	229
10.10.22	deleteRestOfLine	230
10.10.23	backOverEoln	231
10.10.24	moveBackOneChar	233
10.10.25	backOverChar	235
10.10.26	deleteEoln	235
10.10.27	deleteOneChar	237
10.10.28	deleteChar	238
10.10.29	oughEnter	238
10.10.30	enterNewLine	240
10.10.31	Dialog	241
10.11	Format and Display a page	244
10.11.1	showPage	244
10.11.2	exposePage	246
10.11.3	scrollPage	247
10.11.4	pastePage	248
10.12	Event Handling	249
10.12.1	mainEventLoop	249
10.12.2	handleEvent	250
10.12.3	createWindow	253
10.12.4	quitHyperDoc	253
10.12.5	findPage	254
10.12.6	downlink	255
10.12.7	memolink	255
10.12.8	killAxiomPage	255

10.12.9	killPage	256
10.12.10	returnlink	256
10.12.11	hplink	257
10.12.12	showWindowLinkHandler	257
10.12.13	makeWindowLink	257
10.12.14	hideWindowLinkHandler	258
10.12.15	pasteButton	258
10.12.16	helpForHyperDoc	259
10.12.17	findButtonInList	259
10.12.18	getHyperLink	260
10.12.19	handleButton	260
10.12.20	exitHyperDoc	264
10.12.21	setWindow	265
10.12.22	clearExposures	266
10.12.23	getNewWindow	266
10.12.24	setCursor	269
10.12.25	changeCursor	269
10.12.26	handleMotionEvent	269
10.12.27	initCursorState	270
10.12.28	initCursorStates	270
10.12.29	makeBusyCursor	270
10.12.30	makeBusyCursors	271
10.12.31	HyperDocErrorHandler	271
10.12.32	setErrorHandlers	271
10.13	Line Extent Computation	272
10.13.1	computeInputExtent	272
10.13.2	computePunctuationExtent	272
10.13.3	computeWordExtent	274
10.13.4	computeVerbatimExtent	275
10.13.5	computeSpadsrctxtExtent	275
10.13.6	computeDashExtent	275
10.13.7	computeTextExtent	276
10.13.8	computeBeginItemsExtent	283
10.13.9	computeItemExtent	284
10.13.10	computeMitemExtent	284
10.13.11	endifExtent	284
10.13.12	computeIfcondExtent	285
10.13.13	computeCenterExtent	286
10.13.14	computeBfExtent	287
10.13.15	computeEmExtent	287
10.13.16	computeItExtent	287
10.13.17	computeRmExtent	288
10.13.18	computeButtonExtent	288
10.13.19	endbuttonExtent	289
10.13.20	computePastebuttonExtent	290
10.13.21	endpastebuttonExtent	290

10.13.22	computePasteExtent	291
10.13.23	computeSpadcommandExtent	291
10.13.24	computeSpadsrcExtent	292
10.13.25	endSpadcommandExtent	292
10.13.26	endSpadsrcExtent	293
10.13.27	computeMboxExtent	294
10.13.28	computeBoxExtent	294
10.13.29	computeIrExtent	295
10.13.30	computeImageExtent	296
10.13.31	computeTableExtent	296
10.13.32	computeTitleExtent	297
10.13.33	computeHeaderExtent	298
10.13.34	computeFooterExtent	299
10.13.35	computeScrollingExtent	299
10.13.36	startNewline	300
10.13.37	enterNodes	300
10.13.38	punctuationWidth	301
10.13.39	inputStringWidth	301
10.13.40	wordWidth	302
10.13.41	verbatimWidth	302
10.13.42	widthOfDash	302
10.13.43	textWidth	303
10.13.44	totalWidth	307
10.13.45	nitExtents	309
10.13.46	nitTitleExtents	309
10.13.47	nitText	310
10.13.48	extHeight	310
10.13.49	extHeight1	310
10.13.50	maxX	313
10.13.51	Kvalue	315
10.13.52	railingSpace	316
10.13.53	insertBitmapFile	316
10.13.54	insertPixmapFile	317
10.13.55	plh	318
10.14	Handling forms	318
10.14.1	computeFormPage	319
10.14.2	windowWidth	319
10.14.3	windowHeight	319
10.14.4	formHeaderExtent	320
10.14.5	formFooterExtent	320
10.14.6	formScrollingExtent	321
10.15	Managing the HyperDoc group stack	321
10.15.1	popGroupStack	321
10.15.2	pushGroupStack	322
10.15.3	initGroupStack	322
10.15.4	emTopGroup	323

10.15.5	rmTopGroup	323
10.15.6	lineTopGroup	323
10.15.7	bfTopGroup	324
10.15.8	ttTopGroup	324
10.15.9	pushActiveGroup	324
10.15.10	pushSpadGroup	325
10.15.11	initTopGroup	325
10.15.12	enterTopGroup	325
10.15.13	copyGroupStack	326
10.15.14	freeGroupStack	326
10.16	Handle input, output, and Axiom communication	327
10.16.1	makeRecord	327
10.16.2	verifyRecord	327
10.16.3	ht2Input	328
10.16.4	makeInputFileName	328
10.16.5	makePasteFileName	329
10.16.6	makeTheInputFile	329
10.16.7	makeInputFileFromPage	330
10.16.8	strCopy	331
10.16.9	inListAndNewer	332
10.16.10	makeInputFileList	333
10.16.11	printPasteLine	333
10.16.12	getSpadOutput	334
10.16.13	getGraphOutput	334
10.16.14	sendCommand	335
10.16.15	printPaste	336
10.16.16	printGraphPaste	336
10.17	X Window window initialization code	337
10.17.1	initializeWindowSystem	337
10.17.2	initTopWindow	339
10.17.3	openFormWindow	340
10.17.4	initFormWindow	341
10.17.5	setNameAndIcon	342
10.17.6	getBorderProperties	342
10.17.7	openWindow	343
10.17.8	setSizeHints	344
10.17.9	getGCs	346
10.17.10	loadFont	347
10.17.11	ingItColorsAndFonts	347
10.17.12	changeText	351
10.17.13	getColor	351
10.17.14	mergeDatabases	352
10.17.15	isIt850	354
10.18	Handling user page interaction	354
10.18.1	fillBox	354
10.18.2	toggleInputBox	355

10.18.3 toggleRadioBox	355
10.18.4 clearRbs	356
10.18.5 changeInputFocus	356
10.18.6 nextInputFocus	357
10.18.7 prevInputFocus	357
10.18.8 returnItem	358
10.18.9 deleteItem	358
10.19 Manipulate the item stack	359
10.19.1 pushItemStack	359
10.19.2 clearItemStack	359
10.19.3 popItemStack	360
10.19.4 copyItemStack	360
10.19.5 freeItemStack	361
10.20 Keyboard handling	361
10.20.1 handleKey	361
10.20.2 getModifierMask	364
10.20.3 initKeyin	365
10.21 Handle page macros	366
10.21.1 scanHyperDoc	366
10.21.2 number	367
10.21.3 loadMacro	367
10.21.4 initParameterElem	369
10.21.5 pushParameters	369
10.21.6 popParameters	370
10.21.7 parseMacro	370
10.21.8 getParameterStrings	371
10.21.9 parseParameters	373
10.22 Memory management routines	374
10.22.1 freeIfNonNULL	374
10.22.2 allocHdWindow	374
10.22.3 freeHdWindow	375
10.22.4 allocNode	375
10.22.5 freeNode	376
10.22.6 allocIfnode	379
10.22.7 allocCondnode	380
10.22.8 freeCond	380
10.22.9 allocPage	380
10.22.10 freePage	381
10.22.11 freePaste	382
10.22.12 freePastebutton	383
10.22.13 freePastearea	383
10.22.14 freeString	384
10.22.15 freeDepend	384
10.22.16 dontFree	384
10.22.17 freeLines	385
10.22.18 freeInputItem	385

10.22.19	freeInputList	385
10.22.20	freeInputBox	386
10.22.21	freeRadioBoxes	386
10.22.22	allocInputline	386
10.22.23	allocPasteNode	387
10.22.24	allocPatchstore	387
10.22.25	freePatch	388
10.22.26	allocInputbox	388
10.22.27	allocRbs	388
10.22.28	allocButtonList	389
10.22.29	freeButtonList	389
10.22.30	resizeBuffer	389
10.23	Page parsing routines	390
10.23.1	PushMR	390
10.23.2	PopMR	390
10.23.3	loadPage	391
10.23.4	displayPage	391
10.23.5	formatPage	392
10.23.6	parseFromString	393
10.23.7	parseTitle	393
10.23.8	parseHeader	394
10.23.9	initParsePage	394
10.23.10	initParsePatch	395
10.23.11	parsePage	395
10.23.12	parseHyperDoc	396
10.23.13	parsePageFromSocket	403
10.23.14	parsePageFromUnixfd	404
10.23.15	startScrolling	405
10.23.16	startFooter	405
10.23.17	endAPage	406
10.23.18	parseReplacepage	407
10.23.19	windowEqual	407
10.23.20	windowCode	407
10.23.21	windowId	407
10.23.22	readHtDb	408
10.23.23	readHtFile	409
10.23.24	makeLinkWindow	412
10.23.25	makePasteWindow	414
10.23.26	makeSpecialPage	414
10.23.27	main	415
10.23.28	addDependencies	415
10.23.29	Number	416
10.23.30	parserError	417
10.23.31	getFilename	417
10.23.32	getInputString	418
10.23.33	getWhere	419

10.23.34	findFp	419
10.24	Handle InputString, SimpleBox, RadioBox input	420
10.24.1	makeInputWindow	420
10.24.2	makeBoxWindow	421
10.24.3	initializeDefault	421
10.24.4	parseInputstring	422
10.24.5	parseSimplebox	424
10.24.6	parseRadiobox	425
10.24.7	addBoxToRbList	427
10.24.8	checkOthers	428
10.24.9	insertItem	428
10.24.10	initPasteItem	429
10.24.11	repasteItem	429
10.24.12	currentItem	430
10.24.13	alreadyThere	430
10.24.14	parseRadioboxes	431
10.25	Routines for paste-in areas	432
10.25.1	parsePaste	432
10.25.2	parsePastebutton	434
10.25.3	parsePatch	435
10.25.4	loadPatch	437
10.26	parsing routines for node types	438
10.26.1	parseIfcond	438
10.26.2	parseCondnode	440
10.26.3	parseHasreturnto	441
10.26.4	parseNewcond	441
10.26.5	parseSetcond	441
10.26.6	parseBeginItems	442
10.26.7	parseItem	443
10.26.8	parseMitem	443
10.26.9	parseVerbatim	444
10.26.10	parseInputPix	445
10.26.11	parseCenterline	446
10.26.12	parseCommand	446
10.26.13	parseButton	447
10.26.14	parseSpadcommand	448
10.26.15	parseSpadsrc	449
10.26.16	parseEnv	449
10.26.17	parseValue1	450
10.26.18	parseValue2	451
10.26.19	parseTable	451
10.26.20	parseBox	452
10.26.21	parseMbox	453
10.26.22	parseFree	453
10.26.23	parseHelp	454
10.27	Reading bitmaps	454

10.27.1	HTReadBitmapFile	454
10.27.2	readHot	457
10.27.3	readWandH	457
10.27.4	insertImageStruct	458
10.28	Scrollbar handling routines	458
10.28.1	makeScrollBarWindows	459
10.28.2	drawScroller3DEffects	461
10.28.3	showScrollBars	462
10.28.4	moveScroller	463
10.28.5	drawScrollLines	463
10.28.6	calculateScrollBarMeasures	464
10.28.7	linkScrollBars	465
10.28.8	scrollUp	466
10.28.9	scrollUpPage	467
10.28.10	scrollToFirstPage	467
10.28.11	scrollDown	467
10.28.12	scrollDownPage	468
10.28.13	scrollScroller	468
10.28.14	hideScrollBars	469
10.28.15	getScrollBarMinimumSize	470
10.28.16	h	470
10.28.17	changeWindowBackgroundPixmap	470
10.29	Display text object	471
10.29.1	showText	471
10.29.2	showLink	476
10.29.3	showPaste	477
10.29.4	showPastebutton	478
10.29.5	showInput	478
10.29.6	showSimpleBox	479
10.29.7	showSpadcommand	479
10.29.8	showImage	480
10.30	Axiom communication interface	481
10.30.1	issueSpadcommand	481
10.30.2	sendPile	482
10.30.3	issueDependentCommands	483
10.30.4	markAsExecuted	484
10.30.5	startUserBuffer	484
10.30.6	clearExecutionMarks	485
10.30.7	acceptMenuConnection	486
10.30.8	acceptMenuServerConnection	487
10.30.9	printToString	488
10.30.10	printToString1	488
10.30.11	issueServerCommand	493
10.30.12	issueServerpaste	494
10.30.13	issueUnixcommand	495
10.30.14	issueUnixlink	495

10.30.15	IssueUnixpaste	496
10.30.16	ServiceSessionSocket	496
10.30.17	SwitchFrames	497
10.30.18	SendLispCommand	497
10.30.19	EscapeString	497
10.30.20	UnescapeString	498
10.30.21	CloseClient	498
10.30.22	PrintSourceToString	499
10.30.23	PrintSourceToString1	499
10.31	Produce titlebar	507
10.31.1	makeTitleBarWindows	507
10.31.2	showTitleBar	508
10.31.3	linkTitleBarWindows	509
10.31.4	readTitleBarImages	510
10.31.5	getTitleBarMinimumSize	511
10.31.6	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
14	Makefile	531

Volume 7.1: Axiom Hyperdoc

1	Release Notes	1
1.1	releasenotes.ht	1
1.1.1	What is new in Axiom	1
1.1.2	Online Information	3
1.1.3	March 2012 Release Notes	4
1.1.4	January 2012 Release Notes	6
1.1.5	November 2011 Release Notes	9
1.1.6	September 2011 Release Notes	12
1.1.7	July 2011 Release Notes	15
1.1.8	May 2011 Release Notes	16
1.1.9	March 2011 Release Notes	19
1.1.10	January 2011 Release Notes	21
1.1.11	November 2010 Release Notes	24
1.1.12	September 2010 Release Notes	26
1.1.13	July 2010 Release Notes	29
1.1.14	May 2010 Release Notes	32
1.1.15	March 2010 Release Notes	37
1.1.16	January 2010 Release Notes	40
1.1.17	November 2009 Release Notes	42
1.1.18	September 2009 Release Notes	45
1.1.19	July 2009 Release Notes	47
1.1.20	May 2009 Release Notes	49
1.1.21	March 2009 Release Notes	54
1.1.22	January 2009 Release Notes	60
1.1.23	November 23, 2008 Release Notes	65
1.1.24	September 23, 2008 Release Notes	67
1.1.25	July 23, 2008 Release Notes	70
1.1.26	May 27, 2008 Release Notes	74
1.1.27	March 25, 2008 Release Notes	75
1.1.28	January 25, 2008 Release Notes	78
1.1.29	November 23, 2007 Release Notes	84
1.1.30	Feature Complete Release Feb 2005	88
2	Special hyperdoc pages	91
2.1	util.ht	91
2.1.1	Names of software and facilities	91
2.1.2	Special hooks to Unix	91
2.1.3	HyperDoc menu macros	92
2.1.4	Bitmaps and bitmap manipulation macros	93
2.1.5	HyperDoc button objects	94
2.1.6	Standard HyperDoc button configurations	94
2.1.7	HyperDoc graphics macros	94
2.1.8	TeX and LaTeX compatibility macros	95

2.1.9	Book and .ht page macros	97
2.1.10	Browse macros	100
2.1.11	Support for output and graph paste-ins	101
2.1.12	Hook for including a local menu item on the rootpage	101
2.1.13	Not Connected to Axiom	102
2.1.14	Do You Really Want to Exit?	102
2.1.15	Missing Page	102
2.1.16	Something is Wrong	103
2.1.17	Sorry!	103
3	Hyperdoc pages	105
3.1	rootpage.ht	105
3.1.1	Axiom HyperDoc Top Level	105
3.1.2	Axiom – The Scientific Computation System	107
3.1.3	System Commands	108
3.1.4	Axiom Examples	109
3.1.5	Axiom Reference	111
3.1.6	NAG Documentation	113
3.2	algebra.ht	119
3.2.1	Abstract Algebra	119
3.2.2	Number Theory	120
3.3	alist.ht	120
3.3.1	AssociationList	120
3.4	array1.ht	126
3.4.1	OneDimensionalArray	126
3.5	array2.ht	131
3.5.1	TwoDimensionalArray	131
3.6	basic.ht	143
3.6.1	Basic Commands	143
3.6.2	Calculus	144
3.7	bbtree.ht	145
3.7.1	BalancedBinaryTree	145
3.8	binary.ht	151
3.8.1	BinaryExpansion	151
3.9	bmcat.ht	156
3.9.1	Bit Map Catalog	156
3.10	bop.ht	157
3.10.1	BasicOperator	157
3.11	bstree.ht	166
3.11.1	BinarySearchTree	166
3.12	card.ht	173
3.12.1	CardinalNumber	173
3.13	carten.ht	183
3.13.1	CartesianTensor	183
3.14	cclass.ht	209
3.14.1	CharacterClass	209

3.15	char.ht	216
3.15.1	Character	216
3.15.2	CliffordAlgebra	222
3.15.3	The Complex Numbers as a Clifford Algebra	223
3.15.4	The Quaternion Numbers as a Clifford Algebra	227
3.15.5	The Exterior Algebra on a Three Space	232
3.15.6	The Dirac Spin Algebra	238
3.16	complex.ht	242
3.16.1	Complex	242
3.17	contfrac.ht	250
3.17.1	ContinuedFraction	250
3.18	cphelp.ht	267
3.18.1	Control Panel Bits	267
3.19	cycles.ht	267
3.19.1	CycleIndicators	267
3.20	coverex.ht	292
3.20.1	Examples Of Axiom Commands	292
3.20.2	Differentiation	293
3.20.3	Integration	298
3.20.4	Laplace Transforms	305
3.20.5	Limits	308
3.20.6	Matrices	313
3.20.7	2-D Graphics	321
3.20.8	3-D Graphics	323
3.20.9	Series	325
3.20.10	Summations	330
3.21	decimal.ht	336
3.21.1	Decimal Expansion	336
3.22	derham.ht	340
3.22.1	DeRhamComplex	340
3.23	dfloat.ht	357
3.23.1	DoubleFloat	357
3.24	dmp.ht	363
3.24.1	DistributedMultivariatePoly	363
3.25	eq.ht	368
3.25.1	Equation	368
3.26	eqtbl.ht	374
3.26.1	EqTable	374
3.27	evalex.ht	377
3.27.1	Example of Standard Evaluation	377
3.27.2	Example of Standard Evaluation	378
3.28	exdiff.ht	379
3.28.1	Computing Derivatives	379
3.28.2	Derivatives of Functions of Several Variables	380
3.28.3	Derivatives of Higher Order	381
3.28.4	Multiple Derivatives I	382

3.28.5	Multiple Derivatives II	384
3.28.6	Derivatives of Functions Involving Formal Integrals	384
3.28.7	Exit	386
3.29	exlap.ht	390
3.29.1	Laplace transform with a single pole	390
3.29.2	Laplace transform of a trigonometric function	390
3.29.3	Laplace transform requiring a definite integration	391
3.29.4	Laplace transform of exponentials	392
3.29.5	Laplace transform of an exponential integral	393
3.29.6	Laplace transform of special functions	394
3.30	exint.ht	394
3.30.1	Integral of a Rational Function	394
3.30.2	Integral of a Rational Function with a Real Parameter	397
3.30.3	Integral of a Rational Function with a Complex Parameter	398
3.30.4	Two Similar Integrands Producing Very Different Results	398
3.30.5	An Integral Which Does Not Exist	400
3.30.6	A Trigonometric Function of a Quadratic	401
3.30.7	Integrating a Function with a Hidden Algebraic Relation	402
3.30.8	Details for integrating a function with a Hidden Algebraic Relation	403
3.30.9	An Integral Involving a Root of a Transcendental Function	404
3.30.10	An Integral of a Non-elementary Function	405
3.31	exlimit.ht	405
3.31.1	Computing Limits	405
3.31.2	Limits of Functions with Parameters	406
3.31.3	One-sided Limits	407
3.31.4	Two-sided Limits	408
3.31.5	Limits at Infinity	410
3.31.6	Real Limits vs. Complex Limits	411
3.31.7	Complex Limits at Infinity	412
3.32	exmatrix.ht	414
3.32.1	Basic Arithmetic Operations on Matrices	414
3.32.2	Constructing new Matrices	417
3.32.3	Trace of a Matrix	421
3.32.4	Determinant of a Matrix	421
3.32.5	Inverse of a Matrix	422
3.32.6	Rank of a Matrix	423
3.33	expr.ht	424
3.33.1	Expression	424
3.34	explot2d.ht	437
3.34.1	Plotting Functions of One Variable	437
3.34.2	Plotting Parametric Curves	437
3.34.3	Plotting Using Polar Coordinates	438
3.34.4	Plotting Plane Algebraic Curves	439
3.35	explot3d.ht	439
3.35.1	Plotting Functions of Two Variables	439
3.35.2	Plotting Parametric Surfaces	440

3.35.3	Plotting Parametric Curves	441
3.36	expose.ht	442
3.36.1	Exposure	442
3.36.2	System Defined Exposure Groups	443
3.36.3	What is an Exposure Group?	444
3.36.4	Details on Exposure	445
3.37	exseries.ht	445
3.37.1	Converting Expressions to Series	445
3.37.2	Manipulating Power Series	447
3.37.3	Functions on Power Series	449
3.37.4	Substituting Numerical Values in Power Series	450
3.38	exsum.ht	452
3.38.1	Summing the Entries of a List I	452
3.38.2	Summing the Entries of a List II	453
3.38.3	Approximating e	454
3.38.4	Closed Form Summations	455
3.38.5	Sums of Cubes	456
3.38.6	Sums of Polynomials	458
3.38.7	Sums of General Functions	459
3.38.8	Infinite Sums	460
3.39	farray.ht	460
3.39.1	FlexibleArray	460
3.40	file.ht	468
3.40.1	File	468
3.41	float.ht	475
3.41.1	Float	475
3.41.2	Introduction to Float	476
3.41.3	Conversion Functions	478
3.41.4	Output Functions	486
3.41.5	An Example: Determinant of a Hilbert Matrix	490
3.41.6	Expanding Factored Objects	509
3.41.7	Arithmetic with Factored Objects	511
3.41.8	Creating New Factored Objects	518
3.41.9	Factored Objects with Variables	522
3.42	fr2.ht	525
3.42.1	FactoredFunctions2	525
3.43	frac.ht	529
3.43.1	Fraction	529
3.44	fparfrac.ht	535
3.44.1	FullPartialFracExpansion	535
3.45	function.ht	546
3.45.1	Functions in Axiom	546
3.45.2	Rational Functions	547
3.45.3	Algebraic Functions	550
3.45.4	Elementary Functions	553
3.45.5	Simplification	554

3.46	gbf.ht	561
3.46.1	GroebnerFactorizationPkg	561
3.47	gloss.ht	565
3.47.1	Glossary	565
3.48	graphics.ht	587
3.48.1	Graphics	587
3.48.2	Graphics Examples	588
3.48.3	Assorted Graphics Examples	589
3.48.4	Three Dimensional Graphics	591
3.48.5	Functions of One Variable	596
3.48.6	Parametric Curves	598
3.48.7	Polar Coordinates	600
3.48.8	Implicit Curves	602
3.48.9	Lists of Points	605
3.48.10	Two Dimensional Graphics	628
3.48.11	Functions of One Variable	629
3.48.12	Parametric Curves	631
3.48.13	Polar Coordinates	634
3.48.14	Implicit Curves	636
3.48.15	Lists of Points	637
3.48.16	Representation Theory	669
3.48.17	Group Theory	670
3.49	gstbl.ht	671
3.49.1	GeneralSparseTable	671
3.50	heap.ht	675
3.50.1	Heap	675
3.51	hexadec.ht	677
3.51.1	HexadecimalExpansion	677
3.52	int.ht	681
3.52.1	Integer	681
3.52.2	Basic Functions	683
3.52.3	Primes and Factorization	697
3.52.4	Some Number Theoretic Functions	701
3.53	intheory.ht	707
3.53.1	IntegerNumberTheoryFunctions	707
3.54	kafle.ht	719
3.54.1	KeyedAccessFile	719
3.55	kernel.ht	728
3.55.1	Kernel	728
3.56	lzm3pk.ht	737
3.56.1	LazardSetSolvingPackage	737
3.57	lexp.ht	763
3.57.1	LieExponentials	763
3.58	lextripk.ht	769
3.58.1	LexTriangularPackage	769
3.59	lib.ht	825

3.59.1	Library	825
3.60	link.ht	829
3.60.1	The Axiom Link to NAG Software	829
3.60.2	Use of the Link from HyperDoc	830
3.60.3	C02 Zeros of Polynomials	831
3.60.4	C05 Roots of One or More Transcendental Equations	832
3.60.5	C06 Summation of Series	832
3.60.6	D01 Quadrature	834
3.60.7	D02 Ordinary Differential Equations	836
3.60.8	D03 Partial Differential Equations	837
3.60.9	E01 Interpolation	838
3.60.10	E02 Curve and Surface Fitting	839
3.60.11	E04 Minimizing or Maximizing a Function	841
3.60.12	F01 Matrix Operations - Including Inversion	842
3.60.13	F02 Eigenvalues and Eigenvectors	843
3.60.14	F04 Simultaneous Linear Equations	845
3.60.15	F07 Linear Equations (LAPACK)	847
3.60.16	S – Approximations of Special Functions	848
3.61	list.ht	851
3.61.1	List	851
3.61.2	Creating Lists	852
3.61.3	Accessing List Elements	854
3.61.4	Changing List Elements	860
3.61.5	Other Functions	864
3.61.6	Dot, Dot	867
3.62	lodo.ht	869
3.62.1	LinearOrdinaryDifferentialOperator	869
3.62.2	Differential Operators with Series Coefficients	869
3.63	lodo1.ht	879
3.63.1	LinearOrdinaryDifferentialOperator1	879
3.63.2	Differential Operators with Rational Function Coefficients	880
3.64	lodo2.ht	890
3.64.1	LinearOrdinaryDifferentialOperator2	890
3.64.2	Differential Operators with Constant Coefficients	891
3.64.3	Differential Operators with Matrix Coefficients Operating on Vectors	896
3.65	lpoly.ht	905
3.65.1	LiePolynomial	905
3.66	magma.ht	926
3.66.1	Magma	926
3.67	man0.ht	936
3.67.1	Reference Search	936
3.67.2	Lisp Functions	937
3.67.3	Axiom Browser	947
3.67.4	The Hyperdoc Browse Facility	948
3.68	mapping.ht	949
3.68.1	Domain Mapping (T,S,...)	949

3.68.2	Domain Constructor Mapping	949
3.69	mappkg1.ht	950
3.69.1	MappingPackage1	950
3.70	mset.ht	963
3.70.1	MultiSet	963
3.71	matrix.ht	968
3.71.1	Matrix	968
3.71.2	Creating Matrices	969
3.71.3	Operations on Matrices	981
3.72	mkfunc.ht	991
3.72.1	MakeFunction	991
3.73	mpoly.ht	996
3.73.1	MultivariatePolynomial	996
3.74	newuser.ht	1002
3.74.1	No More Help :-)	1002
3.74.2	You Tried It!	1003
3.75	none.ht	1003
3.75.1	None	1003
3.76	numbers.ht	1006
3.76.1	Axiom Number Types	1006
3.76.2	Fraction	1008
3.76.3	Rational Number	1010
3.76.4	Integers	1014
3.76.5	Integer Examples	1019
3.76.6	Integer Example Proof	1021
3.76.7	Integer Problems	1022
3.76.8	Integer Problem Proof	1023
3.76.9	Solution to Problem #1	1023
3.76.10	Solution to Problem #2	1027
3.77	oct.ht	1029
3.77.1	Octonion	1029
3.78	odpol.ht	1038
3.78.1	OrderlyDifferentialPolynomial	1038
3.79	op.ht	1056
3.79.1	Operator	1056
3.80	ovar.ht	1067
3.80.1	OrderedVariableList	1067
3.81	perman.ht	1070
3.81.1	Permanent	1070
3.82	pfr.ht	1073
3.82.1	PartialFraction	1073
3.83	poly.ht	1080
3.83.1	Polynomials	1080
3.83.2	The Specific Polynomial Types	1081
3.83.3	Basic Operations On Polynomials	1082
3.83.4	Polynomial Evaluation and Substitution	1089

3.83.5	Greatest Common Divisors, Resultants, and Discriminants	1093
3.83.6	Roots of Polynomials	1095
3.84	poly1.ht	1095
3.84.1	Polynomial	1095
3.85	quat.ht	1119
3.85.1	Quaternion	1119
3.86	radix.ht	1125
3.86.1	RadixExpansion	1125
3.87	reclos.ht	1134
3.87.1	RealClosure	1134
3.88	sregset.ht	1229
3.88.1	SquareFreeRegularTriangularSet	1229
3.89	stbl.ht	1241
3.89.1	SparseTable	1241
3.90	stream.ht	1245
3.90.1	Stream	1245
3.91	string.ht	1251
3.91.1	String	1251
3.92	strtbl.ht	1266
3.92.1	StringTable	1266
3.93	symbol.ht	1269
3.93.1	Symbol	1269
3.94	table.ht	1280
3.94.1	Table	1280
3.95	textfile.ht	1289
3.95.1	TextFile	1289
3.96	topics.ht	1295
3.96.1	Axiom Topics	1295
3.96.2	Solving Equations	1297
3.96.3	Linear Algebra	1298
3.96.4	Calculus	1300
3.97	type.ht	1301
3.97.1	Category Type	1301
3.98	union.ht	1301
3.98.1	Domain Union(a:A,...,b:B)	1301
3.98.2	Domain Constructor Union	1302
3.98.3	Domain Union(A,...,B)	1303
3.98.4	Domain Constructor Union	1304
3.99	uniseg.ht	1304
3.99.1	UniversalSegment	1304
3.100up	ht	1309
3.100.1	UnivariatePolynomial	1309
3.101oreup	ht	1327
3.101.1	UnivariateSkewPolynomial	1327
3.102vector	ht	1333
3.102.1	Vector	1333

3.103void.ht	1339
3.103.1 Void	1339
3.104wutset.ht	1342
3.104.1 WuWenTsunTriangularSet	1342
3.105xmpexp.ht	1351
3.105.1 Some Examples of Domains and Packages	1351
3.106xpbwpoly.ht	1356
3.106.1 XPBWPolynomial	1356
3.107xpoly.ht	1377
3.107.1 XPolynomial	1377
3.108xpr.ht	1384
3.108.1 XPolynomialRing	1384
3.109zlindep.ht	1445
3.109.1 IntegerLinearDependence	1445
4 Users Guide Pages (ug.ht)	1451
4.0.2 Users Guide	1452
5 Users Guide Chapter 0 (ug00.ht)	1455
5.0.3 What's New for May 2008	1455
5.0.4 New polynomial domains and algorithms	1456
5.0.5 Enhancements to HyperDoc and Graphics	1457
5.0.6 Enhancements to NAGLink	1458
5.0.7 Enhancements to the Lisp system	1458
6 Users Guide Chapter 1 (ug01.ht)	1465
6.0.8 An Overview of Axiom	1465
6.0.9 Starting Up and Winding Down	1466
6.0.10 Clef	1469
6.0.11 Typographic Conventions	1470
6.0.12 The Axiom Language	1471
6.0.13 Arithmetic Expressions	1472
6.0.14 Previous Results	1474
6.0.15 Some Types	1476
6.0.16 Symbols, Variables, Assignments, and Declarations	1479
6.0.17 Conversion	1485
6.0.18 Calling Functions	1487
6.0.19 Some Predefined Macros	1490
6.0.20 Long Lines	1491
6.0.21 Comments	1492
6.0.22 Graphics	1492
6.0.23 Numbers	1495
6.0.24 Data Structures	1514
6.0.25 Expanding to Higher Dimensions	1530
6.0.26 Writing Your Own Functions	1535
6.0.27 Solution of Equations	1583

6.0.28	Records	1625
6.0.29	Subdomains Again	1656
6.0.30	Package Calling and Target Types	1663
6.0.31	Resolving Types	1672
6.0.32	Exposing Domains and Packages	1675
6.0.33	Commands for Snooping	1679
7	Users Guide Chapter 3 (ug03.ht)	1685
7.0.34	Using Hyperdoc	1685
7.0.35	Headings	1686
7.0.36	Key Definitions	1687
7.0.37	Scroll Bars	1688
7.0.38	Input Areas	1689
7.0.39	Radio Buttons and Toggles	1691
7.0.40	Search Strings	1692
7.0.41	Logical Searches	1693
7.0.42	Example Pages	1694
7.0.43	X Window Resources for Hyperdoc	1695
8	Users Guide Chapter 4 (ug04.ht)	1699
8.0.44	Input Files and Output Styles	1699
8.0.45	Input Files	1700
8.0.46	The .axiom.input File	1702
8.0.47	Common Features of Using Output Formats	1703
8.0.48	Monospace 2D Mathematical Format	1706
8.0.49	HTML Format	1720
8.0.50	Immediate and Delayed Assignments	1722
8.0.51	Blocks	1730
8.0.52	if-then-else	1739
8.0.53	Loops	1742
8.0.54	Compiling vs. Interpreting Loops	1744
8.0.55	return in Loops	1744
8.0.56	break in Loops	1748
8.0.57	break vs. => in Loop Bodies	1751
8.0.58	More Examples of break	1752
8.0.59	iterate in Loops	1760
8.0.60	while Loops	1761
8.0.61	for Loops	1768
8.0.62	for i in n..m repeat	1769
8.0.63	for i in n..m by s repeat	1773
8.0.64	for i in n.. repeat	1774
8.0.65	for x in l repeat	1775
8.0.66	“Such that” Predicates	1778
8.0.67	Parallel Iteration	1780
8.0.68	Creating Lists and Streams with Iterators	1786

8.0.69	Addendum: Appending a Graph to a Viewport Window Containing a Graph	1985
8.0.70	Three-Dimensional Graphics	1988
8.0.71	Plotting Three-Dimensional Functions of Two Variables	1989
8.0.72	Plotting Three-Dimensional Parametric Space Curves	1991
8.0.73	Plotting 3D Parametric Surfaces	1994
8.0.74	Three-Dimensional Options	1998
8.0.75	The makeObject Command	2008
8.0.76	Building 3D Objects From Primitives	2010
8.0.77	Coordinate System Transformations	2023
8.0.78	Three-Dimensional Clipping	2030
8.0.79	Three-Dimensional Control-Panel	2032
8.0.80	Operations for Three-Dimensional Graphics	2037
8.0.81	Customization using .Xdefaults	2044
9	Users Guide Chapter 8 (ug08.ht)	2047
9.0.82	Advanced Problem Solving	2047
9.0.83	Numeric Functions	2049
9.0.84	Polynomial Factorization	2071
9.0.85	Integer and Rational Number Coefficients	2072
9.0.86	Finite Field Coefficients	2074
9.0.87	Simple Algebraic Extension Field Coefficients	2076
9.0.88	Factoring Rational Functions	2081
9.0.89	Manipulating Symbolic Roots of a Polynomial	2082
9.0.90	Using a Single Root of a Polynomial	2083
9.0.91	Using All Roots of a Polynomial	2087
9.0.92	Computation of Eigenvalues and Eigenvectors	2093
9.0.93	Solution of Linear and Polynomial Equations	2100
9.0.94	Solution of Systems of Linear Equations	2101
9.0.95	Solution of a Single Polynomial Equation	2105
9.0.96	Solution of Systems of Polynomial Equations	2110
9.0.97	Limits	2115
9.0.98	Laplace Transforms	2122
9.0.99	Integration	2127
9.0.100	Working with Power Series	2134
9.0.101	Creation of Power Series	2136
9.0.102	Coefficients of Power Series	2142
9.0.103	Power Series Arithmetic	2145
9.0.104	Functions on Power Series	2148
9.0.105	Converting to Power Series	2156
9.0.106	Power Series from Formulas	2164
9.0.107	Substituting Numerical Values in Power Series	2171
9.0.108	Example: Bernoulli Polynomials and Sums of Powers	2173
9.0.109	Solution of Differential Equations	2181
9.0.110	Closed-Form Solutions of Linear Differential Equations	2182
9.0.111	Closed-Form Solutions of Non-Linear DEs	2190

9.0.112	Power Series Solutions of Differential Equations	2200
9.0.113	Finite Fields	2205
9.0.114	Modular Arithmetic and Prime Fields	2207
9.0.115	Extensions of Finite Fields	2216
9.0.116	Irreducible Mod Polynomial Representations	2219
9.0.117	Cyclic Group Representations	2228
9.0.118	Normal Basis Representations	2234
9.0.119	Conversion Operations for Finite Fields	2242
9.0.120	Utility Operations for Finite Fields	2250
9.0.121	Primary Decomposition of Ideals	2267
9.0.122	Computation of Galois Groups	2276
9.0.123	Non-Associative Algebras and Genetic Laws	2295
10	Users Guide Chapter 10 (ug10.ht)	2307
10.0.124	Interactive Programming	2307
10.0.125	Drawing Ribbons Interactively	2308
10.0.126	A Ribbon Program	2314
10.0.127	Coloring and Positioning Ribbons	2317
10.0.128	Points, Lines, and Curves	2318
10.0.129	Browse	2395
10.0.130	Representation	2396
10.0.131	Multiple Representations	2397
10.0.132	Add Domain	2399
10.0.133	Defaults	2400
10.0.134	Origins	2401
10.0.135	Short Forms	2402
10.0.136	Example 1: Clifford Algebra	2403
10.0.137	Example 2: Building A Query Facility	2406
10.0.138	A Little Query Language	2407
10.0.139	The Database Constructor	2410
10.0.140	Query Equations	2413
10.0.141	DataLists	2414
10.0.142	Index Cards	2415
10.0.143	Creating a Database	2416
10.0.144	Putting It All Together	2417
10.0.145	Example Queries	2418
11	Users Guide Chapter 14 (ug14.ht)	2431
11.0.146	Browse	2431
11.0.147	The Front Page: Searching the Library	2432
11.0.148	The Constructor Page	2434
11.0.149	Constructor Page Buttons	2436
11.0.150	Cross Reference	2438
11.0.151	Views Of Constructors	2442
11.0.152	Giving Parameters to Constructors	2444
11.0.153	Miscellaneous Features of Browse	2445

