

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	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	4
0.1.5	Interactive Programming	5
0.1.6	Data Structures	6
0.1.7	Mathematical Structures	7
0.1.8	Pattern Matching	8
0.1.9	Polymorphic Algorithms	9
0.1.10	Extensibility	10
0.1.11	Types are Defined by Abstract Datatype Programs	11
0.1.12	The Type of Basic Objects is a Domain or Subdomain . .	12
0.1.13	Domains Have Types Called Categories	13
0.1.14	Operations Can Refer To Abstract Types	13
0.1.15	Categories Form Hierarchies	14
0.1.16	Domains Belong to Categories by Assertion	14
0.1.17	Packages Are Clusters of Polymorphic Operations	15
0.1.18	The Interpreter Builds Domains Dynamically	15
0.1.19	Axiom Code is Compiled	16
0.1.20	Axiom is Extensible	16
0.2	Using Axiom as a Pocket Calculator	17
0.2.1	Basic Arithmetic	17
0.2.2	Type Conversion	19
0.2.3	Useful Functions	21
0.3	Using Axiom as a Symbolic Calculator	24
0.3.1	Expressions Involving Symbols	24
0.3.2	Complex Numbers	26
0.3.3	Number Representations	27
0.3.4	Modular Arithmetic	31
0.4	General Points about Axiom	32
0.4.1	Computation Without Output	32
0.4.2	Accessing Earlier Results	32
0.4.3	Splitting Expressions Over Several Lines	33
0.4.4	Comments and Descriptions	33
0.4.5	Control of Result Types	34
0.5	Data Structures in Axiom	35
0.5.1	Lists	35
0.5.2	Segmented Lists	43
0.5.3	Streams	45
0.5.4	Arrays, Vectors, Strings, and Bits	47
0.5.5	Flexible Arrays	50
0.6	Functions, Choices, and Loops	52
0.6.1	Reading Code from a File	52

0.6.2	Blocks	53
0.6.3	Functions	56
0.6.4	Choices	59
0.6.5	Loops	60
1	An Overview of Axiom	71
1.1	Starting Up and Winding Down	71
1.1.1	Clef	73
1.2	Typographic Conventions	73
1.3	The Axiom Language	74
1.3.1	Arithmetic Expressions	74
1.3.2	Previous Results	75
1.3.3	Some Types	76
1.3.4	Symbols, Variables, Assignments, and Declarations	77
1.3.5	Conversion	80
1.3.6	Calling Functions	80
1.3.7	Some Predefined Macros	81
1.3.8	Long Lines	82
1.3.9	Comments	82
1.4	Numbers	83
1.5	Data Structures	91
1.6	Expanding to Higher Dimensions	98
1.7	Writing Your Own Functions	100
1.8	Polynomials	106
1.9	Limits	107
1.10	Series	109
1.11	Derivatives	112
1.12	Integration	114
1.13	Differential Equations	118
1.14	Solution of Equations	121
1.15	System Commands	123
1.15.1	Undo	124
1.16	Graphics	127
2	Using Types and Modes	129
2.1	The Basic Idea	129
2.1.1	Domain Constructors	131
2.2	Writing Types and Modes	137
2.2.1	Types with No Arguments	138
2.2.2	Types with One Argument	138
2.2.3	Types with More Than One Argument	140
2.2.4	Modes	140
2.2.5	Abbreviations	140
2.3	Declarations	142
2.4	Records	145
2.5	Unions	149

2.5.1	Unions Without Selectors	149
2.5.2	Unions With Selectors	152
2.6	The “Any” Domain	154
2.7	Conversion	155
2.8	Subdomains Again	158
2.9	Package Calling and Target Types	162
2.10	Resolving Types	166
2.11	Exposing Domains and Packages	168
2.12	Commands for Snooping	170
3	Using HyperDoc	175
3.1	Headings	176
3.2	Key Definitions	176
3.3	Scroll Bars	177
3.4	Input Areas	178
3.5	Radio Buttons and Toggles	178
3.6	Search Strings	179
3.6.1	Logical Searches	179
3.7	Example Pages	180
3.8	X Window Resources for HyperDoc	180
4	Input Files and Output Styles	183
4.1	Input Files	183
4.2	The .axiom.input File	184
4.3	Common Features of Using Output Formats	185
4.4	Monospace Two-Dimensional Mathematical Format	186
4.5	TeX Format	187
4.6	IBM Script Formula Format	188
4.7	FORTTRAN Format	188
5	Overview of Interactive Language	195
5.1	Immediate and Delayed Assignments	195
5.2	Blocks	199
5.3	if-then-else	203
5.4	Loops	205
5.4.1	Compiling vs. Interpreting Loops	205
5.4.2	return in Loops	206
5.4.3	break in Loops	207
5.4.4	break vs. => in Loop Bodies	208
5.4.5	More Examples of break	209
5.4.6	iterate in Loops	212
5.4.7	while Loops	212
5.4.8	for Loops	215
5.4.9	for i in n..m repeat	215
5.4.10	for i in n..m by s repeat	217
5.4.11	for i in n.. repeat	218

5.4.12	for x in l repeat	218
5.4.13	“Such that” Predicates	220
5.4.14	Parallel Iteration	221
5.4.15	Mixing Loop Modifiers	223
5.5	Creating Lists and Streams with Iterators	224
5.6	An Example: Streams of Primes	227
6	User-Defined Functions, Macros and Rules	231
6.1	Functions vs. Macros	231
6.2	Macros	232
6.3	Introduction to Functions	235
6.4	Declaring the Type of Functions	237
6.5	One-Line Functions	238
6.6	Declared vs. Undeclared Functions	240
6.7	Functions vs. Operations	243
6.8	Delayed Assignments vs. Functions with No Arguments	243
6.9	How Axiom Determines What Function to Use	245
6.10	Compiling vs. Interpreting	247
6.11	Piece-Wise Function Definitions	249
6.11.1	A Basic Example	249
6.11.2	Picking Up the Pieces	252
6.11.3	Predicates	255
6.12	Caching Previously Computed Results	257
6.13	Recurrence Relations	259
6.14	Making Functions from Objects	261
6.15	Functions Defined with Blocks	265
6.16	Free and Local Variables	269
6.17	Anonymous Functions	276
6.17.1	Some Examples	276
6.17.2	Declaring Anonymous Functions	278
6.18	Example: A Database	280
6.19	Example: A Famous Triangle	283
6.20	Example: Testing for Palindromes	286
6.21	Rules and Pattern Matching	288
7	Graphics	297
7.1	Two-Dimensional Graphics	298
7.1.1	Plotting Two-Dimensional Functions of One Variable	298
7.1.2	Plotting Two-Dimensional Parametric Plane Curves	299
7.1.3	Plotting Plane Algebraic Curves	300
7.1.4	Two-Dimensional Options	301
7.1.5	Color	303
7.1.6	Palette	303
7.1.7	Two-Dimensional Control-Panel	304
7.1.8	Operations for Two-Dimensional Graphics	307
7.1.9	Addendum: Building Two-Dimensional Graphs	309