11.0.154	The Description Page for Operations	2446
11.0.155	Views of Operations	2447
11.0.156	Capitalization Convention	2450
12	Users Guide Chapter 15 (ug15.ht)	2453
12.0.157	What's New in Axiom Version 2.0	2453
12.0.158	Important Things to Read First	2454
12.0.159	The NAG Library Link	2454
12.0.160	Interpreting NAG Documentation	2455
12.0.161	Using the Link	2458
12.0.162	Providing values for Argument Subprograms	2461
12.0.163	General Fortran-generation utilities in Axiom	2465
12.0.164	Some technical information	2490
12.0.165	Interactive Front-end and Language	2491
12.0.166	Library	2492
12.0.167	HyperDoc	2494
12.0.168	Documentation	2495
13	Users Guide Chapter 16 (ug16.ht)	2497
13.0.169	Axiom System Commands	2498
13.0.170	Introduction	2500
13.0.171	abbreviation	2502
13.0.172	boot	2504
13.0.173	cd	2505
13.0.174	close	2506
13.0.175	clear	2507
13.0.176	compile	2509
13.0.177	display	2512
13.0.178	edit	2514
13.0.179	fin	2515
13.0.180	frame	2516
13.0.181	help	2518
13.0.182	history	2519
13.0.183	library	2523
13.0.184	lisp	2525
13.0.185	load	2526
13.0.186	ltrace	2526
13.0.187	pquit	2527
13.0.188	quit	2529
13.0.189	read	2530
13.0.190	set	2531
13.0.191	show	2533
13.0.192	spool	2534
13.0.193	synonym	2535
13.0.194	system	2536
13.0.195	trace	2538

13.0.196	undo	2544
13.0.197	what	2546
14	Users Guide Chapter 21 (ug21.ht)	2549
14.0.198	Programs for Axiom Images	2549
14.0.199	images1.input	2550
14.0.200	images2.input	2551
14.0.201	images3.input	2551
14.0.202	images5.input	2552
14.0.203	images6.input	2554
14.0.204	images7.input	2555
14.0.205	images8.input	2556
14.0.206	conformal.input	2557
14.0.207	knot.input	2561
14.0.208	tube.input	2561
14.0.209	lhtri.input	2564
14.0.210	etra.input	2565
14.0.211	antoine.input	2567
14.0.212	cherk.input	2568
15	Hypertext Language Pages	2571
15.0.213	Creating Hyperdoc Pages	2571
15.1	htxadvpage1.ht	2572
15.1.1	Input Areas	2572
15.1.2	HTXAdvPage1xPatch1 patch	2573
15.1.3	HTXAdvPage1xPatch1A patch	2573
15.1.4	HTXAdvPage1xPatch2 patch	2574
15.1.5	HTXAdvPage1xPatch2A patch	2574
15.2	htxadvpage2.ht	2575
15.2.1	Radio buttons	2575
15.3	htxadvpage3.ht	2578
15.3.1	Macros	2578
15.4	htxadvpage4.ht	2579
15.4.1	Patch and Paste	2579
15.4.2	patch1 patch	2582
15.4.3	Patch1 patch	2582
15.4.4	Patch2 patch	2583
15.5	htxadvpage5.ht	2583
15.5.1	Axiom paste-ins	2583
15.6	htxadvpage6.ht	2586
15.6.1	Miscellaneous	2586
15.6.2	HTXAdvPage6xPatch1 patch	2588
15.6.3	HTXAdvPage6xPatch1A patch	2588
15.6.4	HTXAdvPage6xPatch2 patch	2588
15.6.5	HTXAdvPage6xPatch2A patch	2589
15.6.6	HTXAdvPage6xPatch3 patch	2589

15.6.7 HTXAdvPage6xPatch3A patch	2589
15.7 htxadvtoppage.ht	2590
15.7.1 Advanced features in Hyperdoc	2590
15.8 htxformatpage1.ht	2591
15.8.1 Using the special characters	2591
15.8.2 HTXFormatPage1xPatch1 patch	2592
15.8.3 HTXFormatPage1xPatch2 patch	2592
15.9 htxformatpage2.ht	2593
15.9.1 Formatting without commands	2593
15.9.2 HTXFormatPage2xPatch1 patch	2594
15.9.3 HTXFormatPage2xPatch2 patch	2595
15.9.4 HTXFormatPage2xPatch2A patch	2595
15.9.5 HTXFormatPage2xPatch3 patch	2596
15.9.6 HTXFormatPage2xPatch3A patch	2596
15.9.7 HTXFormatPage2xPatch4 patch	2597
15.9.8 HTXFormatPage2xPatch4A patch	2597
15.10 htxformatpage3.ht	2597
15.10.1 Using different fonts	2597
15.10.2 HTXFormatPage3xPatch1 patch	2599
15.10.3 HTXFormatPage3xPatch2 patch	2600
15.10.4 HTXFormatPage3xPatch3 patch	2600
15.10.5 HTXFormatPage3xPatch4 patch	2601
15.11 htxformatpage4.ht	2601
15.11.1 Indentation	2601
15.11.2 HTXFormatPage4xPatch1 patch	2604
15.11.3 HTXFormatPage4xPatch1A patch	2604
15.11.4 HTXFormatPage4xPatch2 patch	2604
15.11.5 HTXFormatPage4xPatch2A patch	2605
15.11.6 HTXFormatPage4xPatch3 patch	2605
15.11.7 HTXFormatPage4xPatch3A patch	2606
15.11.8 HTXFormatPage4xPatch4 patch	2606
15.11.9 HTXFormatPage4xPatch5 patch	2607
15.11.10 HTXFormatPage4xPatch5A patch	2607
15.12 htxformatpage5.ht	2608
15.12.1 Creating Lists and Tables	2608
15.12.2 HTXFormatPage5xPatch1 patch	2610
15.12.3 HTXFormatPage5xPatch1A patch	2611
15.12.4 HTXFormatPage5xPatch2 patch	2611
15.12.5 HTXFormatPage5xPatch2A patch	2612
15.12.6 HTXFormatPage5xPatch3 patch	2612
15.12.7 HTXFormatPage5xPatch3A patch	2613
15.13 htxformatpage6	2613
15.13.1 Boxes and Lines	2613
15.13.2 HTXFormatPage6xPatch1 patch	2614
15.13.3 HTXFormatPage6xPatch2 patch	2615
15.14 htxformatpage7	2615

15.14.1 Micro-Spacing	2615
15.14.2 HTXFormatPage7xPatch1 patch	2617
15.14.3 HTXFormatPage7xPatch2 patch	2618
15.14.4 HTXFormatPage7xPatch2A patch	2618
15.14.5 HTXFormatPage7xPatch3 patch	2618
15.14.6 HTXFormatPage7xPatch3A patch	2619
15.15htxformatpage8	2620
15.15.1 Bitmaps and Images	2620
15.15.2 HTXFormatPage8xPatch1 patch	2621
15.15.3 HTXFormatPage8xPatch2 patch	2622
15.15.4 HTXFormatPage8xPatch2A patch	2622
15.16htxformattoppage.ht	2622
15.16.1 Formatting in Hyperdoc	2622
15.17htxintropage1.ht	2623
15.17.1 What Hyperdoc does	2623
15.18htxintropage2.ht	2624
15.18.1 How Hyperdoc does it	2624
15.19htxintropage3.ht	2626
15.19.1 A simple text page	2626
15.20htxintrotoppage.ht	2628
15.20.1 First Steps	2628
15.21htxlinkpage1.ht	2629
15.21.1 Linking to a named page	2629
15.21.2 HTXLinkPage1xPatch1 patch	2631
15.21.3 HTXLinkPage1xPatch1A patch	2631
15.21.4 Test Help Page	2632
15.22htxlinkpage2.ht	2632
15.22.1 Standard Pages	2632
15.22.2 HTXLinkPage2xPatch1 patch	2634
15.22.3 HTXLinkPage2xPatch1A patch	2634
15.23htxlinkpage3.ht	2635
15.23.1 Active Axiom commands	2635
15.23.2 HTXLinkPage3xPatch1 patch	2638
15.23.3 HTXLinkPage3xPatch1A patch	2639
15.23.4 HTXLinkPage3xPatch2 patch	2639
15.23.5 HTXLinkPage3xPatch2A patch	2639
15.23.6 HTXLinkPage3xPatch3 patch	2640
15.23.7 HTXLinkPage3xPatch3A patch	2640
15.24htxlinkpage4.ht	2641
15.24.1 Linking to Lisp	2641
15.24.2 HTXLinkPage4xPatch1 patch	2645
15.24.3 HTXLinkPage4xPatch1A patch	2646
15.24.4 HTXLinkPage4xPatch2 patch	2646
15.24.5 HTXLinkPage4xPatch2A patch	2646
15.24.6 HTXLinkPage4xPatch3 patch	2647
15.24.7 HTXLinkPage4xPatch3A patch	2647

15.24.8 HTXLinkPage4xPatch4 patch	2648
15.24.9 HTXLinkPage4xPatch4A patch	2648
15.24.10 HTXLinkPage4xPatch5 patch	2648
15.24.1 HTXLinkPage4xPatch5A patch	2649
15.25 htxlinkpage5.ht	2650
15.25.1 Linking to Unix	2650
15.25.2 HTXLinkPage5xPatch1 patch	2651
15.25.3 HTXLinkPage5xPatch1A patch	2652
15.25.4 HTXLinkPage5xPatch2 patch	2652
15.25.5 HTXLinkPage5xPatch2A patch	2652
15.26 htxlinkpage6.ht	2653
15.26.1 How to use your pages with Hyperdoc	2653
15.26.2 HTXLinkPage6xPatch1 patch	2655
15.26.3 HTXLinkPage6xPatch1A patch	2657
15.26.4 HTXLinkPage6xPatch2 patch	2657
15.26.5 HTXLinkPage6xPatch2A patch	2658
15.27 htxlinktoppage.ht	2658
15.27.1 Actions in Hyperdoc	2658
15.28 htxtoppage.ht	2659
15.28.1 Extending Hyperdoc	2659
15.29 htxtrypage.ht	2660
15.29.1 Try out Hyperdoc	2660

16 NAG Library Routines

2663

16.1 nagaux.ht	2663
16.1.1 NAG On-line Documentation	2663
16.1.2 NAG Documentation: summary	2665
16.1.3 NAG Documentation: introduction	2687
16.1.4 NAG Documentation: keyword in context	2704
16.1.5 NAG Documentation: conversion	2802
16.2 nagc.ht	2805
16.2.1 Zeros of Polynomials	2805
16.2.2 Roots of a complex polynomial equation	2809
16.2.3 Roots of a real polynomial equation	2814
16.2.4 Roots of One or More Transcendental Equations	2820
16.2.5 Zero of a continuous function in a given interval	2824
16.2.6 Solution of a system of nonlinear equations	2828
16.2.7 Solution of a system of nonlinear equations	2832
16.2.8 Checks the gradients of a set of non-linear functions	2838
16.2.9 Discrete Fourier transform of real or complex data values	2841
16.2.10 Discrete Fourier transform of n real data values	2849
16.2.11 Discrete Fourier transform of a Hermitian sequence	2852
16.2.12 Discrete Fourier transform of n complex data values	2856
16.2.13 Circular convolution or correlation of two real vectors	2859
16.2.14 Discrete Fourier transforms of m sequences	2863
16.2.15 Discrete Fourier transforms of m Hermitian sequences	2868

16.2.16	Discrete Fourier transforms of m complex sequences	2872
16.2.17	Discrete Fourier transform of bivariate complex data	2876
16.2.18	Summation of Series	2881
16.2.19	Complex conjugate of a sequence of n data values	2883
16.2.20	Complex conjugates of m Hermitian sequences	2885
16.2.21	Form real and imaginary parts of m Hermitian sequences	2887
16.3	nagd.ht	2890
16.3.1	Quadrature	2890
16.3.2	Approximation of the integral over a finite interval	2903
16.3.3	Adaptive integration over a finite interval	2909
16.3.4	Approximate integration with local singular points	2915
16.3.5	Approximate integration over a (semi-)infinite interval	2921
16.3.6	Approximate sine or cosine transform over finite interval	2927
16.3.7	Adaptive integration of weighted function over an interval	2933
16.3.8	Hilbert transform over finite interval	2939
16.3.9	Approximate Sine or Cosine over $[a, \infty]$	2945
16.3.10	Weights and abscissae for Gaussian quadrature formula	2952
16.3.11	Multidimensional integrals with finite limits	2958
16.3.12	Third-order finite-difference integration	2963
16.3.13	Monte Carlo integration over hyper-rectangular regions	2966
16.3.14	Ordinary Differential Equations	2971
16.3.15	First-order ODE over an interval with initial conditions	2978
16.3.16	First-order ODE with initial conditions and user function	2986
16.3.17	First-order ODE with variable-order, variable-step	2994
16.3.18	Stiff First-order ODE with variable order and step	3003
16.3.19	Two-point boundary-value ODE	3012
16.3.20	Two-point boundary value ODE with deferred correction	3019
16.3.21	Eigenvalue of regular singular 2nd-order Sturm-Liouville	3027
16.3.22	Two-point boundary-value ODE equation systems	3050
16.3.23	Partial differential equations	3064
16.3.24	Discrete elliptic PDE on rectangular region	3071
16.3.25	Discrete 2nd-order elliptic PDE on rectangular regions	3079
16.3.26	Helmholtz equation in 3 dimensions	3092
16.4	nage.ht	3102
16.4.1	Interpolation	3102
16.4.2	Cubic spline interpolant	3107
16.4.3	Monotonicity-preserving piecewise cubic Hermite interpolant	3112
16.4.4	Piecewise cubic Hermite interpolant	3115
16.4.5	Piecewise cubic Hermite interpolant and 1st deriv	3118
16.4.6	Definite integral of piecewise cubic Hermite interpolant	3121
16.4.7	Bicubic spline interpolated surface	3123
16.4.8	Two-D surface interpolating a set of scattered data points	3130
16.4.9	Evaluate 2D interpolant function from E01SAF	3133
16.4.10	Generate 2D surface interpolating a scattered data points	3136
16.4.11	Evaluate 2D interpolating function from E01SEF	3142
16.4.12	Curve and Surface Fitting	3145

16.4.13	Least-squares polynomial approximations	3170
16.4.14	Evaluate polynomial from Chebyshev-series representation	3176
16.4.15	Constrained weighted least-squares polynomial	3180
16.4.16	Coefficients of polynomial derivative	3188
16.4.17	Find coefficients of indefinite integral of polynomial	3193
16.4.18	Evaluate polynomial in Chebyshev-series representation	3198
16.4.19	Weighted least-squares approx to data points	3203
16.4.20	Evaluates a cubic spline from its B-spline representation	3210
16.4.21	Evaluate cubic spline and 3 derivatives from B-spline	3214
16.4.22	Definite integral of cubic spline from B-spline	3219
16.4.23	Cubic spline approximation to an arbitrary set points	3223
16.4.24	Minimal, weighted least-squares bicubic spline fit	3232
16.4.25	Bicubic spline approximation to a set of data values	3241
16.4.26	Bicubic spline approximation to a set of scattered data	3252
16.4.27	Calculates values of a bicubic spline from B-spline	3264
16.4.28	Calculates values of a bicubic spline from B-spline	3268
16.4.29	Calculates l_1 solution to over-determined system equations	3272
16.4.30	Sorts two-dimensional data into rectangular panels	3278
16.4.31	Minimizing or Maximizing a Function	3282
16.4.32	Minimizes a nonlinear function of several variable	3307
16.4.33	Supply optional parameters to E04DGF from file	3322
16.4.34	Supply individual optional params to E04DGF	3325
16.4.35	Finding an unconstrained minimum of a sum of squares	3327
16.4.36	Finding an unconstrained minimum of a sum of squares	3333
16.4.37	Finding a minimum of a function	3340
16.4.38	Solving linear programming problems	3346
16.4.39	Solving linear or quadratic problems	3355
16.4.40	Minimize an arbitrary smooth constrained function	3375
16.4.41	Supply optional parameters to E04UCF from file	3426
16.4.42	Supply individual optional params to E04UCF	3429
16.4.43	Estimates of elements of the variance-covariance matrix	3432
16.5	nagf.ht	3438
16.5.1	Linear Algebra	3438
16.5.2	Matrix Factorization	3442
16.5.3	Factorizes a real sparse matrix	3445
16.5.4	Factorizes a real sparse matrix	3455
16.5.5	Incomplete Cholesky factorization	3461
16.5.6	Cholesky factor of a symmetric positive-definite matrix	3468
16.5.7	QR factorization of the real m by n matrix A	3473
16.5.8	$B := QB$ or $B := Q^T B$	3478
16.5.9	First ncolq columns of the real m by m orthogonal matrix	3483
16.5.10	QR factorization of the complex m by n matrix A	3487
16.5.11	$B := QB$ or $B := Q^H B$	3492
16.5.12	First ncolq columns of the complex m by m unitary matrix	3498
16.5.13	Eigenvalues and Eigenvectors	3503
16.5.14	Calculates all the eigenvalues of a real symmetric matrix	3509

16.5.15	Eigenvalues and eigenvectors of a real symmetric matrix	3511
16.5.16	Calculates all the eigenvalues of $Ax = \lambda Bx$	3514
16.5.17	Eigenvalues and eigenvectors of $Ax = \lambda Bx$	3517
16.5.18	Calculates all the eigenvalues of a real unsymmetric matrix	3521
16.5.19	Eigenvalues and eigenvectors of a real unsymmetric matrix	3523
16.5.20	Calculates all the eigenvalues of a complex matrix	3526
16.5.21	Eigenvalues and eigenvectors of a complex matrix	3529
16.5.22	Eigenvalues of a complex Hermitian matrix	3532
16.5.23	Eigenvalues/eigenvectors complex Hermitian matrix	3535
16.5.24	Eigenvalues and eigenvectors of a real symmetric matrix	3538
16.5.25	Eigenvalues of generalized eigenproblem $Ax = \lambda Bx$	3542
16.5.26	Eigenvalues and eigenvectors of real sparse symmetric problem	3547
16.5.27	Singular value decomposition of a general real matrix	3560
16.5.28	Singular value decomposition of a general complex matrix	3568
16.5.29	Simultaneous Linear Equations	3575
16.5.30	Approximate solution of a set of complex linear equations	3581
16.5.31	Approximate solution of a set of real linear equations	3584
16.5.32	Real symmetric positive-definite linear equations	3587
16.5.33	Set of real linear equations with a single right-hand side	3591
16.5.34	Solution of a set of real sparse linear equations	3594
16.5.35	Real symmetric positive-definite tridiagonal linear equations	3597
16.5.36	Solution of a linear least-squares problem, $Ax = b$	3603
16.5.37	Sparse symmetric positive-definite system linear equations	3609
16.5.38	Solves a system of real sparse symmetric linear equations	3615
16.5.39	Solution of a system of real linear equations	3626
16.5.40	Solves sparse unsymmetric equations	3631
16.5.41	Linear Algebra Support Routines	3645
16.5.42	Linear Equations (LAPACK)	3678
16.5.43	Computes the LU factorization of a real m by n matrix	3679
16.5.44	Solves a real system of linear equations	3683
16.5.45	Factorization of a real symmetric positive-definite matrix	3687
16.5.46	Real symmetric positive-definite system of linear equations	3690
16.5.47	Sort vector of double precision numbers	3697
16.5.48	Ranks a vector of double precision numbers	3700
16.5.49	Ranks the rows of a matrix of double precision numbers	3703
16.5.50	Ranks the columns of a matrix of double precision numbers	3706
16.5.51	Rearranges a vector of double precision numbers	3709
16.5.52	Inverts a permutation	3711
16.6	nags.ht	3714
16.6.1	Approximations of Special Functions	3714
16.6.2	Exponential function e^z , for complex z	3727
16.6.3	Returns the value of the exponential integral $E(x)$	3730
16.6.4	Returns the value of the cosine integral	3733
16.6.5	Returns the value of the sine integral	3736
16.6.6	Returns the value of the Gamma function	3739
16.6.7	Returns a value for the logarithm of the Gamma function	3742

16.6.8	Incomplete gamma functions $P(a,x)$ and $Q(a,x)$	3746
16.6.9	Returns the value of the complementary error function	3749
16.6.10	Returns the value of the error function erfx	3753
16.6.11	Returns the value of the Bessel Function $Y_0(x)$	3755
16.6.12	Returns the value of the Bessel Function $Y_1(x)$	3759
16.6.13	Returns the value of the Bessel Function $J_0(x)$	3764
16.6.14	Returns the value of the Bessel Function $J_1(x)$	3768
16.6.15	Returns a value for the Airy function, $Ai(x)$	3771
16.6.16	Returns a value of the Airy function, $Bi(x)$	3776
16.6.17	Value of the derivative of the Airy function $Ai(x)$	3780
16.6.18	Value for the derivative of the Airy function $Bi(x)$	3784
16.6.19	Values for the Bessel functions $Y_{\nu+n}(z)$	3788
16.6.20	Values for the Bessel functions $J_{\nu+n}(z)$	3793
16.6.21	Value of the Airy function $Ai(z)$ or derivative $Ai'(z)$	3798
16.6.22	Value of the Airy function $Bi(z)$ or derivative $Bi'(z)$	3802
16.6.23	Returns a sequence of values for the Hankel functions	3806
16.6.24	Returns the value of the modified Bessel Function $K_0(x)$	3812
16.6.25	Returns the value of the modified Bessel Function $K_1(x)$	3815
16.6.26	Returns the value of the modified Bessel Function $I_0(x)$	3819
16.6.27	Returns a value for the modified Bessel Function $I_1(x)$	3823
16.6.28	Sequence of values for the modified Bessel $K_{\nu_n}(z)$	3826
16.6.29	Sequence of values for the modified Bessel $I_{\nu+n}$	3831
16.6.30	Returns a value for the Kelvin function $\operatorname{ber} x$	3835
16.6.31	Returns a value for the Kelvin function $\operatorname{bei} x$	3839
16.6.32	Returns a value for the Kelvin function $\operatorname{ker} x$	3842
16.6.33	Returns a value for the Kelvin function keix	3846
16.6.34	Returns a value for the Fresnel Integral $S(x)$	3850
16.6.35	Returns a value for the Fresnel Integral $C(x)$	3854
16.6.36	Returns a value of an elementary integral	3859
16.6.37	Value of the symmetrised elliptic integral of first kind	3862
16.6.38	Value of the symmetrised elliptic integral of second kind	3866
16.6.39	Value of the symmetrised elliptic integral of third kind	3871
16.7	<code>nagx.ht</code>	3876
16.7.1	Mathematical Constants	3876
16.7.2	Machine Constants	3877
16.7.3	Input/Output Utilities	3884
16.7.4	Value of the current error message unit number	3886
16.7.5	Value of the current advisory message unit number	3889
16.7.6	Print a real matrix stored in a two-dimensional array	3891
16.7.7	Print a complex matrix stored in a 2D array	3894
16.7.8	Date and Time Utilities	3898
16.7.9	Returns the current date and time	3900
16.7.10	From seven-integer format time and date to character string	3901
16.7.11	Compares two date/time character strings	3904
16.7.12	Amount of processor time used	3907

17 NAG ASP Example Code	3909
17.1 aspex.ht	3909
17.1.1 Asp1 Example Code	3909
17.1.2 Asp10 Example Code	3909
17.1.3 Asp12 Example Code	3910
17.1.4 Asp19 Example Code	3910
17.1.5 Asp20 Example Code	3913
17.1.6 Asp24 Example Code	3913
17.1.7 Asp27 Example Code	3914
17.1.8 Asp28 Example Code	3914
17.1.9 Asp29 Example Code	3917
17.1.10 Asp30 Example Code	3918
17.1.11 Asp31 Example Code	3919
17.1.12 Asp33 Example Code	3919
17.1.13 Asp34 Example Code	3920
17.1.14 Asp35 Example Code	3920
17.1.15 Asp4 Example Code	3921
17.1.16 Asp41 Example Code	3921
17.1.17 Asp42 Example Code	3922
17.1.18 Asp49 Example Code	3923
17.1.19 Asp50 Example Code	3924
17.1.20 Asp55 Example Code	3925
17.1.21 Asp6 Example Code	3926
17.1.22 Asp7 Example Code	3926
17.1.23 Asp73 Example Code	3927
17.1.24 Asp74 Example Code	3927
17.1.25 Asp77 Example Code	3928
17.1.26 Asp78 Example Code	3929
17.1.27 Asp8 Example Code	3929
17.1.28 Asp80 Example Code	3930
17.1.29 Asp9 Example Code	3930
18 NAG ANNA Expert System	3933
18.1 annaex.ht	3933
18.1.1 Axiom/NAG Expert System	3933
18.1.2 Integration	3934
18.1.3 Ordinary Differential Equations	3935
18.1.4 Optimization	3935
18.1.5 Partial Differential Equations	3936
18.1.6 Examples Using the Axiom/NAG Expert System	3937
18.1.7 Examples Using the Axiom/NAG Expert System	3938
18.1.8 Examples Using the Axiom/NAG Expert System	3939
18.1.9 Examples Using the Axiom/NAG Expert System	3941
18.1.10 About the Axiom/NAG Expert System	3942
18.1.11 Introduction to the Axiom/NAG Expert System	3943
18.1.12 Example using the Axiom/NAG Expert System	3944

18.1.13 Example using the Axiom/NAG Expert System	3949
18.1.14 Example using the Axiom/NAG Expert System	3950
18.1.15 Decision Agents	3951
18.1.16 Inference Mechanisms	3952
18.1.17 Method Domains	3953
18.1.18 Measure Functions	3954
18.1.19 Computational Agents	3955
19 ANNA Algebra Code	3957
20 Page hierarchy layout	3959
21 Makefile	3993

Volume 8: Axiom Graphics

1	Overview	1
1.1	Standard Curves and Surfaces	1
1.2	CRC graphs	3
1.3	Environment Settings	4
1.3.1	X11 .Xdefaults	4
1.3.2	Shell Variables	5
1.4	Pre-release change history	5
2	Graphics File Formats	11
2.1	The viewFile data file format	11
2.1.1	The viewType	11
2.1.2	The title	11
2.1.3	The window boundaries	12
2.1.4	The graph specifications	12
2.2	The graph file format	14
2.2.1	The bounding values	14
2.3	The parabola	16
2.4	3D graph information	20
3	include	23
3.1	actions.h	23
3.2	colors.h	27
3.3	component.h	28
3.4	g.h	30
3.5	nox10.h	31
3.6	override.h	32
3.7	rgb.h	33
3.8	spadcolors.h	34
3.9	tube.h	34
3.10	view2d.h	37
3.11	view3d.h	39
3.12	viewcommand.h	41
3.13	view.h	42
3.14	write.h	43
3.15	xdefs.h	44
4	viewman	45
4.1	viewman Call Graph	45
4.2	Constants and Headers	47
4.2.1	defines	47
4.2.2	System includes	48
4.2.3	Local includes	49
4.2.4	extern references	49

4.2.5	forward references	50
4.2.6	global variables	50
4.3	Code	51
4.3.1	endChild	51
4.3.2	rmViewMgr	52
4.3.3	closeChildViewport	53
4.3.4	goodbye	54
4.3.5	funView2D	55
4.3.6	forkView2D	58
4.3.7	sendGraphToView2D	61
4.3.8	funView3D	63
4.3.9	forkView3D	67
4.3.10	makeView2DFromSpadData	70
4.3.11	makeView3DFromSpadData	71
4.3.12	makeGraphFromSpadData	74
4.3.13	discardGraph	75
4.3.14	readViewport	75
4.3.15	superSelect	76
4.3.16	brokenPipe	76
4.3.17	main	77
5	viewalone	81
5.1	viewalone Call Graph	81
5.2	Constants and Headers	82
5.2.1	System includes	82
5.2.2	Local includes	83
5.2.3	defines	83
5.2.4	extern references	84
5.2.5	global variables	85
5.3	Code	86
5.3.1	sendGraphToView2D	86
5.3.2	makeView2DFromFileData	88
5.3.3	makeView3DFromFileData	92
5.3.4	spoonView2D	95
5.3.5	spoonView3D	97
5.3.6	main	100
6	view2d	101
6.1	view2d Call Graph	101
6.2	Constants and Headers	110
6.2.1	System includes	110
6.2.2	local includes	111
6.2.3	static variables	111
6.2.4	structs	111
6.2.5	defines	113
6.2.6	extern references	119

6.2.7	forward references	120
6.2.8	global variables	122
6.3	Code	125
6.3.1	initButtons	125
6.3.2	writeControlTitle	138
6.3.3	makeMessageFromData	139
6.3.4	writeControlMessage	140
6.3.5	drawControlPanel	141
6.3.6	getControlXY	145
6.3.7	makeControlPanel	147
6.3.8	putControlPanelSomewhere	149
6.3.9	clearControlMessage	149
6.3.10	getGraphFromViewman	150
6.3.11	freeGraph	152
6.3.12	mergeDatabases	153
6.3.13	getPotValue	154
6.3.14	doPick	154
6.3.15	doDrop	155
6.3.16	clickedOnGraphSelect	156
6.3.17	drawControlPushButton	157
6.3.18	buttonAction	158
6.3.19	processEvents	164
6.3.20	clickedOnGraph	171
6.3.21	readViewman	172
6.3.22	spadAction	173
6.3.23	absolute	177
6.3.24	goodbye	178
6.3.25	writeTitle	179
6.3.26	drawTheViewport	180
6.3.27	makeViewport	189
6.3.28	makeView2D	191
6.3.29	writeViewport	192
6.3.30	main	196
7	view3d	203
7.1	view3d Call Graph	203
7.2	Constants and Headers	216
7.2.1	System includes	216
7.2.2	Local includes	216
7.2.3	defines	217
7.2.4	static variables	232
7.2.5	structs	233
7.2.6	extern references	236
7.2.7	forward references	239
7.2.8	global variables	243
7.3	Code	249

7.3.1	initButtons	249
7.3.2	closeViewport	256
7.3.3	scaleComponents	257
7.3.4	makeTriangle	259
7.3.5	triangulate	260
7.3.6	readComponentsFromViewman	263
7.3.7	calcNormData	265
7.3.8	make3DComponents	267
7.3.9	draw3DComponents	268
7.3.10	drawColorMap	277
7.3.11	writeControlTitle	278
7.3.12	clearControlMessage	279
7.3.13	writeControlMessage	279
7.3.14	drawControlPanel	280
7.3.15	getControlXY	292
7.3.16	makeControlPanel	294
7.3.17	putControlPanelSomewhere	296
7.3.18	phong	297
7.3.19	hueValue	298
7.3.20	getHue	298
7.3.21	Value	299
7.3.22	hlsTOrgb	299
7.3.23	initLightButtons	300
7.3.24	makeLightingPanel	302
7.3.25	drawLightingAxes	304
7.3.26	drawLightTransArrow	306
7.3.27	drawLightingPanel	308
7.3.28	theHandler	312
7.3.29	mergeDatabases	313
7.3.30	getMeshNormal	314
7.3.31	normalizeVector	314
7.3.32	dotProduct	315
7.3.33	merge	316
7.3.34	msort	317
7.3.35	getPotValue	318
7.3.36	getLinearPotValue	318
7.3.37	buttonAction	319
7.3.38	processEvents	335
7.3.39	project	351
7.3.40	projectAPoint	352
7.3.41	projectAllPoints	353
7.3.42	projectAllPolys	354
7.3.43	projectAPoly	356
7.3.44	projectStuff	358
7.3.45	makeQuitPanel	359
7.3.46	drawQuitPanel	361

7.3.47	initQuitButtons	362
7.3.48	makeSavePanel	363
7.3.49	drawSavePanel	364
7.3.50	initSaveButtons	365
7.3.51	getCBufferAxes	366
7.3.52	putCBufferAxes	366
7.3.53	getCBufferIndx	366
7.3.54	putCBufferIndx	366
7.3.55	putZBuffer	367
7.3.56	getZBuffer	367
7.3.57	putImageX	367
7.3.58	drawPhongSpan	368
7.3.59	scanPhong	370
7.3.60	boxTObuffer	373
7.3.61	clipboxTObuffer	375
7.3.62	axesTObuffer	377
7.3.63	scanLines	379
7.3.64	freePolyList	382
7.3.65	showAxesLabels	383
7.3.66	makeTriangle	385
7.3.67	drawPhong	387
7.3.68	readViewman	390
7.3.69	scalePoint	390
7.3.70	spadAction	391
7.3.71	traverse	397
7.3.72	absolute	397
7.3.73	getRandom	397
7.3.74	normDist	398
7.3.75	goodbye	398
7.3.76	drawLineComponent	399
7.3.77	drawOpaquePolygon	400
7.3.78	copyPolygons	402
7.3.79	minMaxPolygons	404
7.3.80	polyCompare	405
7.3.81	makeTriangle	405
7.3.82	makeTriangle	406
7.3.83	freePointReservoir	409
7.3.84	freeListOfPolygons	409
7.3.85	drawPolygons	410
7.3.86	lessThan	413
7.3.87	greaterThan	413
7.3.88	isNaN	413
7.3.89	isNaNPoint	413
7.3.90	equal	414
7.3.91	matrixMultiply4x4	415
7.3.92	vectorMatrix4	416

7.3.93	ROTATE	416
7.3.94	ROTATE1	417
7.3.95	SCALE	417
7.3.96	TRANSLATE	417
7.3.97	writeTitle	418
7.3.98	drawPreViewport	419
7.3.99	drawTheViewport	425
7.3.100	makeViewport	427
7.3.101	postMakeViewport	432
7.3.102	keepDrawingViewport	434
7.3.103	initVolumeButtons	435
7.3.104	makeVolumePanel	438
7.3.105	drawClipXBut	440
7.3.106	drawClipYBut	442
7.3.107	drawClipZBut	444
7.3.108	drawClipVolume	445
7.3.109	drawHitherControl	447
7.3.110	drawEyeControl	448
7.3.111	drawFrustrum	449
7.3.112	drawVolumePanel	450
7.3.113	writeViewport	453
7.3.114	main	457
8	gdraws	465
8.0.115	Gdraw	465
8.0.116	To use G Functions	466
8.1	gfun.c	468
8.1.1	filecopy	469
8.1.2	PSCreateFile	470
8.1.3	GdrawsDrawFrame	471
8.1.4	GdrawsSetDimension	472
8.1.5	GDrawImageString	473
8.1.6	GDrawArc	474
8.1.7	GDrawLine	475
8.1.8	GDrawLines	476
8.1.9	GDrawPoint	477
8.1.10	GDrawRectangle	478
8.1.11	GDraw3DButtonIn	479
8.1.12	GDraw3DButtonIn	479
8.1.13	GDrawPushButton	480
8.1.14	GDrawString	481
8.1.15	GFillArc	482
8.1.16	PSGlobalInit	483
8.1.17	PSInit	485
8.1.18	PSCreateContext	486
8.1.19	PSfindGC	487

8.1.20	GSetForeground	488
8.1.21	GSetBackground	489
8.1.22	GSetLineAttributes	490
8.1.23	PSClose	491
8.1.24	centerX	492
8.1.25	centerY	492
8.1.26	PSColorPolygon	493
8.1.27	PSColorwOutline	494
8.1.28	PSDrawColor	495
8.1.29	PSFillPolygon	496
8.1.30	PSFillwOutline	497
8.1.31	TrivEqual	497
8.1.32	TrivHashCode	498
8.1.33	XCreateAssocTable	498
8.1.34	XMakeAssoc	498
8.1.35	XLookupAssoc	498
8.1.36	XDeleteAssoc	499
8.2	The postscript command definitions	499
8.2.1	colorpoly	499
8.2.2	colorwol	500
8.2.3	drawarc	501
8.2.4	drawcolor	502
8.2.5	drawIstr	503
8.2.6	drawline	504
8.2.7	drawlines	505
8.2.8	drawpoint	505
8.2.9	draw	506
8.2.10	drawrect	506
8.2.11	drawstr	507
8.2.12	drwfilled	507
8.2.13	end	508
8.2.14	fillarc	509
8.2.15	fillpoly	510
8.2.16	fillwol	511
8.2.17	header	512
8.2.18	setup	515
9	The APIs	517
9.1	Graphics API	517
9.1.1	XDrawString	517
9.1.2	XDrawPoint	518
9.1.3	XDrawLine	518
9.1.4	XDrawImageString	519
9.1.5	XFillArc	520
9.1.6	XDrawArc	521
9.1.7	XSetForeground	522

<i>CONTENTS</i>	119
9.1.8 XSetBackground	522
9.1.9 XSetLineAttributes	522
9.1.10 DefaultScreen	523
9.1.11 RootWindow	523
9.1.12 XCreateAssocTable	523
9.1.13 XOpenDisplay	523
9.2 X11 API calls	524
10 Makefile	531

Volume 8.1: Axiom Gallery

1	General examples	1
1.1	Two dimensional functions	1
1.1.1	A Simple Sine Function	2
1.1.2	A Simple Sine Function, Non-adaptive plot	3
1.1.3	A Simple Sine Function, Drawn to Scale	4
1.1.4	A Simple Sine Function, Polar Plot	5
1.1.5	A Simple Tangent Function, Clipping On	6
1.1.6	A Simple Tangent Function, Clipping On	7
1.1.7	Tangent and Sine	8
1.1.8	A 2D Sine Function in BiPolar Coordinates	9
1.1.9	A 2D Sine Function in Elliptic Coordinates	10
1.1.10	A 2D Sine Wave in Polar Coordinates	11
1.2	Two dimensional curves	11
1.2.1	A Line in Parabolic Coordinates	12
1.2.2	Lissajous Curve	13
1.2.3	A Parametric Curve	14
1.2.4	A Parametric Curve in Polar Coordinates	15
1.3	Three dimensional functions	15
1.3.1	A 3D Constant Function in Elliptic Coordinates	16
1.3.2	A 3D Constant Function in Oblate Spheroidal	17
1.3.3	A 3D Constant in Polar Coordinates	18
1.3.4	A 3D Constant in Prolate Spheroidal Coordinates	19
1.3.5	A 3D Constant in Spherical Coordinates	20
1.3.6	A 2-Equation Space Function	21
1.4	Three dimensional curves	21
1.4.1	A Parametric Space Curve	22
1.4.2	A Tube around a Parametric Space Curve	23
1.4.3	A 2-Equation Cylindrical Curve	24
1.5	Three dimensional surfaces	24
1.5.1	A Icosahedron	25
1.5.2	A 3D figure 8 immersion (Klein bagel)	27
1.5.3	A 2-Equation bipolarCylindrical Surface	28
1.5.4	A 3-Equation Parametric Space Surface	29
1.5.5	A 3D Vector of Points in Elliptic Cylindrical	30
1.5.6	A 3D Constant Function in BiPolar Coordinates	31
1.5.7	A Swept in Parabolic Coordinates	32
1.5.8	A Swept Cone in Parabolic Cylindrical Coordinates	33
1.5.9	A Truncated Cone in Toroidal Coordinates	34
1.5.10	A Swept Surface in Paraboloidal Coordinates	35
2	Jenks Book images	37
2.0.11	The Complex Gamma Function	38
2.0.12	The Complex Arctangent Function	39

3	Hyperdoc examples	41
3.1	Two dimensional examples	41
3.1.1	A function of one variable	42
3.1.2	A Parametric function	43
3.1.3	A Polynomial in 2 variables	44
3.2	Three dimensional examples	44
3.2.1	A function of two variables	45
3.2.2	A parametrically defined curve	46
3.2.3	A parametrically defined surface	47
4	Pasta by Design[?]	49
4.1	Acini Di Pepe	50
4.2	Agnolotti	51
4.3	Anellini	52
4.4	Bucatini	53
4.5	Buccoli	54
4.6	Calamaretti	55
4.7	Cannelloni	56
4.8	Cannolicchi Rigati	57
4.9	Capellini	58
4.10	Cappelletti	59
4.11	Casarecce	60
4.12	Castellane	61
4.13	Cavatappi	62
4.14	Cavatelli	63
4.15	Chifferi Rigati	64
4.16	Colonne Pompeii	65
4.17	Conchiglie Rigate	67
4.18	Conchigliette Lisce	68
4.19	Conchiglioni Rigate	69
4.20	Corallini Lisci	70
4.21	Creste Di Galli	71
4.22	Couretti	72
4.23	Ditali Rigati	73
4.24	Fagottini	74
4.25	Farfalle	75
4.26	Farfalline	77
4.27	Farfalloni	78
4.28	Festonati	80
4.29	Fettuccine	81
4.30	Fiocchi Rigati	82
4.31	Fisarmoniche	83
4.32	Funghini	84
4.33	Fusilli	85
4.34	Fusilli al Ferretto	86
4.35	Fusilli Capri	87

4.36 Fusilli Lunghi Bucati	88
4.37 Galletti	90
4.38 Garganelli	91
4.39 Gemelli	92
4.40 Gigli	93
4.41 Giglio Ondulato	94
4.42 Gnocchetti Sardi	95
4.43 Gnocchi	96
4.44 Gramigna	97
4.45 Lancette	98
4.46 Lasagna Larga Doppia Riccia	99
4.47 Linguine	100
4.48 Lumaconi Rigati	101
4.49 Maccheroni	102
4.50 Maccheroni Alla Chitarra	103
4.51 Mafaldine	104
4.52 Manicotti	105
4.53 Orecchiette	107
4.54 Paccheri	108
4.55 Pappardelle	109
4.56 Penne Rigate	110
4.57 Pennoni Lisci	111
4.58 Pennoni Rigati	112
4.59 Puntalette	113
4.60 Quadrefiore	114
4.61 Quadretti	115
4.62 Racchette	116
4.63 Radiatori	118
4.64 Ravioli Quadrati	119
4.65 Ravioli Tondi	120
4.66 Riccioli	121
4.67 Riccioli al Cinque Saponi	122
4.68 Rigatoni	123
4.69 Rombi	124
4.70 Rotelle	125
4.71 Saccottini	126
4.72 Sagnarelli	127
4.73 Sagne Incannulate	128
4.74 Scialatielli	129
4.75 Spaccatelle	130
4.76 Spaghetti	131
4.77 Spiralli	132
4.78 Stelletta	133
4.79 Stortini	134
4.80 Strozzapreti	136
4.81 Tagliatelle	137

<i>CONTENTS</i>	123
-----------------	-----

4.82 Taglierini	138
4.83 Tagliolini	139
4.84 Torchietti	141
4.85 Tortellini	143
4.86 Tortiglioni	144
4.87 Trenne	145
4.88 Tripoline	147
4.89 Trofie	148
4.90 Trottole	149
4.91 Tubetti Rigati	151
4.92 Ziti	152

5 Index	155
----------------	------------

Volume 9: Axiom Compiler

0.1	Makefile	1
1	Overview	3
1.1	The Input	4
1.2	The Output, the EQ.nrlib directory	8
1.3	The code.lsp and EQ.lsp files	9
1.4	The code.o file	23
1.5	The info file	23
1.6	The EQ.fn file	26
1.7	The index.kaf file	31
1.7.1	The index offset byte	33
1.7.2	The “loadTimeStuff”	33
1.7.3	The “compilerInfo”	35
1.7.4	The “constructorForm”	42
1.7.5	The “constructorKind”	42
1.7.6	The “constructorModemap”	42
1.7.7	The “constructorCategory”	44
1.7.8	The “sourceFile”	45
1.7.9	The “modemaps”	45
1.7.10	The “operationAlist”	47
1.7.11	The “superDomain”	49
1.7.12	The “signaturesAndLocals”	49
1.7.13	The “attributes”	49
1.7.14	The “predicates”	49
1.7.15	The “abbreviation”	50
1.7.16	The “parents”	50
1.7.17	The “ancestors”	51
1.7.18	The “documentation”	51
1.7.19	The “slotInfo”	53
1.7.20	The “index”	55
2	Compiler top level	57
2.1	Global Data Structures	57
2.2	Pratt Parsing	57
2.3	)compile	58
2.3.1	Spad compiler	61
2.4	Operator Precedence Table Initialization	62
2.4.1	LED and NUD Tables	62
2.5	Gliph Table	65
2.5.1	Rename Token Table	65
2.5.2	Generic function table	66
2.6	Giant steps, Baby steps	66

3	The Parser	67
3.1	EQ.spad	67
3.2	boot transformations	71
3.2.1	defun string2BootTree	71
3.2.2	defun new2OldLisp	72
3.2.3	defun new2OldTran	72
3.2.4	defun newIf2Cond	73
3.2.5	defun newDef2Def	74
3.2.6	defun new2OldDefForm	74
3.2.7	defun newConstruct	74
3.3	preparse	75
3.3.1	defvar \$index	75
3.3.2	defvar \$linelist	75
3.3.3	defvar \$echolinestack	75
3.3.4	defvar \$preparse-last-line	76
3.4	Parsing routines	76
3.4.1	defun initialize-preparse	76
3.4.2	defun preparse	80
3.4.3	defun Build the lines from the input for piles	84
3.4.4	defun parsepiles	87
3.4.5	defun add-parens-and-semis-to-line	88
3.4.6	defun preparseReadLine	89
3.4.7	defun skip-ifblock	89
3.4.8	defun preparseReadLine1	90
3.4.9	defun expand-tabs	91
3.5	I/O Handling	92
3.5.1	defun preparse-echo	92
3.5.2	Parsing stack	92
3.5.3	defstruct \$stack	92
3.5.4	defun stack-load	92
3.5.5	defun stack-clear	93
3.5.6	defmacro stack-/empty	93
3.5.7	defun stack-push	93
3.5.8	defun stack-pop	94
3.5.9	Parsing token	94
3.5.10	defstruct \$token	94
3.5.11	defvar \$prior-token	94
3.5.12	defvar \$nonblank	95
3.5.13	defvar \$current-token	95
3.5.14	defvar \$next-token	95
3.5.15	defvar \$valid-tokens	95
3.5.16	defun token-install	96
3.5.17	defun token-print	96
3.5.18	Parsing reduction	96
3.5.19	defstruct \$reduction	96

4	Parse Transformers	97
4.1	Direct called parse routines	97
4.1.1	defun parseTransform	97
4.1.2	defun parseTran	97
4.1.3	defun parseAtom	98
4.1.4	defun parseTranList	99
4.1.5	defplist parseConstruct	99
4.1.6	defun parseConstruct	99
4.2	Indirect called parse routines	100
4.2.1	defplist parseAnd	101
4.2.2	defun parseAnd	101
4.2.3	defplist parseAtSign	101
4.2.4	defun parseAtSign	102
4.2.5	defun parseType	102
4.2.6	defplist parseCategory	102
4.2.7	defun parseCategory	103
4.2.8	defun parseDropAssertions	103
4.2.9	defplist parseCoerce	103
4.2.10	defun parseCoerce	104
4.2.11	defplist parseColon	104
4.2.12	defun parseColon	104
4.2.13	defplist parseDEF	105
4.2.14	defun parseDEF	105
4.2.15	defun parseLhs	106
4.2.16	defun transIs	106
4.2.17	defun transIs1	106
4.2.18	defun isListConstructor	107
4.2.19	defplist parseDollarGreaterthan	107
4.2.20	defun parseDollarGreaterThan	108
4.2.21	defplist parseDollarGreaterEqual	108
4.2.22	defun parseDollarGreaterEqual	108
4.2.23	defun parseDollarLessEqual	109
4.2.24	defplist parseDollarNotEqual	109
4.2.25	defun parseDollarNotEqual	109
4.2.26	defplist parseEquivalence	110
4.2.27	defun parseEquivalence	110
4.2.28	defplist parseExit	110
4.2.29	defun parseExit	110
4.2.30	defplist parseGreaterEqual	111
4.2.31	defun parseGreaterEqual	111
4.2.32	defplist parseGreaterThan	111
4.2.33	defun parseGreaterThan	112
4.2.34	defplist parseHas	112
4.2.35	defun parseHas	112
4.2.36	defun parseHasRhs	114
4.2.37	defun loadIfNecessary	114

4.2.38	defun loadLibIfNecessary	115
4.2.39	defun updateCategoryFrameForConstructor	116
4.2.40	defun convertOpAlist2compilerInfo	116
4.2.41	defun updateCategoryFrameForCategory	117
4.2.42	defplist parseIf	117
4.2.43	defun parseIf	118
4.2.44	defun parseIf,ifTran	118
4.2.45	defplist parseImplies	120
4.2.46	defun parseImplies	120
4.2.47	defplist parseIn	121
4.2.48	defun parseIn	121
4.2.49	defplist parseInBy	122
4.2.50	defun parseInBy	122
4.2.51	defplist parseIs	123
4.2.52	defun parseIs	123
4.2.53	defplist parseIsnt	123
4.2.54	defun parseIsnt	123
4.2.55	defplist parseJoin	124
4.2.56	defun parseJoin	124
4.2.57	defplist parseLeave	124
4.2.58	defun parseLeave	125
4.2.59	defplist parseLessEqual	125
4.2.60	defun parseLessEqual	125
4.2.61	defplist parseLET	126
4.2.62	defun parseLET	126
4.2.63	defplist parseLETD	126
4.2.64	defun parseLETD	127
4.2.65	defplist parseMDEF	127
4.2.66	defun parseMDEF	127
4.2.67	defplist parseNot	128
4.2.68	defplist parseNot	128
4.2.69	defun parseNot	128
4.2.70	defplist parseNotEqual	129
4.2.71	defun parseNotEqual	129
4.2.72	defplist parseOr	129
4.2.73	defun parseOr	129
4.2.74	defplist parsePretend	130
4.2.75	defun parsePretend	130
4.2.76	defplist parseReturn	131
4.2.77	defun parseReturn	131
4.2.78	defplist parseSegment	131
4.2.79	defun parseSegment	131
4.2.80	defplist parseSeq	132
4.2.81	defun parseSeq	132
4.2.82	defplist parseVCONS	132
4.2.83	defun parseVCONS	133

4.2.84	defplist parseWhere	133
4.2.85	defun parseWhere	133
5	Compile Transformers	135
5.0.86	defun compExpression	135
5.1	Handline Category DEF forms	138
5.1.1	defplist compDefine plist	140
5.1.2	defun compDefine	140
5.1.3	defun compDefine1	141
5.1.4	defun compDefineAddSignature	143
5.1.5	defun compDefineFunctor	144
5.1.6	defun compDefineFunctor1	144
5.1.7	defun compDefineCapsuleFunction	151
5.1.8	defun compInternalFunction	155
5.1.9	defun compDefWhereClause	155
5.1.10	defun compDefineCategory	158
5.1.11	defun compDefineCategory1	158
5.1.12	defun compDefineCategory2	159
5.1.13	defun compDefineLisplib	163
5.1.14	defun compileDocumentation	165
5.1.15	defun compArgumentConditions	166
5.1.16	defun compileCases	167
5.1.17	defun compFunctorBody	168
5.1.18	defun compile	169
5.1.19	defvar \$NoValueMode	172
5.1.20	defvar \$EmptyMode	172
5.1.21	defun hasFullSignature	172
5.1.22	defun addEmptyCapsuleIfNecessary	173
5.1.23	defun getTargetFromRhs	173
5.1.24	defun giveFormalParametersValues	174
5.1.25	defun macroExpandInPlace	174
5.1.26	defun macroExpand	174
5.1.27	defun macroExpandList	175
5.1.28	defun makeCategoryPredicates	175
5.1.29	defun mkCategoryPackage	176
5.1.30	defun mkEvalableCategoryForm	178
5.1.31	defun encodeFunctionName	179
5.1.32	defun mkRepetitionAssoc	180
5.1.33	defun splitEncodedFunctionName	180
5.1.34	defun encodeItem	181
5.1.35	defun getCaps	181
5.1.36	defun constructMacro	182
5.1.37	defun spadCompileOrSetq	182
5.1.38	defun compileConstructor	183
5.1.39	defun compileConstructor1	184
5.1.40	defun compAndDefine	185

5.1.41	defun putInLocalDomainReferences	185
5.1.42	defun NRTputInTail	185
5.1.43	defun NRTputInHead	186
5.1.44	defun getArgumentModeOrMoan	187
5.1.45	defun augLisplibModemapsFromCategory	187
5.1.46	defun mkAlistOfExplicitCategoryOps	189
5.1.47	defun flattenSignatureList	190
5.1.48	defun interactiveModemapForm	191
5.1.49	defun replaceVars	192
5.1.50	defun fixUpPredicate	192
5.1.51	defun orderPredicateItems	193
5.1.52	defun signatureTran	193
5.1.53	defun orderPredTran	194
5.1.54	defun isDomainSubst	196
5.1.55	defun moveORsOutside	197
5.1.56	defun substVars	198
5.1.57	defun modemapPattern	199
5.1.58	defun evalAndRwriteLispForm	200
5.1.59	defun rwriteLispForm	200
5.1.60	defun mkConstructor	201
5.1.61	defun unloadOneConstructor	201
5.1.62	defun lisplibDoRename	201
5.1.63	defun initializeLisplib	202
5.1.64	defun writeLib1	203
5.1.65	defun finalizeLisplib	203
5.1.66	defun getConstructorOpsAndAtts	205
5.1.67	defun getCategoryOpsAndAtts	205
5.1.68	defun getSlotFromCategoryForm	206
5.1.69	defun transformOperationAlist	206
5.1.70	defun getFunctorOpsAndAtts	208
5.1.71	defun getSlotFromFunctor	208
5.1.72	defun compMakeCategoryObject	208
5.1.73	defun mergeSignatureAndLocalVarAlists	209
5.1.74	defun lisplibWrite	209
5.1.75	defun isCategoryPackageName	210
5.1.76	defun NRTgetLookupFunction	210
5.1.77	defun NRTgetLocalIndex	211
5.1.78	defun augmentLisplibModemapsFromFunctor	212
5.1.79	defun allLASSOCs	213
5.1.80	defun formal2Pattern	214
5.1.81	defun mkDatabasePred	214
5.1.82	defun disallowNilAttribute	214
5.1.83	defun bootStrapError	215
5.1.84	defun reportOnFunctorCompilation	215
5.1.85	defun displayMissingFunctions	216
5.1.86	defun makeFunctorArgumentParameters	217

5.1.87	defun genDomainViewList0	219
5.1.88	defun genDomainViewList	219
5.1.89	defun genDomainView	219
5.1.90	defun genDomainOps	220
5.1.91	defun mkOpVec	221
5.1.92	defun AssocBarGensym	222
5.1.93	defun orderByDependency	222
5.2	Code optimization routines	223
5.2.1	defun optimizeFunctionDef	223
5.2.2	defun optimize	225
5.2.3	defun optXLAMCond	226
5.2.4	defun optCONDtail	226
5.2.5	defvar \$BasicPredicates	227
5.2.6	defun optPredicateIfTrue	227
5.2.7	defun optIF2COND	227
5.2.8	defun subrname	228
5.2.9	Special case optimizers	228
5.2.10	defplist optCall	229
5.2.11	defun Optimize “call” expressions	229
5.2.12	defun optPackageCall	230
5.2.13	defun optCallSpecially	231
5.2.14	defun optSpecialCall	232
5.2.15	defun compileTimeBindingOf	233
5.2.16	defun optCallEval	233
5.2.17	defplist optSEQ	234
5.2.18	defun optSEQ	234
5.2.19	defplist optEQ	235
5.2.20	defun optEQ	236
5.2.21	defplist optMINUS	236
5.2.22	defun optMINUS	236
5.2.23	defplist optQSMINUS	237
5.2.24	defun optQSMINUS	237
5.2.25	defplist opt-	237
5.2.26	defun opt-	238
5.2.27	defplist optLESSP	238
5.2.28	defun optLESSP	238
5.2.29	defplist optSPADCALL	239
5.2.30	defun optSPADCALL	239
5.2.31	defplist optSuchthat	240
5.2.32	defun optSuchthat	240
5.2.33	defplist optCatch	240
5.2.34	defun optCatch	240
5.2.35	defplist optCond	242
5.2.36	defun optCond	242
5.2.37	defun EqualBarGensym	244
5.2.38	defplist optMkRecord	245

5.2.39	defun optMkRecord	245
5.2.40	defplist optRECORDELT	245
5.2.41	defun optRECORDELT	245
5.2.42	defplist optSETRECORDELT	246
5.2.43	defun optSETRECORDELT	246
5.2.44	defplist optRECORDCOPY	247
5.2.45	defun optRECORDCOPY	247
5.3	Functions to manipulate modemaps	248
5.3.1	defun addDomain	248
5.3.2	defun unknownTypeError	249
5.3.3	defun isFunctor	249
5.3.4	defun getDomainsInScope	250
5.3.5	defun putDomainsInScope	250
5.3.6	defun isSuperDomain	251
5.3.7	defun addNewDomain	251
5.3.8	defun augModemapsFromDomain	252
5.3.9	defun augModemapsFromDomain1	252
5.3.10	defun substituteCategoryArguments	253
5.3.11	defun addConstructorModemaps	254
5.3.12	defun getModemap	254
5.3.13	defun compApplyModemap	255
5.3.14	defun compMapCond	256
5.3.15	defun compMapCond'	257
5.3.16	defun compMapCond"	257
5.3.17	defun compMapCondFun	258
5.3.18	defun getUniqueSignature	259
5.3.19	defun getUniqueModemap	259
5.3.20	defun getModemapList	259
5.3.21	defun getModemapListFromDomain	260
5.3.22	defun domainMember	260
5.3.23	defun augModemapsFromCategory	260
5.3.24	defun addEltModemap	261
5.3.25	defun mkNewModemapList	262
5.3.26	defun insertModemap	263
5.3.27	defun mergeModemap	263
5.3.28	defun TruthP	264
5.3.29	defun evalAndSub	265
5.3.30	defun getOperationAlist	265
5.3.31	defvar \$FormalMapVariableList	266
5.3.32	defun substNames	266
5.3.33	defun augModemapsFromCategoryRep	267
5.4	Maintaining Modemaps	268
5.4.1	defun addModemapKnown	268
5.4.2	defun addModemap	269
5.4.3	defun addModemap0	269
5.4.4	defun addModemap1	270

5.5	Indirect called comp routines	270
5.5.1	defplist compAdd plist	271
5.5.2	defun compAdd	271
5.5.3	defun compTuple2Record	273
5.5.4	defplist compCapsule plist	273
5.5.5	defun compCapsule	274
5.5.6	defun compCapsuleInner	274
5.5.7	defun processFunctor	275
5.5.8	defun compCapsuleItems	275
5.5.9	defun compSingleCapsuleItem	276
5.5.10	defun doIt	276
5.5.11	defun doItIf	281
5.5.12	defun isMacro	282
5.5.13	defplist compCase plist	283
5.5.14	defun compCase	283
5.5.15	defun compCase1	284
5.5.16	defplist compCat plist	284
5.5.17	defplist compCat plist	285
5.5.18	defplist compCat plist	285
5.5.19	defun compCat	285
5.5.20	defplist compCategory plist	286
5.5.21	defun compCategory	286
5.5.22	defun compCategoryItem	287
5.5.23	defun mkExplicitCategoryFunction	288
5.5.24	defun mustInstantiate	289
5.5.25	defun wrapDomainSub	290
5.5.26	defplist compColon plist	290
5.5.27	defun compColon	290
5.5.28	defun makeCategoryForm	293
5.5.29	defplist compCons plist	294
5.5.30	defun compCons	294
5.5.31	defun compCons1	294
5.5.32	defplist compConstruct plist	295
5.5.33	defun compConstruct	295
5.5.34	defplist compConstructorCategory plist	296
5.5.35	defplist compConstructorCategory plist	296
5.5.36	defplist compConstructorCategory plist	297
5.5.37	defplist compConstructorCategory plist	297
5.5.38	defun compConstructorCategory	297
5.5.39	defun getAbbreviation	298
5.5.40	defun mkAbbrev	298
5.5.41	defun addSuffix	299
5.5.42	defun alistSize	299
5.5.43	defun getSignatureFromMode	299
5.5.44	defun getSpecialCaseAssoc	300
5.5.45	defun addArgumentConditions	300

5.5.46	defun stripOffSubdomainConditions	301
5.5.47	defun stripOffArgumentConditions	302
5.5.48	defun getSignature	302
5.5.49	defun checkAndDeclare	304
5.5.50	defun hasSigInTargetCategory	304
5.5.51	defun getArgumentMode	305
5.5.52	defplist compElt plist	306
5.5.53	defun compElt	306
5.5.54	defplist compExit plist	307
5.5.55	defun compExit	308
5.5.56	defplist compHas plist	308
5.5.57	defun compHas	309
5.5.58	defun compHasFormat	309
5.5.59	defun mkList	310
5.5.60	defplist compIf plist	310
5.5.61	defun compIf	311
5.5.62	defun compFromIf	312
5.5.63	defun canReturn	312
5.5.64	defun compBoolean	314
5.5.65	defun getSuccessEnvironment	314
5.5.66	defun getInverseEnvironment	316
5.5.67	defun getUnionMode	317
5.5.68	defun isUnionMode	317
5.5.69	defplist compImport plist	318
5.5.70	defun compImport	318
5.5.71	defplist compIs plist	318
5.5.72	defun compIs	318
5.5.73	defplist compJoin plist	319
5.5.74	defun compJoin	319
5.5.75	defun compForMode	321
5.5.76	defplist compLambda plist	321
5.5.77	defun compLambda	321
5.5.78	defplist compLeave plist	322
5.5.79	defun compLeave	323
5.5.80	defplist compMacro plist	323
5.5.81	defun compMacro	323
5.5.82	defplist compPretend plist	324
5.5.83	defun compPretend	324
5.5.84	defplist compQuote plist	325
5.5.85	defun compQuote	326
5.5.86	defplist compReduce plist	326
5.5.87	defun compReduce	326
5.5.88	defun compReduce1	326
5.5.89	defplist compRepeatOrCollect plist	328
5.5.90	defplist compRepeatOrCollect plist	328
5.5.91	defun compRepeatOrCollect	329

5.5.92	defplist compReturn plist	331
5.5.93	defun compReturn	331
5.5.94	defplist compSeq plist	332
5.5.95	defun compSeq	332
5.5.96	defun compSeq1	332
5.5.97	defun replaceExitEtc	333
5.5.98	defun convertOrCroak	334
5.5.99	defun compSeqItem	334
5.5.100	defplist compSetq plist	335
5.5.101	defplist compSetq plist	335
5.5.102	defun compSetq	335
5.5.103	defun compSetq1	335
5.5.104	defun uncons	336
5.5.105	defun setqMultiple	337
5.5.106	defun setqMultipleExplicit	339
5.5.107	defun setqSetelt	340
5.5.108	defun setqSingle	340
5.5.109	defun NRTassocIndex	342
5.5.110	defun assignError	342
5.5.111	defun outputComp	343
5.5.112	defun maxSuperType	344
5.5.113	defun isDomainForm	344
5.5.114	defun isDomainConstructorForm	344
5.5.115	defplist compString plist	345
5.5.116	defun compString	345
5.5.117	defplist compSubDomain plist	346
5.5.118	defun compSubDomain	346
5.5.119	defun compSubDomain1	346
5.5.120	defun lispize	347
5.5.121	defplist compSubsetCategory plist	348
5.5.122	defun compSubsetCategory	348
5.5.123	defplist compSuchthat plist	348
5.5.124	defun compSuchthat	349
5.5.125	defplist compVector plist	349
5.5.126	defun compVector	349
5.5.127	defplist compWhere plist	350
5.5.128	defun compWhere	350
5.6	Functions for coercion	351
5.6.1	defun coerce	351
5.6.2	defun coerceEasy	352
5.6.3	defun coerceSubset	353
5.6.4	defun coerceHard	354
5.6.5	defun coerceExtraHard	355
5.6.6	defun hasType	356
5.6.7	defun coerceable	356
5.6.8	defun coerceExit	357

5.6.9	defplist compAtSign plist	357
5.6.10	defun compAtSign	357
5.6.11	defplist compCoerce plist	358
5.6.12	defun compCoerce	358
5.6.13	defun compCoerce1	359
5.6.14	defun coerceByModemap	359
5.6.15	defun autoCoerceByModemap	360
5.6.16	defun resolve	361
5.6.17	defun mkUnion	362
5.6.18	defun This orders Unions	362
5.6.19	defun modeEqualSubst	363
6	Post Transformers	365
6.1	Direct called postparse routines	365
6.1.1	defun postTransform	365
6.1.2	defun postTran	366
6.1.3	defun postOp	367
6.1.4	defun postAtom	367
6.1.5	defun postTranList	368
6.1.6	defun postScriptsForm	368
6.1.7	defun postTranScripts	368
6.1.8	defun postTransformCheck	369
6.1.9	defun postcheck	369
6.1.10	defun postError	370
6.1.11	defun postForm	370
6.2	Indirect called postparse routines	371
6.2.1	defplist postAdd plist	372
6.2.2	defun postAdd	372
6.2.3	defun postCapsule	373
6.2.4	defun postBlockItemList	373
6.2.5	defun postBlockItem	373
6.2.6	defplist postAtSign plist	374
6.2.7	defun postAtSign	374
6.2.8	defun postType	375
6.2.9	defplist postBigFloat plist	375
6.2.10	defun postBigFloat	376
6.2.11	defplist postBlock plist	376
6.2.12	defun postBlock	376
6.2.13	defplist postCategory plist	377
6.2.14	defun postCategory	377
6.2.15	defun postCollect,finish	377
6.2.16	defun postMakeCons	378
6.2.17	defplist postCollect plist	379
6.2.18	defun postCollect	379
6.2.19	defun postIteratorList	380
6.2.20	defplist postColon plist	380

6.2.21	defun postColon	381
6.2.22	defplist postColonColon plist	381
6.2.23	defun postColonColon	381
6.2.24	defplist postComma plist	382
6.2.25	defun postComma	382
6.2.26	defun comma2Tuple	382
6.2.27	defun postFlatten	382
6.2.28	defplist postConstruct plist	383
6.2.29	defun postConstruct	383
6.2.30	defun postTranSegment	384
6.2.31	defplist postDef plist	384
6.2.32	defun postDef	384
6.2.33	defun postDefArgs	386
6.2.34	defplist postExit plist	386
6.2.35	defun postExit	387
6.2.36	defplist postIf plist	387
6.2.37	defun postIf	387
6.2.38	defplist postin plist	388
6.2.39	defun postin	388
6.2.40	defun postInSeq	388
6.2.41	defplist postIn plist	389
6.2.42	defun postIn	389
6.2.43	defplist postJoin plist	389
6.2.44	defun postJoin	390
6.2.45	defplist postMapping plist	390
6.2.46	defun postMapping	390
6.2.47	defplist postMDef plist	391
6.2.48	defun postMDef	391
6.2.49	defplist postPretend plist	392
6.2.50	defun postPretend	392
6.2.51	defplist postQUOTE plist	392
6.2.52	defun postQUOTE	393
6.2.53	defplist postReduce plist	393
6.2.54	defun postReduce	393
6.2.55	defplist postRepeat plist	394
6.2.56	defun postRepeat	394
6.2.57	defplist postScripts plist	394
6.2.58	defun postScripts	394
6.2.59	defplist postSemiColon plist	395
6.2.60	defun postSemiColon	395
6.2.61	defun postFlattenLeft	395
6.2.62	defplist postSignature plist	396
6.2.63	defun postSignature	396
6.2.64	defun removeSuperfluousMapping	396
6.2.65	defun killColons	397
6.2.66	defplist postSlash plist	397

6.2.67	defun postSlash	397
6.2.68	defplist postTuple plist	398
6.2.69	defun postTuple	398
6.2.70	defplist postTupleCollect plist	398
6.2.71	defun postTupleCollect	398
6.2.72	defplist postWhere plist	399
6.2.73	defun postWhere	399
6.2.74	defplist postWith plist	399
6.2.75	defun postWith	400
6.3	Support routines	400
6.3.1	defun setDefOp	400
6.3.2	defun aplTran	401
6.3.3	defun aplTran1	401
6.3.4	defun aplTranList	403
6.3.5	defun hasAplExtension	403
6.3.6	defun deepestExpression	404
6.3.7	defun containsBang	404
6.3.8	defun getScriptName	404
6.3.9	defun decodeScripts	405
7	DEF forms	407
7.0.10	defvar \$defstack	407
7.0.11	defvar \$is-spill	407
7.0.12	defvar \$is-spill-list	407
7.0.13	defvar \$vl	408
7.0.14	defvar \$is-gensymlist	408
7.0.15	defvar \$initial-gensym	408
7.0.16	defvar \$is-eqlist	408
7.0.17	defun hackforis	408
7.0.18	defun hackforis1	409
7.0.19	defun unTuple	409
7.0.20	defun errhuh	409
8	PARSE forms	411
8.1	The original meta specification	411
8.2	The PARSE code	416
8.2.1	defvar \$tmptok	416
8.2.2	defvar \$tok	416
8.2.3	defvar \$ParseMode	417
8.2.4	defvar \$definition-name	417
8.2.5	defvar \$lablasoc	417
8.2.6	defun PARSE-NewExpr	417
8.2.7	defun PARSE-Command	418
8.2.8	defun PARSE-SpecialKeyword	418
8.2.9	defun PARSE-SpecialCommand	419
8.2.10	defun PARSE-TokenCommandTail	419

8.2.11	defun PARSE-TokenOption	420
8.2.12	defun PARSE-TokenList	420
8.2.13	defun PARSE-CommandTail	421
8.2.14	defun PARSE-PrimaryOrQM	421
8.2.15	defun PARSE-Option	422
8.2.16	defun PARSE-Statement	422
8.2.17	defun PARSE-InfixWith	423
8.2.18	defun PARSE-With	423
8.2.19	defun PARSE-Category	423
8.2.20	defun PARSE-Expression	425
8.2.21	defun PARSE-Import	425
8.2.22	defun PARSE-Expr	426
8.2.23	defun PARSE-LedPart	426
8.2.24	defun PARSE-NudPart	426
8.2.25	defun PARSE-Operation	427
8.2.26	defun PARSE-leftBindingPowerOf	427
8.2.27	defun PARSE-rightBindingPowerOf	428
8.2.28	defun PARSE-getSemanticForm	428
8.2.29	defun PARSE-Prefix	428
8.2.30	defun PARSE-Infix	429
8.2.31	defun PARSE-TokTail	430
8.2.32	defun PARSE-Qualification	430
8.2.33	defun PARSE-Reduction	431
8.2.34	defun PARSE-ReductionOp	431
8.2.35	defun PARSE-Form	431
8.2.36	defun PARSE-Application	432
8.2.37	defun PARSE-Label	433
8.2.38	defun PARSE-Selector	433
8.2.39	defun PARSE-PrimaryNoFloat	434
8.2.40	defun PARSE-Primary	434
8.2.41	defun PARSE-Primary1	434
8.2.42	defun PARSE-Float	435
8.2.43	defun PARSE-FloatBase	436
8.2.44	defun PARSE-FloatBasePart	436
8.2.45	defun PARSE-FloatExponent	437
8.2.46	defun PARSE-Enclosure	438
8.2.47	defun PARSE-IntegerTok	438
8.2.48	defun PARSE-FormalParameter	439
8.2.49	defun PARSE-FormalParameterTok	439
8.2.50	defun PARSE-Quad	439
8.2.51	defun PARSE-String	439
8.2.52	defun PARSE-VarForm	440
8.2.53	defun PARSE-Scripts	440
8.2.54	defun PARSE-ScriptItem	441
8.2.55	defun PARSE-Name	441
8.2.56	defun PARSE-Data	442

8.2.57	defun PARSE-Sexpr	442
8.2.58	defun PARSE-Sexpr1	442
8.2.59	defun PARSE-NBGlyphTok	443
8.2.60	defun PARSE-GlyphTok	444
8.2.61	defun PARSE-AnyId	444
8.2.62	defun PARSE-Sequence	445
8.2.63	defun PARSE-Sequence1	445
8.2.64	defun PARSE-OpenBracket	446
8.2.65	defun PARSE-OpenBrace	446
8.2.66	defun PARSE-IteratorTail	447
8.2.67	defun PARSE-Iterator	447
8.2.68	The PARSE implicit routines	448
8.2.69	defun PARSE-Suffix	448
8.2.70	defun PARSE-SemiColon	449
8.2.71	defun PARSE-Return	449
8.2.72	defun PARSE-Exit	449
8.2.73	defun PARSE-Leave	450
8.2.74	defun PARSE-Seg	450
8.2.75	defun PARSE-Conditional	451
8.2.76	defun PARSE-ElseClause	451
8.2.77	defun PARSE-Loop	452
8.2.78	defun PARSE-LabelExpr	452
8.2.79	defun PARSE-FloatTok	453
8.3	The PARSE support routines	453
8.3.1	String grabbing	454
8.3.2	defun match-string	454
8.3.3	defun skip-blanks	454
8.3.4	defun token-lookahead-type	455
8.3.5	defun match-advance-string	455
8.3.6	defun initial-substring-p	456
8.3.7	defun quote-if-string	456
8.3.8	defun escape-keywords	457
8.3.9	defun isTokenDelimiter	457
8.3.10	defun underscore	458
8.3.11	Token Handling	458
8.3.12	defun getToken	458
8.3.13	defun unget-tokens	458
8.3.14	defun match-current-token	459
8.3.15	defun match-token	460
8.3.16	defun match-next-token	460
8.3.17	defun current-symbol	460
8.3.18	defun make-symbol-of	460
8.3.19	defun current-token	461
8.3.20	defun try-get-token	461
8.3.21	defun next-token	462
8.3.22	defun advance-token	462

8.3.23	defvar \$XTokenReader	463
8.3.24	defun get-token	463
8.3.25	Character handling	463
8.3.26	defun current-char	463
8.3.27	defun next-char	463
8.3.28	defun char-eq	464
8.3.29	defun char-ne	464
8.3.30	Error handling	464
8.3.31	defvar \$meta-error-handler	464
8.3.32	defun meta-syntax-error	465
8.3.33	Floating Point Support	465
8.3.34	defun floatexpid	465
8.3.35	Dollar Translation	465
8.3.36	defun dollarTran	465
8.3.37	Applying metagrammatical elements of a production (e.g., Star). . . .	466
8.3.38	defmacro Bang	466
8.3.39	defmacro must	466
8.3.40	defun action	467
8.3.41	defun optional	467
8.3.42	defmacro star	467
8.3.43	Stacking and retrieving reductions of rules.	468
8.3.44	defvar \$reduce-stack	468
8.3.45	defmacro reduce-stack-clear	468
8.3.46	defun push-reduction	468
9	Comment Recording	469
9.1	Comment Recording Layer 0 – API	470
9.1.1	defun recordSignatureDocumentation	470
9.1.2	defun recordAttributeDocumentation	470
9.2	Comment Recording Layer 1	471
9.2.1	defun recordDocumentation	471
9.3	Comment Recording Layer 2	471
9.3.1	defun collectComBlock	471
9.4	Comment Recording Layer 3	472
9.4.1	defun recordHeaderDocumentation	472
9.4.2	defun collectAndDeleteAssoc	472
10	Category handling	475
10.0.3	defun getConstructorExports	475
11	Building libdb.text	477
11.0.4	defun extendLocalLibdb	477
11.0.5	defun buildLibdb	478
11.0.6	defun buildLibdbString	480
11.0.7	defun dbReadLines	481
11.0.8	defun purgeNewConstructorLines	481