7.1.10	Addendum: Appending a Graph to a Viewport Window Containing a Graph	316
7.2	Three-Dimensional Graphics	317
7.2.1	Plotting Three-Dimensional Functions of Two Variables	317
7.2.2	Plotting Three-Dimensional Parametric Space Curves	318
7.2.3	Plotting Three-Dimensional Parametric Surfaces	320
7.2.4	Three-Dimensional Options	321
7.2.5	The makeObject Command	325
7.2.6	Building Three-Dimensional Objects From Primitives	326
7.2.7	Coordinate System Transformations	331
7.2.8	Three-Dimensional Clipping	334
7.2.9	Three-Dimensional Control-Panel	334
7.2.10	Operations for Three-Dimensional Graphics	339
7.2.11	Customization using .Xdefaults	343
8	Advanced Problem Solving	345
8.1	Numeric Functions	345
8.2	Polynomial Factorization	355
8.2.1	Integer and Rational Number Coefficients	355
8.2.2	Finite Field Coefficients	356
8.2.3	Simple Algebraic Extension Field Coefficients	357
8.2.4	Factoring Rational Functions	359
8.3	Manipulating Symbolic Roots of a Polynomial	359
8.3.1	Using a Single Root of a Polynomial	359
8.3.2	Using All Roots of a Polynomial	361
8.4	Computation of Eigenvalues and Eigenvectors	363
8.5	Solution of Linear and Polynomial Equations	367
8.5.1	Solution of Systems of Linear Equations	367
8.5.2	Solution of a Single Polynomial Equation	369
8.5.3	Solution of Systems of Polynomial Equations	371
8.6	Limits	374
8.7	Laplace Transforms	378
8.8	Integration	379
8.9	Working with Power Series	383
8.9.1	Creation of Power Series	383
8.9.2	Coefficients of Power Series	386
8.9.3	Power Series Arithmetic	387
8.9.4	Functions on Power Series	388
8.9.5	Converting to Power Series	391
8.9.6	Power Series from Formulas	395
8.9.7	Substituting Numerical Values in Power Series	398
8.9.8	Example: Bernoulli Polynomials and Sums of Powers	399
8.10	Solution of Differential Equations	403
8.10.1	Closed-Form Solutions of Linear Differential Equations	403
8.10.2	Closed-Form Solutions of Non-Linear Differential Equations	407
8.10.3	Power Series Solutions of Differential Equations	411

8.11	Finite Fields	413
8.11.1	Modular Arithmetic and Prime Fields	414
8.11.2	Extensions of Finite Fields	418
8.11.3	Irreducible Modulus Polynomial Representations	419
8.11.4	Cyclic Group Representations	423
8.11.5	Normal Basis Representations	425
8.11.6	Conversion Operations for Finite Fields	428
8.11.7	Utility Operations for Finite Fields	431
8.12	Primary Decomposition of Ideals	439
8.13	Computation of Galois Groups	442
8.14	Non-Associative Algebras and Modelling Genetic Laws	451
9	Some Examples of Domains and Packages	457
9.1	ApplicationProgramInterface	457
9.2	ArrayStack	458
9.3	AssociationList	463
9.4	BalancedBinaryTree	465
9.5	BasicOperator	468
9.6	BinaryExpansion	471
9.7	BinarySearchTree	473
9.8	CardinalNumber	476
9.9	CartesianTensor	480
9.10	Character	491
9.11	CharacterClass	494
9.12	CliffordAlgebra	497
9.12.1	The Complex Numbers as a Clifford Algebra	497
9.12.2	The Quaternion Numbers as a Clifford Algebra	498
9.12.3	The Exterior Algebra on a Three Space	500
9.12.4	The Dirac Spin Algebra	503
9.13	Complex	504
9.14	ContinuedFraction	507
9.15	CycleIndicators	514
9.16	DeRhamComplex	525
9.17	DecimalExpansion	533
9.18	Dequeue	534
9.19	DistributedMultivariatePolynomial	541
9.20	DoubleFloat	543
9.21	EqTable	546
9.22	Equation	547
9.23	EuclideanGroebnerBasisPackage	549
9.24	Exit	550
9.25	Expression	552
9.26	Factored	557
9.26.1	Decomposing Factored Objects	557
9.26.2	Expanding Factored Objects	559
9.26.3	Arithmetic with Factored Objects	560

9.26.4	Creating New Factored Objects	563
9.26.5	Factored Objects with Variables	564
9.27	FactoredFunctions2	565
9.28	File	566
9.29	FileName	569
9.30	FlexibleArray	572
9.31	Float	576
9.31.1	Introduction to Float	576
9.31.2	Conversion Functions	577
9.31.3	Output Functions	580
9.31.4	An Example: Determinant of a Hilbert Matrix	582
9.32	Fraction	584
9.33	FullPartialFractionExpansion	587
9.34	GeneralDistributedMultivariatePolynomial	592
9.35	GeneralSparseTable	594
9.36	GroebnerFactorizationPackage	595
9.37	GroebnerPackage	598
9.38	Heap	599
9.39	HexadecimalExpansion	600
9.40	HomogeneousDistributedMultivariatePolynomial	602
9.41	Integer	604
9.41.1	Basic Functions	604
9.41.2	Primes and Factorization	610
9.41.3	Some Number Theoretic Functions	611
9.42	IntegerLinearDependence	613
9.43	IntegerNumberTheoryFunctions	615
9.44	Kernel	620
9.45	KeyedAccessFile	624
9.46	LexTriangularPackage	628
9.47	LazardSetSolvingPackage	655
9.48	Library	666
9.49	LieExponentials	667
9.50	LiePolynomial	670
9.51	LinearOrdinaryDifferentialOperator	674
9.51.1	Differential Operators with Series Coefficients	674
9.52	LinearOrdinaryDifferentialOperator1	679
9.52.1	Differential Operators with Rational Function Coefficients	679
9.53	LinearOrdinaryDifferentialOperator2	684
9.53.1	Differential Operators with Constant Coefficients	684
9.53.2	Differential Operators with Matrix Coefficients Operating on Vectors	687
9.54	List	691
9.54.1	Creating Lists	691
9.54.2	Accessing List Elements	692
9.54.3	Changing List Elements	694
9.54.4	Other Functions	696

9.54.5 Dot, Dot	697
9.55 LyndonWord	698
9.56 Magma	702
9.57 MakeFunction	705
9.58 MappingPackage1	708
9.59 Matrix	713
9.59.1 Creating Matrices	713
9.59.2 Operations on Matrices	718
9.60 Multiset	722
9.61 MultivariatePolynomial	725
9.62 None	727
9.63 NottinghamGroup	728
9.64 Octonion	729
9.65 OneDimensionalArray	732
9.66 Operator	734
9.67 OrderedVariableList	738
9.68 OrderlyDifferentialPolynomial	739
9.69 PartialFraction	747
9.70 Permanent	750
9.71 Permutation	751
9.72 Polynomial	752
9.73 Quaternion	762
9.74 Queue	764
9.75 RadixExpansion	767
9.76 RealClosure	770
9.77 RealSolvePackage	784
9.78 RegularTriangularSet	785
9.79 RomanNumeral	802
9.80 Segment	804
9.81 SegmentBinding	807
9.82 Set	808
9.83 SingleInteger	812
9.84 SparseTable	814
9.85 SquareMatrix	816
9.86 SquareFreeRegularTriangularSet	817
9.87 Stack	823
9.88 Stream	826
9.89 String	828
9.90 StringTable	835
9.91 Symbol	835
9.92 Table	840
9.93 TextFile	844
9.94 TwoDimensionalArray	846
9.95 TwoDimensionalViewport	851
9.96 UnivariatePolynomial	858
9.97 UnivariateSkewPolynomial	866

9.97.1 A second example	868
9.97.2 A third example	870
9.97.3 A fourth example	871
9.98 UniversalSegment	872
9.99 Vector	873
9.100Void	876
9.101WuWenTsunTriangularSet	877
9.102XPBWPolynomial	881
9.103XPolynomial	889
9.104XPolynomialRing	892
9.105ZeroDimensionalSolvePackage	895
10 Interactive Programming	919
10.1 Drawing Ribbons Interactively	919
10.2 A Ribbon Program	921
10.3 Coloring and Positioning Ribbons	923
10.4 Points, Lines, and Curves	924
10.5 A Bouquet of Arrows	926
10.6 Diversion: When Things Go Wrong	926
10.7 Drawing Complex Vector Fields	926
10.8 Drawing Complex Functions	928
10.9 Functions Producing Functions	930
10.10Automatic Newton Iteration Formulas	930
11 Packages	935
11.1 Names, Abbreviations, and File Structure	935
11.2 Syntax	936
11.3 Abstract Datatypes	937
11.4 Capsules	937
11.5 Input Files vs. Packages	938
11.6 Compiling Packages	939
11.7 Parameters	940
11.8 Conditionals	942
11.9 Testing	943
11.10How Packages Work	945
12 Categories	949
12.1 Definitions	950
12.2 Exports	951
12.3 Documentation	951
12.4 Hierarchies	952
12.5 Membership	953
12.6 Defaults	953
12.7 Axioms	955
12.8 Correctness	955
12.9 Attributes	956

12.10	Parameters	957
12.11	Conditionals	958
12.12	Anonymous Categories	959
13	Domains	961
13.1	Domains vs. Packages	961
13.2	Definitions	962
13.3	Category Assertions	962
13.4	A Demo	964
13.5	Browse	965
13.6	Representation	965
13.7	Multiple Representations	966
13.8	Add Domain	967
13.9	Defaults	967
13.10	Origins	968
13.11	Short Forms	969
13.12	Example 1: Clifford Algebra	969
13.13	Example 2: Building A Query Facility	970
13.13.1	A Little Query Language	971
13.13.2	The Database Constructor	972
13.13.3	Query Equations	974
13.13.4	DataLists	975
13.13.5	Index Cards	976
13.13.6	Creating a Database	976
13.13.7	Putting It All Together	977
13.13.8	Example Queries	977
14	Browse	981
14.1	The Front Page: Searching the Library	981
14.2	The Constructor Page	985
14.2.1	Constructor Page Buttons	988
14.2.2	Cross Reference	991
14.2.3	Views Of Constructors	995
14.2.4	Giving Parameters to Constructors	997
14.3	Miscellaneous Features of Browse	997
14.3.1	The Description Page for Operations	997
14.3.2	Views of Operations	999
14.3.3	Capitalization Convention	1004
15	What's New in Axiom Version 2.0	1005
15.1	Important Things to Read First	1005
15.2	The NAG Library Link	1005
15.2.1	Interpreting NAG Documentation	1006
15.2.2	Using the Link	1007
15.2.3	Providing values for Argument Subprograms	1009
15.2.4	General Fortran-generation utilities in Axiom	1010

15.2.5	Some technical information	1019
15.3	Interactive Front-end and Language	1020
15.4	Library	1020
15.5	HyperTex	1021
15.6	Documentation	1022
A	Axiom System Commands	1023
A.1	Introduction	1023
A.2	)abbreviation	1025
A.3	)boot	1026
A.4	)browse	1026
A.5	)cd	1027
A.6	)close	1027
A.7	)clear	1028
A.8	)compile	1030
A.9	)display	1032
A.10	)edit	1033
A.11	)fin	1034
A.12	)frame	1034
A.13	)help	1036
A.14	)history	1037
A.15	)include	1039
A.16	)library	1040
A.17	)lisp	1041
A.18	)load	1041
A.19	)trace	1041
A.20	)pquit	1042
A.21	)quit	1042
A.22	)read	1043
A.23	)set	1044
A.24	)show	1045
A.25	)spool	1045
A.26	)synonym	1046
A.27	)system	1047
A.28	)trace	1047
A.29	)undo	1052
A.30	)what	1053
B	Categories	1055
C	constructorListing	1057
C	Domains	1069
D	Packages	1103

<i>CONTENTS</i>	13
E Operations	1119
F Programs for AXIOM Images	1121
F.1 images1.input	1121
F.2 images2.input	1122
F.3 images3.input	1122
F.4 images5.input	1122
F.5 images6.input	1124
F.6 images7.input	1124
F.7 images8.input	1125
F.8 conformal.input	1125
F.9 tknot.input	1128
F.10 ntube.input	1129
F.11 dhtri.input	1130
F.12 tetra.input	1131
F.13 antoine.input	1133
F.14 scherk.input	1134
G Glossary	1137
H License	1159

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	9
1.1.9	Polymorphic Algorithms	10
1.1.10	Extensibility	11
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	16
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	23
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	29
3.2.6	Calling Functions	30
3.2.7	Some Predefined Macros	31
3.2.8	Long Lines	31
3.2.9	Comments	32
3.3	Using Axiom as a Pocket Calculator	32
3.3.1	Basic Arithmetic	32
3.3.2	Type Conversion	34