11.0.9 defun dbWriteLines	481
11.0.10 defun buildLibdbConEntry	482
11.0.11 defun buildLibOps	484
11.0.12 defun buildLibOp	484
11.0.13 defun buildLibAttrs	485
11.0.14 defun buildLibAttr	485
11.0.15 defun screenLocalLine	486
12 Comment Syntax Checking	487
12.1 Comment Checking Layer 0 – API	492
12.1.1 defun finalizeDocumentation	492
12.2 Comment Checking Layer 1	495
12.2.1 defun transDocList	495
12.3 Comment Checking Layer 2	496
12.3.1 defun transDoc	496
12.4 Comment Checking Layer 3	497
12.4.1 defun transformAndRecheckComments	497
12.5 Comment Checking Layer 4	498
12.5.1 defun checkComments	498
12.5.2 defun checkRewrite	499
12.6 Comment Checking Layer 5	501
12.6.1 defun checkArguments	501
12.6.2 defun checkBalance	501
12.7 Comment Checking Layer 6	502
12.7.1 defun checkBeginEnd	502
12.7.2 defun checkDecorate	504
12.7.3 defun checkDecorateForHt	506
12.7.4 defun checkDocError1	507
12.7.5 defun checkFixCommonProblem	508
12.7.6 defun checkGetLispFunctionName	508
12.7.7 defun checkHTargs	509
12.7.8 defun checkRecordHash	509
12.7.9 defun checkTexht	512
12.7.10 defun checkTransformFirsts	513
12.7.11 defun checkTrim	516
12.8 Comment Checking Layer 7	517
12.8.1 defun checkDocError	517
12.8.2 defun checkRemoveComments	518
12.8.3 defun checkSkipToken	518
12.8.4 defun checkSplit2Words	518
12.9 Comment Checking Layer 8	519
12.9.1 defun checkAddIndented	519
12.9.2 defun checkDocMessage	519
12.9.3 defun checkExtract	520
12.9.4 defun checkGetArgs	521
12.9.5 defun checkGetMargin	522

12.9.6	defun checkGetParse	522
12.9.7	defun checkGetStringBeforeRightBrace	523
12.9.8	defun checkIeEg	523
12.9.9	defun checkIndentedLines	524
12.9.10	defun checkSkipIdentifierToken	525
12.9.11	defun checkSkipOpToken	525
12.9.12	defun checkSplitBrace	525
12.9.13	defun checkTrimCommented	526
12.9.14	defun newString2Words	527
12.10	Comment Checking Layer 9	527
12.10.1	defun checkAddBackSlashes	527
12.10.2	defun checkAddMacros	528
12.10.3	defun checkAddPeriod	529
12.10.4	defun checkAddSpaceSegments	529
12.10.5	defun checkAddSpaces	530
12.10.6	defun checkAlphabetic	531
12.10.7	defun checkIeEgfun	531
12.10.8	defun checkIsValidType	532
12.10.9	defun checkLookForLeftBrace	533
12.10.10	defun checkLookForRightBrace	533
12.10.11	defun checkNumOfArgs	534
12.10.12	defun checkSayBracket	534
12.10.13	defun checkSkipBlanks	534
12.10.14	defun checkSplitBackslash	535
12.10.15	defun checkSplitOn	536
12.10.16	defun checkSplitPunctuation	537
12.10.17	defun firstNonBlankPosition	538
12.10.18	defun getMatchingRightPren	538
12.10.19	defun hasNoVowels	539
12.10.20	defun htcharPosition	539
12.10.21	defun newWordFrom	540
12.10.22	defun removeBackslashes	541
12.10.23	defun whoOwns	541
13	Utility Functions	543
13.0.24	defun translablel	543
13.0.25	defun translablel1	543
13.0.26	defun displayPreCompilationErrors	544
13.0.27	defun bumperrorcount	545
13.0.28	defun parseTranCheckForRecord	545
13.0.29	defun makeSimplePredicateOrNil	546
13.0.30	defun parse-spadstring	546
13.0.31	defun parse-string	546
13.0.32	defun parse-identifier	547
13.0.33	defun parse-number	547
13.0.34	defun parse-keyword	548

13.0.35 defun parse-argument-designator	548
13.0.36 defun print-package	549
13.0.37 defun checkWarning	549
13.0.38 defun tuple2List	549
13.0.39 defmacro pop-stack-1	550
13.0.40 defmacro pop-stack-2	550
13.0.41 defmacro pop-stack-3	551
13.0.42 defmacro pop-stack-4	551
13.0.43 defmacro nth-stack	551
13.0.44 defun Pop-Reduction	552
13.0.45 defun addclose	552
13.0.46 defun blankp	552
13.0.47 defun drop	553
13.0.48 defun escaped	553
13.0.49 defvar \$comblocklist	553
13.0.50 defun fincomblock	553
13.0.51 defun indent-pos	554
13.0.52 defun infixtok	555
13.0.53 defun is-console	555
13.0.54 defun next-tab-loc	555
13.0.55 defun nonblankloc	555
13.0.56 defun parseprint	556
13.0.57 defun skip-to-endif	556
14 The Compiler	557
14.0.58 defvar \$newConlist	557
14.1 Compiling EQ.spad	557
14.2 The top level compiler command	560
14.2.1 defun compiler	562
14.2.2 defun compileSpad2Cmd	565
14.2.3 defun compileSpadLispCmd	568
14.2.4 compilerDoitWithScreenedLisplib	569
14.2.5 defun compilerDoit	570
14.2.6 defun /rq	571
14.2.7 defun /rf	571
14.2.8 defun /RQ,LIB	572
14.2.9 defun /rf-1	572
14.2.10 defun spad	573
14.2.11 defun Interpreter interface to the compiler	576
14.2.12 defun compTopLevel	586
14.2.13 defun print-defun	587
14.2.14 defun def-rename	587
14.2.15 defun compOrCroak	588
14.2.16 defun compOrCroak1	589
14.2.17 defun comp	590
14.2.18 defun compNoStacking	590

14.2.19 defun compNoStacking1	591
14.2.20 defun comp2	591
14.2.21 defun comp3	592
14.2.22 defun applyMapping	593
14.2.23 defun compApply	595
14.2.24 defun compTypeOf	596
14.2.25 defun compColonInside	596
14.2.26 defun compAtom	597
14.2.27 defun compAtomWithModemap	598
14.2.28 defun transImplementation	599
14.2.29 defun convert	600
14.2.30 defun primitiveType	600
14.2.31 defun compSymbol	600
14.2.32 defun compList	602
14.2.33 defun compForm	602
14.2.34 defun compForm1	603
14.2.35 defun compToApply	605
14.2.36 defun compApplication	605
14.2.37 defun getFormModemaps	607
14.2.38 defun eltModemapFilter	608
14.2.39 defun seteltModemapFilter	609
14.2.40 defun compExpressionList	609
14.2.41 defun compForm2	610
14.2.42 defun compForm3	612
14.2.43 defun compFocompFormWithModemap	613
14.2.44 defun substituteIntoFunctorModemap	614
14.2.45 defun compFormPartiallyBottomUp	615
14.2.46 defun compFormMatch	615
14.2.47 defun compUniquely	616
14.2.48 defun compArgumentsAndTryAgain	616
14.2.49 defun compWithMappingMode	617
14.2.50 defun compWithMappingMode1	617
14.2.51 defun extractCodeAndConstructTriple	622
14.2.52 defun hasFormalMapVariable	623
14.2.53 defun argsToSig	623
14.2.54 defun compMakeDeclaration	624
14.2.55 defun modifyModeStack	625
14.2.56 defun Create a list of unbound symbols	625
14.2.57 defun compOrCroak1,compactify	626
14.2.58 defun Compiler/Interpreter interface	627
14.2.59 defun recompile-lib-file-if-necessary	627
14.2.60 defun spad-fixed-arg	627
14.2.61 defun compile-lib-file	628
14.2.62 defun compileFileQuietly	628
14.2.63 defvar \$byConstructors	629
14.2.64 defvar \$constructorsSeen	629

15 Level 1	631
15.0.65 defvar \$current-fragment	631
15.0.66 defun read-a-line	631
16 Level 0	633
16.1 Line Handling	633
16.1.1 Line Buffer	633
16.1.2 defstruct \$line	633
16.1.3 defvar \$current-line	634
16.1.4 defmacro line-clear	634
16.1.5 defun line-print	634
16.1.6 defun line-at-end-p	634
16.1.7 defun line-past-end-p	635
16.1.8 defun line-next-char	635
16.1.9 defun line-advance-char	635
16.1.10 defun line-current-segment	636
16.1.11 defun line-new-line	636
16.1.12 defun next-line	636
16.1.13 defun Advance-Char	637
16.1.14 defun storeblanks	637
16.1.15 defun initial-substring	637
16.1.16 defun get-a-line	638
17 The Chunks	639
18 Index	657

Volume 10: Axiom Algebra: Implementation

1	Implementation	1
1.1	Elementary Functions[?]	1
1.1.1	Rationale for Branch Cuts and Identities	1
1.1.2	Inverse trigonometric functions	3
1.1.3	Inverse hyperbolic functions	4

Volume 10.1: Axiom Algebra: Theory

1	Integration	1
1.1	Rational Functions	2
1.1.1	The full partial-fraction algorithm	2
1.1.2	The Hermite reduction	3
1.1.3	The Rothstein-Trager and Lazard-Rioboo-Trager algorithms	5
1.2	Algebraic Functions	5
1.2.1	The Hermite reduction	6
1.2.2	Simple radical extensions	10
1.2.3	Liouville's Theorem	12
1.2.4	The integral part	12
1.2.5	The logarithmic part	14
1.3	Elementary Functions	16
1.3.1	Differential algebra	17
1.3.2	The Hermite reduction	18
1.3.3	The polynomial reduction	19
1.3.4	The residue criterion	20
1.3.5	The transcendental logarithmic case	22
1.3.6	The transcendental exponential case	23
1.3.7	The transcendental tangent case	24
1.3.8	The algebraic logarithmic case	24
1.3.9	The algebraic exponential case	27
2	Singular Value Decomposition	31
2.1	Singular Value Decomposition Tutorial	31
3	Quaternions	37
	Preface	37
3.1	Quaternions	38
3.2	Vectors, and their Composition	38
3.3	Examples To Chapter 1.	65
3.4	Products And Quotients of Vectors	67
3.5	Examples To Chapter 2.	93
3.6	Interpretations And Transformations	94
3.7	Examples to Chapter 3	124
3.8	Axiom Examples	130
4	Clifford Algebra[?]	133
4.1	Introduction	133
4.2	Clifford Basis Matrix Theory	134
4.3	Calculation of the inverse of a Clifford number	136
4.3.1	Example 1: Clifford (2)	137
4.3.2	Example 2: Clifford (3)	137
4.3.3	Example 3: Clifford (2,2)	139

4.3.4 Conclusion	142
5 Package for Algebraic Function Fields	143
6 Groebner Basis	145
7 Greatest Common Divisor	147
8 Polynomial Factorization	149
9 Cylindrical Algebraic Decomposition	151
10 Pade approximant	153
11 Schwartz-Zippel lemma and testing polynomial identities	155
12 Chinese Remainder Theorem	157
13 Gaussian Elimination	159
14 Diophantine Equations	161
15 Index	167

Volume 10.2: Axiom Algebra: Categories

1	Categories	1
2	Category Layer 1	3
2.0.1	Category (CATEGORY)	3
2.0.2	ArcHyperbolicFunctionCategory (AHYP)	5
2.0.3	ArcTrigonometricFunctionCategory (ATRIG)	7
2.0.4	AttributeRegistry (ATTREG)	10
2.0.5	BasicType (BASTYPE)	14
2.0.6	CoercibleTo (KOERCE)	17
2.0.7	CombinatorialFunctionCategory (CFCAT)	20
2.0.8	ConvertibleTo (KONVERT)	23
2.0.9	ElementaryFunctionCategory (ELEMFUN)	27
2.0.10	Eltable (ELTAB)	29
2.0.11	HyperbolicFunctionCategory (HYPCAT)	32
2.0.12	InnerEvalable (IEVALAB)	35
2.0.13	OpenMath (OM)	39
2.0.14	PartialTranscendentalFunctions (PTRANFN)	42
2.0.15	Patternable (PATAB)	47
2.0.16	PrimitiveFunctionCategory (PRIMCAT)	50
2.0.17	RadicalCategory (RADCAT)	52
2.0.18	RetractableTo (RETRACT)	55
2.0.19	SpecialFunctionCategory (SPFCAT)	60
2.0.20	TrigonometricFunctionCategory (TRIGCAT)	63
2.0.21	Type (TYPE)	66
3	Category Layer 2	69
3.0.22	Aggregate (AGG)	69
3.0.23	CombinatorialOpsCategory (COMBOPC)	73
3.0.24	EltableAggregate (ELTAGG)	76
3.0.25	Evalable (EVALAB)	80
3.0.26	FortranProgramCategory (FORTCAT)	84
3.0.27	FullyRetractableTo (FRETRCT)	87
3.0.28	FullyPatternMatchable (FPATMAB)	92
3.0.29	Logic (LOGIC)	96
3.0.30	PlottablePlaneCurveCategory (PPCURVE)	99
3.0.31	PlottableSpaceCurveCategory (PSCURVE)	103
3.0.32	RealConstant (REAL)	107
3.0.33	SegmentCategory (SEGCAT)	110
3.0.34	SetCategory (SETCAT)	114
3.0.35	TranscendentalFunctionCategory (TRANFUN)	118

4	Category Layer 3	125
4.0.36	AbelianSemiGroup (ABELSG)	125
4.0.37	BlowUpMethodCategory (BLMETCT)	129
4.0.38	DesingTreeCategory (DSTRCAT)	133
4.0.39	FortranFunctionCategory (FORTFN)	138
4.0.40	FortranMatrixCategory (FMC)	143
4.0.41	FortranMatrixFunctionCategory (FMFUN)	147
4.0.42	FortranVectorCategory (FVC)	152
4.0.43	FortranVectorFunctionCategory (FVFUN)	156
4.0.44	FullyEvaluableOver (FEVALAB)	161
4.0.45	FileCategory (FILECAT)	166
4.0.46	Finite (FINITE)	171
4.0.47	FileNameCategory (FNCAT)	175
4.0.48	GradedModule (GRMOD)	179
4.0.49	HomogeneousAggregate (HOAGG)	184
4.0.50	IndexedDirectProductCategory (IDPC)	191
4.0.51	LiouvillianFunctionCategory (LFCAT)	195
4.0.52	Monad (MONAD)	200
4.0.53	NumericalIntegrationCategory (NUMINT)	205
4.0.54	NumericalOptimizationCategory (OPTCAT)	210
4.0.55	OrdinaryDifferentialEquationsSolverCategory (ODECAT)	215
4.0.56	OrderedSet (ORDSET)	219
4.0.57	PartialDifferentialEquationsSolverCategory (PDECAT)	224
4.0.58	PatternMatchable (PATMAB)	229
4.0.59	RealRootCharacterizationCategory (RRCC)	233
4.0.60	SegmentExpansionCategory (SEGXCAT)	238
4.0.61	SemiGroup (SGROUP)	242
4.0.62	SetCategoryWithDegree (SETCATD)	246
4.0.63	SExpressionCategory (SEXCAT)	249
4.0.64	StepThrough (STEP)	255
4.0.65	ThreeSpaceCategory (SPACEC)	259
5	Category Layer 4	271
5.0.66	AbelianMonoid (ABELMON)	271
5.0.67	AffineSpaceCategory (AFSPCAT)	276
5.0.68	BagAggregate (BGAGG)	281
5.0.69	CachableSet (CACHSET)	287
5.0.70	Collection (CLAGG)	291
5.0.71	DifferentialVariableCategory (DVARCAT)	298
5.0.72	ExpressionSpace (ES)	304
5.0.73	GradedAlgebra (GRALG)	317
5.0.74	IndexedAggregate (IXAGG)	322
5.0.75	MonadWithUnit (MONADWU)	329
5.0.76	Monoid (MONOID)	335
5.0.77	OrderedFinite (ORDFIN)	340
5.0.78	PlacesCategory (PLACESC)	344

5.0.79	ProjectiveSpaceCategory (PRSPCAT)	349
5.0.80	RecursiveAggregate (RCAGG)	355
5.0.81	TwoDimensionalArrayCategory (ARR2CAT)	361
6	Category Layer 5	375
6.0.82	BinaryRecursiveAggregate (BRAGG)	376
6.0.83	CancellationAbelianMonoid (CABMON)	384
6.0.84	DictionaryOperations (DIOPS)	389
6.0.85	DoublyLinkedAggregate (DLAGG)	396
6.0.86	Group (GROUP)	402
6.0.87	LinearAggregate (LNAGG)	408
6.0.88	MatrixCategory (MATCAT)	416
6.0.89	OrderedAbelianSemiGroup (OASGP)	460
6.0.90	OrderedMonoid (ORDMON)	465
6.0.91	PolynomialSetCategory (PSETCAT)	469
6.0.92	PriorityQueueAggregate (PRQAGG)	484
6.0.93	QueueAggregate (QUAGG)	490
6.0.94	SetAggregate (SETAGG)	496
6.0.95	StackAggregate (SKAGG)	504
6.0.96	UnaryRecursiveAggregate (URAGG)	510
7	Category Layer 6	523
7.0.97	AbelianGroup (ABELGRP)	524
7.0.98	BinaryTreeCategory (BTCAT)	530
7.0.99	Dictionary (DIAGG)	537
7.0.100	DequeueAggregate (DQAGG)	544
7.0.101	ExtensibleLinearAggregate (ELAGG)	551
7.0.102	FiniteLinearAggregate (FLAGG)	559
7.0.103	FreeAbelianMonoidCategory (FAMONC)	568
7.0.104	MultiDictionary (MDAGG)	574
7.0.105	OrderedAbelianMonoid (OAMON)	580
7.0.106	PermutationCategory (PERMCAT)	584
7.0.107	StreamAggregate (STAGG)	590
7.0.108	TriangularSetCategory (TSETCAT)	600
8	Category Layer 7	619
8.0.109	FiniteDivisorCategory (FDIVCAT)	620
8.0.110	FiniteSetAggregate (FSAGG)	625
8.0.111	KeyedDictionary (KDAGG)	634
8.0.112	LazyStreamAggregate (LZSTAGG)	641
8.0.113	LeftModule (LMODULE)	659
8.0.114	ListAggregate (LSAGG)	663
8.0.115	MultisetAggregate (MSETAGG)	677
8.0.116	NonAssociativeRng (NARNG)	683
8.0.117	OneDimensionalArrayAggregate (A1AGG)	688
8.0.118	OrderedCancellationAbelianMonoid (OCAMON)	700

8.0.119 RegularTriangularSetCategory (RSETCAT)	704
8.0.120 RightModule (RMODULE)	719
8.0.121 Rng (RNG)	723
9 Category Layer 8	729
9.0.122 BiModule (BMODULE)	730
9.0.123 BitAggregate (BTAGG)	735
9.0.124 NonAssociativeRing (NASRING)	744
9.0.125 NormalizedTriangularSetCategory (NTSCAT)	749
9.0.126 OrderedAbelianGroup (OAGROUP)	759
9.0.127 OrderedAbelianMonoidSup (OAMONS)	763
9.0.128 OrderedMultisetAggregate (OMSAGG)	767
9.0.129 Ring (RING)	774
9.0.130 SquareFreeRegularTriangularSetCategory (SFRTCAT)	779
9.0.131 StringAggregate (SRAGG)	790
9.0.132 TableAggregate (TBAGG)	801
9.0.133 VectorCategory (VECTCAT)	812
10 Category Layer 9	823
10.0.134 AssociationListAggregate (ALAGG)	823
10.0.135 CharacteristicNonZero (CHARNZ)	837
10.0.136 CharacteristicZero (CHARZ)	842
10.0.137 CommutativeRing (COMRING)	847
10.0.138 DifferentialRing (DIFRING)	852
10.0.139 EntireRing (ENTIRER)	857
10.0.140 FreeModuleCat (FMCAT)	862
10.0.141 LeftAlgebra (LALG)	868
10.0.142 LinearlyExplicitRingOver (LINEXP)	873
10.0.143 Module (MODULE)	878
10.0.144 OrderedRing (ORDRING)	883
10.0.145 PartialDifferentialRing (PDRING)	889
10.0.146 PointCategory (PTCAT)	897
10.0.147 RectangularMatrixCategory (RMATCAT)	905
10.0.148 SquareFreeNormalizedTriangularSetCategory (SNTSCAT)	914
10.0.149 StringCategory (STRICAT)	924
10.0.150 UnivariateSkewPolynomialCategory (OREPCAT)	933
10.0.151 KAlgebra (XALG)	944
11 Category Layer 10	951
11.0.152 Algebra (ALGEBRA)	951
11.0.153 DifferentialExtension (DIFEXT)	957
11.0.154 FullyLinearlyExplicitRingOver (FLINEXP)	964
11.0.155 LieAlgebra (LIECAT)	970
11.0.156 LinearOrdinaryDifferentialOperatorCategory (LODOCAT)	975
11.0.157 NonAssociativeAlgebra (NAALG)	984
11.0.158 VectorSpace (VSPACE)	991

11.0.15	X FreeAlgebra (XFALG)	996
12	Category Layer 11	1005
12.0.16	D irectProductCategory (DIRPCAT)	1005
12.0.16	D ivisionRing (DIVRING)	1017
12.0.16	F initeRankNonAssociativeAlgebra (FINAALG)	1023
12.0.16	F reeLieAlgebra (FLALG)	1045
12.0.16	I ntegralDomain (INTDOM)	1051
12.0.16	M onogenicLinearOperator (MLO)	1057
12.0.16	O ctonionCategory (OC)	1063
12.0.16	Q uaternionCategory (QUATCAT)	1075
12.0.16	S quareMatrixCategory (SMATCAT)	1086
12.0.16	X PolynomialsCat (XPOLYC)	1098
13	Category Layer 12	1105
13.0.17	A belianMonoidRing (AMR)	1105
13.0.17	F ortranMachineTypeCategory (FMTC)	1112
13.0.17	F ramedNonAssociativeAlgebra (FRNAALG)	1119
13.0.17	G cdDomain (GCDDOM)	1133
13.0.17	O rderedIntegralDomain (OINTDOM)	1139
14	Category Layer 13	1145
14.0.17	F initeAbelianMonoidRing (FAMR)	1145
14.0.17	I ntervalCategory (INTCAT)	1154
14.0.17	P owerSeriesCategory (PSCAT)	1163
14.0.17	P rincipalIdealDomain (PID)	1170
14.0.17	U niqueFactorizationDomain (UFD)	1176
15	Category Layer 14	1183
15.0.18	D ivisorCategory (DIVCAT)	1183
15.0.18	E uclideanDomain (EUCDOM)	1189
15.0.18	M ultivariateTaylorSeriesCategory (MTSCAT)	1197
15.0.18	P olynomialFactorizationExplicit (PFECAT)	1206
15.0.18	U nivariatePowerSeriesCategory (UPSCAT)	1214
16	Category Layer 15	1225
16.0.18	F ield (FIELD)	1225
16.0.18	I ntegerNumberSystem (INS)	1232
16.0.18	L ocalPowerSeriesCategory (LOCPOWC)	1243
16.0.18	P AdicIntegerCategory (PADICCT)	1253
16.0.18	P olynomialCategory (POLYCAT)	1259
16.0.19	U nivariateTaylorSeriesCategory (UTSCAT)	1281

17 Category Layer 16	1297
17.0.191AlgebraicallyClosedField (ACF)	1297
17.0.192DifferentialPolynomialCategory (DPOLCAT)	1310
17.0.193FieldOfPrimeCharacteristic (FPC)	1327
17.0.194FiniteRankAlgebra (FINRALG)	1334
17.0.195FunctionSpace (FS)	1340
17.0.196InfinitelyClosePointCategory (INFCLCT)	1368
17.0.197PseudoAlgebraicClosureOfPerfectFieldCategory (PACPERC)	1374
17.0.198QuotientFieldCategory (QFCAT)	1380
17.0.199RealClosedField (RCFIELD)	1394
17.0.200RealNumberSystem (RNS)	1405
17.0.201RecursivePolynomialCategory (RPOLCAT)	1413
17.0.202UnivariateLaurentSeriesCategory (ULSCAT)	1452
17.0.203UnivariatePuisseuxSeriesCategory (UPXSCAT)	1464
17.0.204UnivariatePolynomialCategory (UPOLYC)	1475
18 Category Layer 17	1499
18.0.205AlgebraicallyClosedFunctionSpace (ACFS)	1499
18.0.206ExtensionField (XF)	1514
18.0.207FiniteFieldCategory (FFIELD C)	1522
18.0.208FloatingPointSystem (FPS)	1534
18.0.209FramedAlgebra (FRAMALG)	1543
18.0.210PseudoAlgebraicClosureOfFiniteFieldCategory (PACFFC)	1550
18.0.211UnivariateLaurentSeriesConstructorCategory (ULSCCAT)	1557
18.0.212UnivariatePuisseuxSeriesConstructorCategory (UPXSCCA)	1574
19 Category Layer 18	1587
19.0.213FiniteAlgebraicExtensionField (FAXF)	1587
19.0.214MonogenicAlgebra (MONOGEN)	1602
19.0.215PseudoAlgebraicClosureOfRationalNumberCategory (PACRATC)	1614
20 Category Layer 19	1623
20.0.216ComplexCategory (COMPCAT)	1623
20.0.217FunctionFieldCategory (FFCAT)	1646
20.0.218PseudoAlgebraicClosureOfAlgExtOfRationalNumberCategory (PACEXTC)	1669
21 The bootstrap code	1679
21.1 ABELGRP.lsp BOOTSTRAP	1679
21.2 ABELGRP-.lsp BOOTSTRAP	1680
21.3 ABELMON.lsp BOOTSTRAP	1682
21.4 ABELMON-.lsp BOOTSTRAP	1683
21.5 ABELSG.lsp BOOTSTRAP	1684
21.6 ABELSG-.lsp BOOTSTRAP	1685
21.7 ALAGG.lsp BOOTSTRAP	1687
21.8 CABMON.lsp BOOTSTRAP	1688
21.9 CLAGG.lsp BOOTSTRAP	1689

21.10CLAGG-.lsp BOOTSTRAP	1691
21.11COMRING.lsp BOOTSTRAP	1695
21.12DIFRING.lsp BOOTSTRAP	1696
21.13DIFRING-.lsp BOOTSTRAP	1697
21.14DIVRING.lsp BOOTSTRAP	1699
21.15DIVRING-.lsp BOOTSTRAP	1700
21.16ES.lsp BOOTSTRAP	1702
21.17ES-.lsp BOOTSTRAP	1704
21.18EUCDOM.lsp BOOTSTRAP	1720
21.18.1 The Lisp Implementation	1720
21.19EUCDOM-.lsp BOOTSTRAP	1723
21.19.1 The Lisp Implementation	1723
21.20ENTIRER.lsp BOOTSTRAP	1736
21.21FFIELD.lsp BOOTSTRAP	1737
21.22FFIELD-.lsp BOOTSTRAP	1738
21.23FPS.lsp BOOTSTRAP	1749
21.24FPS-.lsp BOOTSTRAP	1751
21.25GCDDOM.lsp BOOTSTRAP	1753
21.26GCDDOM-.lsp BOOTSTRAP	1754
21.27HOAGG.lsp BOOTSTRAP	1759
21.28HOAGG-.lsp BOOTSTRAP	1761
21.29INS.lsp BOOTSTRAP	1767
21.30INS-.lsp BOOTSTRAP	1769
21.31INTDOM.lsp BOOTSTRAP	1777
21.32INTDOM-.lsp BOOTSTRAP	1778
21.33LNAGG.lsp BOOTSTRAP	1780
21.34LNAGG-.lsp BOOTSTRAP	1782
21.35LSAGG.lsp BOOTSTRAP	1784
21.36LSAGG-.lsp BOOTSTRAP	1785
21.37MONOID.lsp BOOTSTRAP	1802
21.38MONOID-.lsp BOOTSTRAP	1803
21.39MTSCAT.lsp BOOTSTRAP	1805
21.40OINTDOM.lsp BOOTSTRAP	1807
21.41ORDRING.lsp BOOTSTRAP	1808
21.42ORDRING-.lsp BOOTSTRAP	1809
21.43POLYCAT.lsp BOOTSTRAP	1811
21.44POLYCAT-.lsp BOOTSTRAP	1813
21.45PSETCAT.lsp BOOTSTRAP	1844
21.46PSETCAT-.lsp BOOTSTRAP	1846
21.47QFCAT.lsp BOOTSTRAP	1863
21.48QFCAT-.lsp BOOTSTRAP	1865
21.49RCAGG.lsp BOOTSTRAP	1873
21.50RCAGG-.lsp BOOTSTRAP	1875
21.51RING.lsp BOOTSTRAP	1876
21.52RING-.lsp BOOTSTRAP	1877
21.53RNG.lsp BOOTSTRAP	1879

21.54RNS.lsp BOOTSTRAP	1879
21.55RNS-.lsp BOOTSTRAP	1881
21.56SETAGG.lsp BOOTSTRAP	1885
21.57SETAGG-.lsp BOOTSTRAP	1886
21.58SETCAT.lsp BOOTSTRAP	1888
21.59SETCAT-.lsp BOOTSTRAP	1889
21.60STAGG.lsp BOOTSTRAP	1890
21.61STAGG-.lsp BOOTSTRAP	1891
21.62TSETCAT.lsp BOOTSTRAP	1898
21.63TSETCAT-.lsp BOOTSTRAP	1901
21.64UFD.lsp BOOTSTRAP	1921
21.65UFD-.lsp BOOTSTRAP	1922
21.66ULSCAT.lsp BOOTSTRAP	1925
21.67UPOLYC.lsp BOOTSTRAP	1926
21.68UPOLYC-.lsp BOOTSTRAP	1930
21.69URAGG.lsp BOOTSTRAP	1957
21.70URAGG-.lsp BOOTSTRAP	1959
22 Chunk collections	1975

Volume 10.3: Axiom Algebra: Domains

1	Chapter Overview	1
2	Chapter A	3
2.1	domain AFFPL AffinePlane	3
2.1.1	AffinePlane (AFFPL)	4
2.2	domain AFFPLPS AffinePlaneOverPseudoAlgebraicClosureOfFiniteField . .	5
2.2.1	AffinePlaneOverPseudoAlgebraicClosureOfFiniteField (AFFPLPS) . .	7
2.3	domain AFFSP AffineSpace	8
2.3.1	AffineSpace (AFFSP)	9
2.4	domain ALGSC AlgebraGivenByStructuralConstants	12
2.4.1	AlgebraGivenByStructuralConstants (ALGSC)	14
2.5	domain ALGFF AlgebraicFunctionField	23
2.5.1	AlgebraicFunctionField (ALGFF)	27
2.6	domain AN AlgebraicNumber	32
2.6.1	AlgebraicNumber (AN)	35
2.7	domain ANON AnonymousFunction	37
2.7.1	AnonymousFunction (ANON)	38
2.8	domain ANTISYM AntiSymm	38
2.8.1	AntiSymm (ANTISYM)	40
2.9	domain ANY Any	45
2.9.1	Any (ANY)	50
2.10	domain ASTACK ArrayStack	52
2.10.1	ArrayStack (ASTACK)	65
2.11	domain ASP1 Asp1	70
2.11.1	Asp1 (ASP1)	71
2.12	domain ASP10 Asp10	73
2.12.1	Asp10 (ASP10)	75
2.13	domain ASP12 Asp12	78
2.13.1	Asp12 (ASP12)	79
2.14	domain ASP19 Asp19	81
2.14.1	Asp19 (ASP19)	82
2.15	domain ASP20 Asp20	88
2.15.1	Asp20 (ASP20)	89
2.16	domain ASP24 Asp24	93
2.16.1	Asp24 (ASP24)	95
2.17	domain ASP27 Asp27	97
2.17.1	Asp27 (ASP27)	99
2.18	domain ASP28 Asp28	101
2.18.1	Asp28 (ASP28)	102
2.19	domain ASP29 Asp29	107
2.19.1	Asp29 (ASP29)	108
2.20	domain ASP30 Asp30	110
2.20.1	Asp30 (ASP30)	111

2.21	domain ASP31 Asp31	114
2.21.1	Asp31 (ASP31)	115
2.22	domain ASP33 Asp33	119
2.22.1	Asp33 (ASP33)	120
2.23	domain ASP34 Asp34	121
2.23.1	Asp34 (ASP34)	123
2.24	domain ASP35 Asp35	125
2.24.1	Asp35 (ASP35)	127
2.25	domain ASP4 Asp4	131
2.25.1	Asp4 (ASP4)	132
2.26	domain ASP41 Asp41	135
2.26.1	Asp41 (ASP41)	136
2.27	domain ASP42 Asp42	141
2.27.1	Asp42 (ASP42)	142
2.28	domain ASP49 Asp49	147
2.28.1	Asp49 (ASP49)	149
2.29	domain ASP50 Asp50	152
2.29.1	Asp50 (ASP50)	153
2.30	domain ASP55 Asp55	157
2.30.1	Asp55 (ASP55)	158
2.31	domain ASP6 Asp6	163
2.31.1	Asp6 (ASP6)	164
2.32	domain ASP7 Asp7	168
2.32.1	Asp7 (ASP7)	169
2.33	domain ASP73 Asp73	172
2.33.1	Asp73 (ASP73)	174
2.34	domain ASP74 Asp74	177
2.34.1	Asp74 (ASP74)	178
2.35	domain ASP77 Asp77	183
2.35.1	Asp77 (ASP77)	184
2.36	domain ASP78 Asp78	187
2.36.1	Asp78 (ASP78)	189
2.37	domain ASP8 Asp8	192
2.37.1	Asp8 (ASP8)	193
2.38	domain ASP80 Asp80	196
2.38.1	Asp80 (ASP80)	197
2.39	domain ASP9 Asp9	201
2.39.1	Asp9 (ASP9)	202
2.40	domain JORDAN AssociatedJordanAlgebra	205
2.40.1	AssociatedJordanAlgebra (JORDAN)	208
2.41	domain LIE AssociatedLieAlgebra	211
2.41.1	AssociatedLieAlgebra (LIE)	213
2.42	domain ALIST AssociationList	216
2.42.1	AssociationList (ALIST)	220
2.43	domain ATTRBUT AttributeButtons	223
2.43.1	AttributeButtons (ATTRBUT)	224

2.44	domain AUTOMOR Automorphism	229
2.44.1	Automorphism (AUTOMOR)	230
3	Chapter B	233
3.1	domain BBTREE BalancedBinaryTree	233
3.1.1	BalancedBinaryTree (BBTREE)	236
3.2	domain BPADIC BalancedPAdicInteger	240
3.2.1	BalancedPAdicInteger (BPADIC)	242
3.3	domain BPADICRT BalancedPAdicRational	243
3.3.1	BalancedPAdicRational (BPADICRT)	246
3.4	domain BFUNCT BasicFunctions	248
3.4.1	BasicFunctions (BFUNCT)	249
3.5	domain BOP BasicOperator	251
3.5.1	BasicOperator (BOP)	258
3.6	domain BSD BasicStochasticDifferential	262
3.6.1	BasicStochasticDifferential (BSD)	270
3.7	domain BINARY BinaryExpansion	272
3.7.1	BinaryExpansion (BINARY)	276
3.8	domain BINFILE BinaryFile	278
3.8.1	BinaryFile (BINFILE)	279
3.9	domain BSTREE BinarySearchTree	282
3.9.1	BinarySearchTree (BSTREE)	287
3.10	domain BTOURN BinaryTournament	289
3.10.1	BinaryTournament (BTOURN)	291
3.11	domain BTREE BinaryTree	292
3.11.1	BinaryTree (BTREE)	294
3.12	domain BITS Bits	296
3.12.1	Bits (BITS)	299
3.13	domain BLHN BlowUpWithHamburgerNoether	300
3.13.1	BlowUpWithHamburgerNoether (BLHN)	301
3.14	domain BLQT BlowUpWithQuadTrans	302
3.14.1	BlowUpWithQuadTrans (BLQT)	304
3.15	domain BOOLEAN Boolean	305
3.15.1	Boolean (BOOLEAN)	306
4	Chapter C	311
4.1	domain CARD CardinalNumber	311
4.1.1	CardinalNumber (CARD)	318
4.2	domain CARTEN CartesianTensor	322
4.2.1	CartesianTensor (CARTEN)	342
4.3	domain CHAR Character	354
4.3.1	Character (CHAR)	359
4.4	domain CCLASS CharacterClass	362
4.4.1	CharacterClass (CCLASS)	367
4.5	domain CLIF CliffordAlgebra[?, ?]	371
4.5.1	Vector (linear) spaces	371

4.5.2	Quadratic Forms[?]	372
4.5.3	Quadratic spaces, Clifford Maps[?, ?]	372
4.5.4	Universal Clifford algebras[?]	372
4.5.5	Real Clifford algebras $\mathbb{R}_{p,q}$ [?]	373
4.5.6	Notation for integer sets	373
4.5.7	Frames for Clifford algebras[?, ?, ?]	373
4.5.8	Real frame groups[?, ?]	373
4.5.9	Canonical products[?, ?, ?]	374
4.5.10	Clifford algebra of frame group[?, ?, ?, ?]	374
4.5.11	Neutral matrix representations[?, ?, ?]	375
4.5.12	CliffordAlgebra (CLIF)	388
4.6	domain COLOR Color	392
4.6.1	Color (COLOR)	394
4.7	domain COMM Commutator	396
4.7.1	Commutator (COMM)	397
4.8	domain COMPLEX Complex	399
4.8.1	Complex (COMPLEX)	405
4.9	domain CDFMAT ComplexDoubleFloatMatrix	409
4.9.1	ComplexDoubleFloatMatrix (CDFMAT)	413
4.10	domain CDFVEC ComplexDoubleFloatVector	415
4.10.1	ComplexDoubleFloatVector (CDFVEC)	419
4.11	domain CONTFRAC ContinuedFraction	420
4.11.1	ContinuedFraction (CONTFRAC)	432
5	Chapter D	441
5.1	domain DBASE Database	441
5.1.1	Database (DBASE)	442
5.2	domain DLIST DataList	444
5.2.1	DataList (DLIST)	447
5.3	domain DECIMAL DecimalExpansion	449
5.3.1	DecimalExpansion (DECIMAL)	453
5.4	Denavit-Hartenberg Matrices	455
5.4.1	Homogeneous Transformations	455
5.4.2	Notation	455
5.4.3	Vectors	456
5.4.4	Planes	457
5.4.5	Transformations	459
5.4.6	Translation Transformation	459
5.4.7	Rotation Transformations	461
5.4.8	Coordinate Frames	465
5.4.9	Relative Transformations	465
5.4.10	Objects	466
5.4.11	Inverse Transformations	467
5.4.12	General Rotation Transformation	467
5.4.13	Equivalent Angle and Axis of Rotation	470
5.4.14	Example 1.1	473

5.4.15	Stretching and Scaling	474
5.4.16	Perspective Transformations	475
5.4.17	Transform Equations	477
5.4.18	Summary	478
5.4.19	DenavitHartenbergMatrix (DHMATRIX)	478
5.5	domain DEQUEUE Dequeue	481
5.5.1	Dequeue (DEQUEUE)	499
5.6	domain DERHAM DeRhamComplex	505
5.6.1	DeRhamComplex (DERHAM)	517
5.7	domain DSTREE DesingTree	520
5.7.1	DesingTree (DSTREE)	522
5.8	domain DSMP DifferentialSparseMultivariatePolynomial	524
5.8.1	DifferentialSparseMultivariatePolynomial (DSMP)	528
5.9	domain DIRPROD DirectProduct	530
5.9.1	DirectProduct (DIRPROD)	534
5.10	domain DPMM DirectProductMatrixModule	537
5.10.1	DirectProductMatrixModule (DPMM)	540
5.11	domain DPMO DirectProductModule	541
5.11.1	DirectProductModule (DPMO)	544
5.12	domain DIRRING DirichletRing	546
5.12.1	DirichletRing (DIRRING)	551
5.13	domain DMP DistributedMultivariatePolynomial	554
5.13.1	DistributedMultivariatePolynomial (DMP)	559
5.14	domain DIV Divisor	561
5.14.1	Divisor (DIV)	563
5.15	domain DFLOAT DoubleFloat	566
5.15.1	DoubleFloat (DFLOAT)	574
5.16	domain DFMAT DoubleFloatMatrix	582
5.16.1	DoubleFloatMatrix (DFMAT)	586
5.17	domain DFVEC DoubleFloatVector	588
5.17.1	DoubleFloatVector (DFVEC)	592
5.18	domain DROPT DrawOption	594
5.18.1	DrawOption (DROPT)	595
5.19	domain D01AJFA d01ajfAnnaType	600
5.19.1	d01ajfAnnaType (D01AJFA)	602
5.20	domain D01AKFA d01akfAnnaType	603
5.20.1	d01akfAnnaType (D01AKFA)	605
5.21	domain D01ALFA d01alfAnnaType	606
5.21.1	d01alfAnnaType (D01ALFA)	608
5.22	domain D01AMFA d01amfAnnaType	610
5.22.1	d01amfAnnaType (D01AMFA)	611
5.23	domain D01ANFA d01anfAnnaType	613
5.23.1	d01anfAnnaType (D01ANFA)	614
5.24	domain D01APFA d01apfAnnaType	616
5.24.1	d01apfAnnaType (D01APFA)	617
5.25	domain D01AQFA d01aqfAnnaType	619

5.25.1	d01aqfAnnaType (D01AQFA)	620
5.26	domain D01ASFA d01asfAnnaType	622
5.26.1	d01asfAnnaType (D01ASFA)	624
5.27	domain D01FCFA d01fcfAnnaType	626
5.27.1	d01fcfAnnaType (D01FCFA)	627
5.28	domain D01GBFA d01gbfAnnaType	629
5.28.1	d01gbfAnnaType (D01GBFA)	630
5.29	domain D01TRNS d01TransformFunctionType	632
5.29.1	d01TransformFunctionType (D01TRNS)	633
5.30	domain D02BBFA d02bbfAnnaType	637
5.30.1	d02bbfAnnaType (D02BBFA)	638
5.31	domain D02BHFA d02bhfAnnaType	640
5.31.1	d02bhfAnnaType (D02BHFA)	641
5.32	domain D02CJFA d02cjfAnnaType	644
5.32.1	d02cjfAnnaType (D02CJFA)	645
5.33	domain D02EJFA d02ejfAnnaType	647
5.33.1	d02ejfAnnaType (D02EJFA)	648
5.34	domain D03EEFA d03eefAnnaType	651
5.34.1	d03eefAnnaType (D03EEFA)	652
5.35	domain D03FAFA d03fafAnnaType	654
5.35.1	d03fafAnnaType (D03FAFA)	655
6	Chapter E	657
6.1	domain EQ Equation	657
6.1.1	Equation (EQ)	661
6.2	domain EQTBL EqTable	666
6.2.1	EqTable (EQTBL)	669
6.3	domain EMR EuclideanModularRing	670
6.3.1	EuclideanModularRing (EMR)	672
6.4	domain EXIT Exit	675
6.4.1	Exit (EXIT)	677
6.5	domain EXPEXPAN ExponentialExpansion	678
6.5.1	ExponentialExpansion (EXPEXPAN)	681
6.6	domain EXPR Expression	685
6.6.1	Expression (EXPR)	693
6.7	domain EXPUPXS ExponentialOfUnivariatePuisseuxSeries	705
6.7.1	ExponentialOfUnivariatePuisseuxSeries (EXPUPXS)	709
6.8	domain EAB ExtAlgBasis	712
6.8.1	ExtAlgBasis (EAB)	713
6.9	domain E04DGFA e04dgmAnnaType	715
6.9.1	e04dgmAnnaType (E04DGFA)	717
6.10	domain E04FDFA e04fdfAnnaType	719
6.10.1	e04fdfAnnaType (E04FDFA)	720
6.11	domain E04GCFA e04gcfAnnaType	723
6.11.1	e04gcfAnnaType (E04GCFA)	724
6.12	domain E04JAFA e04jafAnnaType	727

6.12.1	e04jafAnnaType (E04JAFA)	728
6.13	domain E04MBFA e04mbfAnnaType	730
6.13.1	e04mbfAnnaType (E04MBFA)	731
6.14	domain E04NAFA e04nafAnnaType	733
6.14.1	e04nafAnnaType (E04NAFA)	735
6.15	domain E04UCFA e04ucfAnnaType	737
6.15.1	e04ucfAnnaType (E04UCFA)	738
7	Chapter F	743
7.1	domain FR Factored	743
7.1.1	Factored (FR)	756
7.2	domain FILE File	767
7.2.1	File (FILE)	772
7.3	domain FNAME FileName	774
7.3.1	FileName (FNAME)	780
7.4	domain FDIV FiniteDivisor	781
7.4.1	FiniteDivisor (FDIV)	783
7.5	domain FF FiniteField	786
7.5.1	FiniteField (FF)	789
7.6	domain FFCG FiniteFieldCyclicGroup	791
7.6.1	FiniteFieldCyclicGroup (FFCG)	794
7.7	domain FFCGX FiniteFieldCyclicGroupExtension	796
7.7.1	FiniteFieldCyclicGroupExtension (FFCGX)	799
7.8	domain FFCGP FiniteFieldCyclicGroupExtensionByPolynomial	801
7.8.1	FiniteFieldCyclicGroupExtensionByPolynomial (FFCGP)	804
7.9	domain FFX FiniteFieldExtension	812
7.9.1	FiniteFieldExtension (FFX)	815
7.10	domain FFP FiniteFieldExtensionByPolynomial	817
7.10.1	FiniteFieldExtensionByPolynomial (FFP)	820
7.11	domain FFNB FiniteFieldNormalBasis	826
7.11.1	FiniteFieldNormalBasis (FFNB)	829
7.12	domain FFNBX FiniteFieldNormalBasisExtension	832
7.12.1	FiniteFieldNormalBasisExtension (FFNBX)	835
7.13	domain FFNBP FiniteFieldNormalBasisExtensionByPolynomial	838
7.13.1	FiniteFieldNormalBasisExtensionByPolynomial (FFNBP)	841
7.14	domain FARRAY FlexibleArray	850
7.14.1	FlexibleArray (FARRAY)	856
7.15	domain FLOAT Float	857
7.15.1	Float (FLOAT)	878
7.16	domain FC FortranCode	899
7.16.1	FortranCode (FC)	901
7.17	domain FEXPR FortranExpression	914
7.17.1	FortranExpression (FEXPR)	917
7.18	domain FORTRAN FortranProgram	925
7.18.1	FortranProgram (FORTRAN)	926
7.19	domain FST FortranScalarType	931

7.19.1	FortranScalarType (FST)	932
7.20	domain FTEM FortranTemplate	936
7.20.1	FortranTemplate (FTEM)	937
7.21	domain FT FortranType	940
7.21.1	FortranType (FT)	941
7.22	domain FCOMP FourierComponent	944
7.22.1	FourierComponent (FCOMP)	945
7.23	domain FSERIES FourierSeries	946
7.23.1	FourierSeries (FSERIES)	948
7.24	domain FRAC Fraction	950
7.24.1	Fraction (FRAC)	956
7.25	domain FRIDEAL FractionalIdeal	963
7.25.1	FractionalIdeal (FRIDEAL)	965
7.26	domain FRMOD FramedModule	969
7.26.1	FramedModule (FRMOD)	970
7.27	domain FAGROUP FreeAbelianGroup	973
7.27.1	FreeAbelianGroup (FAGROUP)	974
7.28	domain FAMONOID FreeAbelianMonoid	976
7.28.1	FreeAbelianMonoid (FAMONOID)	977
7.29	domain FGROUPE FreeGroup	978
7.29.1	FreeGroup (FGROUPE)	980
7.30	domain FM FreeModule	982
7.30.1	FreeModule (FM)	983
7.31	domain FM1 FreeModule1	985
7.31.1	FreeModule1 (FM1)	987
7.32	domain FMONOID FreeMonoid	989
7.32.1	FreeMonoid (FMONOID)	991
7.33	domain FNLA FreeNilpotentLie	995
7.33.1	FreeNilpotentLie (FNLA)	997
7.34	domain FPARFRAC FullPartialFractionExpansion	1000
7.34.1	FullPartialFractionExpansion (FPARFRAC)	1010
7.35	domain FUNCTION FunctionCalled	1014
7.35.1	FunctionCalled (FUNCTION)	1015
8	Chapter G	1017
8.1	domain GDMP GeneralDistributedMultivariatePolynomial	1017
8.1.1	GeneralDistributedMultivariatePolynomial (GDMP)	1022
8.2	domain GMODPOL GeneralModulePolynomial	1028
8.2.1	GeneralModulePolynomial (GMODPOL)	1029
8.3	domain GCNAALG GenericNonAssociativeAlgebra	1031
8.3.1	GenericNonAssociativeAlgebra (GCNAALG)	1034
8.4	domain GPOLSET GeneralPolynomialSet	1042
8.4.1	GeneralPolynomialSet (GPOLSET)	1044
8.5	domain GSTBL GeneralSparseTable	1046
8.5.1	GeneralSparseTable (GSTBL)	1048
8.6	domain GTSET GeneralTriangularSet	1050

8.6.1	GeneralTriangularSet (GTSET)	1053
8.7	domain GSERIES GeneralUnivariatePowerSeries	1057
8.7.1	GeneralUnivariatePowerSeries (GSERIES)	1060
8.8	domain GRIMAGE GraphImage	1064
8.8.1	GraphImage (GRIMAGE)	1065
8.9	domain GOPT GuessOption	1074
8.9.1	GuessOption (GOPT)	1075
8.10	domain GOPT0 GuessOptionFunctions0	1079
8.10.1	GuessOptionFunctions0 (GOPT0)	1081
9	Chapter H	1087
9.1	domain HASHTBL HashTable	1087
9.1.1	HashTable (HASHTBL)	1089
9.2	domain HEAP Heap	1091
9.2.1	Heap (HEAP)	1104
9.3	domain HEXADEC HexadecimalExpansion	1109
9.3.1	HexadecimalExpansion (HEXADEC)	1112
9.4	package HTMLFORM HTMLFormat	1114
9.4.1	Overview	1115
9.4.2	Why output to HTML?	1115
9.5	Using the formatter	1115
9.6	Form of the output	1116
9.7	Matrix Formatting	1116
9.8	Programmers Guide	1117
9.8.1	Future Developments	1117
9.8.2	HTMLFormat (HTMLFORM)	1122
9.9	domain HDP HomogeneousDirectProduct	1139
9.9.1	HomogeneousDirectProduct (HDP)	1142
9.10	domain HDMP HomogeneousDistributedMultivariatePolynomial	1144
9.10.1	HomogeneousDistributedMultivariatePolynomial (HDMP)	1149
9.11	domain HELLFDIV HyperellipticFiniteDivisor	1151
9.11.1	HyperellipticFiniteDivisor (HELLFDIV)	1153
10	Chapter I	1159
10.1	domain ICP InfClsPt	1159
10.1.1	InfClsPt (ICP)	1160
10.2	domain ICARD IndexCard	1162
10.2.1	IndexCard (ICARD)	1163
10.3	domain IBITS IndexedBits	1165
10.3.1	IndexedBits (IBITS)	1169
10.4	domain IDPAG IndexedDirectProductAbelianGroup	1171
10.4.1	IndexedDirectProductAbelianGroup (IDPAG)	1172
10.5	domain IDPAM IndexedDirectProductAbelianMonoid	1174
10.5.1	IndexedDirectProductAbelianMonoid (IDPAM)	1175
10.6	domain IDPO IndexedDirectProductObject	1178
10.6.1	IndexedDirectProductObject (IDPO)	1179

10.7 domain IDPOAM IndexedDirectProductOrderedAbelianMonoid	1180
10.7.1 IndexedDirectProductOrderedAbelianMonoid (IDPOAM)	1182
10.8 domain IDPOAMS IndexedDirectProductOrderedAbelianMonoidSup	1183
10.8.1 IndexedDirectProductOrderedAbelianMonoidSup (IDPOAMS)	1184
10.9 domain INDE IndexedExponents	1186
10.9.1 IndexedExponents (INDE)	1187
10.10domain IFARRAY IndexedFlexibleArray	1189
10.10.1 IndexedFlexibleArray (IFARRAY)	1191
10.11domain ILIST IndexedList	1197
10.11.1 IndexedList (ILIST)	1200
10.12domain IMATRIX IndexedMatrix	1205
10.12.1 IndexedMatrix (IMATRIX)	1208
10.13domain IARRAY1 IndexedOneDimensionalArray	1210
10.13.1 IndexedOneDimensionalArray (IARRAY1)	1212
10.14domain ISTRING IndexedString	1215
10.14.1 IndexedString (ISTRING)	1218
10.15domain IARRAY2 IndexedTwoDimensionalArray	1223
10.15.1 IndexedTwoDimensionalArray (IARRAY2)	1225
10.16domain IVECTOR IndexedVector	1226
10.16.1 IndexedVector (IVECTOR)	1229
10.17domain ITUPLE InfiniteTuple	1230
10.17.1 InfiniteTuple (ITUPLE)	1231
10.18domain INFCLSPT InfinitelyClosePoint	1232
10.18.1 InfinitelyClosePoint (INFCLSPT)	1234
10.19domain INFCLSPS InfinitelyClosePointOverPseudoAlgebraicClosureOfFinite- Field	1238
10.19.1 InfinitelyClosePointOverPseudoAlgebraicClosureOfFiniteField (INFCLSPS)	1239
10.20domain IAN InnerAlgebraicNumber	1241
10.20.1 InnerAlgebraicNumber (IAN)	1244
10.21domain IFF InnerFiniteField	1248
10.21.1 InnerFiniteField (IFF)	1251
10.22domain IFAMON InnerFreeAbelianMonoid	1253
10.22.1 InnerFreeAbelianMonoid (IFAMON)	1254
10.23domain IIARRAY2 InnerIndexedTwoDimensionalArray	1256
10.23.1 InnerIndexedTwoDimensionalArray (IIARRAY2)	1258
10.24domain IPADIC InnerPAdicInteger	1260
10.24.1 InnerPAdicInteger (IPADIC)	1262
10.25domain IPF InnerPrimeField	1268
10.25.1 InnerPrimeField (IPF)	1271
10.26domain ISUPS InnerSparseUnivariatePowerSeries	1275
10.26.1 InnerSparseUnivariatePowerSeries (ISUPS)	1278
10.27domain INTABL InnerTable	1301
10.27.1 InnerTable (INTABL)	1303
10.28domain ITAYLOR InnerTaylorSeries	1305
10.28.1 InnerTaylorSeries (ITAYLOR)	1306
10.29domain INFORM InputForm	1309

10.29.1 InputForm (INFORM)	1311
10.30 domain INT Integer	1315
10.30.1 Integer (INT)	1329
10.31 domain ZMOD IntegerMod	1334
10.31.1 IntegerMod (ZMOD)	1335
10.32 domain INTFTBL IntegrationFunctionsTable	1338
10.32.1 IntegrationFunctionsTable (INTFTBL)	1339
10.33 domain IR IntegrationResult	1341
10.33.1 IntegrationResult (IR)	1343
10.34 domain INTRVL Interval	1347
10.34.1 Interval (INTRVL)	1352
11 Chapter J	1363
12 Chapter K	1365
12.1 domain KERNEL Kernel	1365
12.1.1 Kernel (KERNEL)	1372
12.2 domain KAFILE KeyedAccessFile	1375
12.2.1 KeyedAccessFile (KAFILE)	1381
13 Chapter L	1387
13.1 domain LAUPOL LaurentPolynomial	1387
13.1.1 LaurentPolynomial (LAUPOL)	1389
13.2 domain LIB Library	1393
13.2.1 Library (LIB)	1396
13.3 domain LEXP LieExponentials	1398
13.3.1 LieExponentials (LEXP)	1403
13.4 domain LPOLY LiePolynomial	1406
13.4.1 LiePolynomial (LPOLY)	1414
13.5 domain LSQM LieSquareMatrix	1419
13.5.1 LieSquareMatrix (LSQM)	1423
13.6 domain LODO LinearOrdinaryDifferentialOperator	1427
13.6.1 LinearOrdinaryDifferentialOperator (LODO)	1437
13.7 domain LODO1 LinearOrdinaryDifferentialOperator1	1438
13.7.1 LinearOrdinaryDifferentialOperator1 (LODO1)	1447
13.8 domain LODO2 LinearOrdinaryDifferentialOperator2	1448
13.8.1 LinearOrdinaryDifferentialOperator2 (LODO2)	1459
13.9 domain LIST List	1460
13.9.1 List (LIST)	1472
13.10 domain LMOPS ListMonoidOps	1475
13.10.1 ListMonoidOps (LMOPS)	1477
13.11 domain LMDICT ListMultiDictionary	1481
13.11.1 ListMultiDictionary (LMDICT)	1483
13.12 domain LA LocalAlgebra	1486
13.12.1 LocalAlgebra (LA)	1488
13.13 domain LO Localize	1489

13.13.1	Localize (LO)	1491
13.14	domain LWORD LyndonWord	1493
13.14.1	LyndonWord (LWORD)	1500
14	Chapter M	1505
14.1	domain MCMPLX MachineComplex	1505
14.1.1	MachineComplex (MCMPLX)	1510
14.2	domain MFLOAT MachineFloat	1513
14.2.1	MachineFloat (MFLOAT)	1515
14.3	domain MINT MachineInteger	1522
14.3.1	MachineInteger (MINT)	1525
14.4	domain MAGMA Magma	1527
14.4.1	Magma (MAGMA)	1533
14.5	domain MKCHSET MakeCachableSet	1537
14.5.1	MakeCachableSet (MKCHSET)	1538
14.6	domain MMLFORM MathMLFormat	1539
14.6.1	Introduction to Mathematical Markup Language	1540
14.6.2	Displaying MathML	1540
14.6.3	Test Cases	1541
14.6.4	)set output mathml on	1542
14.6.5	File src/interp/setvars.boot.pamphlet	1542
14.6.6	File setvart.boot.pamphlet	1542
14.6.7	File src/algebra/Makefile.pamphlet	1543
14.6.8	File src/algebra/exposed.lsp.pamphlet	1543
14.6.9	File src/algebra/Lattice.pamphlet	1543
14.6.10	File src/doc/axiom.bib.pamphlet	1544
14.6.11	File interp/i-output.boot.pamphlet	1544
14.6.12	Public Declarations	1544
14.6.13	Private Constant Declarations	1546
14.6.14	Private Function Declarations	1547
14.6.15	Public Function Definitions	1549
14.6.16	Private Function Definitions	1551
14.6.17	Mathematical Markup Language Form	1567
14.6.18	MathMLForm (MMLFORM)	1571
14.7	domain MATRIX Matrix	1572
14.7.1	Matrix (MATRIX)	1590
14.8	domain MODMON ModMonic	1595
14.8.1	ModMonic (MODMON)	1599
14.9	domain MODFIELD ModularField	1604
14.9.1	ModularField (MODFIELD)	1606
14.10	domain MODRING ModularRing	1607
14.10.1	ModularRing (MODRING)	1608
14.11	domain MODMONOM ModuleMonomial	1611
14.11.1	ModuleMonomial (MODMONOM)	1612
14.12	domain MODOP ModuleOperator	1613
14.12.1	ModuleOperator (MODOP)	1615

14.13domain MOEBIUS MoebiusTransform	1620
14.13.1 MoebiusTransform (MOEBIUS)	1622
14.14domain MRING MonoidRing	1624
14.14.1 MonoidRing (MRING)	1626
14.15domain MSET Multiset	1633
14.15.1 Multiset (MSET)	1638
14.16domain MPOLY MultivariatePolynomial	1644
14.16.1 MultivariatePolynomial (MPOLY)	1649
14.17domain MYEXPR MyExpression	1651
14.17.1 MyExpression (MYEXPR)	1655
14.18domain MYUP MyUnivariatePolynomial	1657
14.18.1 MyUnivariatePolynomial (MYUP)	1662

15 Chapter N**1665**

15.1 domain NSDPS NeitherSparseOrDensePowerSeries	1665
15.1.1 NeitherSparseOrDensePowerSeries (NSDPS)	1669
15.2 domain NSMP NewSparseMultivariatePolynomial	1676
15.2.1 NewSparseMultivariatePolynomial (NSMP)	1680
15.3 domain NSUP NewSparseUnivariatePolynomial	1690
15.3.1 NewSparseUnivariatePolynomial (NSUP)	1695
15.4 domain NONE None	1702
15.4.1 None (NONE)	1704
15.5 domain NNI NonNegativeInteger	1705
15.5.1 NonNegativeInteger (NNI)	1706
15.6 domain NOTTING NottinghamGroup	1708
15.6.1 NottinghamGroup (NOTTING)	1711
15.7 domain NIPROB NumericalIntegrationProblem	1712
15.7.1 NumericalIntegrationProblem (NIPROB)	1713
15.8 domain ODEPROB NumericalODEProblem	1715
15.8.1 NumericalODEProblem (ODEPROB)	1716
15.9 domain OPTPROB NumericalOptimizationProblem	1718
15.9.1 NumericalOptimizationProblem (OPTPROB)	1719
15.10domain PDEPROB NumericalPDEProblem	1721
15.10.1 NumericalPDEProblem (PDEPROB)	1722

16 Chapter O**1725**

16.1 domain OCT Octonion	1725
16.1.1 Octonion (OCT)	1731
16.2 domain ODEIFTBL ODEIntensityFunctionsTable	1733
16.2.1 ODEIntensityFunctionsTable (ODEIFTBL)	1734
16.3 domain ARRAY1 OneDimensionalArray	1736
16.3.1 OneDimensionalArray (ARRAY1)	1740
16.4 domain ONECOMP OnePointCompletion	1741
16.4.1 OnePointCompletion (ONECOMP)	1743
16.5 domain OMCONN OpenMathConnection	1746
16.5.1 OpenMathConnection (OMCONN)	1747

16.6 domain OMDEV OpenMathDevice	1749
16.6.1 OpenMathDevice (OMDEV)	1750
16.7 domain OMENC OpenMathEncoding	1754
16.7.1 OpenMathEncoding (OMENC)	1755
16.8 domain OMERR OpenMathError	1757
16.8.1 OpenMathError (OMERR)	1758
16.9 domain OMERRK OpenMathErrorKind	1759
16.9.1 OpenMathErrorKind (OMERRK)	1761
16.10 domain OP Operator	1762
16.10.1 Operator (OP)	1770
16.11 domain OMLO OppositeMonogenicLinearOperator	1771
16.11.1 OppositeMonogenicLinearOperator (OMLO)	1773
16.12 domain ORDCOMP OrderedCompletion	1774
16.12.1 OrderedCompletion (ORDCOMP)	1776
16.13 domain ODP OrderedDirectProduct	1780
16.13.1 OrderedDirectProduct (ODP)	1783
16.14 domain OFMONOID OrderedFreeMonoid	1784
16.14.1 OrderedFreeMonoid (OFMONOID)	1795
16.15 domain OVAR OrderedVariableList	1800
16.15.1 OrderedVariableList (OVAR)	1803
16.16 domain ODPOL OrderlyDifferentialPolynomial	1804
16.16.1 OrderlyDifferentialPolynomial (ODPOL)	1817
16.17 domain ODVAR OrderlyDifferentialVariable	1819
16.17.1 OrderlyDifferentialVariable (ODVAR)	1821
16.18 domain ODR OrdinaryDifferentialRing	1822
16.18.1 OrdinaryDifferentialRing (ODR)	1824
16.19 domain OWP OrdinaryWeightedPolynomials	1826
16.19.1 OrdinaryWeightedPolynomials (OWP)	1827
16.20 domain OSI OrdSetInts	1829
16.20.1 OrdSetInts (OSI)	1830
16.21 domain OUTFORM OutputForm	1831
16.21.1 OutputForm (OUTFORM)	1833
17 Chapter P	1845
17.1 domain PADIC PAdicInteger	1845
17.1.1 PAdicInteger (PADIC)	1847
17.2 domain PADICRAT PAdicRational	1848
17.2.1 PAdicRational (PADICRAT)	1851
17.3 domain PADICRC PAdicRationalConstructor	1853
17.3.1 PAdicRationalConstructor (PADICRC)	1856
17.4 domain PALETTE Palette	1861
17.4.1 Palette (PALETTE)	1862
17.5 domain PARPCURV ParametricPlaneCurve	1864
17.5.1 ParametricPlaneCurve (PARPCURV)	1865
17.6 domain PARSCURV ParametricSpaceCurve	1866
17.6.1 ParametricSpaceCurve (PARSCURV)	1867

17.7 domain PARSURF ParametricSurface	1869
17.7.1 ParametricSurface (PARSURF)	1870
17.8 domain PFR PartialFraction	1871
17.8.1 PartialFraction (PFR)	1880
17.9 domain PRTITION Partition	1888
17.9.1 Partition (PRTITION)	1889
17.10domain PATTERN Pattern	1892
17.10.1 Pattern (PATTERN)	1894
17.11domain PATLRES PatternMatchListResult	1902
17.11.1 PatternMatchListResult (PATLRES)	1903
17.12domain PATRES PatternMatchResult	1905
17.12.1 PatternMatchResult (PATRES)	1906
17.13domain PENDTREE PendantTree	1909
17.13.1 PendantTree (PENDTREE)	1911
17.14domain PERM Permutation	1912
17.14.1 Permutation (PERM)	1915
17.15domain PERMGRP PermutationGroup	1924
17.15.1 PermutationGroup (PERMGRP)	1926
17.16domain HACKPI Pi	1941
17.16.1 Pi (HACKPI)	1943
17.17domain ACPLLOT PlaneAlgebraicCurvePlot	1945
17.17.1 PlaneAlgebraicCurvePlot (ACPLLOT)	1958
17.18domain PLACES Places	1983
17.18.1 Places (PLACES)	1984
17.19domain PLACESPS PlacesOverPseudoAlgebraicClosureOfFiniteField	1985
17.19.1 PlacesOverPseudoAlgebraicClosureOfFiniteField (PLACESPS)	1987
17.20domain PLCS Plcs	1988
17.20.1 Plcs (PLCS)	1989
17.21domain PLOT Plot	1992
17.21.1 Plot (PLOT)	1995
17.22domain PLOT3D Plot3D	2007
17.22.1 Plot3D (PLOT3D)	2008
17.23domain PBWLB PoincareBirkhoffWittLyndonBasis	2018
17.23.1 PoincareBirkhoffWittLyndonBasis (PBWLB)	2020
17.24domain POINT Point	2022
17.24.1 Point (POINT)	2025
17.25domain POLY Polynomial	2027
17.25.1 Polynomial (POLY)	2043
17.26domain IDEAL PolynomialIdeals	2045
17.26.1 PolynomialIdeals (IDEAL)	2047
17.27domain PR PolynomialRing	2056
17.27.1 PolynomialRing (PR)	2058
17.28domain PI PositiveInteger	2065
17.28.1 PositiveInteger (PI)	2066
17.29domain PF PrimeField	2067
17.29.1 PrimeField (PF)	2070

17.30domain PRIMARR PrimitiveArray	2072
17.30.1 PrimitiveArray (PRIMARR)	2075
17.31domain PRODUCT Product	2076
17.31.1 Product (PRODUCT)	2078
17.32domain PROJPL ProjectivePlane	2081
17.32.1 ProjectivePlane (PROJPL)	2083
17.33domain PROJPLPS ProjectivePlaneOverPseudoAlgebraicClosureOfFiniteField	2084
17.33.1 ProjectivePlaneOverPseudoAlgebraicClosureOfFiniteField (PROJPLPS)	2085
17.34domain PROJSP ProjectiveSpace	2086
17.34.1 ProjectiveSpace (PROJSP)	2087
17.35domain PACEXT PseudoAlgebraicClosureOfAlgExtOfRationalNumber . . .	2091
17.35.1 PseudoAlgebraicClosureOfAlgExtOfRationalNumber (PACEXT) . . .	2092
17.36domain PACOFF PseudoAlgebraicClosureOfFiniteField	2098
17.36.1 PseudoAlgebraicClosureOfFiniteField (PACOFF)	2101
17.37domain PACRAT PseudoAlgebraicClosureOfRationalNumber	2109
17.37.1 PseudoAlgebraicClosureOfRationalNumber (PACRAT)	2112
18 Chapter Q	2119
18.1 domain QFORM QuadraticForm	2119
18.1.1 QuadraticForm (QFORM)	2120
18.2 domain QALGSET QuasiAlgebraicSet	2122
18.2.1 QuasiAlgebraicSet (QALGSET)	2123
18.3 domain QUAT Quaternion	2127
18.3.1 Quaternion (QUAT)	2132
18.4 domain QEQUAT QueryEquation	2134
18.4.1 QueryEquation (QEQUAT)	2135
18.5 domain QUEUE Queue	2136
18.5.1 Queue (QUEUE)	2150
19 Chapter R	2155
19.1 domain RADFF RadicalFunctionField	2155
19.1.1 RadicalFunctionField (RADFF)	2159
19.2 domain RADIX RadixExpansion	2165
19.2.1 RadixExpansion (RADIX)	2171
19.3 domain RECLOS RealClosure	2177
19.3.1 RealClosure (RECLOS)	2202
19.4 domain RMATRIX RectangularMatrix	2209
19.4.1 RectangularMatrix (RMATRIX)	2211
19.5 domain REF Reference	2214
19.5.1 Reference (REF)	2215
19.6 domain RGCHAIN RegularChain	2217
19.6.1 RegularChain (RGCHAIN)	2220
19.7 domain REGSET RegularTriangularSet	2223
19.7.1 RegularTriangularSet (REGSET)	2251
19.8 domain RESRING ResidueRing	2261
19.8.1 ResidueRing (RESRING)	2262

19.9 domain RESULT Result	2264
19.9.1 Result (RESULT)	2266
19.10domain RULE RewriteRule	2269
19.10.1 RewriteRule (RULE)	2271
19.11domain ROIRC RightOpenIntervalRootCharacterization	2274
19.11.1 RightOpenIntervalRootCharacterization (ROIRC)	2276
19.12domain ROMAN RomanNumeral	2286
19.12.1 RomanNumeral (ROMAN)	2292
19.13domain ROUTINE RoutinesTable	2294
19.13.1 RoutinesTable (ROUTINE)	2297
19.14domain RULECOLD RuleCalled	2306
19.14.1 RuleCalled (RULECOLD)	2307
19.15domain RULESET Ruleset	2308
19.15.1 Ruleset (RULESET)	2309

20 Chapter S**2311**

20.1 domain FORMULA ScriptFormulaFormat	2311
20.1.1 ScriptFormulaFormat (FORMULA)	2312
20.2 domain SEG Segment	2321
20.2.1 Segment (SEG)	2325
20.3 domain SEGBIND SegmentBinding	2327
20.3.1 SegmentBinding (SEGBIND)	2330
20.4 domain SET Set	2331
20.4.1 Set (SET)	2338
20.5 domain SETMN SetOfMIntegersInOneToN	2342
20.5.1 SetOfMIntegersInOneToN (SETMN)	2344
20.6 domain SDPOL SequentialDifferentialPolynomial	2347
20.6.1 SequentialDifferentialPolynomial (SDPOL)	2351
20.7 domain SDVAR SequentialDifferentialVariable	2353
20.7.1 SequentialDifferentialVariable (SDVAR)	2357
20.8 domain SEX SExpression	2359
20.8.1 SExpression (SEX)	2360
20.9 domain SEXOF SExpressionOf	2361
20.9.1 SExpressionOf (SEXOF)	2362
20.10domain SAE SimpleAlgebraicExtension	2364
20.10.1 SimpleAlgebraicExtension (SAE)	2368
20.11domain SFORT SimpleFortranProgram	2372
20.11.1 SimpleFortranProgram (SFORT)	2373
20.12domain SINT SingleInteger	2375
20.12.1 SingleInteger (SINT)	2380
20.13domain SAOS SingletonAsOrderedSet	2385
20.13.1 SingletonAsOrderedSet (SAOS)	2386
20.14domain SMP SparseMultivariatePolynomial	2387
20.14.1 SparseMultivariatePolynomial (SMP)	2390
20.15domain SMTS SparseMultivariateTaylorSeries	2403
20.15.1 SparseMultivariateTaylorSeries (SMTS)	2408

20.16domain STBL SparseTable	2415
20.16.1 SparseTable (STBL)	2418
20.17domain SULS SparseUnivariateLaurentSeries	2419
20.17.1 SparseUnivariateLaurentSeries (SULS)	2424
20.18domain SUP SparseUnivariatePolynomial	2430
20.18.1 SparseUnivariatePolynomial (SUP)	2434
20.19domain SUEXPR SparseUnivariatePolynomialExpressions	2443
20.19.1 SparseUnivariatePolynomialExpressions (SUEXPR)	2448
20.20domain SUPXS SparseUnivariatePuisseuxSeries	2451
20.20.1 SparseUnivariatePuisseuxSeries (SUPXS)	2454
20.21domain ORESUP SparseUnivariateSkewPolynomial	2457
20.21.1 SparseUnivariateSkewPolynomial (ORESUP)	2459
20.22domain SUTS SparseUnivariateTaylorSeries	2461
20.22.1 SparseUnivariateTaylorSeries (SUTS)	2464
20.23domain SHDP SplitHomogeneousDirectProduct	2472
20.23.1 SplitHomogeneousDirectProduct (SHDP)	2476
20.24domain SPLNODE SplittingNode	2478
20.24.1 SplittingNode (SPLNODE)	2479
20.25domain SPLTREE SplittingTree	2483
20.25.1 SplittingTree (SPLTREE)	2485
20.26domain SREGSET SquareFreeRegularTriangularSet	2492
20.26.1 SquareFreeRegularTriangularSet (SREGSET)	2501
20.27domain SQMATRIX SquareMatrix	2511
20.27.1 SquareMatrix (SQMATRIX)	2514
20.28domain STACK Stack	2518
20.28.1 Stack (STACK)	2530
20.29domain SD StochasticDifferential	2535
20.29.1 StochasticDifferential (SD)	2539
20.30domain STREAM Stream	2545
20.30.1 Stream (STREAM)	2549
20.31domain STRING String	2564
20.31.1 String (STRING)	2574
20.32domain STRTBL StringTable	2576
20.32.1 StringTable (STRTBL)	2578
20.33domain SUBSPACE SubSpace	2579
20.33.1 SubSpace (SUBSPACE)	2582
20.34domain COMPPROP SubSpaceComponentProperty	2591
20.34.1 SubSpaceComponentProperty (COMPPROP)	2592
20.35domain SUCH SuchThat	2593
20.35.1 SuchThat (SUCH)	2595
20.36domain SWITCH Switch	2596
20.36.1 Switch (SWITCH)	2597
20.37domain SYMBOL Symbol	2599
20.37.1 Symbol (SYMBOL)	2608
20.38domain SYMTAB SymbolTable	2615
20.38.1 SymbolTable (SYMTAB)	2616