3.3.3	Useful Functions	36
3.4	Using Axiom as a Symbolic Calculator	39
3.4.1	Expressions Involving Symbols	39
3.4.2	Complex Numbers	41
3.4.3	Number Representations	42
3.4.4	Modular Arithmetic	46
3.5	General Points about Axiom	47
3.5.1	Computation Without Output	47
3.5.2	Accessing Earlier Results	48
3.5.3	Splitting Expressions Over Several Lines	48
3.5.4	Comments and Descriptions	49
3.5.5	Control of Result Types	49
3.5.6	Using system commands	50
3.5.7	Using undo	51
3.6	Data Structures in Axiom	54
3.6.1	Lists	54
3.6.2	Segmented Lists	63
3.6.3	Streams	64
3.6.4	Arrays, Vectors, Strings, and Bits	66
3.6.5	Flexible Arrays	69
3.7	Functions, Choices, and Loops	71
3.7.1	Reading Code from a File	71
3.7.2	Blocks	72
3.7.3	Functions	75
3.7.4	Choices	78
3.7.5	Loops	79
3.8	Numbers	89
3.9	Data Structures	97
3.10	Expanding to Higher Dimensions	104
3.11	Writing Your Own Functions	106
3.12	Polynomials	111
3.13	Limits	113
3.14	Series	115
3.15	Derivatives	117
3.16	Integration	120
3.17	Differential Equations	124
3.18	Solution of Equations	127
4	Graphics	129
4.0.1	Plotting 2D graphs	130
4.0.2	Palette	135
4.0.3	Two-Dimensional Control-Panel	136
4.0.4	Operations for Two-Dimensional Graphics	139
4.0.5	Building Two-Dimensional Graphs Manually	142
4.0.6	Appending a Graph to a Viewport Window Containing a Graph	151

4.0.7	Plotting 3D Graphs	152
4.0.8	Three-Dimensional Options	155
4.0.9	Three-Dimensional Control-Panel	157
4.0.10	Operations for Three-Dimensional Graphics	161
4.0.11	Customization using .Xdefaults	165
5	Using Types and Modes	167
5.1	The Basic Idea	167
5.1.1	Domain Constructors	169
5.2	Writing Types and Modes	174
5.2.1	Types with No Arguments	175
5.2.2	Types with One Argument	176
5.2.3	Types with More Than One Argument	177
5.2.4	Modes	177
5.2.5	Abbreviations	178
5.3	Declarations	179
5.4	Records	182
5.5	Unions	186
5.5.1	Unions Without Selectors	186
5.5.2	Unions With Selectors	190
5.6	The “Any” Domain	191
5.7	Conversion	192
5.8	Subdomains Again	196
5.9	Package Calling and Target Types	199
5.10	Resolving Types	203
5.11	Exposing Domains and Packages	205
5.12	Commands for Snooping	207
6	Using HyperDoc	211
6.1	Headings	212
6.2	Key Definitions	212
6.3	Scroll Bars	213
6.4	Input Areas	213
6.5	Radio Buttons and Toggles	214
6.6	Search Strings	214
6.6.1	Logical Searches	215
6.7	Example Pages	215
6.8	X Window Resources for HyperDoc	216
7	Input Files and Output Styles	219
7.1	Input Files	219
7.2	The .axiom.input File	220
7.3	Common Features of Using Output Formats	221
7.4	Monospace Two-Dimensional Mathematical Format	222
7.5	TeX Format	223
7.6	IBM Script Formula Format	224

7.7	FORTTRAN Format	224
8	Axiom System Commands	231
8.1	Introduction	231
8.2	)abbreviation	233
8.3	)boot	234
8.4	)cd	234
8.5	)close	235
8.6	)clear	235
8.7	)compile	237
8.8	)display	239
8.9	)edit	241
8.10	)fin	242
8.11	)frame	242
8.12	)hd	244
8.13	)help	244
8.14	)history	244
8.15	)library	247
8.16	)lisp	248
8.17	)ltrace	248
8.18	)pquit	249
8.19	)quit	249
8.20	)read	250
8.21	)set	251
8.22	)show	252
8.23	)spool	252
8.24	)synonym	253
8.25	)system	254
8.26	)trace	254
8.27	)undo	259
8.28	)what	260
8.29	Makefile	261

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	19
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	43
0.4.5	Lucid Common Lisp	43
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	44
0.5.2	noweb	44
0.6	Databases	46
0.6.1	libcheck	46
0.6.2	asq	47
0.7	Axiom internal representations	47
0.8	axiom command	50
0.9	help command documentation	50
0.9.1	help documentation for algebra	50
0.9.2	Adding help documentation in Makefile	51
0.9.3	Using help documentation for regression testing	51
0.9.4	help documentation as algebra test files	52
0.10	debugsys	52
0.10.1	debugging hyperdoc	52
0.11	Understanding a compiled function	53
0.12	The axiom.input startup file	62

0.13	Where are Axiom symbols stored?	62
0.14	Translating individual boot files to common lisp	65
0.15	Directories	66
0.15.1	The mnt/linux/bin directory	67
0.15.2	The mnt/linux/doc directory	68
0.15.3	The mnt/linux/algebra directory	72
0.15.4	The mnt/linux/lib directory	72
0.15.5	The mnt/linux/lib directory	74
0.16	The)set command	74
0.16.1	The example bug	80
0.16.2	Operating system level I/O trace (strace)	97
0.17	How to make graphs in algebra books	98
0.18	Adding or Editing pages in Hyperdoc	99
0.19	Graphviz file creation	100
0.20	Adding Algebra	102
0.20.1	Adding algebra to the books	102
0.20.2	Creating a stand-alone pamphlet file	114
0.21	Makefile	114

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	9
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	10
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	11
3.1.21 defvar \$SpadServer	11
3.1.22 defvar \$SpadServer	12
3.1.23 defvar \$SpadServerName	12
3.1.24 defvar \$SpadServerName	12
4 Starting Axiom	13
4.1 Variables Used	13
4.2 Data Structures	13
4.3 Functions	13
4.3.1 Set the restart hook	13
4.3.2 restart function (The restart function)	15
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	19
4.3.6 Starts the interpreter but do not read in profiles	20
4.3.7 defvar \$quitTag	20

<i>CONTENTS</i>	23
-----------------	----

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	24
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	27
5.1.17	defvar \$newcompErrorCount	27
5.1.18	defvar \$nopus	27
5.2	The Read-Eval-Print Loop	29
5.2.1	defun intloopReadConsole	29
5.3	Helper Functions	31
5.3.1	Get the value of an environment variable	31
5.3.2	defvar \$intCoerceFailure	31
5.3.3	defvar \$intSpadReader	31
5.3.4	defun InterpExecuteSpadSystemCommand	32
5.3.5	defun ExecuteInterpSystemCommand	32
5.3.6	defun Handle Synonyms	33
5.3.7	defun Synonym File Reader	34
5.3.8	defun init-memory-config	35
5.3.9	Set spadroot to be the AXIOM shell variable	36
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	37
5.3.13	Prepend the absolute path to a filename	37
5.3.14	Make the initial modemap frame	37
5.3.15	defun ncloopEscaped	38
5.3.16	defun intloopProcessString	38
5.3.17	defun ncloopParse	39
5.3.18	defun next	39
5.3.19	defun next1	40
5.3.20	defun incString	40