20.39domain SYMPOLY SymmetricPolynomial	2620
20.39.1 SymmetricPolynomial (SYMPOLY)	2622
21 Chapter T	2625
21.1 domain TABLE Table	2625
21.1.1 Table (TABLE)	2631
21.2 domain TABLEAU Tableau	2633
21.2.1 Tableau (TABLEAU)	2634
21.3 domain TS TaylorSeries	2635
21.3.1 TaylorSeries (TS)	2638
21.4 domain TEX TexFormat	2640
21.4.1 product(product(i*j,i=a..b),j=c..d) fix	2640
21.4.2 TexFormat (TEX)	2645
21.5 domain TEXTFILE TextFile	2657
21.5.1 TextFile (TEXTFILE)	2661
21.6 domain SYMS TheSymbolTable	2663
21.6.1 TheSymbolTable (SYMS)	2665
21.7 domain M3D ThreeDimensionalMatrix	2669
21.7.1 ThreeDimensionalMatrix (M3D)	2671
21.8 domain VIEW3D ThreeDimensionalViewport	2677
21.8.1 ThreeDimensionalViewport (VIEW3D)	2679
21.9 domain SPACE3 ThreeSpace	2699
21.9.1 ThreeSpace (SPACE3)	2700
21.10domain TREE Tree	2708
21.10.1 Tree (TREE)	2710
21.11domain TUBE TubePlot	2717
21.11.1 TubePlot (TUBE)	2718
21.12domain TUPLE Tuple	2720
21.12.1 Tuple (TUPLE)	2721
21.13domain ARRAY2 TwoDimensionalArray	2723
21.13.1 TwoDimensionalArray (ARRAY2)	2732
21.14domain VIEW2D TwoDimensionalViewport	2733
21.14.1 TwoDimensionalViewport (VIEW2D)	2738
22 Chapter U	2753
22.1 domain UFPS UnivariateFormalPowerSeries	2753
22.1.1 UnivariateFormalPowerSeries (UFPS)	2756
22.2 domain ULS UnivariateLaurentSeries	2758
22.2.1 UnivariateLaurentSeries (ULS)	2762
22.3 domain ULSCONS UnivariateLaurentSeriesConstructor	2765
22.3.1 UnivariateLaurentSeriesConstructor (ULSCONS)	2770
22.4 domain UP UnivariatePolynomial	2781
22.4.1 UnivariatePolynomial (UP)	2794
22.5 domain UPXS UnivariatePuisseuxSeries	2797
22.5.1 UnivariatePuisseuxSeries (UPXS)	2800
22.6 domain UPXSCONS UnivariatePuisseuxSeriesConstructor	2805

22.6.1	UnivariatePuisseuxSeriesConstructor (UPXSCONS)	2808
22.7	domain UPXSSING UnivariatePuisseuxSeriesWithExponentialSingularity	2816
22.7.1	UnivariatePuisseuxSeriesWithExponentialSingularity (UPXSSING)	2819
22.8	domain OREUP UnivariateSkewPolynomial	2825
22.8.1	UnivariateSkewPolynomial (OREUP)	2839
22.9	domain UTS UnivariateTaylorSeries	2841
22.9.1	UnivariateTaylorSeries (UTS)	2844
22.10	domain UTSZ UnivariateTaylorSeriesCZero	2850
22.10.1	UnivariateTaylorSeriesCZero (UTSZ)	2853
22.11	domain UNISEG UniversalSegment	2859
22.11.1	UniversalSegment (UNISEG)	2863
22.12	domain U32VEC U32Vector	2866
22.12.1	U32Vector (U32VEC)	2868
23	Chapter V	2871
23.1	domain VARIABLE Variable	2871
23.1.1	Variable (VARIABLE)	2872
23.2	domain VECTOR Vector	2873
23.2.1	Vector (VECTOR)	2877
23.3	domain VOID Void	2879
23.3.1	Void (VOID)	2881
24	Chapter W	2883
24.1	domain WP WeightedPolynomials	2883
24.1.1	WeightedPolynomials (WP)	2884
24.2	domain WUTSET WuWenTsunTriangularSet	2887
24.2.1	WuWenTsunTriangularSet (WUTSET)	2894
25	Chapter X	2903
25.1	domain XDPOLY XDistributedPolynomial	2903
25.1.1	XDistributedPolynomial (XDPOLY)	2905
25.2	domain XPBWPOLY XPBWPolynomial	2908
25.2.1	XPBWPolynomial (XPBWPOLY)	2925
25.3	domain XPOLY XPolynomial	2930
25.3.1	XPolynomial (XPOLY)	2936
25.4	domain XPR XPolynomialRing	2937
25.4.1	XPolynomialRing (XPR)	2945
25.5	domain XRPOLY XRecursivePolynomial	2949
25.5.1	XRecursivePolynomial (XRPOLY)	2951
26	Chapter Y	2959
27	Chapter Z	2961

28 The bootstrap code	2963
28.1 BOOLEAN.lsp	2963
28.2 CHAR.lsp BOOTSTRAP	2968
28.3 DFLOAT.lsp BOOTSTRAP	2972
28.4 ILIST.lsp BOOTSTRAP	2988
28.5 INT.lsp BOOTSTRAP	3000
28.6 ISTRING.lsp BOOTSTRAP	3011
28.7 LIST.lsp BOOTSTRAP	3029
28.8 NNI.lsp BOOTSTRAP	3035
28.9 OUTFORM.lsp BOOTSTRAP	3038
28.10PI.lsp BOOTSTRAP	3052
28.11PRIMARR.lsp BOOTSTRAP	3054
28.12REF.lsp BOOTSTRAP	3057
28.13SINT.lsp BOOTSTRAP	3060
28.14SYMBOL.lsp BOOTSTRAP	3073
28.15VECTOR.lsp BOOTSTRAP	3089
29 Chunk collections	3093
30 Index	3103

Volume 10.4: Axiom Algebra: Packages

1	Chapter Overview	1
2	Chapter A	3
2.1	package AFALGGRO AffineAlgebraicSetComputeWithGroebnerBasis	3
2.1.1	AffineAlgebraicSetComputeWithGroebnerBasis (AFALGGRO)	4
2.2	package AFALGRES AffineAlgebraicSetComputeWithResultant	8
2.2.1	AffineAlgebraicSetComputeWithResultant (AFALGRES)	9
2.3	package AF AlgebraicFunction	13
2.3.1	AlgebraicFunction (AF)	13
2.4	package INTHERAL AlgebraicHermiteIntegration	19
2.4.1	AlgebraicHermiteIntegration (INTHERAL)	19
2.5	package INTALG AlgebraicIntegrate	21
2.5.1	AlgebraicIntegrate (INTALG)	21
2.6	package INTAF AlgebraicIntegration	28
2.6.1	AlgebraicIntegration (INTAF)	28
2.7	package ALGMANIP AlgebraicManipulations	30
2.7.1	AlgebraicManipulations (ALGMANIP)	30
2.8	package ALGMFACT AlgebraicMultFact	35
2.8.1	AlgebraicMultFact (ALGMFACT)	35
2.9	package ALGPKG AlgebraPackage	37
2.9.1	AlgebraPackage (ALGPKG)	37
2.10	package ALGFACT AlgFactor	47
2.10.1	AlgFactor (ALGFACT)	47
2.11	package INTPACK AnnaNumericalIntegrationPackage	50
2.11.1	AnnaNumericalIntegrationPackage (INTPACK)	50
2.12	package OPTPACK AnnaNumericalOptimizationPackage	61
2.12.1	AnnaNumericalOptimizationPackage (OPTPACK)	61
2.13	package ODEPACK AnnaOrdinaryDifferentialEquationPackage	69
2.13.1	AnnaOrdinaryDifferentialEquationPackage (ODEPACK)	69
2.14	package PDEPACK AnnaPartialDifferentialEquationPackage	78
2.14.1	AnnaPartialDifferentialEquationPackage (PDEPACK)	78
2.15	package ANY1 AnyFunctions1	84
2.15.1	AnyFunctions1 (ANY1)	84
2.16	package API ApplicationProgramInterface	86
2.16.1	ApplicationProgramInterface (API)	90
2.17	package APPRULE ApplyRules	92
2.17.1	ApplyRules (APPRULE)	92
2.18	package APPLYORE ApplyUnivariateSkewPolynomial	95
2.18.1	ApplyUnivariateSkewPolynomial (APPLYORE)	95
2.19	package ASSOCEQ AssociatedEquations	96
2.19.1	AssociatedEquations (ASSOCEQ)	96
2.20	package PMPRED AttachPredicates	99
2.20.1	AttachPredicates (PMPRED)	99

2.21	package AXSERV AxiomServer	100
2.21.1	AxiomServer (AXSERV)	100
3	Chapter B	117
3.1	package BALFACT BalancedFactorisation	117
3.1.1	BalancedFactorisation (BALFACT)	117
3.2	package BOP1 BasicOperatorFunctions1	119
3.2.1	BasicOperatorFunctions1 (BOP1)	119
3.3	package BEZIER Bezier	122
3.3.1	Bezier (BEZIER)	139
3.4	package BEZOUT BezoutMatrix	141
3.4.1	BezoutMatrix (BEZOUT)	141
3.5	package BLUPPACK BlowUpPackage	144
3.5.1	BlowUpPackage (BLUPPACK)	146
3.6	package BOUNDZRO BoundIntegerRoots	151
3.6.1	BoundIntegerRoots (BOUNDZRO)	151
3.7	package BRILL BrillhartTests	154
3.7.1	BrillhartTests (BRILL)	154
4	Chapter C	157
4.1	package CARTEN2 CartesianTensorFunctions2	157
4.1.1	CartesianTensorFunctions2 (CARTEN2)	157
4.2	package CHVAR ChangeOfVariable	159
4.2.1	ChangeOfVariable (CHVAR)	159
4.3	package CPIMA CharacteristicPolynomialInMonogenicalAlgebra	162
4.3.1	CharacteristicPolynomialInMonogenicalAlgebra (CPIMA)	162
4.4	package CHARPOL CharacteristicPolynomialPackage	164
4.4.1	CharacteristicPolynomialPackage (CHARPOL)	164
4.5	package IBACHIN ChineseRemainderToolsForIntegralBases	165
4.5.1	ChineseRemainderToolsForIntegralBases (IBACHIN)	165
4.6	package CVMP CoerceVectorMatrixPackage	170
4.6.1	CoerceVectorMatrixPackage (CVMP)	170
4.7	package COMBF CombinatorialFunction	171
4.7.1	CombinatorialFunction (COMBF)	175
4.8	package CDEN CommonDenominator	187
4.8.1	CommonDenominator (CDEN)	187
4.9	package COMMONOP CommonOperators	189
4.9.1	CommonOperators (COMMONOP)	189
4.10	package COMMUPC CommuteUnivariatePolynomialCategory	194
4.10.1	CommuteUnivariatePolynomialCategory (COMMUPC)	194
4.11	package COMPFAC ComplexFactorization	195
4.11.1	ComplexFactorization (COMPFAC)	195
4.12	package COMPLEX2 ComplexFunctions2	198
4.12.1	ComplexFunctions2 (COMPLEX2)	198
4.13	package CINTSLPE ComplexIntegerSolveLinearPolynomialEquation	199
4.13.1	ComplexIntegerSolveLinearPolynomialEquation (CINTSLPE)	199

4.14	package COMPLPAT ComplexPattern	201
4.14.1	ComplexPattern (COMPLPAT)	201
4.15	package CPMATCH ComplexPatternMatch	202
4.15.1	ComplexPatternMatch (CPMATCH)	202
4.16	package CRFP ComplexRootFindingPackage	204
4.16.1	ComplexRootFindingPackage (CRFP)	204
4.17	package CMPLXRT ComplexRootPackage	216
4.17.1	ComplexRootPackage (CMPLXRT)	216
4.18	package CTRIGMNP ComplexTrigonometricManipulations	218
4.18.1	ComplexTrigonometricManipulations (CTRIGMNP)	218
4.19	package ODECONST ConstantLODE	221
4.19.1	ConstantLODE (ODECONST)	221
4.20	package COORDSYS CoordinateSystems	223
4.20.1	CoordinateSystems (COORDSYS)	223
4.21	package CRAPACK CRAPackage	228
4.21.1	CRAPackage (CRAPACK)	228
4.22	package CYCLES CycleIndicators	230
4.22.1	CycleIndicators (CYCLES)	249
4.23	package CSTTOOLS CyclicStreamTools	254
4.23.1	CyclicStreamTools (CSTTOOLS)	254
4.24	package CYCLOTOM CyclotomicPolynomialPackage	256
4.24.1	CyclotomicPolynomialPackage (CYCLOTOM)	256
5	Chapter D	259
5.1	package DFINTTLS DefiniteIntegrationTools	259
5.1.1	DefiniteIntegrationTools (DFINTTLS)	259
5.2	package DEGRED DegreeReductionPackage	265
5.2.1	DegreeReductionPackage (DEGRED)	265
5.3	package DTP DesingTreePackage	266
5.3.1	DesingTreePackage (DTP)	268
5.4	package DIOSP DiophantineSolutionPackage	277
5.4.1	DiophantineSolutionPackage (DIOSP)	277
5.5	package DIRPROD2 DirectProductFunctions2	281
5.5.1	DirectProductFunctions2 (DIRPROD2)	281
5.6	package DLP DiscreteLogarithmPackage	283
5.6.1	DiscreteLogarithmPackage (DLP)	283
5.7	package DISPLAY DisplayPackage	285
5.7.1	DisplayPackage (DISPLAY)	285
5.8	package DDFACT DistinctDegreeFactorize	288
5.8.1	DistinctDegreeFactorize (DDFACT)	288
5.9	package DFSFUN DoubleFloatSpecialFunctions	294
5.9.1	DoubleFloatSpecialFunctions (DFSFUN)	309
5.9.2	The Exponential Integral	313
5.9.3	En:(PI,R)→OPR	319
5.9.4	The Ei Function	319
5.9.5	The Fresnel Integral[?, ?]	346

5.10	package DBLRESP DoubleResultantPackage	350
5.10.1	DoubleResultantPackage (DBLRESP)	350
5.11	package DRAWCX DrawComplex	352
5.11.1	DrawComplex (DRAWCX)	352
5.12	package DRAWHACK DrawNumericHack	356
5.12.1	DrawNumericHack (DRAWHACK)	356
5.13	package DROPT0 DrawOptionFunctions0	357
5.13.1	DrawOptionFunctions0 (DROPT0)	357
5.14	package DROPT1 DrawOptionFunctions1	361
5.14.1	DrawOptionFunctions1 (DROPT1)	361
5.15	package D01AGNT d01AgentsPackage	363
5.15.1	d01AgentsPackage (D01AGNT)	363
5.16	package D01WGTS d01WeightsPackage	369
5.16.1	d01WeightsPackage (D01WGTS)	369
5.17	package D02AGNT d02AgentsPackage	375
5.17.1	d02AgentsPackage (D02AGNT)	375
5.18	package D03AGNT d03AgentsPackage	381
5.18.1	d03AgentsPackage (D03AGNT)	381
6	Chapter E	385
6.1	package EP EigenPackage	385
6.1.1	EigenPackage (EP)	385
6.2	package EF ElementaryFunction	391
6.2.1	ElementaryFunction (EF)	403
6.3	package DEFINTEF ElementaryFunctionDefiniteIntegration	421
6.3.1	ElementaryFunctionDefiniteIntegration (DEFINTEF)	421
6.4	package LODEEF ElementaryFunctionLODESolver	426
6.4.1	ElementaryFunctionLODESolver (LODEEF)	426
6.5	package ODEEF ElementaryFunctionODESolver	432
6.5.1	ElementaryFunctionODESolver (ODEEF)	432
6.6	package SIGNEF ElementaryFunctionSign	438
6.6.1	ElementaryFunctionSign (SIGNEF)	438
6.7	package EFSTRUC ElementaryFunctionStructurePackage	442
6.7.1	ElementaryFunctionStructurePackage (EFSTRUC)	442
6.8	package EFULS ElementaryFunctionsUnivariateLaurentSeries	451
6.8.1	ElementaryFunctionsUnivariateLaurentSeries (EFULS)	451
6.9	package EFUPXS ElementaryFunctionsUnivariatePuisseuxSeries	459
6.9.1	ElementaryFunctionsUnivariatePuisseuxSeries (EFUPXS)	459
6.10	package INTEF ElementaryIntegration	465
6.10.1	ElementaryIntegration (INTEF)	465
6.11	package RDEEF ElementaryRischDE	474
6.11.1	ElementaryRischDE (RDEEF)	474
6.12	package RDEEFS ElementaryRischDESystem	482
6.12.1	ElementaryRischDESystem (RDEEFS)	482
6.13	package ELFUTS EllipticFunctionsUnivariateTaylorSeries	485
6.13.1	EllipticFunctionsUnivariateTaylorSeries (ELFUTS)	485

6.14	package EQ2 EquationFunctions2	487
6.14.1	EquationFunctions2 (EQ2)	487
6.15	package ERROR ErrorFunctions	488
6.15.1	ErrorFunctions (ERROR)	488
6.16	package GBEUCLID EuclideanGroebnerBasisPackage	490
6.16.1	EuclideanGroebnerBasisPackage (GBEUCLID)	513
6.17	package EVALCYC EvaluateCycleIndicators	525
6.17.1	EvaluateCycleIndicators (EVALCYC)	525
6.18	package ESCONT ExpertSystemContinuityPackage	526
6.18.1	ExpertSystemContinuityPackage (ESCONT)	526
6.19	package ESCONT1 ExpertSystemContinuityPackage1	532
6.19.1	ExpertSystemContinuityPackage1 (ESCONT1)	532
6.20	package ESTOOLS ExpertSystemToolsPackage	534
6.20.1	ExpertSystemToolsPackage (ESTOOLS)	534
6.21	package ESTOOLS1 ExpertSystemToolsPackage1	542
6.21.1	ExpertSystemToolsPackage1 (ESTOOLS1)	542
6.22	package ESTOOLS2 ExpertSystemToolsPackage2	543
6.22.1	ExpertSystemToolsPackage2 (ESTOOLS2)	543
6.23	package EXPR2 ExpressionFunctions2	544
6.23.1	ExpressionFunctions2 (EXPR2)	544
6.24	package EXPRSOL ExpressionSolve	545
6.24.1	Bugs	545
6.24.2	ExpressionSolve (EXPRSOL)	546
6.25	package ES1 ExpressionSpaceFunctions1	548
6.25.1	ExpressionSpaceFunctions1 (ES1)	548
6.26	package ES2 ExpressionSpaceFunctions2	550
6.26.1	ExpressionSpaceFunctions2 (ES2)	550
6.27	package EXPRODE ExpressionSpaceODESolver	551
6.27.1	ExpressionSpaceODESolver (EXPRODE)	551
6.28	package OMEXPR ExpressionToOpenMath	556
6.28.1	ExpressionToOpenMath (OMEXPR)	556
6.29	package EXPR2UPS ExpressionToUnivariatePowerSeries	562
6.29.1	ExpressionToUnivariatePowerSeries (EXPR2UPS)	562
6.30	package EXPRTUBE ExpressionTubePlot	569
6.30.1	ExpressionTubePlot (EXPRTUBE)	569
6.31	package EXP3D Export3D	573
6.31.1	Export3D (EXP3D)	574
6.32	package E04AGNT e04AgentsPackage	577
6.32.1	e04AgentsPackage (E04AGNT)	577
7	Chapter F	585
7.1	package FACTFUNC FactoredFunctions	585
7.1.1	FactoredFunctions (FACTFUNC)	585
7.2	package FR2 FactoredFunctions2	587
7.2.1	FactoredFunctions2 (FR2)	589
7.3	package FRUTIL FactoredFunctionUtilities	591

7.3.1	FactoredFunctionUtilities (FRUTIL)	591
7.4	package FACUTIL FactoringUtilities	593
7.4.1	FactoringUtilities (FACUTIL)	593
7.5	package FACTEXT FactorisationOverPseudoAlgebraicClosureOfAlgExtOfRationalNumber	595
7.5.1	FactorisationOverPseudoAlgebraicClosureOfAlgExtOfRationalNumber (FACTEXT)	596
7.6	package FACTRN FactorisationOverPseudoAlgebraicClosureOfRationalNumber	599
7.6.1	FactorisationOverPseudoAlgebraicClosureOfRationalNumber (FACTRN)	601
7.7	package FGLMICPK FGLMIfCanPackage	604
7.7.1	FGLMIfCanPackage (FGLMICPK)	604
7.8	package FORDER FindOrderFinite	606
7.8.1	FindOrderFinite (FORDER)	606
7.9	package FAMR2 FiniteAbelianMonoidRingFunctions2	608
7.9.1	FiniteAbelianMonoidRingFunctions2 (FAMR2)	608
7.10	package FDIV2 FiniteDivisorFunctions2	609
7.10.1	FiniteDivisorFunctions2 (FDIV2)	609
7.11	package FFFACTSE FiniteFieldFactorizationWithSizeParseBySideEffect	610
7.11.1	FiniteFieldFactorizationWithSizeParseBySideEffect (FFFACTSE)	611
7.12	package FFF FiniteFieldFunctions	617
7.12.1	FiniteFieldFunctions (FFF)	617
7.13	package FFHOM FiniteFieldHomomorphisms	622
7.13.1	FiniteFieldHomomorphisms (FFHOM)	622
7.14	package FFPOLY FiniteFieldPolynomialPackage	630
7.14.1	FiniteFieldPolynomialPackage (FFPOLY)	630
7.15	package FFPOLY2 FiniteFieldPolynomialPackage2	651
7.15.1	FiniteFieldPolynomialPackage2 (FFPOLY2)	651
7.16	package FFSLPE FiniteFieldSolveLinearPolynomialEquation	654
7.16.1	FiniteFieldSolveLinearPolynomialEquation (FFSLPE)	654
7.17	package FFSQFR FiniteFieldSquareFreeDecomposition	655
7.17.1	FiniteFieldSquareFreeDecomposition (FFSQFR)	656
7.18	package FLAGG2 FiniteLinearAggregateFunctions2	659
7.18.1	FiniteLinearAggregateFunctions2 (FLAGG2)	659
7.19	package FLASORT FiniteLinearAggregateSort	662
7.19.1	FiniteLinearAggregateSort (FLASORT)	662
7.20	package FSAGG2 FiniteSetAggregateFunctions2	665
7.20.1	FiniteSetAggregateFunctions2 (FSAGG2)	665
7.21	package FLOATCP FloatingComplexPackage	666
7.21.1	FloatingComplexPackage (FLOATCP)	666
7.22	package FLOATRP FloatingRealPackage	670
7.22.1	FloatingRealPackage (FLOATRP)	670
7.23	package FCPAK1 FortranCodePackage1	673
7.23.1	FortranCodePackage1 (FCPAK1)	673
7.24	package FOP FortranOutputStackPackage	676
7.24.1	FortranOutputStackPackage (FOP)	676

7.25	package FORT FortranPackage	679
7.25.1	FortranPackage (FORT)	679
7.26	package FRIDEAL2 FractionalIdealFunctions2	681
7.26.1	FractionalIdealFunctions2 (FRIDEAL2)	681
7.27	package FFFG FractionFreeFastGaussian	683
7.27.1	FractionFreeFastGaussian (FFFG)	683
7.28	package FFFGF FractionFreeFastGaussianFractions	693
7.28.1	FractionFreeFastGaussianFractions (FFFGF)	693
7.29	package FRAC2 FractionFunctions2	696
7.29.1	FractionFunctions2 (FRAC2)	696
7.30	package FRNAAF2 FramedNonAssociativeAlgebraFunctions2	697
7.30.1	FramedNonAssociativeAlgebraFunctions2 (FRNAAF2)	697
7.31	package FSPECF FunctionalSpecialFunction	699
7.31.1	FunctionalSpecialFunction (FSPECF)	699
7.31.2	differentiation of special functions	705
7.32	package FFCAT2 FunctionFieldCategoryFunctions2	708
7.32.1	FunctionFieldCategoryFunctions2 (FFCAT2)	708
7.33	package FFINTBAS FunctionFieldIntegralBasis	709
7.33.1	FunctionFieldIntegralBasis (FFINTBAS)	709
7.34	package PMASSFS FunctionSpaceAssertions	712
7.34.1	FunctionSpaceAssertions (PMASSFS)	712
7.35	package PMPREDFS FunctionSpaceAttachPredicates	714
7.35.1	FunctionSpaceAttachPredicates (PMPREDFS)	714
7.36	package FSCINT FunctionSpaceComplexIntegration	716
7.36.1	FunctionSpaceComplexIntegration (FSCINT)	716
7.37	package FS2 FunctionSpaceFunctions2	718
7.37.1	FunctionSpaceFunctions2 (FS2)	718
7.38	package FSINT FunctionSpaceIntegration	720
7.38.1	FunctionSpaceIntegration (FSINT)	720
7.39	package FSPRMELT FunctionSpacePrimitiveElement	723
7.39.1	FunctionSpacePrimitiveElement (FSPRMELT)	723
7.40	package FSRED FunctionSpaceReduce	726
7.40.1	FunctionSpaceReduce (FSRED)	726
7.41	package SUMFS FunctionSpaceSum	728
7.41.1	FunctionSpaceSum (SUMFS)	728
7.42	package FS2EXPPX FunctionSpaceToExponentialExpansion	730
7.42.1	FunctionSpaceToExponentialExpansion (FS2EXPPX)	730
7.43	package FS2UPS FunctionSpaceToUnivariatePowerSeries	741
7.43.1	FunctionSpaceToUnivariatePowerSeries (FS2UPS)	741
7.44	package FSUPFACT FunctionSpaceUnivariatePolynomialFactor	757
7.44.1	FunctionSpaceUnivariatePolynomialFactor (FSUPFACT)	757

8 Chapter G	763
8.1 package GALFACTU GaloisGroupFactorizationUtilities	763
8.1.1 GaloisGroupFactorizationUtilities (GALFACTU)	763
8.2 package GALFACT GaloisGroupFactorizer	767
8.2.1 GaloisGroupFactorizer (GALFACT)	767
8.3 package GALPOLYU GaloisGroupPolynomialUtilities	784
8.3.1 GaloisGroupPolynomialUtilities (GALPOLYU)	784
8.4 package GALUTIL GaloisGroupUtilities	787
8.4.1 GaloisGroupUtilities (GALUTIL)	787
8.5 package GAUSSFAC GaussianFactorizationPackage	790
8.5.1 GaussianFactorizationPackage (GAUSSFAC)	790
8.6 package GHENSEL GeneralHenselPackage	794
8.6.1 GeneralHenselPackage (GHENSEL)	794
8.7 package GENMFACT GeneralizedMultivariateFactorize	798
8.7.1 GeneralizedMultivariateFactorize (GENMFACT)	798
8.8 package GPAFF GeneralPackageForAlgebraicFunctionField	799
8.8.1 GeneralPackageForAlgebraicFunctionField (GPAFF)	801
8.9 package GENPGCD GeneralPolynomialGcdPackage	815
8.9.1 GeneralPolynomialGcdPackage (GENPGCD)	815
8.10 package GENUPS GenerateUnivariatePowerSeries	829
8.10.1 GenerateUnivariatePowerSeries (GENUPS)	829
8.11 package GENEEZ GenExEuclid	833
8.11.1 GenExEuclid (GENEEZ)	833
8.12 package GENUFACT GenUFactorize	838
8.12.1 GenUFactorize (GENUFACT)	838
8.13 package INTG0 GenusZeroIntegration	840
8.13.1 GenusZeroIntegration (INTG0)	840
8.14 package GDRAW GnuDraw	846
8.14.1 GnuDraw (GDRAW)	847
8.15 package GOSPER GosperSummationMethod	849
8.15.1 GosperSummationMethod (GOSPER)	849
8.16 package GRDEF GraphicsDefaults	854
8.16.1 GraphicsDefaults (GRDEF)	854
8.17 package GRAY GrayCode	857
8.17.1 GrayCode (GRAY)	857
8.18 package GBF GroebnerFactorizationPackage	859
8.18.1 GroebnerFactorizationPackage (GBF)	863
8.19 package GBINTERN GroebnerInternalPackage	871
8.19.1 GroebnerInternalPackage (GBINTERN)	871
8.20 package GB GroebnerPackage	881
8.20.1 GroebnerPackage (GB)	907
8.21 package GROEBSOL GroebnerSolve	911
8.21.1 GroebnerSolve (GROEBSOL)	911
8.22 package GUESS Guess	915
8.22.1 Guess (GUESS)	916
8.23 package GUESSAN GuessAlgebraicNumber	951

8.23.1	GuessAlgebraicNumber (GUESSAN)	951
8.24	package GUESSF GuessFinite	952
8.24.1	GuessFinite (GUESSF)	952
8.25	package GUESSF1 GuessFiniteFunctions	953
8.25.1	GuessFiniteFunctions (GUESSF1)	953
8.26	package GUESSINT GuessInteger	954
8.26.1	GuessInteger (GUESSINT)	954
8.27	package GUESSP GuessPolynomial	955
8.27.1	GuessPolynomial (GUESSP)	955
8.28	package GUESSUP GuessUnivariatePolynomial	956
8.28.1	GuessUnivariatePolynomial (GUESSUP)	956
9	Chapter H	963
9.1	package HB HallBasis	963
9.1.1	HallBasis (HB)	963
9.2	package HEUGCD HeuGcd	966
9.2.1	HeuGcd (HEUGCD)	966
10	Chapter I	973
10.1	package IDECOMP IdealDecompositionPackage	973
10.1.1	IdealDecompositionPackage (IDECOMP)	973
10.2	package INCRMAPS IncrementingMaps	982
10.2.1	IncrementingMaps (INCRMAPS)	982
10.3	package INFPROD0 InfiniteProductCharacteristicZero	983
10.3.1	InfiniteProductCharacteristicZero (INFPROD0)	983
10.4	package INPRODFE InfiniteProductFiniteField	985
10.4.1	InfiniteProductFiniteField (INPRODFE)	985
10.5	package INPRODPF InfiniteProductPrimeField	988
10.5.1	InfiniteProductPrimeField (INPRODPF)	988
10.6	package ITFUN2 InfiniteTupleFunctions2	990
10.6.1	InfiniteTupleFunctions2 (ITFUN2)	990
10.7	package ITFUN3 InfiniteTupleFunctions3	991
10.7.1	InfiniteTupleFunctions3 (ITFUN3)	991
10.8	package INFINITY Infinity	992
10.8.1	Infinity (INFINITY)	992
10.9	package IALGFACT InnerAlgFactor	993
10.9.1	InnerAlgFactor (IALGFACT)	993
10.10	package ICDEN InnerCommonDenominator	996
10.10.1	InnerCommonDenominator (ICDEN)	996
10.11	package IMATLIN InnerMatrixLinearAlgebraFunctions	998
10.11.1	InnerMatrixLinearAlgebraFunctions (IMATLIN)	998
10.12	package IMATQF InnerMatrixQuotientFieldFunctions	1003
10.12.1	InnerMatrixQuotientFieldFunctions (IMATQF)	1003
10.13	package INMODGCD InnerModularGcd	1005
10.13.1	InnerModularGcd (INMODGCD)	1005
10.14	package INNMFAC InnerMultFact	1011

10.14.1 InnerMultFact (INNMFACT)	1011
10.15package INBFF InnerNormalBasisFieldFunctions	1020
10.15.1 InnerNormalBasisFieldFunctions (INBFF)	1020
10.16package INEP InnerNumericEigenPackage	1028
10.16.1 InnerNumericEigenPackage (INEP)	1028
10.17package INFSP InnerNumericFloatSolvePackage	1033
10.17.1 InnerNumericFloatSolvePackage (INFSP)	1033
10.18package INPSIGN InnerPolySign	1037
10.18.1 InnerPolySign (INPSIGN)	1037
10.19package ISUMP InnerPolySum	1039
10.19.1 InnerPolySum (ISUMP)	1039
10.20package ITRIGMNP InnerTrigonometricManipulations	1041
10.20.1 InnerTrigonometricManipulations (ITRIGMNP)	1041
10.21package INFORM1 InputFormFunctions1	1045
10.21.1 InputFormFunctions1 (INFORM1)	1045
10.22package INTERGB InterfaceGroebnerPackage	1046
10.22.1 InterfaceGroebnerPackage (INTERGB)	1047
10.23package INTBIT IntegerBits	1049
10.23.1 IntegerBits (INTBIT)	1049
10.24package COMBINAT IntegerCombinatoricFunctions	1050
10.24.1 IntegerCombinatoricFunctions (COMBINAT)	1053
10.25package INTFACT IntegerFactorizationPackage	1056
10.25.1 IntegerFactorizationPackage (INTFACT)	1056
10.25.2 squareFree	1057
10.25.3 PollardSmallFactor	1058
10.25.4 BasicSieve	1060
10.25.5 BasicMethod	1061
10.25.6 factor	1062
10.26package ZLINDEP IntegerLinearDependence	1063
10.26.1 IntegerLinearDependence (ZLINDEP)	1067
10.27package INTHEORY IntegerNumberTheoryFunctions	1068
10.27.1 IntegerNumberTheoryFunctions (INTHEORY)	1082
10.28package PRIMES IntegerPrimesPackage	1087
10.28.1 IntegerPrimesPackage (PRIMES)	1088
10.28.2 smallPrimes	1089
10.28.3 primes	1094
10.28.4 rabinProvesCompositeSmall	1094
10.28.5 rabinProvesComposite	1095
10.28.6 prime?	1095
10.28.7 nextPrime	1097
10.28.8 prevPrime	1097
10.29package INTRET IntegerRetractions	1098
10.29.1 IntegerRetractions (INTRET)	1098
10.30package IROOT IntegerRoots	1099
10.30.1 IntegerRoots (IROOT)	1099
10.30.2 perfectSquare?	1100

10.30.3 perfectNthPower?	1101
10.30.4 perfectNthRoot	1101
10.30.5 approxNthRoot	1101
10.30.6 perfectNthRoot	1102
10.30.7 perfectSqrt	1102
10.30.8 approxSqrt	1102
10.31package INTSLPE IntegerSolveLinearPolynomialEquation	1103
10.31.1 IntegerSolveLinearPolynomialEquation (INTSLPE)	1103
10.32package IBATool IntegralBasisTools	1105
10.32.1 IntegralBasisTools (IBATool)	1105
10.33package IBPTOOLS IntegralBasisPolynomialTools	1108
10.33.1 IntegralBasisPolynomialTools (IBPTOOLS)	1108
10.34package IR2 IntegrationResultFunctions2	1111
10.34.1 IntegrationResultFunctions2 (IR2)	1111
10.35package IRRF2F IntegrationResultRFToFunction	1113
10.35.1 IntegrationResultRFToFunction (IRRF2F)	1113
10.36package IR2F IntegrationResultToFunction	1115
10.36.1 IntegrationResultToFunction (IR2F)	1115
10.37package INTTOOLS IntegrationTools	1120
10.37.1 IntegrationTools (INTTOOLS)	1120
10.38package IPRNTPK InternalPrintPackage	1124
10.38.1 InternalPrintPackage (IPRNTPK)	1124
10.39package IRURPK InternalRationalUnivariateRepresentationPackage	1125
10.39.1 InternalRationalUnivariateRepresentationPackage (IRURPK)	1125
10.40package INTFRSP InterpolateFormsPackage	1129
10.40.1 InterpolateFormsPackage (INTFRSP)	1131
10.41package INTDIVP IntersectionDivisorPackage	1137
10.41.1 IntersectionDivisorPackage (INTDIVP)	1138
10.42package IRREDFFX IrredPolyOverFiniteField	1141
10.42.1 IrredPolyOverFiniteField (IRREDFFX)	1141
10.43package IRSN IrrRepSymNatPackage	1143
10.43.1 IrrRepSymNatPackage (IRSN)	1143
10.44package INVLAPLA InverseLaplaceTransform	1150
10.44.1 InverseLaplaceTransform (INVLAPLA)	1150
11 Chapter J	1153
12 Chapter K	1155
12.1 package KERNEL2 KernelFunctions2	1155
12.1.1 KernelFunctions2 (KERNEL2)	1155
12.2 package KOVACIC Kovacic	1156
12.2.1 Kovacic (KOVACIC)	1156

13 Chapter L	1159
13.1 package LAPLACE LaplaceTransform	1159
13.1.1 LaplaceTransform (LAPLACE)	1159
13.2 package LAZM3PK LazardSetSolvingPackage	1164
13.2.1 LazardSetSolvingPackage (LAZM3PK)	1184
13.3 package LEADCDET LeadingCoefDetermination	1188
13.3.1 LeadingCoefDetermination (LEADCDET)	1188
13.4 package LEXTRIPK LexTriangularPackage	1191
13.4.1 LexTriangularPackage (LEXTRIPK)	1260
13.5 package LINDEP LinearDependence	1265
13.5.1 LinearDependence (LINDEP)	1265
13.6 package LODOF LinearOrdinaryDifferentialOperatorFactorizer	1267
13.6.1 LinearOrdinaryDifferentialOperatorFactorizer (LODOF)	1267
13.7 package LODOOPS LinearOrdinaryDifferentialOperatorsOps	1271
13.7.1 LinearOrdinaryDifferentialOperatorsOps (LODOOPS)	1271
13.8 package LPEFRAC LinearPolynomialEquationByFractions	1274
13.8.1 LinearPolynomialEquationByFractions (LPEFRAC)	1274
13.9 package LISYSER LinearSystemFromPowerSeriesPackage	1275
13.9.1 LinearSystemFromPowerSeriesPackage (LISYSER)	1277
13.10package LSMP LinearSystemMatrixPackage	1279
13.10.1 LinearSystemMatrixPackage (LSMP)	1279
13.11package LSMP1 LinearSystemMatrixPackage1	1281
13.11.1 LinearSystemMatrixPackage1 (LSMP1)	1281
13.12package LSPP LinearSystemPolynomialPackage	1283
13.12.1 LinearSystemPolynomialPackage (LSPP)	1283
13.13package LGROBP LinGroebnerPackage	1285
13.13.1 LinGroebnerPackage (LGROBP)	1285
13.14package LOP LinesOpPack	1292
13.14.1 LinesOpPack (LOP)	1293
13.15package LF LiouvillianFunction	1296
13.15.1 LiouvillianFunction (LF)	1296
13.16package LIST2 ListFunctions2	1301
13.16.1 ListFunctions2 (LIST2)	1301
13.17package LIST3 ListFunctions3	1302
13.17.1 ListFunctions3 (LIST3)	1302
13.18package LIST2MAP ListToMap	1304
13.18.1 ListToMap (LIST2MAP)	1304
13.19package LPARSPT LocalParametrizationOfSimplePointPackage	1306
13.19.1 LocalParametrizationOfSimplePointPackage (LPARSPT)	1307
14 Chapter M	1315
14.1 package MKBCFUNC MakeBinaryCompiledFunction	1315
14.1.1 MakeBinaryCompiledFunction (MKBCFUNC)	1315
14.2 package MKFLCFN MakeFloatCompiledFunction	1317
14.2.1 MakeFloatCompiledFunction (MKFLCFN)	1317
14.3 package MKFUNC MakeFunction	1320