5.3.21	Call the garbage collector	41
5.3.22	defun reroot	42
5.3.23	defun setCurrentLine	44
5.3.24	Show the Axiom prompt	45
5.3.25	defvar \$frameAlist	45
5.3.26	defvar \$frameNumber	45
5.3.27	defvar \$currentFrameNum	45
5.3.28	defvar \$EndServerSession	46
5.3.29	defvar \$NeedToSignalSessionManager	46
5.3.30	defvar \$sockBufferLength	46
5.3.31	READ-LINE in an Axiom server system	47
5.3.32	defun protectedEVAL	49
5.3.33	defvar \$QuietCommand	50
5.3.34	defun executeQuietCommand	50
5.3.35	defun parseAndInterpret	51
5.3.36	defun ncParseAndInterpretString	51
5.3.37	defun parseFromString	52
5.3.38	defvar \$interpOnly	52
5.3.39	defvar \$minivectorNames	52
5.3.40	defvar \$domPvar	52
5.3.41	defun processInteractive	53
5.3.42	defvar \$ProcessInteractiveValue	55
5.3.43	defvar \$HTCompanionWindowID	55
5.3.44	defun processInteractive1	56
5.3.45	defun interpretTopLevel	57
5.3.46	defvar \$genValue	57
5.3.47	defun Type analyzes and evaluates expression x, returns object	58
5.3.48	defun Dispatcher for the type analysis routines	59
5.3.49	defun interpret2	60
5.3.50	defun Result Output Printing	61
5.3.51	defun printStatisticsSummary	62
5.3.52	defun printStorage	63
5.3.53	defun printTypeAndTime	63
5.3.54	defun printTypeAndTimeNormal	64
5.3.55	defun printTypeAndTimeSaturn	66
5.3.56	defun printAsTeX	67
5.3.57	defun sameUnionBranch	67
5.3.58	defun msgText	68
5.3.59	defun Right-justify the Type output	68
5.3.60	defun Destructively fix quotes in strings	69
5.3.61	Include a file into the stream	69
5.3.62	defun intloopInclude0	70
5.3.63	defun intloopProcess	71
5.3.64	defun intloopSpadProcess	72
5.3.65	defun intloopSpadProcess,interp	73

5.3.66	defun phParse	73
5.3.67	defun intSayKeyedMsg	73
5.3.68	defun packageTran	74
5.3.69	defun phIntReportMsgs	75
5.3.70	defun phInterpret	75
5.3.71	defun intInterpretPform	76
5.3.72	defun zeroOneTran	76
5.3.73	defun ncConversationPhase	76
5.3.74	defun ncConversationPhase,wrapup	77
5.3.75	defun ncError	77
5.3.76	defun intloopEchoParse	78
5.3.77	defun ncloopPrintLines	78
5.3.78	defun mkLineList	79
5.3.79	defun nonBlank	80
5.3.80	defun ncloopDQlines	80
5.3.81	defun poGlobalLinePosn	81
5.3.82	defun streamChop	81
5.3.83	defun ncloopInclude0	82
5.3.84	defun incStream	82
5.3.85	defun incRenumber	83
5.3.86	defun incZip	83
5.3.87	defun incZip1	83
5.3.88	defun incIgen	84
5.3.89	defun incIgen1	84
5.3.90	defun incRenumberLine	84
5.3.91	defun incRenumberItem	85
5.3.92	defun incHandleMessage	85
5.3.93	defun incLude	85
5.3.94	defmacro Rest	86
5.3.95	defvar \$Top	86
5.3.96	defvar \$IfSkipToEnd	86
5.3.97	defvar \$IfKeepPart	86
5.3.98	defvar \$IfSkipPart	86
5.3.99	defvar \$ElseifSkipToEnd	86
5.3.100	defvar \$ElseifKeepPart	87
5.3.101	defvar \$ElseifSkipPart	87
5.3.102	defvar \$ElseSkipToEnd	87
5.3.103	defvar \$ElseKeepPart	87
5.3.104	defvar \$Top?	87
5.3.105	defvar \$If?	88
5.3.106	defvar \$Elseif?	88
5.3.107	defvar \$Else?	88
5.3.108	defvar \$SkipEnd?	88
5.3.109	defvar \$KeepPart?	89
5.3.110	defvar \$SkipPart?	89
5.3.111	defvar \$Skipping?	89

5.3.112 defun incLude1	90
5.3.113 defun xlPrematureEOF	94
5.3.114 defun xlMsg	95
5.3.115 defun xlOK	95
5.3.116 defun xlOK1	95
5.3.117 defun incAppend	95
5.3.118 defun incAppend1	96
5.3.119 defun incLine	96
5.3.120 defun incLine1	96
5.3.121 defun inclmsgPrematureEOF	97
5.3.122 defun theorigin	97
5.3.123 defun porigin	97
5.3.124 defun ifCond	97
5.3.125 defun xlSkip	98
5.3.126 defun xlSay	98
5.3.127 defun inclmsgSay	98
5.3.128 defun theid	98
5.3.129 defun xlNoSuchFile	99
5.3.130 defun inclmsgNoSuchFile	99
5.3.131 defun thefname	99
5.3.132 defun pfname	99
5.3.133 defun xlCannotRead	100
5.3.134 defun inclmsgCannotRead	100
5.3.135 defun xlFileCycle	100
5.3.136 defun inclmsgFileCycle	101
5.3.137 defun xlConActive	102
5.3.138 defun inclmsgConActive	102
5.3.139 defun xlConStill	102
5.3.140 defun inclmsgConStill	102
5.3.141 defun xlConsole	103
5.3.142 defun inclmsgConsole	103
5.3.143 defun xlSkippingFin	103
5.3.144 defun inclmsgFinSkipped	103
5.3.145 defun xlPrematureFin	104
5.3.146 defun inclmsgPrematureFin	104
5.3.147 defun assertCond	104
5.3.148 defun xlIfSyntax	105
5.3.149 defun inclmsgIfSyntax	105
5.3.150 defun xlIfBug	106
5.3.151 defun inclmsgIfBug	106
5.3.152 defun xlCmdBug	106
5.3.153 defun inclmsgCmdBug	106
5.3.154 defvar \$incCommands	107
5.3.155 defvar \$pfMacros	107
5.3.156 defun incClassify	108
5.3.157 defun incCommand?	109