14.3.1	MakeFunction (MKFUNC)	1324
14.4	package MKRECORD MakeRecord	1326
14.4.1	MakeRecord (MKRECORD)	1326
14.5	package MKUCFUNC MakeUnaryCompiledFunction	1327
14.5.1	MakeUnaryCompiledFunction (MKUCFUNC)	1327
14.6	package MAPHACK1 MappingPackageInternalHacks1	1328
14.6.1	MappingPackageInternalHacks1 (MAPHACK1)	1328
14.7	package MAPHACK2 MappingPackageInternalHacks2	1330
14.7.1	MappingPackageInternalHacks2 (MAPHACK2)	1330
14.8	package MAPHACK3 MappingPackageInternalHacks3	1331
14.8.1	MappingPackageInternalHacks3 (MAPHACK3)	1331
14.9	package MAPPKG1 MappingPackage1	1332
14.9.1	MappingPackage1 (MAPPKG1)	1341
14.10	package MAPPKG2 MappingPackage2	1343
14.10.1	MappingPackage2 (MAPPKG2)	1352
14.11	package MAPPKG3 MappingPackage3	1353
14.11.1	MappingPackage3 (MAPPKG3)	1362
14.12	package MAPPKG4 MappingPackage4	1364
14.12.1	MappingPackage4 (MAPPKG4)	1369
14.13	package MATCAT2 MatrixCategoryFunctions2	1371
14.13.1	MatrixCategoryFunctions2 (MATCAT2)	1371
14.14	package MCDEN MatrixCommonDenominator	1373
14.14.1	MatrixCommonDenominator (MCDEN)	1373
14.15	package MATLIN MatrixLinearAlgebraFunctions	1375
14.15.1	MatrixLinearAlgebraFunctions (MATLIN)	1375
14.16	package MTHING MergeThing	1382
14.16.1	MergeThing (MTHING)	1382
14.17	package MESH MeshCreationRoutinesForThreeDimensions	1384
14.17.1	MeshCreationRoutinesForThreeDimensions (MESH)	1384
14.18	package MDDFACT ModularDistinctDegreeFactorizer	1387
14.18.1	ModularDistinctDegreeFactorizer (MDDFACT)	1387
14.19	package MHROWRED ModularHermitianRowReduction	1393
14.19.1	ModularHermitianRowReduction (MHROWRED)	1393
14.20	package MRF2 MonoidRingFunctions2	1398
14.20.1	MonoidRingFunctions2 (MRF2)	1398
14.21	package MONOTOOL MonomialExtensionTools	1400
14.21.1	MonomialExtensionTools (MONOTOOL)	1400
14.22	package MSYSCMD MoreSystemCommands	1402
14.22.1	MoreSystemCommands (MSYSCMD)	1402
14.23	package MPCPF MPolyCatPolyFactorizer	1403
14.23.1	MPolyCatPolyFactorizer (MPCPF)	1403
14.24	package MPRFF MPolyCatRationalFunctionFactorizer	1405
14.24.1	MPolyCatRationalFunctionFactorizer (MPRFF)	1405
14.25	package MPC2 MPolyCatFunctions2	1409
14.25.1	MPolyCatFunctions2 (MPC2)	1409
14.26	package MPC3 MPolyCatFunctions3	1410

14.26.1 MPolyCatFunctions3 (MPC3)	1410
14.27package MRATFAC MRationalFactorize	1412
14.27.1 MRationalFactorize (MRATFAC)	1412
14.28package MFINFACT MultFiniteFactorize	1414
14.28.1 MultFiniteFactorize (MFINFACT)	1414
14.29package MMAP MultipleMap	1424
14.29.1 MultipleMap (MMAP)	1424
14.30package MCALCFN MultiVariableCalculusFunctions	1426
14.30.1 MultiVariableCalculusFunctions (MCALCFN)	1426
14.31package MULTFACT MultivariateFactorize	1430
14.31.1 MultivariateFactorize (MULTFACT)	1430
14.32package MLIFT MultivariateLifting	1431
14.33package MULTSQFR MultivariateSquareFree	1436
14.33.1 MultivariateSquareFree (MULTSQFR)	1436

15 Chapter N**1445**

15.1 package NAGF02 NagEigenPackage	1445
15.1.1 NagEigenPackage (NAGF02)	1511
15.2 package NAGE02 NagFittingPackage	1523
15.2.1 NagFittingPackage (NAGE02)	1652
15.3 package NAGF04 NagLinearEquationSolvingPackage	1665
15.3.1 NagLinearEquationSolvingPackage (NAGF04)	1731
15.4 package NAGSP NAGLinkSupportPackage	1739
15.4.1 NAGLinkSupportPackage (NAGSP)	1739
15.5 package NAGD01 NagIntegrationPackage	1741
15.5.1 NagIntegrationPackage (NAGD01)	1818
15.6 package NAGE01 NagInterpolationPackage	1827
15.6.1 NagInterpolationPackage (NAGE01)	1866
15.7 package NAGF07 NagLapack	1873
15.7.1 NagLapack (NAGF07)	1887
15.8 package NAGF01 NagMatrixOperationsPackage	1890
15.8.1 NagMatrixOperationsPackage (NAGF01)	1946
15.9 package NAGE04 NagOptimisationPackage	1953
15.9.1 NagOptimisationPackage (NAGE04)	2104
15.10package NAGD02 NagOrdinaryDifferentialEquationsPackage	2113
15.10.1 NagOrdinaryDifferentialEquationsPackage (NAGD02)	2203
15.11package NAGD03 NagPartialDifferentialEquationsPackage	2213
15.11.1 NagPartialDifferentialEquationsPackage (NAGD03)	2249
15.12package NAGC02 NagPolynomialRootsPackage	2253
15.12.1 NagPolynomialRootsPackage (NAGC02)	2267
15.13package NAGC05 NagRootFindingPackage	2269
15.13.1 NagRootFindingPackage (NAGC05)	2286
15.14package NAGC06 NagSeriesSummationPackage	2289
15.14.1 NagSeriesSummationPackage (NAGC06)	2333
15.15package NAGS NagSpecialFunctionsPackage	2340
15.15.1 NagSpecialFunctionsPackage (NAGS)	2486

15.16package NSUP2 NewSparseUnivariatePolynomialFunctions2	2502
15.16.1 NewSparseUnivariatePolynomialFunctions2 (NSUP2)	2502
15.17package NEWTON NewtonInterpolation	2504
15.17.1 NewtonInterpolation (NEWTON)	2504
15.18package NPOLYGON NewtonPolygon	2505
15.18.1 NewtonPolygon (NPOLYGON)	2506
15.19package NCODIV NonCommutativeOperatorDivision	2511
15.19.1 NonCommutativeOperatorDivision (NCODIV)	2511
15.20package NONE1 NoneFunctions1	2514
15.20.1 NoneFunctions1 (NONE1)	2514
15.21package NODE1 NonLinearFirstOrderODESolver	2515
15.21.1 NonLinearFirstOrderODESolver (NODE1)	2515
15.22package NLINSOL NonLinearSolvePackage	2519
15.22.1 NonLinearSolvePackage (NLINSOL)	2519
15.23package NORMPK NormalizationPackage	2521
15.23.1 NormalizationPackage (NORMPK)	2521
15.24package NORMMA NormInMonogenicAlgebra	2526
15.24.1 NormInMonogenicAlgebra (NORMMA)	2526
15.25package NORMRETR NormRetractPackage	2528
15.25.1 NormRetractPackage (NORMRETR)	2528
15.26package NPCOEF NPCoef	2530
15.26.1 NPCoef (NPCOEF)	2530
15.27package NFINTBAS NumberFieldIntegralBasis	2534
15.27.1 NumberFieldIntegralBasis (NFINTBAS)	2534
15.28package NUMFMT NumberFormats	2539
15.28.1 NumberFormats (NUMFMT)	2539
15.29package NTPOLFN NumberTheoreticPolynomialFunctions	2544
15.29.1 NumberTheoreticPolynomialFunctions (NTPOLFN)	2544
15.30package NUMERIC Numeric	2546
15.30.1 Numeric (NUMERIC)	2546
15.31package NUMODE NumericalOrdinaryDifferentialEquations	2555
15.31.1 NumericalOrdinaryDifferentialEquations (NUMODE)	2555
15.32package NUMQUAD NumericalQuadrature	2563
15.32.1 NumericalQuadrature (NUMQUAD)	2563
15.33package NCEP NumericComplexEigenPackage	2575
15.33.1 NumericComplexEigenPackage (NCEP)	2575
15.34package NCNTFRAC NumericContinuedFraction	2577
15.34.1 NumericContinuedFraction (NCNTFRAC)	2577
15.35package NREP NumericRealEigenPackage	2579
15.35.1 NumericRealEigenPackage (NREP)	2579
15.36package NUMTUBE NumericTubePlot	2581
15.36.1 NumericTubePlot (NUMTUBE)	2581

16 Chapter O	2585
16.1 package OCTCT2 OctonionCategoryFunctions2	2585
16.1.1 OctonionCategoryFunctions2 (OCTCT2)	2585
16.2 package ODEINT ODEIntegration	2587
16.2.1 ODEIntegration (ODEINT)	2587
16.3 package ODETOOLS ODETools	2589
16.3.1 ODETools (ODETOOLS)	2589
16.4 package ARRAY12 OneDimensionalArrayFunctions2	2591
16.4.1 OneDimensionalArrayFunctions2 (ARRAY12)	2591
16.5 package ONECOMP2 OnePointCompletionFunctions2	2593
16.5.1 OnePointCompletionFunctions2 (ONECOMP2)	2593
16.6 package OMPKG OpenMathPackage	2594
16.6.1 OpenMathPackage (OMPKG)	2594
16.7 package OMSERVER OpenMathServerPackage	2597
16.7.1 OpenMathServerPackage (OMSERVER)	2597
16.8 package OPQUERY OperationsQuery	2599
16.8.1 OperationsQuery (OPQUERY)	2599
16.9 package ORDCOMP2 OrderedCompletionFunctions2	2600
16.9.1 OrderedCompletionFunctions2 (ORDCOMP2)	2600
16.10 package ORDFUNS OrderingFunctions	2601
16.10.1 OrderingFunctions (ORDFUNS)	2601
16.11 package ORTHPOL OrthogonalPolynomialFunctions	2603
16.11.1 OrthogonalPolynomialFunctions (ORTHPOL)	2603
16.12 package OUT OutputPackage	2606
16.12.1 OutputPackage (OUT)	2606
17 Chapter P	2609
17.1 package PAFF PackageForAlgebraicFunctionField	2609
17.1.1 PackageForAlgebraicFunctionField (PAFF)	2611
17.2 package PAFFFF PackageForAlgebraicFunctionFieldOverFiniteField	2617
17.2.1 PackageForAlgebraicFunctionFieldOverFiniteField (PAFFFF)	2619
17.3 package PFORP PackageForPoly	2627
17.3.1 PackageForPoly (PFORP)	2628
17.4 package PADEPAC PadeApproximantPackage	2635
17.4.1 PadeApproximantPackage (PADEPAC)	2635
17.5 package PADE PadeApproximants	2636
17.5.1 PadeApproximants (PADE)	2637
17.6 package PWFFINTB PAdicWildFunctionFieldIntegralBasis	2641
17.6.1 PAdicWildFunctionFieldIntegralBasis (PWFFINTB)	2641
17.7 package YSTREAM ParadoxicalCombinatorsForStreams	2646
17.7.1 ParadoxicalCombinatorsForStreams (YSTREAM)	2646
17.8 package PLEQN ParametricLinearEquations	2648
17.8.1 ParametricLinearEquations (PLEQN)	2648
17.9 package PARPC2 ParametricPlaneCurveFunctions2	2662
17.9.1 ParametricPlaneCurveFunctions2 (PARPC2)	2662
17.10 package PARSC2 ParametricSpaceCurveFunctions2	2663

17.10.1 ParametricSpaceCurveFunctions2 (PARSC2)	2663
17.11package PARSU2 ParametricSurfaceFunctions2	2664
17.11.1 ParametricSurfaceFunctions2 (PARSU2)	2664
17.12package PARAMP ParametrizationPackage	2665
17.12.1 ParametrizationPackage (PARAMP)	2666
17.13package PFRPAC PartialFractionPackage	2668
17.13.1 PartialFractionPackage (PFRPAC)	2670
17.14package PARTPERM PartitionsAndPermutations	2672
17.14.1 PartitionsAndPermutations (PARTPERM)	2672
17.15package PATTERN1 PatternFunctions1	2675
17.15.1 PatternFunctions1 (PATTERN1)	2675
17.16package PATTERN2 PatternFunctions2	2677
17.16.1 PatternFunctions2 (PATTERN2)	2677
17.17package PATMATCH PatternMatch	2678
17.17.1 PatternMatch (PATMATCH)	2678
17.18package PMASS PatternMatchAssertions	2681
17.18.1 PatternMatchAssertions (PMASS)	2681
17.19package PMFS PatternMatchFunctionSpace	2682
17.19.1 PatternMatchFunctionSpace (PMFS)	2682
17.20package PMINS PatternMatchIntegerNumberSystem	2684
17.20.1 PatternMatchIntegerNumberSystem (PMINS)	2684
17.21package INTPM PatternMatchIntegration	2687
17.21.1 PatternMatchIntegration (INTPM)	2687
17.22package PMKERNEL PatternMatchKernel	2694
17.22.1 PatternMatchKernel (PMKERNEL)	2694
17.23package PMLSAGG PatternMatchListAggregate	2697
17.23.1 PatternMatchListAggregate (PMLSAGG)	2697
17.24package PMPLCAT PatternMatchPolynomialCategory	2698
17.24.1 PatternMatchPolynomialCategory (PMPLCAT)	2698
17.25package PMDOWN PatternMatchPushDown	2701
17.25.1 PatternMatchPushDown (PMDOWN)	2701
17.26package PMQFCAT PatternMatchQuotientFieldCategory	2704
17.26.1 PatternMatchQuotientFieldCategory (PMQFCAT)	2704
17.27package PATRES2 PatternMatchResultFunctions2	2705
17.27.1 PatternMatchResultFunctions2 (PATRES2)	2705
17.28package PMSYM PatternMatchSymbol	2707
17.28.1 PatternMatchSymbol (PMSYM)	2707
17.29package PMTOOLS PatternMatchTools	2708
17.29.1 PatternMatchTools (PMTOOLS)	2708
17.30package PERMAN Permanent	2712
17.30.1 Permanent (PERMAN)	2714
17.31package PGE PermutationGroupExamples	2718
17.31.1 PermutationGroupExamples (PGE)	2718
17.32package PICOERCE PiCoercions	2726
17.32.1 PiCoercions (PICOERCE)	2726
17.33package PLOT1 PlotFunctions1	2728

17.33.1 PlotFunctions1 (PLOT1)	2728
17.34 package PLOTTOOL PlotTools	2729
17.34.1 PlotTools (PLOTTOOL)	2729
17.35 package PRJALGPK ProjectiveAlgebraicSetPackage	2731
17.35.1 ProjectiveAlgebraicSetPackage (PRJALGPK)	2733
17.36 package PTFUNC2 PointFunctions2	2737
17.36.1 PointFunctions2 (PTFUNC2)	2737
17.37 package PTPACK PointPackage	2738
17.37.1 PointPackage (PTPACK)	2738
17.38 package PFO PointsOfFiniteOrder	2740
17.38.1 PointsOfFiniteOrder (PFO)	2740
17.39 package PFOQ PointsOfFiniteOrderRational	2747
17.39.1 PointsOfFiniteOrderRational (PFOQ)	2747
17.40 package PFOTOOLS PointsOfFiniteOrderTools	2749
17.40.1 PointsOfFiniteOrderTools (PFOTOOLS)	2749
17.41 package PLPKCRV PolynomialPackageForCurve	2751
17.41.1 PolynomialPackageForCurve (PLPKCRV)	2752
17.42 package POLTOPOL PolToPol	2754
17.42.1 PolToPol (POLTOPOL)	2754
17.43 package PGROEB PolyGroebner	2757
17.43.1 PolyGroebner (PGROEB)	2757
17.44 package PAN2EXPR PolynomialAN2Expression	2759
17.44.1 PolynomialAN2Expression (PAN2EXPR)	2759
17.45 package POLYLIFT PolynomialCategoryLifting	2760
17.45.1 PolynomialCategoryLifting (POLYLIFT)	2760
17.46 package POLYCATQ PolynomialCategoryQuotientFunctions	2762
17.46.1 PolynomialCategoryQuotientFunctions (POLYCATQ)	2762
17.47 package PCOMP PolynomialComposition	2765
17.47.1 PolynomialComposition (PCOMP)	2765
17.48 package PDECOMP PolynomialDecomposition	2766
17.48.1 PolynomialDecomposition (PDECOMP)	2766
17.49 package PFBR PolynomialFactorizationByRecursion	2768
17.49.1 PolynomialFactorizationByRecursion (PFBR)	2768
17.50 package PFBRU PolynomialFactorizationByRecursionUnivariate	2775
17.50.1 PolynomialFactorizationByRecursionUnivariate (PFBRU)	2775
17.51 package POLY2 PolynomialFunctions2	2780
17.51.1 PolynomialFunctions2 (POLY2)	2780
17.52 package PGCD PolynomialGcdPackage	2782
17.52.1 PolynomialGcdPackage (PGCD)	2782
17.53 package PINTERP PolynomialInterpolation	2790
17.53.1 PolynomialInterpolation (PINTERP)	2790
17.54 package PINTERPA PolynomialInterpolationAlgorithms	2792
17.54.1 PolynomialInterpolationAlgorithms (PINTERPA)	2792
17.55 package PNTHEORY PolynomialNumberTheoryFunctions	2793
17.55.1 PolynomialNumberTheoryFunctions (PNTHEORY)	2793
17.56 package POLYROOT PolynomialRoots	2798

17.56.1 PolynomialRoots (POLYROOT)	2798
17.57package PSETPK PolynomialSetUtilitiesPackage	2801
17.57.1 PolynomialSetUtilitiesPackage (PSETPK)	2801
17.58package SOLVEFOR PolynomialSolveByFormulas	2819
17.58.1 PolynomialSolveByFormulas (SOLVEFOR)	2819
17.59package PSQFR PolynomialSquareFree	2825
17.59.1 PolynomialSquareFree (PSQFR)	2825
17.60package POLY2UP PolynomialToUnivariatePolynomial	2828
17.60.1 PolynomialToUnivariatePolynomial (POLY2UP)	2828
17.61package LIMITPS PowerSeriesLimitPackage	2830
17.61.1 PowerSeriesLimitPackage (LIMITPS)	2830
17.62package PREASSOC PrecomputedAssociatedEquations	2841
17.62.1 PrecomputedAssociatedEquations (PREASSOC)	2841
17.63package PRIMARR2 PrimitiveArrayFunctions2	2844
17.63.1 PrimitiveArrayFunctions2 (PRIMARR2)	2844
17.64package PRIMELT PrimitiveElement	2846
17.64.1 PrimitiveElement (PRIMELT)	2846
17.65package ODEPRIM PrimitiveRatDE	2849
17.65.1 PrimitiveRatDE (ODEPRIM)	2849
17.66package ODEPRRIC PrimitiveRatRicDE	2853
17.66.1 PrimitiveRatRicDE (ODEPRRIC)	2853
17.67package PRINT PrintPackage	2859
17.67.1 PrintPackage (PRINT)	2859
17.68package PSEUDLIN PseudoLinearNormalForm	2860
17.68.1 PseudoLinearNormalForm (PSEUDLIN)	2860
17.69package PRS PseudoRemainderSequence	2864
17.69.1 PseudoRemainderSequence (PRS)	2864
17.70package INTPAF PureAlgebraicIntegration	2883
17.70.1 PureAlgebraicIntegration (INTPAF)	2883
17.71package ODEPAL PureAlgebraicLODE	2892
17.71.1 PureAlgebraicLODE (ODEPAL)	2892
17.72package PUSHVAR PushVariables	2893
17.72.1 PushVariables (PUSHVAR)	2893
 18 Chapter Q	 2897
18.1 package QALGSET2 QuasiAlgebraicSet2	2897
18.1.1 QuasiAlgebraicSet2 (QALGSET2)	2897
18.2 package QCMPACK QuasiComponentPackage	2900
18.2.1 QuasiComponentPackage (QCMPACK)	2900
18.3 package QFCAT2 QuotientFieldCategoryFunctions2	2909
18.3.1 QuotientFieldCategoryFunctions2 (QFCAT2)	2909
18.4 package QUATCT2 QuaternionCategoryFunctions2	2910
18.4.1 QuaternionCategoryFunctions2 (QUATCT2)	2912

19 Chapter R	2915
19.1 package REP RadicalEigenPackage	2915
19.1.1 RadicalEigenPackage (REP)	2915
19.2 package SOLVERAD RadicalSolvePackage	2919
19.2.1 RadicalSolvePackage (SOLVERAD)	2929
19.3 package RADUTIL RadixUtilities	2936
19.3.1 RadixUtilities (RADUTIL)	2936
19.4 package RDIST RandomDistributions	2937
19.4.1 RandomDistributions (RDIST)	2937
19.5 package RFDIST RandomFloatDistributions	2939
19.5.1 RandomFloatDistributions (RFDIST)	2939
19.6 package RIDIST RandomIntegerDistributions	2941
19.6.1 RandomIntegerDistributions (RIDIST)	2941
19.7 package RANDSRC RandomNumberSource	2943
19.7.1 RandomNumberSource (RANDSRC)	2943
19.8 package RATFACT RationalFactorize	2945
19.8.1 RationalFactorize (RATFACT)	2945
19.9 package RF RationalFunction	2947
19.9.1 RationalFunction (RF)	2947
19.10 package DEFINTRF RationalFunctionDefiniteIntegration	2949
19.10.1 RationalFunctionDefiniteIntegration (DEFINTRF)	2949
19.11 package RFFACT RationalFunctionFactor	2952
19.11.1 RationalFunctionFactor (RFFACT)	2952
19.12 package RFFACTOR RationalFunctionFactorizer	2953
19.12.1 RationalFunctionFactorizer (RFFACTOR)	2953
19.13 package INTRF RationalFunctionIntegration	2955
19.13.1 RationalFunctionIntegration (INTRF)	2955
19.14 package LIMITRF RationalFunctionLimitPackage	2957
19.14.1 RationalFunctionLimitPackage (LIMITRF)	2957
19.15 package SIGNRF RationalFunctionSign	2960
19.15.1 RationalFunctionSign (SIGNRF)	2960
19.16 package SUMRF RationalFunctionSum	2963
19.16.1 RationalFunctionSum (SUMRF)	2968
19.17 package INTRAT RationalIntegration	2970
19.17.1 RationalIntegration (INTRAT)	2970
19.18 package RINTERP RationalInterpolation	2972
19.18.1 Introduction	2972
19.18.2 Questions and Outlook	2972
19.18.3 RationalInterpolation (RINTERP)	2973
19.19 package ODERAT RationalLODE	2976
19.19.1 RationalLODE (ODERAT)	2976
19.20 package RATRET RationalRetractions	2981
19.20.1 RationalRetractions (RATRET)	2981
19.21 package ODERTRIC RationalRicDE	2982
19.21.1 RationalRicDE (ODERTRIC)	2982
19.22 package RURPK RationalUnivariateRepresentationPackage	2989

19.22.1 RationalUnivariateRepresentationPackage (RURPK)	2989
19.23package POLUTIL RealPolynomialUtilitiesPackage	2992
19.23.1 RealPolynomialUtilitiesPackage (POLUTIL)	2993
19.24package REALSOLV RealSolvePackage	2996
19.24.1 RealSolvePackage (REALSOLV)	2999
19.25package REAL0 RealZeroPackage	3001
19.25.1 RealZeroPackage (REAL0)	3001
19.26package REAL0Q RealZeroPackageQ	3008
19.26.1 RealZeroPackageQ (REAL0Q)	3008
19.27package RMCAT2 RectangularMatrixCategoryFunctions2	3010
19.27.1 RectangularMatrixCategoryFunctions2 (RMCAT2)	3010
19.28package RECOP RecurrenceOperator	3012
19.28.1 RecurrenceOperator (RECOP)	3012
19.28.2 Defining new operators	3013
19.28.3 Recurrences	3015
19.28.4 Functional Equations	3019
19.29package RDIV ReducedDivisor	3023
19.29.1 ReducedDivisor (RDIV)	3023
19.30package ODERED ReduceLODE	3025
19.30.1 ReduceLODE (ODERED)	3025
19.31package REDORDER ReductionOfOrder	3027
19.31.1 ReductionOfOrder (REDORDER)	3027
19.32package RSDCMPK RegularSetDecompositionPackage	3029
19.32.1 RegularSetDecompositionPackage (RSDCMPK)	3029
19.33package RSETGCD RegularTriangularSetGcdPackage	3035
19.33.1 RegularTriangularSetGcdPackage (RSETGCD)	3035
19.34package REPDB RepeatedDoubling	3043
19.34.1 RepeatedDoubling (REPDB)	3043
19.35package REPSQ RepeatedSquaring	3044
19.35.1 RepeatedSquaring (REPSQ)	3045
19.36package REP1 RepresentationPackage1	3046
19.36.1 RepresentationPackage1 (REP1)	3046
19.37package REP2 RepresentationPackage2	3053
19.37.1 RepresentationPackage2 (REP2)	3053
19.38package RESLATC ResolveLatticeCompletion	3070
19.38.1 ResolveLatticeCompletion (RESLATC)	3070
19.39package RETSOL RetractSolvePackage	3071
19.39.1 RetractSolvePackage (RETSOL)	3071
19.40package RFP RootsFindingPackage	3073
19.40.1 RootsFindingPackage (RFP)	3074
20 Chapter S	3079
20.1 package SAERFFC SAERationalFunctionAlgFactor	3079
20.1.1 SAERationalFunctionAlgFactor (SAERFFC)	3079
20.2 package FORMULA1 ScriptFormulaFormat1	3080
20.2.1 ScriptFormulaFormat1 (FORMULA1)	3080

20.3 package SEGBIND2 SegmentBindingFunctions2	3082
20.3.1 SegmentBindingFunctions2 (SEGBIND2)	3082
20.4 package SEG2 SegmentFunctions2	3083
20.4.1 SegmentFunctions2 (SEG2)	3083
20.5 package SAEFACT SimpleAlgebraicExtensionAlgFactor	3085
20.5.1 SimpleAlgebraicExtensionAlgFactor (SAEFACT)	3085
20.6 package SIMPAN SimplifyAlgebraicNumberConvertPackage	3086
20.6.1 SimplifyAlgebraicNumberConvertPackage (SIMPAN)	3086
20.7 package SMITH SmithNormalForm	3087
20.7.1 SmithNormalForm (SMITH)	3087
20.8 package SCACHE SortedCache	3092
20.8.1 SortedCache (SCACHE)	3092
20.9 package SORTPAK SortPackage	3095
20.9.1 SortPackage (SORTPAK)	3095
20.10 package SUP2 SparseUnivariatePolynomialFunctions2	3097
20.10.1 SparseUnivariatePolynomialFunctions2 (SUP2)	3097
20.11 package SPECOUT SpecialOutputPackage	3098
20.11.1 SpecialOutputPackage (SPECOUT)	3098
20.12 package SFQCMPPK SquareFreeQuasiComponentPackage	3100
20.12.1 SquareFreeQuasiComponentPackage (SFQCMPPK)	3100
20.13 package SRDCMPK SquareFreeRegularSetDecompositionPackage	3109
20.13.1 SquareFreeRegularSetDecompositionPackage (SRDCMPK)	3109
20.14 package SFRGCD SquareFreeRegularTriangularSetGcdPackage	3116
20.14.1 SquareFreeRegularTriangularSetGcdPackage (SFRGCD)	3116
20.15 package MATSTOR StorageEfficientMatrixOperations	3126
20.15.1 StorageEfficientMatrixOperations (MATSTOR)	3126
20.16 package STREAM1 StreamFunctions1	3130
20.16.1 StreamFunctions1 (STREAM1)	3130
20.17 package STREAM2 StreamFunctions2	3132
20.17.1 StreamFunctions2 (STREAM2)	3132
20.18 package STREAM3 StreamFunctions3	3134
20.18.1 StreamFunctions3 (STREAM3)	3134
20.19 package STINPROD StreamInfiniteProduct	3136
20.19.1 StreamInfiniteProduct (STINPROD)	3136
20.20 package STTAYLOR StreamTaylorSeriesOperations	3138
20.20.1 StreamTaylorSeriesOperations (STTAYLOR)	3138
20.21 package STNSR StreamTensor	3148
20.21.1 StreamTensor (STNSR)	3149
20.22 package STTF StreamTranscendentalFunctions	3150
20.22.1 StreamTranscendentalFunctions (STTF)	3150
20.23 package STTFNC StreamTranscendentalFunctionsNonCommutative	3160
20.23.1 StreamTranscendentalFunctionsNonCommutative (STTFNC)	3160
20.24 package SCPKG StructuralConstantsPackage	3165
20.24.1 StructuralConstantsPackage (SCPKG)	3165
20.25 package SHP SturmHabichtPackage	3169
20.25.1 SturmHabichtPackage (SHP)	3169

20.26package SUBRESP SubResultantPackage	3177
20.26.1 SubResultantPackage (SUBRESP)	3177
20.27package SUPFRACF SupFractionFactorizer	3180
20.27.1 SupFractionFactorizer (SUPFRACF)	3180
20.28package ODESYS SystemODESolver	3182
20.28.1 SystemODESolver (ODESYS)	3182
20.29package SYSSOLP SystemSolvePackage	3188
20.29.1 SystemSolvePackage (SYSSOLP)	3188
20.30package SGCF SymmetricGroupCombinatoricFunctions	3193
20.30.1 SymmetricGroupCombinatoricFunctions (SGCF)	3193
20.31package SYMFUNC SymmetricFunctions	3204
20.31.1 SymmetricFunctions (SYMFUNC)	3204
21 Chapter T	3207
21.1 package TABLBUMP TableauxBumpers	3207
21.1.1 TableauxBumpers (TABLBUMP)	3207
21.2 package TBCMPPK TabulatedComputationPackage	3210
21.2.1 TabulatedComputationPackage (TBCMPPK)	3210
21.3 package TANEXP TangentExpansions	3214
21.3.1 TangentExpansions (TANEXP)	3214
21.4 package UTSSOL TaylorSolve	3215
21.4.1 TaylorSolve (UTSSOL)	3216
21.5 package TEMUTL TemplateUtilities	3219
21.5.1 TemplateUtilities (TEMUTL)	3219
21.6 package TEX1 TexFormat1	3221
21.6.1 TexFormat1 (TEX1)	3221
21.7 package TOOLSIGN ToolsForSign	3222
21.7.1 ToolsForSign (TOOLSIGN)	3222
21.8 package DRAW TopLevelDrawFunctions	3224
21.8.1 TopLevelDrawFunctions (DRAW)	3224
21.9 package DRAWCURV TopLevelDrawFunctionsForAlgebraicCurves	3231
21.9.1 TopLevelDrawFunctionsForAlgebraicCurves (DRAWCURV)	3231
21.10package DRAWCFUN TopLevelDrawFunctionsForCompiledFunctions	3235
21.10.1 TopLevelDrawFunctionsForCompiledFunctions (DRAWCFUN)	3235
21.11package DRAWPT TopLevelDrawFunctionsForPoints	3248
21.11.1 TopLevelDrawFunctionsForPoints (DRAWPT)	3248
21.12package TOPSP TopLevelThreeSpace	3251
21.12.1 TopLevelThreeSpace (TOPSP)	3251
21.13package INTHERTR TranscendentalHermiteIntegration	3252
21.13.1 TranscendentalHermiteIntegration (INTHERTR)	3252
21.14package INTTR TranscendentalIntegration	3254
21.14.1 TranscendentalIntegration (INTTR)	3254
21.15package TRMANIP TranscendentalManipulations	3264
21.15.1 TranscendentalManipulations (TRMANIP)	3264
21.16package RDETR TranscendentalRischDE	3273
21.16.1 TranscendentalRischDE (RDETR)	3273

21.17package RDETRS TranscendentalRischDESystem	3277
21.17.1 TranscendentalRischDESystem (RDETRS)	3277
21.18package SOLVETRA TransSolvePackage	3282
21.18.1 TransSolvePackage (SOLVETRA)	3288
21.19package SOLVESER TransSolvePackageService	3299
21.19.1 TransSolvePackageService (SOLVESER)	3299
21.20package TRIMAT TriangularMatrixOperations	3302
21.20.1 TriangularMatrixOperations (TRIMAT)	3302
21.21package TRIGMNIP TrigonometricManipulations	3304
21.21.1 TrigonometricManipulations (TRIGMNIP)	3304
21.22package TUBETOOL TubePlotTools	3308
21.22.1 TubePlotTools (TUBETOOL)	3308
21.23package CLIP TwoDimensionalPlotClipping	3311
21.23.1 TwoDimensionalPlotClipping (CLIP)	3311
21.24package TWOFACT TwoFactorize	3317
21.24.1 TwoFactorize (TWOFACT)	3317

22 Chapter U**3323**

22.1 package UNIFACT UnivariateFactorize	3323
22.1.1 UnivariateFactorize (UNIFACT)	3323
22.2 package UFPS1 UnivariateFormalPowerSeriesFunctions	3330
22.2.1 UnivariateFormalPowerSeriesFunctions (UFPS1)	3330
22.3 package ULS2 UnivariateLaurentSeriesFunctions2	3331
22.3.1 UnivariateLaurentSeriesFunctions2 (ULS2)	3331
22.4 package UPOLYC2 UnivariatePolynomialCategoryFunctions2	3333
22.4.1 UnivariatePolynomialCategoryFunctions2 (UPOLYC2)	3333
22.5 package UPCDEN UnivariatePolynomialCommonDenominator	3334
22.5.1 UnivariatePolynomialCommonDenominator (UPCDEN)	3334
22.6 package UPDECOMP UnivariatePolynomialDecompositionPackage	3336
22.6.1 UnivariatePolynomialDecompositionPackage (UPDECOMP)	3336
22.7 package UPDIVP UnivariatePolynomialDivisionPackage	3339
22.7.1 UnivariatePolynomialDivisionPackage (UPDIVP)	3339
22.8 package UP2 UnivariatePolynomialFunctions2	3341
22.8.1 UnivariatePolynomialFunctions2 (UP2)	3341
22.9 package UPMP UnivariatePolynomialMultiplicationPackage	3342
22.9.1 UnivariatePolynomialMultiplicationPackage (UPMP)	3342
22.10package UPSQFREE UnivariatePolynomialSquareFree	3345
22.10.1 UnivariatePolynomialSquareFree (UPSQFREE)	3345
22.11package UPXS2 UnivariatePuisseuxSeriesFunctions2	3348
22.11.1 UnivariatePuisseuxSeriesFunctions2 (UPXS2)	3348
22.12package OREPCTO UnivariateSkewPolynomialCategoryOps	3349
22.12.1 UnivariateSkewPolynomialCategoryOps (OREPCTO)	3349
22.13package UTS2 UnivariateTaylorSeriesFunctions2	3353
22.13.1 UnivariateTaylorSeriesFunctions2 (UTS2)	3353
22.14package UTSODE UnivariateTaylorSeriesODESolver	3354
22.14.1 UnivariateTaylorSeriesODESolver (UTSODE)	3354

22.15package UNISEG2 UniversalSegmentFunctions2	3357
22.15.1 UniversalSegmentFunctions2 (UNISEG2)	3357
22.16package UDPO UserDefinedPartialOrdering	3359
22.16.1 UserDefinedPartialOrdering (UDPO)	3359
22.17package UDVO UserDefinedVariableOrdering	3361
22.17.1 UserDefinedVariableOrdering (UDVO)	3361
22.18package UTSODETL UTSodetools	3363
22.18.1 UTSodetools (UTSODETL)	3363
23 Chapter V	3365
23.1 package VECTOR2 VectorFunctions2	3365
23.1.1 VectorFunctions2 (VECTOR2)	3365
23.2 package VIEWDEF ViewDefaultsPackage	3367
23.2.1 ViewDefaultsPackage (VIEWDEF)	3367
23.3 package VIEW ViewportPackage	3372
23.3.1 ViewportPackage (VIEW)	3372
24 Chapter W	3375
24.1 package WEIER WeierstrassPreparation	3375
24.1.1 WeierstrassPreparation (WEIER)	3375
24.2 package WFFINTBS WildFunctionFieldIntegralBasis	3379
24.2.1 WildFunctionFieldIntegralBasis (WFFINTBS)	3379
25 Chapter X	3385
25.1 package XEXPPKG XExponentialPackage	3385
25.1.1 XExponentialPackage (XEXPPKG)	3385
26 Chapter Y	3389
27 Chapter Z	3391
27.1 package ZDSOLVE ZeroDimensionalSolvePackage	3391
27.1.1 ZeroDimensionalSolvePackage (ZDSOLVE)	3454
28 Chunk collections	3465
29 Index	3477

Volume 10.5: Axiom Algebra: Numerics

1	Numerical Analysis [?]	1
2	Chapter Overview	3
3	Algebra Cover Code	5
3.1	package BLAS1 BlasLevelOne	5
3.1.1	BlasLevelOne (BLAS1)	8
3.2	dcabs1 BLAS	10
3.3	lsame BLAS	14
3.4	xerbla BLAS	14
4	BLAS Level 1	15
4.1	dasum BLAS	15
4.2	daxpy BLAS	24
4.3	dcopy BLAS	32
4.4	ddot BLAS	38
4.5	dnrm2 BLAS	42
4.6	drotg BLAS	45
4.7	drot BLAS	48
4.8	dscal BLAS	51
4.9	dswap BLAS	55
4.10	dzasum BLAS	58
4.11	dznrm2 BLAS	61
4.12	icamax BLAS	64
4.13	idamax BLAS	66
4.14	isamax BLAS	69
4.15	izamax BLAS	72
4.16	zaxpy BLAS	75
4.17	zcopy BLAS	78
4.18	zdotc BLAS	81
4.19	zdotu BLAS	84
4.20	zdscal BLAS	87
4.21	zrotg BLAS	89
4.22	zscal BLAS	92
4.23	zswap BLAS	94
5	BLAS Level 2	99
5.1	dgbmv BLAS	99
5.2	dgemv BLAS	107
5.3	dger BLAS	115
5.4	dsbmv BLAS	119
5.5	dspmv BLAS	128
5.6	dspr2 BLAS	137
5.7	dspr BLAS	144

5.8	dsymv BLAS	151
5.9	dsyr2 BLAS	159
5.10	dsyr BLAS	166
5.11	dtbmv BLAS	172
5.12	dtbsv BLAS	184
5.13	dtpmv BLAS	196
5.14	dtpsv BLAS	208
5.15	dtrmv BLAS	219
5.16	dtrsv BLAS	229
5.17	zgbmv BLAS	240
5.18	zgemv BLAS	249
5.19	zgerc BLAS	257
5.20	zgeru BLAS	262
5.21	zhbmrv BLAS	266
5.22	zhemv BLAS	275
5.23	zher2 BLAS	284
5.24	zher BLAS	295
5.25	zhpmv BLAS	303
5.26	zhpr2 BLAS	312
5.27	zhpr BLAS	327
5.28	ztbmv BLAS	336
5.29	ztbsv BLAS	351
5.30	ztpmv BLAS	366
5.31	ztpsv BLAS	380
5.32	ztrmv BLAS	394
5.33	ztrsv BLAS	407
6	BLAS Level 3	421
6.1	dgemm BLAS	421
6.2	dsymm BLAS	430
6.3	dsyr2k BLAS	440
6.4	dsyrk BLAS	451
6.5	dtrmm BLAS	460
6.6	dtrsm BLAS	473
6.7	zgemm BLAS	487
6.8	zhemm BLAS	501
6.9	zher2k BLAS	512
6.10	zherk BLAS	527
6.11	zsymm BLAS	540
6.12	zsyr2k BLAS	551
6.13	zsyrk BLAS	561
6.14	ztrmm BLAS	570
6.15	ztrsm BLAS	585

7 LAPACK	603
7.1 dbdsdc LAPACK	603
7.2 dbdsqr LAPACK	616
7.3 ddisna LAPACK	642
7.4 dgebak LAPACK	647
7.5 dgebal LAPACK	651
7.6 dgebd2 LAPACK	658
7.7 dgebrd LAPACK	666
7.8 dgeev LAPACK	672
7.9 dgeevx LAPACK	686
7.10 dgehd2 LAPACK	703
7.11 dgehrd LAPACK	707
7.12 dgelq2 LAPACK	713
7.13 dgelqf LAPACK	716
7.14 dgeqr2 LAPACK	721
7.15 dgeqrf LAPACK	724
7.16 dgesdd LAPACK	728
7.17 dgesvd LAPACK	772
7.18 dgesv LAPACK	903
7.19 dgetf2 LAPACK	905
7.20 dgetrf LAPACK	909
7.21 dgetrs LAPACK	913
7.22 dhseqr LAPACK	916
7.23 dlabad LAPACK	929
7.24 dlabrd LAPACK	931
7.25 dlacon LAPACK	944
7.26 dlacpy LAPACK	949
7.27 dladiv LAPACK	952
7.28 dlaed6 LAPACK	953
7.29 dlaexc LAPACK	962
7.30 dlahqr LAPACK	973
7.31 dlahrd LAPACK	989
7.32 dlaln2 LAPACK	995
7.33 dlamch LAPACK	1012
7.34 dlamc1 LAPACK	1015
7.35 dlamc2 LAPACK	1020
7.36 dlamc3 LAPACK	1026
7.37 dlamc4 LAPACK	1028
7.38 dlamc5 LAPACK	1030
7.39 dlamrg LAPACK	1033
7.40 dlange LAPACK	1036
7.41 dlanhs LAPACK	1040
7.42 dlanst LAPACK	1044
7.43 dlanv2 LAPACK	1048
7.44 dlapy2 LAPACK	1052
7.45 dlaqtr LAPACK	1053

7.46	dlarfb LAPACK	1079
7.47	dlarfg LAPACK	1093
7.48	dlarf LAPACK	1096
7.49	dlarft LAPACK	1098
7.50	dlarfx LAPACK	1105
7.51	dlartg LAPACK	1148
7.52	das2 LAPACK	1151
7.53	dascl LAPACK	1154
7.54	dasd0 LAPACK	1161
7.55	dasd1 LAPACK	1168
7.56	dasd2 LAPACK	1174
7.57	dasd3 LAPACK	1187
7.58	dasd4 LAPACK	1200
7.59	dasd5 LAPACK	1233
7.60	dasd6 LAPACK	1239
7.61	dasd7 LAPACK	1246
7.62	dasd8 LAPACK	1258
7.63	dasda LAPACK	1267
7.64	dasdq LAPACK	1281
7.65	dasdt LAPACK	1289
7.66	daset LAPACK	1293
7.67	dasq1 LAPACK	1296
7.68	dasq2 LAPACK	1300
7.69	dasq3 LAPACK	1319
7.70	dasq4 LAPACK	1333
7.71	dasq5 LAPACK	1346
7.72	dasq6 LAPACK	1356
7.73	dasr LAPACK	1365
7.74	dasrt LAPACK	1379
7.75	dasq LAPACK	1385
7.76	dasv2 LAPACK	1388
7.77	daswp LAPACK	1392
7.78	das2 LAPACK	1396
7.79	dorg2r LAPACK	1412
7.80	dorgbr LAPACK	1415
7.81	dorghr LAPACK	1422
7.82	dorgl2 LAPACK	1426
7.83	dorglq LAPACK	1429
7.84	dorgqr LAPACK	1435
7.85	dorm2r LAPACK	1440
7.86	dormbr LAPACK	1444
7.87	dorml2 LAPACK	1450
7.88	dormlq LAPACK	1454
7.89	dormqr LAPACK	1460
7.90	dtrevc LAPACK	1466
7.91	dtrexcl LAPACK	1508

7.92	dtrsna LAPACK	1517
7.93	ieeeck LAPACK	1533
7.94	ilaenv LAPACK	1536
7.95	zlange LAPACK	1548
7.96	zlassq LAPACK	1552
8	Chunk collections	1555
9	Index	1563

Volume 11: Axiom Browser

1	Overview	1
1.1	Build Instructions	1
1.2	The Makefile	2
1.3	Building new pages	3
1.3.1	Communicating with Axiom	3
1.3.2	Handling statements with no free variables	4
1.3.3	Handling statements with free variables	4
1.3.4	Handling domain database lookups	4
1.3.5	Handling)show domain	4
1.3.6	Handling lisp expressions	5
1.3.7	Handling expressions that have no output	5
1.4	Defined Pages	5
1.5	The Standard Layout	19
1.6	Cascading Style Sheet	20
1.6.1	Standard Style Sheet	20
1.6.2	Menu style sheet	22
1.7	standard head	26
1.8	Javascript functions	27
1.8.1	Show only mathml	27
1.8.2	Show Full Answer	28
1.8.3	Handle Free Variables	29
1.8.4	axiom talker	31
1.9	Pages	33
1.9.1	axiomfonts.xhtml	48
1.9.2	aldorusersguidepage.xhtml	99
1.9.3	algebrapage.xhtml	99
1.9.4	algrouptheory.xhtml	100
1.9.5	algrouptheorygroup.xhtml	101
1.9.6	algrouptheoryrepa6.xhtml	102
1.9.7	algrouptheoryrepththeory.xhtml	106
1.9.8	alnumbertheory.xhtml	107
1.9.9	alnumbertheorygalois.xhtml	108
1.9.10	basiccommand.xhtml	116
1.9.11	basiclimit.xhtml	117
1.9.12	bcexpand.xhtml	118
1.9.13	bcmatrix.xhtml	120
1.9.14	calculus.xhtml	125
1.9.15	calculuspage.xhtml	126
1.9.16	calderivatives.xhtml	128
1.9.17	calintegrals.xhtml	131
1.9.18	callaplace.xhtml	135
1.9.19	callimits.xhtml	137
1.9.20	calmoreintegrals.xhtml	141

1.9.21	calseries.xhtml	145
1.9.22	calseries1.xhtml	147
1.9.23	calseries2.xhtml	150
1.9.24	calseries3.xhtml	152
1.9.25	calseries4.xhtml	154
1.9.26	calseries5.xhtml	158
1.9.27	calseries6.xhtml	161
1.9.28	calseries7.xhtml	164
1.9.29	calseries8.xhtml	165
1.9.30	cats.xhtml	169
1.9.31	commandline.xhtml	170
1.9.32	complexlimit.xhtml	187
1.9.33	conversionfunctions.xhtml	189
1.9.34	cryptopage.xhtml	193
1.9.35	cryptoclass1.xhtml	195
1.9.36	cryptoclass2.xhtml	200
1.9.37	cryptoclass3.xhtml	204
1.9.38	cryptoclass4.xhtml	208
1.9.39	cryptoclass5.xhtml	212
1.9.40	cryptoclass6.xhtml	216
1.9.41	cryptoclass7.xhtml	219
1.9.42	cryptoclass8.xhtml	223
1.9.43	cryptoclass9.xhtml	228
1.9.44	cryptoclass10.xhtml	232
1.9.45	cryptoclass11.xhtml	234
1.9.46	dbopbinary.xhtml	237
1.9.47	dbcharacteristic.xhtml	238
1.9.48	dbcomplexcomplex.xhtml	238
1.9.49	dbcomplexconjugate.xhtml	238
1.9.50	dbcomplexfactor.xhtml	238
1.9.51	dbcomplexdoublefloat.xhtml	239
1.9.52	dbcomplexfloat.xhtml	239
1.9.53	dbcompleximag.xhtml	239
1.9.54	dbcomplexnorm.xhtml	239
1.9.55	dbcomplexreal.xhtml	240
1.9.56	dbcomplexinteger.xhtml	240
1.9.57	dbexpressioninteger.xhtml	240
1.9.58	dbfractioninteger.xhtml	240
1.9.59	dbfractionpolynomialinteger.xhtml	241
1.9.60	dblookup.xhtml	241
1.9.61	dbopacos.xhtml	241
1.9.62	dbopacosh.xhtml	241
1.9.63	dbopacot.xhtml	242
1.9.64	dbopacoth.xhtml	242
1.9.65	dbopacsc.xhtml	242
1.9.66	dbopacsch.xhtml	242

1.9.67	dbopaddmod.xhtml	243
1.9.68	dbopairyai.xhtml	243
1.9.69	dbopairybi.xhtml	243
1.9.70	dbopapproximants.xhtml	243
1.9.71	dbopasin.xhtml	244
1.9.72	dbopasinh.xhtml	244
1.9.73	dbopasec.xhtml	244
1.9.74	dbopasech.xhtml	244
1.9.75	dbopatan.xhtml	245
1.9.76	dbopatanh.xhtml	245
1.9.77	dbopbernoullib.xhtml	245
1.9.78	dbopbesseli.xhtml	245
1.9.79	dbopbesselj.xhtml	246
1.9.80	dbopbesselk.xhtml	246
1.9.81	dbopbessely.xhtml	246
1.9.82	dbopbeta.xhtml	246
1.9.83	dbopcardinalnumber.xhtml	247
1.9.84	dbopchebyshevt.xhtml	247
1.9.85	dbopchebyshevu.xhtml	247
1.9.86	dbopcoefficient.xhtml	247
1.9.87	dbopcoefficients.xhtml	248
1.9.88	dbopcoerce.xhtml	248
1.9.89	dbopcolumn.xhtml	248
1.9.90	dbopcompactfraction.xhtml	248
1.9.91	dbopcomplexeigenvectors.xhtml	249
1.9.92	dbopcomplexelementary.xhtml	249
1.9.93	dbopcomplexintegrate.xhtml	249
1.9.94	dbopcomplexlimit.xhtml	249
1.9.95	dbopcomplexsolve.xhtml	250
1.9.96	dbopcontent.xhtml	250
1.9.97	dbopcontinuedfraction.xhtml	250
1.9.98	dbopconvergents.xhtml	250
1.9.99	dbopconvert.xhtml	251
1.9.100	dbopcopy.xhtml	251
1.9.101	dbopcos.xhtml	251
1.9.102	dbopcosh.xhtml	251
1.9.103	dbopcot.xhtml	252
1.9.104	dbopcoth.xhtml	252
1.9.105	dbopcount.xhtml	252
1.9.106	dbopcountableq.xhtml	252
1.9.107	dbopcreate3space.xhtml	253
1.9.108	dbopcsc.xhtml	253
1.9.109	dbopcsch.xhtml	253
1.9.110	dbopcurve.xhtml	253
1.9.111	dbopcycleragits.xhtml	254
1.9.112	dbopcyclotomic.xhtml	254

1.9.113 dbopd.xhtml	254
1.9.114 dbopdecimal.xhtml	254
1.9.115 dbopdefiningpolynomial.xhtml	255
1.9.116 dbopdegree.xhtml	255
1.9.117 dbopdenom.xhtml	255
1.9.118 dbopdraw.xhtml	255
1.9.119 dbopdeterminant.xhtml	256
1.9.120 dbopdiagonalmatrix.xhtml	256
1.9.121 dbopdigamma.xhtml	256
1.9.122 dbopdigits.xhtml	256
1.9.123 dbopdimension.xhtml	257
1.9.124 dbopdivide.xhtml	257
1.9.125 dbopdivisors.xhtml	257
1.9.126 dbopei.xhtml	257
1.9.127 dbopeigenmatrix.xhtml	258
1.9.128 dbopeigenvalues.xhtml	258
1.9.129 dbopeigenvector.xhtml	258
1.9.130 dbopeigenvectors.xhtml	258
1.9.131 dbopelt.xhtml	259
1.9.132 dbopequal.xhtml	259
1.9.133 dbopeulere.xhtml	259
1.9.134 dbopeulerphi.xhtml	259
1.9.135 dbopeval.xhtml	260
1.9.136 dbopevenq.xhtml	260
1.9.137 dbopexp.xhtml	260
1.9.138 dbopexquo.xhtml	260
1.9.139 dbopfactor.xhtml	261
1.9.140 dbopfactorfraction.xhtml	261
1.9.141 dbopfibonacci.xhtml	261
1.9.142 dbopfiniteq.xhtml	261
1.9.143 dbopfirstdenom.xhtml	262
1.9.144 dbopfirstnumer.xhtml	262
1.9.145 dbopfractragits.xhtml	262
1.9.146 dbopfractionpart.xhtml	262
1.9.147 dbopgamma.xhtml	263
1.9.148 dbopgcd.xhtml	263
1.9.149 dbophermiteh.xhtml	263
1.9.150 dbophex.xhtml	263
1.9.151 dbophorizconcat.xhtml	264
1.9.152 dbophtrigs.xhtml	264
1.9.153 dbophypergeometric0f1.xhtml	264
1.9.154 dbopinteger.xhtml	264
1.9.155 dbopintegrate.xhtml	265
1.9.156 dbopinverse.xhtml	265
1.9.157 dbopinvmod.xhtml	265
1.9.158 dbopjacobi.xhtml	265

1.9.159 dboplaguerrel.xhtml	266
1.9.160 dboplaurent.xhtml	266
1.9.161 dboplcm.xhtml	266
1.9.162 dbopleadingcoefficient.xhtml	266
1.9.163 dbopleadingmonomial.xhtml	267
1.9.164 dboplegendre.xhtml	267
1.9.165 dboplenth.xhtml	267
1.9.166 dboplimit.xhtml	267
1.9.167 dboplog.xhtml	268
1.9.168 dboploggamma.xhtml	268
1.9.169 dbopmainvariable.xhtml	268
1.9.170 dbopmakegraphimage.xhtml	268
1.9.171 dbopmakeobject.xhtml	269
1.9.172 dbopmakeviewport3d.xhtml	269
1.9.173 dbopmap.xhtml	269
1.9.174 dbopmapbang.xhtml	269
1.9.175 dbopmatrix.xhtml	270
1.9.176 dbopmax.xhtml	270
1.9.177 dbopmemberq.xhtml	270
1.9.178 dbopmin.xhtml	270
1.9.179 dbopminimumdegree.xhtml	271
1.9.180 dbopminus.xhtml	271
1.9.181 dbopmoebiusmu.xhtml	271
1.9.182 dbopmonicdivide.xhtml	271
1.9.183 dbopmulmod.xhtml	272
1.9.184 dbopncols.xhtml	272
1.9.185 dbopnegativeq.xhtml	272
1.9.186 dbopnew.xhtml	272
1.9.187 dbopnextprime.xhtml	273
1.9.188 dbopnorm.xhtml	273
1.9.189 dbopnrows.xhtml	273
1.9.190 dbopnthfractionalterm.xhtml	273
1.9.191 dbopnthroot.xhtml	274
1.9.192 dbopnumer.xhtml	274
1.9.193 dbopnumeric.xhtml	274
1.9.194 dbopoddq.xhtml	274
1.9.195 dboponedimensionalarray.xhtml	275
1.9.196 dbopoperator.xhtml	275
1.9.197 dboporthonormalbasis.xhtml	275
1.9.198 dbopoutputfixed.xhtml	275
1.9.199 dbopoutputfloating.xhtml	276
1.9.200 dbopoutputgeneral.xhtml	276
1.9.201 dbopoutputspacing.xhtml	276
1.9.202 dboppadicfraction.xhtml	276
1.9.203 dbopnullity.xhtml	277
1.9.204 dbopnullspace.xhtml	277

1.9.205 dbopnumberoffractionalterms.xhtml	277
1.9.206 dboppartialfraction.xhtml	277
1.9.207 dboppartialquotients.xhtml	278
1.9.208 dbopplus.xhtml	278
1.9.209 dboppattern.xhtml	278
1.9.210 dboppermanent.xhtml	278
1.9.211 dboppi.xhtml	279
1.9.212 dboppolygamma.xhtml	279
1.9.213 dboppositiveq.xhtml	279
1.9.214 dboppositiveremainder.xhtml	279
1.9.215 dbopprefixragits.xhtml	280
1.9.216 dbopprevprime.xhtml	280
1.9.217 dbopprimefactor.xhtml	280
1.9.218 dbopprimeq.xhtml	280
1.9.219 dbopprimes.xhtml	281
1.9.220 dboppuiseux.xhtml	281
1.9.221 dbopqelt.xhtml	281
1.9.222 dbopqseteltbang.xhtml	281
1.9.223 dbopquatern.xhtml	282
1.9.224 dbopradicaleigenvectors.xhtml	282
1.9.225 dbopradicalsolve.xhtml	282
1.9.226 dboprank.xhtml	282
1.9.227 dbopratdenom.xhtml	283
1.9.228 dboprealeigenvectors.xhtml	283
1.9.229 dboprealelementary.xhtml	283
1.9.230 dbopreduce.xhtml	283
1.9.231 dbopreductum.xhtml	284
1.9.232 dboprem.xhtml	284
1.9.233 dbopquo.xhtml	284
1.9.234 dbopresetvariableorder.xhtml	284
1.9.235 dbopresultant.xhtml	285
1.9.236 dboprootof.xhtml	285
1.9.237 dboprootsimp.xhtml	285
1.9.238 dboprootsof.xhtml	285
1.9.239 dbopseries.xhtml	286
1.9.240 dbopround.xhtml	286
1.9.241 dboprow.xhtml	286
1.9.242 dboprowechelon.xhtml	286
1.9.243 dbopsetcolumnbang.xhtml	287
1.9.244 dbopseteltbang.xhtml	287
1.9.245 dbopsetrowbang.xhtml	287
1.9.246 dbopsetelt.xhtml	287
1.9.247 dbopsetsubmatrixbang.xhtml	288
1.9.248 dbopsign.xhtml	288
1.9.249 dbopsimplify.xhtml	288
1.9.250 dbopseriesolve.xhtml	288

1.9.251 dbopsin.xhtml	289
1.9.252 dbopsintegerand.xhtml	289
1.9.253 dbopsintegernot.xhtml	289
1.9.254 dbopsintegeror.xhtml	289
1.9.255 dbopsintegerxor.xhtml	290
1.9.256 dbopsec.xhtml	290
1.9.257 dbopsech.xhtml	290
1.9.258 dbopsetvariableorder.xhtml	290
1.9.259 dbopsinh.xhtml	291
1.9.260 dbopsolve.xhtml	291
1.9.261 dbopsqrt.xhtml	291
1.9.262 dbopstar.xhtml	291
1.9.263 dbopstarstar.xhtml	292
1.9.264 dbopsubmatrix.xhtml	292
1.9.265 dbopsubmod.xhtml	292
1.9.266 dbopsurface.xhtml	292
1.9.267 dbopsumofkthpowerdivisors.xhtml	293
1.9.268 dboptan.xhtml	293
1.9.269 dboptanh.xhtml	293
1.9.270 dboptaylor.xhtml	293
1.9.271 dboptimes.xhtml	294
1.9.272 dboptotaldegree.xhtml	294
1.9.273 dboptrace.xhtml	294
1.9.274 dboptranspose.xhtml	294
1.9.275 dboptrigs.xhtml	295
1.9.276 dboptruncate.xhtml	295
1.9.277 dbopvariables.xhtml	295
1.9.278 dbopvectorise.xhtml	295
1.9.279 dbopvectorspace.xhtml	296
1.9.280 dbopwrite.xhtml	296
1.9.281 dbopzeroof.xhtml	296
1.9.282 dbopzerosof.xhtml	296
1.9.283 dbopzeroq.xhtml	297
1.9.284 dbopvertconcat.xhtml	297
1.9.285 dbopwholepart.xhtml	297
1.9.286 dbopolynomialinteger.xhtml	297
1.9.287 dbopolynomialfractioninteger.xhtml	298
1.9.288 dbopwholeragits.xhtml	298
1.9.289 definiteintegral.xhtml	299
1.9.290 determinantofhilbert.xhtml	300
1.9.291 differentiate.xhtml	302
1.9.292 dlmf.xhtml	303
1.9.293 dlmfapproximations.xhtml	305
1.9.294 dlmfasymptoticexpansions.xhtml	316
1.9.295 dlmfbarnesgfunction.xhtml	369
1.9.296 dlmfbetafunction.xhtml	388

1.9.297 dlmfcontinuedfractions.xhtml	420
1.9.298 dlmfdefinitions.xhtml	428
1.9.299 dlmffunctionrelations.xhtml	438
1.9.300 dlmfgraphics.xhtml	457
1.9.301 dlmfinequalities.xhtml	463
1.9.302 dlmfinfiniteproducts.xhtml	479
1.9.303 dlmfintegrals.xhtml	490
1.9.304 dlmfintegralrepresentations.xhtml	510
1.9.305 dlmfmathematicalapplications.xhtml	552
1.9.306 dlmfmethodsofcomputation.xhtml	563
1.9.307 dlmfmultidimensionalintegral.xhtml	565
1.9.308 dlmfnotation.xhtml	597
1.9.309 dlmfphysicalapplications.xhtml	606
1.9.310 dlmfpolygammafunctions.xhtml	619
1.9.311 dlmfqgammaandbetafunctions.xhtml	631
1.9.312 dlmfseriesexpansions.xhtml	650
1.9.313 dlmfsums.xhtml	669
1.9.314 dlmfsoftware.xhtml	672
1.9.315 dlmfspecialvaluesandextrema.xhtml	673
1.9.316 dlmftables.xhtml	702
1.9.317 draw.xhtml	756
1.9.318 draw2donevariable.xhtml	759
1.9.319 draw2ddefinedcurve.xhtml	761
1.9.320 draw2dpolynomialequation.xhtml	763
1.9.321 draw3dtwovariable.xhtml	765
1.9.322 draw3ddefinedtube.xhtml	767
1.9.323 draw3ddefinedsurface.xhtml	769
1.9.324 equdifferential.xhtml	771
1.9.325 equdifferentiallinear.xhtml	773
1.9.326 equdifferentialnonlinear.xhtml	777
1.9.327 equdifferentialpowerseries.xhtml	782
1.9.328 equationpage.xhtml	785
1.9.329 equsystemlinear.xhtml	787
1.9.330 examplesexposedpage.xhtml	790
1.9.331 factored.xhtml	790
1.9.332 foundationlibrarydocpage.xhtml	790
1.9.333 funalgebraicfunctions.xhtml	791
1.9.334 funelementaryfunctions.xhtml	793
1.9.335 funoperatoralgebra.xhtml	794
1.9.336 functionpage.xhtml	799
1.9.337 funpatternmatching.xhtml	801
1.9.338 funrationalfunctions.xhtml	810
1.9.339 funsimplification.xhtml	812
1.9.340 glossarypage.xhtml	815
1.9.341 graphexamples.xhtml	852
1.9.342 graphexamplesassorted.xhtml	853

1.9.343 graphexamplesimplicit.xhtml	855
1.9.344 graphexampleslistofpoints.xhtml	857
1.9.345 graphexamplesonevariable.xhtml	859
1.9.346 graphexamplesparametric.xhtml	860
1.9.347 graphexamplespolar.xhtml	862
1.9.348 graphexamplesthreed.xhtml	864
1.9.349 graphicspage.xhtml	866
1.9.350 graphviewports.xhtml	867
1.9.351 graph2d.xhtml	868
1.9.352 graph2dimplicit.xhtml	869
1.9.353 graph2dlistsofpoints.xhtml	870
1.9.354 graph2donevariable.xhtml	873
1.9.355 graph2dparametric.xhtml	875
1.9.356 graph2dpolar.xhtml	877
1.9.357 graph3d.xhtml	878
1.9.358 graph3dobjects.xhtml	879
1.9.359 graph3dparametric.xhtml	883
1.9.360 graph3dsurfaces.xhtml	885
1.9.361 graph3dtubeplots.xhtml	887
1.9.362 graph3dtwovariables.xhtml	889
1.9.363 htxtoppage.xhtml	890
1.9.364 indefiniteintegral.xhtml	891
1.9.365 introtofloat.xhtml	892
1.9.366 jenks.xhtml	894
1.9.367 laurentseries.xhtml	897
1.9.368 linalgpage.xhtml	899
1.9.369 linconversion.xhtml	902
1.9.370 lincreate.xhtml	906
1.9.371 lineigen.xhtml	911
1.9.372 linhilbert.xhtml	915
1.9.373 linintro.xhtml	917
1.9.374 linoperations.xhtml	920
1.9.375 linpermaent.xhtml	925
1.9.376 linsquarematrices.xhtml	927
1.9.377 linvectors.xhtml	929
1.9.378 lin1darrays.xhtml	933
1.9.379 lin2darrays.xhtml	936
1.9.380 man0page.xhtml	942
1.9.381 menualgebraadjointmatrix.xhtml	944
1.9.382 menualgebraapplytolist.xhtml	944
1.9.383 menualgebracharacteristicpolynomial.xhtml	944
1.9.384 menualgebradeterminant.xhtml	945
1.9.385 menualgebraeigenvalues.xhtml	945
1.9.386 menualgebraeigenvectors.xhtml	945
1.9.387 menualgebraentermatrix.xhtml	945
1.9.388 menualgebrainvertmatrix.xhtml	946

1.9.389 menualgebrageneratematrix.xhtml	946
1.9.390 menualgebramakelist.xhtml	946
1.9.391 menualgebramaptolist.xhtml	946
1.9.392 menualgebramaptomatrix.xhtml	947
1.9.393 menualgebrareducelist.xhtml	947
1.9.394 menualgebratransposematrix.xhtml	947
1.9.395 menuaxiomaddtopath.xhtml	947
1.9.396 menuaxiomclearmemory.xhtml	948
1.9.397 menuaxiomdeletefunction.xhtml	948
1.9.398 menuaxiomdeletevariable.xhtml	948
1.9.399 menuaxiominterrupt.xhtml	948
1.9.400 menuaxiomrestart.xhtml	949
1.9.401 menuaxiomshowdefinition.xhtml	949
1.9.402 menuaxiomdisplay.xhtml	949
1.9.403 menuaxiomset.xhtml	949
1.9.404 menuaxiomshowfunctions.xhtml	950
1.9.405 menuaxiomshowvariables.xhtml	950
1.9.406 menuaxiomtoggl timedisplay.xhtml	950
1.9.407 menucalculuscalculusum.xhtml	950
1.9.408 menucalculuscalculusproduct.xhtml	951
1.9.409 menucalculuschangevariable.xhtml	951
1.9.410 menucalculuscontinuedfractions.xhtml	951
1.9.411 menucalculusdifferentiate.xhtml	951
1.9.412 menucalculusdividepolynomials.xhtml	952
1.9.413 menucalculusfindlimit.xhtml	952
1.9.414 menucalculusgetseries.xhtml	952
1.9.415 menucalculusgreatestcommondivisor.xhtml	952
1.9.416 menucalculusleastcommonmultiple.xhtml	953
1.9.417 menucalculusintegrate.xhtml	953
1.9.418 menucalculusinverselaplace transform.xhtml	953
1.9.419 menucalculuslaplace transform.xhtml	953
1.9.420 menucalculuslevel3.xhtml	954
1.9.421 menucalculuslevel3a.xhtml	954
1.9.422 menucalculuslevel3b.xhtml	954
1.9.423 menucalculuslevel3c.xhtml	954
1.9.424 menucalculuspadeapproximation.xhtml	955
1.9.425 menucalculuspartialfractions.xhtml	955
1.9.426 menucalculusrischintegrate.xhtml	955
1.9.427 menueditcopy.xhtml	955
1.9.428 menueditcopyasimage.xhtml	956
1.9.429 menueditcopytex.xhtml	956
1.9.430 menueditcopytext.xhtml	956
1.9.431 menueditcut.xhtml	956
1.9.432 menueditpaste.xhtml	957
1.9.433 menueditdeleteselection.xhtml	957
1.9.434 menueditselectiontoimage.xhtml	957

1.9.435 menueditselectiontoinput.xhtml	957
1.9.436 menuequationsrealrootsofpolynomial.xhtml	958
1.9.437 menuequationsatvalue.xhtml	958
1.9.438 menuequationsboundaryvalueproblem.xhtml	958
1.9.439 menuequationsinitialvalueproblem1.xhtml	958
1.9.440 menuequationsinitialvalueproblem2.xhtml	959
1.9.441 menuequationssolvealgebraicsystem.xhtml	959
1.9.442 menuequationsseliminatevariable.xhtml	959
1.9.443 menuequationssolveinearsystem.xhtml	959
1.9.444 menuequationssolveode.xhtml	960
1.9.445 menuequationssolveodewithlaplace.xhtml	960
1.9.446 menuequationsrootsofpolynomial.xhtml	960
1.9.447 menuequationssolve.xhtml	960
1.9.448 menuequationssolvenumerically.xhtml	961
1.9.449 menufileexit.xhtml	961
1.9.450 menufileinputfile.xhtml	961
1.9.451 menufileloadlibrary.xhtml	961
1.9.452 menufileopen.xhtml	962
1.9.453 menufileprint.xhtml	962
1.9.454 menufileread.xhtml	962
1.9.455 menufilesave.xhtml	962
1.9.456 menufilesaveas.xhtml	963
1.9.457 menufiletogglespool.xhtml	963
1.9.458 menunumericsetprecision.xhtml	963
1.9.459 menunumerictobigfloat.xhtml	963
1.9.460 menunumerictofloat.xhtml	964
1.9.461 menunumerictogglenumericoutput.xhtml	964
1.9.462 menusimplifyaddalgebraicequality.xhtml	964
1.9.463 menusimplifycomplexsimplification.xhtml	964
1.9.464 menusimplifycontractlogarithms.xhtml	965
1.9.465 menusimplifyevalutenounform.xhtml	965
1.9.466 menusimplifyexpandexpression.xhtml	965
1.9.467 menusimplifyexpandlogarithms.xhtml	965
1.9.468 menusimplifyfactorialsandgamma.xhtml	966
1.9.469 menusimplifyfactorcomplex.xhtml	966
1.9.470 menusimplifyfactorexpression.xhtml	966
1.9.471 menusimplifymoduluscomputation.xhtml	966
1.9.472 menusimplifysimplifyexpression.xhtml	967
1.9.473 menusimplifysubstitute.xhtml	967
1.9.474 menusimplifysimplifyradicals.xhtml	967
1.9.475 menusimplifytogglealgebraicflag.xhtml	967
1.9.476 menusimplifytrigsimplification.xhtml	968
1.9.477 numbasicfunctions.xhtml	969
1.9.478 numberspage.xhtml	976
1.9.479 numcardinalnumbers.xhtml	978
1.9.480 numcomplexnumbers.xhtml	983

1.9.481 numcontinuedfractions.xhtml	987
1.9.482 numexamples.xhtml	994
1.9.483 numfactorization.xhtml	996
1.9.484 numfinitefields.xhtml	998
1.9.485 numfloat.xhtml	1000
1.9.486 numfractions.xhtml	1002
1.9.487 numfunctions.xhtml	1004
1.9.488 numgeneralinfo.xhtml	1010
1.9.489 numintegerfractions.xhtml	1010
1.9.490 numintegers.xhtml	1011
1.9.491 nummachinefloats.xhtml	1014
1.9.492 nummachinesizedintegers.xhtml	1018
1.9.493 numnumbertheoreticfunctions.xhtml	1021
1.9.494 numnumericfunctions.xhtml	1024
1.9.495 numoctonions.xhtml	1036
1.9.496 numotherbases.xhtml	1040
1.9.497 numpartialfractions.xhtml	1044
1.9.498 numproblems.xhtml	1048
1.9.499 numquaternions.xhtml	1051
1.9.500 numquotientfields.xhtml	1054
1.9.501 numrationalnumbers.xhtml	1058
1.9.502 numrepeatingbinaryexpansions.xhtml	1060
1.9.503 numrepeatingdecimals.xhtml	1062
1.9.504 numrepeatinghexexpansions.xhtml	1064
1.9.505 numromannumerals.xhtml	1066
1.9.506 ocwmit18085.xhtml	1069
1.9.507 ocwmit18085lecture1.xhtml	1070
1.9.508 ocwmit18085lecture2.xhtml	1079
1.9.509 operations.xhtml	1079
1.9.510 outputfunctions.xhtml	1080
1.9.511 pagelist.xhtml	1082
1.9.512 pagematrix.xhtml	1082
1.9.513 pageonedimensionalarray.xhtml	1082
1.9.514 pageset.xhtml	1082
1.9.515 pagetable.xhtml	1083
1.9.516 pagepermanent.xhtml	1083
1.9.517 pagesquarematrix.xhtml	1083
1.9.518 pagetwodimensionalarray.xhtml	1084
1.9.519 pagevector.xhtml	1089
1.9.520 polybasicfunctions.xhtml	1090
1.9.521 polyfactorization.xhtml	1094
1.9.522 polyfactorization1.xhtml	1095
1.9.523 polyfactorization2.xhtml	1096
1.9.524 polyfactorization3.xhtml	1097
1.9.525 polyfactorization4.xhtml	1099
1.9.526 polygcdandfriends.xhtml	1100

1.9.527 polynomialpage.xhtml	1102
1.9.528 polyroots.xhtml	1104
1.9.529 polyroots1.xhtml	1106
1.9.530 polyroots2.xhtml	1108
1.9.531 polyroots3.xhtml	1111
1.9.532 polyroots4.xhtml	1114
1.9.533 polyspecifictypes.xhtml	1117
1.9.534 polyspecifictypes1.xhtml	1119
1.9.535 polyspecifictypes2.xhtml	1131
1.9.536 polyspecifictypes3.xhtml	1140
1.9.537 polyspecifictypes4.xhtml	1144
1.9.538 polysubstitutions.xhtml	1147
1.9.539 puiseuxseries.xhtml	1149
1.9.540 reallimit.xhtml	1151
1.9.541 refsearchpage.xhtml	1152
1.9.542 releasenotes.xhtml	1153
1.9.543 rootpage.xhtml	1155
1.9.544 series.xhtml	1158
1.9.545 serieexpand.xhtml	1160
1.9.546 solve.xhtml	1161
1.9.547 solvelinearequations.xhtml	1162
1.9.548 solvelinearmatrix.xhtml	1165
1.9.549 solvesinglepolynomial.xhtml	1170
1.9.550 solvesystempolynomials.xhtml	1171
1.9.551 summation.xhtml	1171
1.9.552 systemvariables.xhtml	1172
1.9.553 taylorseries.xhtml	1173
1.9.554 topexamplepage.xhtml	1175
1.9.555 topicspage.xhtml	1176
1.9.556 topreferencepage.xhtml	1178
1.9.557 topsettingspage.xhtml	1179
1.9.558 tutorial.xhtml	1179
1.9.559 uglangpage.xhtml	1180
1.9.560 ugsyscmdpage.xhtml	1180
1.9.561 usersguidepage.xhtml	1180
1.9.562 rcm3720.input	1181
1.9.563 signatures.txt	1182
1.9.564 strang.input	1183
1.9.565 bitmaps/axiom1.bitmap	1184
1.10 License	1191

Volume 12: Axiom Crystal

1	Axiom Crystal Design	1
1.1	Book presentation	1
1.1.1	Book spines	1
1.1.2	Linking information	2
2	Experiments	3
2.1	Hide/Show a div element	3
2.2	Hide/Show a nested div element	4
2.3	Hide/Show a ring of elements	5
3	Other work	9
3.1	Understanding the Dynamics of Complex Lisp Programs [?]	9

Bibliography: Axiom Bibliography

0.1	Axiom Citations in the Literature	v
0.2	Axiom Citations of External Sources	xxii