5.3.158 defun incPrefix?	110
5.3.159 defun incCommandTail	110
5.3.160 defun incDrop	111
5.3.161 defun inclFname	111
5.3.162 defun incFileInput	111
5.3.163 defun incConsoleInput	111
5.3.164 defun incNConsoles	112
5.3.165 defun incActive?	112
5.3.166 defun incRgen	112
5.3.167 defun Delay	112
5.3.168 defvar \$StreamNil	112
5.3.169 defvar \$StreamNil	113
5.3.170 defun incRgen1	113

6 The Token Scanner 115

6.0.171 defvar \$space	115
6.0.172 defvar \$escape	115
6.0.173 defvar \$stringchar	115
6.0.174 defvar \$pluscomment	115
6.0.175 defvar \$minuscomment	116
6.0.176 defvar \$radixchar	116
6.0.177 defvar \$dot	116
6.0.178 defvar \$exponent1	116
6.0.179 defvar \$exponent2	116
6.0.180 defvar \$closeparen	116
6.0.181 defvar \$closeangle	117
6.0.182 defvar \$question	117
6.0.183 defvar \$scanKeyWords	118
6.0.184 defvar \$infgeneric	121
6.0.185 defun lineoftoks	122
6.0.186 defun nextline	124
6.0.187 defun scanIgnoreLine	125
6.0.188 defun constoken	125
6.0.189 defun scanToken	126
6.0.190 defun lfid	127
6.0.191 defun startsComment?	127
6.0.192 defun scanComment	128
6.0.193 defun lfcomment	128
6.0.194 defun startsNegComment?	129
6.0.195 defun scanNegComment	129
6.0.196 defun lfnegcomment	130
6.0.197 defun punctuation?	130
6.0.198 defun scanPunct	130
6.0.199 defun subMatch	130
6.0.200 defun substringMatch	131
6.0.201 defun scanKeyTr	132

6.0.202 defun keyword	132
6.0.203 defun keyword?	133
6.0.204 defun scanPossFloat	133
6.0.205 defun digit?	133
6.0.206 defun lfkey	134
6.0.207 defun spleI	134
6.0.208 defun spleI1	135
6.0.209 defun scanEsc	136
6.0.210 defvar \$scanCloser	138
6.0.211 defun scanCloser?	138
6.0.212 defun scanWord	138
6.0.213 defun scanExponent	139
6.0.214 defun lffloat	140
6.0.215 defmacro idChar?	140
6.0.216 defun scanW	141
6.0.217 defun posend	142
6.0.218 defun scanSpace	142
6.0.219 defun lfspaces	142
6.0.220 defun scanString	143
6.0.221 defun lfstring	143
6.0.222 defun scanS	144
6.0.223 defun scanTransform	145
6.0.224 defun scanNumber	146
6.0.225 defun rdigit?	147
6.0.226 defun lfinteger	147
6.0.227 defun lfrinteger	147
6.0.228 defun scanCheckRadix	148
6.0.229 defun scanEscape	149
6.0.230 defun scanError	149
6.0.231 defun lferror	149
6.0.232 defvar \$scanKeyTable	150
6.0.233 defun scanKeyTableCons	150
6.0.234 defvar \$scanDict	150
6.0.235 defun scanDictCons	151
6.0.236 defun scanInsert	152
6.0.237 defvar \$scanPun	153
6.0.238 defun scanPunCons	154
7 Input Stream Parser	155
7.0.239 defun Input Stream Parser	155
7.0.240 defun npItem	156
7.0.241 defun npItem1	157
7.0.242 defun npFirstTok	157
7.0.243 defun Push one item onto \$stack	158
7.0.244 defun Pop one item off \$stack	158
7.0.245 defun Pop the second item off \$stack	158

7.0.246 defun Pop the third item off \$stack	159
7.0.247 defun npQualDef	159
7.0.248 defun Advance over a keyword	159
7.0.249 defun Advance the input stream	160
7.0.250 defun npComma	160
7.0.251 defun npTuple	160
7.0.252 defun npCommaBackSet	161
7.0.253 defun npQualifiedDefinition	161
7.0.254 defun npQualified	161
7.0.255 defun npDefinitionOrStatement	162
7.0.256 defun npBackTrack	162
7.0.257 defun npGives	162
7.0.258 defun npLambda	163
7.0.259 defun npType	164
7.0.260 defun npMatch	164
7.0.261 defun npSuch	164
7.0.262 defun npWith	165
7.0.263 defun npCompMissing	165
7.0.264 defun npMissing	166
7.0.265 defun npRestore	166
7.0.266 defun Peek for keyword s, no advance of token stream . .	166
7.0.267 defun npCategoryL	167
7.0.268 defun npCategory	167
7.0.269 defun npSCategory	168
7.0.270 defun npSignature	169
7.0.271 defun npSigItemList	169
7.0.272 defun npListing	169
7.0.273 defun Always produces a list, fn is applied to it	170
7.0.274 defun npSigItem	170
7.0.275 defun npTypeVariable	171
7.0.276 defun npSignatureDefinee	171
7.0.277 defun npTypeVariablelist	171
7.0.278 defun npSigDecl	172
7.0.279 defun npPrimary	172
7.0.280 defun npPrimary2	173
7.0.281 defun npADD	173
7.0.282 defun npAdd	174
7.0.283 defun npAtom2	175
7.0.284 defun npInfixOperator	176
7.0.285 defun npInfixOp	177
7.0.286 defun npPrefixColon	177
7.0.287 defun npApplication	178
7.0.288 defun npDotted	178
7.0.289 defun npAnyNo	178
7.0.290 defun npSelector	179
7.0.291 defun npApplication2	179

7.0.292 defun npPrimary1	180
7.0.293 defun npMacro	180
7.0.294 defun npMdef	181
7.0.295 defun npMDEF	181
7.0.296 defun npMDEFinition	182
7.0.297 defun npFix	182
7.0.298 defun npLet	182
7.0.299 defun npLetQualified	183
7.0.300 defun npDefinition	183
7.0.301 defun npDefinitionItem	184
7.0.302 defun npTyping	185
7.0.303 defun npDefaultItemList	185
7.0.304 defun npSDefaultItem	186
7.0.305 defun npDefaultItem	186
7.0.306 defun npDefaultDecl	187
7.0.307 defun npStatement	188
7.0.308 defun npExport	189
7.0.309 defun npLocalItemList	189
7.0.310 defun npSLocalItem	190
7.0.311 defun npLocalItem	190
7.0.312 defun npLocalDecl	191
7.0.313 defun npLocal	191
7.0.314 defun npFree	192
7.0.315 defun npInline	192
7.0.316 defun npIterate	192
7.0.317 defun npBreak	193
7.0.318 defun npLoop	193
7.0.319 defun npIterators	194
7.0.320 defun npIterator	194
7.0.321 defun npSuchThat	195
7.0.322 defun Apply argument 0 or more times	195
7.0.323 defun npWhile	195
7.0.324 defun npForIn	196
7.0.325 defun npReturn	197
7.0.326 defun npVoid	197
7.0.327 defun npExpress	198
7.0.328 defun npExpress1	198
7.0.329 defun npConditionalStatement	198
7.0.330 defun npImport	199
7.0.331 defun npQualTypelist	199
7.0.332 defun npSQualTypelist	199
7.0.333 defun npQualType	200
7.0.334 defun npAndOr	200
7.0.335 defun npEncAp	200
7.0.336 defun npEncl	201
7.0.337 defun npAtom1	201

7.0.338 defun npPDefinition	202
7.0.339 defun npDollar	202
7.0.340 defun npConstTok	203
7.0.341 defun npBDefinition	204
7.0.342 defun npBracketed	204
7.0.343 defun npParened	204
7.0.344 defun npBracked	205
7.0.345 defun npBraced	205
7.0.346 defun npAngleBared	205
7.0.347 defun npDefn	206
7.0.348 defun npDef	206
7.0.349 defun npBPILEDefinition	207
7.0.350 defun npPILEBracketed	207
7.0.351 defun npPILEDefinitionlist	208
7.0.352 defun npListAndRecover	209
7.0.353 defun npRecoverTrap	210
7.0.354 defun npMoveTo	211
7.0.355 defun syIgnoredFromTo	211
7.0.356 defun syGeneralErrorHere	212
7.0.357 defun sySpecificErrorHere	212
7.0.358 defun sySpecificErrorAtToken	212
7.0.359 defun npDefinitionlist	212
7.0.360 defun npSemiListing	213
7.0.361 defun npSemiBackSet	213
7.0.362 defun npRule	213
7.0.363 defun npSingleRule	214
7.0.364 defun npDefTail	214
7.0.365 defun npDefaultValue	215
7.0.366 defun npWConditional	215
7.0.367 defun npConditional	216
7.0.368 defun npElse	217
7.0.369 defun npBacksetElse	217
7.0.370 defun npLogical	218
7.0.371 defun npDisjand	218
7.0.372 defun npDiscrim	218
7.0.373 defun npQuiver	218
7.0.374 defun npRelation	219
7.0.375 defun npSynthetic	219
7.0.376 defun npBy	220
7.0.377 defun	220
7.0.378 defun npSegment	221
7.0.379 defun npArith	221
7.0.380 defun npSum	221
7.0.381 defun npTerm	222
7.0.382 defun npRemainder	222
7.0.383 defun npProduct	222

7.0.384 defun npPower	223
7.0.385 defun npAmpersandFrom	223
7.0.386 defun npFromdom	223
7.0.387 defun npFromdom1	224
7.0.388 defun npAmpersand	224
7.0.389 defun npName	224
7.0.390 defvar \$npPParg	225
7.0.391 defun npId	225
7.0.392 defun npSymbolVariable	226
7.0.393 defun npRightAssoc	227
7.0.394 defun p o p o p o p = (((p o p) o p) o p)	228
7.0.395 defun npInfGeneric	229
7.0.396 defun npDDInfKey	230
7.0.397 defun npInfKey	231
7.0.398 defun npPushId	231
7.0.399 defvar \$npPParg	231
7.0.400 defun npPP	232
7.0.401 defun npPPff	232
7.0.402 defun npPPg	233
7.0.403 defun npPPf	233
7.0.404 defun npEnclosed	234
7.0.405 defun npState	234
7.0.406 defun npTrap	235
7.0.407 defun npTrapForm	235
7.0.408 defun npVariable	236
7.0.409 defun npVariablelist	236
7.0.410 defun npVariableName	236
7.0.411 defun npDecl	237
7.0.412 defun npParenthesized	237
7.0.413 defun npParenthesize	238
7.0.414 defun npMissingMate	238
7.0.415 defun npExit	239
7.0.416 defun npPileExit	239
7.0.417 defun npAssign	239
7.0.418 defun npAssignment	240
7.0.419 defun npAssignVariable	240
7.0.420 defun npColon	240
7.0.421 defun npTagged	241
7.0.422 defun npTypedForm1	241
7.0.423 defun npTypified	241
7.0.424 defun npTypeStyle	242
7.0.425 defun npPretend	242
7.0.426 defun npColonQuery	242
7.0.427 defun npCoerceTo	242
7.0.428 defun npTypedForm	243
7.0.429 defun npRestrict	243

7.0.430	defun npListofFun	244
7.1	Macro handling	245
7.1.1	defun phMacro	245
7.1.2	defun macroExpanded	245
7.1.3	defun macExpand	246
7.1.4	defun macApplication	247
7.1.5	defun mac0MLambdaApply	248
7.1.6	defun mac0ExpandBody	249
7.1.7	defun mac0InfiniteExpansion	250
7.1.8	defun mac0InfiniteExpansion,name	250
7.1.9	defun mac0GetName	251
7.1.10	defun macId	252
7.1.11	defun mac0Get	252
7.1.12	defun macWhere	253
7.1.13	defun macWhere,mac	253
7.1.14	defun macLambda	253
7.1.15	defun macLambda,mac	254
7.1.16	defun Add appropriate definition the a Macro pform	255
7.1.17	defun Add a macro to the global pfMacros list	256
7.1.18	defun macSubstituteOuter	256
7.1.19	defun mac0SubstituteOuter	257
7.1.20	defun macLambdaParameterHandling	258
7.1.21	defun macSubstituteId	259
8	Pftrees	261
8.1	Abstract Syntax Trees Overview	261
8.2	Structure handlers	263
8.2.1	defun pfGlobalLinePosn	263
8.2.2	defun pfCharPosn	263
8.2.3	defun pfLinePosn	263
8.2.4	defun pfFileName	264
8.2.5	defun pfCopyWithPos	264
8.2.6	defun pfMapParts	265
8.2.7	defun pf0ApplicationArgs	265
8.2.8	defun pf0FlattenSyntacticTuple	266
8.2.9	defun pfSourcePosition	267
8.2.10	defun Convert a Sequence node to a list	267
8.2.11	defun pfSpread	268
8.2.12	defun Deconstruct nodes to lists	269
8.2.13	defun pfCheckMacroOut	270
8.2.14	defun pfCheckArg	271
8.2.15	defun pfCheckId	271
8.2.16	defun pfFlattenApp	272
8.2.17	defun pfCollect1?	272
8.2.18	defun pfCollectVariable1	273
8.2.19	defun pfPushMacroBody	273

8.2.20	defun pfSourceStok	274
8.2.21	defun pfTransformArg	274
8.2.22	defun pfTaggedToTyped1	275
8.2.23	defun pfSuch	275
8.3	Special Nodes	275
8.3.1	defun Create a Listof node	275
8.3.2	defun pfNothing	276
8.3.3	defun Is this a Nothing node?	276
8.4	Leaves	276
8.4.1	defun Create a Document node	276
8.4.2	defun Construct an Id node	276
8.4.3	defun Is this an Id node?	277
8.4.4	defun Construct an Id leaf node	277
8.4.5	defun Return the Id part	277
8.4.6	defun Construct a Leaf node	277
8.4.7	defun Is this a leaf node?	278
8.4.8	defun Return the token position of a leaf node	278
8.4.9	defun Return the Leaf Token	278
8.4.10	defun Is this a Literal node?	278
8.4.11	defun Create a LiteralClass node	279
8.4.12	defun Return the LiteralString	279
8.4.13	defun Return the parts of a tree node	279
8.4.14	defun Return the argument unchanged	279
8.4.15	defun pfPushBody	280
8.4.16	defun An S-expression which people can read.	280
8.4.17	defun Create a human readable S-expression	281
8.4.18	defun Construct a Symbol or Expression node	282
8.4.19	defun Construct a Symbol leaf node	282
8.4.20	defun Is this a Symbol node?	282
8.4.21	defun Return the Symbol part	283
8.5	Trees	283
8.5.1	defun Construct a tree node	283
8.5.2	defun Construct an Add node	283
8.5.3	defun Construct an And node	283
8.5.4	defun pfAttribute	284
8.5.5	defun Return an Application node	284
8.5.6	defun Return the Arg part of an Application node	284
8.5.7	defun Return the Op part of an Application node	284
8.5.8	defun Is this an And node?	284
8.5.9	defun Return the Left part of an And node	285
8.5.10	defun Return the Right part of an And node	285
8.5.11	defun Flatten a list of lists	285
8.5.12	defun Is this an Application node?	285
8.5.13	defun Create an Assign node	285
8.5.14	defun Is this an Assign node?	286
8.5.15	defun Return the parts of an LhsItem of an Assign node	286

8.5.16	defun Return the LhsItem of an Assign node	286
8.5.17	defun Return the RHS of an Assign node	286
8.5.18	defun Construct an application node for a brace	287
8.5.19	defun Construct an Application node for brace-bars	287
8.5.20	defun Construct an Application node for a bracket	287
8.5.21	defun Construct an Application node for bracket-bars	288
8.5.22	defun Create a Break node	288
8.5.23	defun Is this a Break node?	288
8.5.24	defun Return the From part of a Break node	288
8.5.25	defun Construct a Coerceto node	289
8.5.26	defun Is this a CoerceTo node?	289
8.5.27	defun Return the Expression part of a CoerceTo node	289
8.5.28	defun Return the Type part of a CoerceTo node	289
8.5.29	defun Return the Body of a Collect node	289
8.5.30	defun Return the Iterators of a Collect node	290
8.5.31	defun Create a Collect node	290
8.5.32	defun Is this a Collect node?	290
8.5.33	defun pfDefinition	290
8.5.34	defun Return the Lhs of a Definition node	290
8.5.35	defun Return the Rhs of a Definition node	291
8.5.36	defun Is this a Definition node?	291
8.5.37	defun Return the parts of a Definition node	291
8.5.38	defun Create a Do node	291
8.5.39	defun Is this a Do node?	292
8.5.40	defun Return the Body of a Do node	292
8.5.41	defun Construct a Sequence node	292
8.5.42	defun Construct an Exit node	292
8.5.43	defun Is this an Exit node?	293
8.5.44	defun Return the Cond part of an Exit	293
8.5.45	defun Return the Expression part of an Exit	293
8.5.46	defun Create an Export node	293
8.5.47	defun Construct an Expression leaf node	293
8.5.48	defun pfFirst	294
8.5.49	defun Create an Application Fix node	294
8.5.50	defun Create a Free node	294
8.5.51	defun Is this a Free node?	294
8.5.52	defun Return the parts of the Items of a Free node	295
8.5.53	defun Return the Items of a Free node	295
8.5.54	defun Construct a Forin node	295
8.5.55	defun Is this a ForIn node?	295
8.5.56	defun Return all the parts of the LHS of a ForIn node	296
8.5.57	defun Return the LHS part of a ForIn node	296
8.5.58	defun Return the Whole part of a ForIn node	296
8.5.59	defun pfFromDom	296
8.5.60	defun Construct a Fromdom node	297
8.5.61	defun Is this a Fromdom mode?	297

8.5.62	defun Return the What part of a Fromdom node	297
8.5.63	defun Return the Domain part of a Fromdom node	297
8.5.64	defun Construct a Hide node	297
8.5.65	defun pIf	298
8.5.66	defun Is this an If node?	298
8.5.67	defun Return the Cond part of an If	298
8.5.68	defun Return the Then part of an If	298
8.5.69	defun pIfThenOnly	298
8.5.70	defun Return the Else part of an If	299
8.5.71	defun Construct an Import node	299
8.5.72	defun Construct an Iterate node	299
8.5.73	defun Is this an Iterate node?	299
8.5.74	defun Handle an infix application	300
8.5.75	defun Create an Inline node	300
8.5.76	defun pLam	301
8.5.77	defun pLambda	301
8.5.78	defun Return the Body part of a Lambda node	301
8.5.79	defun Return the Rets part of a Lambda node	301
8.5.80	defun Is this a Lambda node?	302
8.5.81	defun Return the Args part of a Lambda node	302
8.5.82	defun Return the Args of a Lambda Node	302
8.5.83	defun Construct a Local node	302
8.5.84	defun Is this a Local node?	303
8.5.85	defun Return the parts of Items of a Local node	303
8.5.86	defun Return the Items of a Local node	303
8.5.87	defun Construct a Loop node	303
8.5.88	defun pLoop1	304
8.5.89	defun Is this a Loop node?	304
8.5.90	defun Return the Iterators of a Loop node	304
8.5.91	defun pf0LoopIterators	304
8.5.92	defun pLp	305
8.5.93	defun Create a Macro node	305
8.5.94	defun Is this a Macro node?	305
8.5.95	defun Return the Lhs of a Macro node	305
8.5.96	defun Return the Rhs of a Macro node	305
8.5.97	defun Construct an MLambda node	306
8.5.98	defun Is this an MLambda node?	306
8.5.99	defun Return the Args of an MLambda	306
8.5.100	defun Return the parts of an MLambda argument	306
8.5.101	defun pfMLambdaBody	306
8.5.102	defun Is this a Not node?	307
8.5.103	defun Return the Arg part of a Not node	307
8.5.104	defun Construct a NoValue node	307
8.5.105	defun Is this a Novalue node?	307
8.5.106	defun Return the Expr part of a Novalue node	307
8.5.107	defun Construct an Or node	308

8.5.108 defun Is this an Or node?	308
8.5.109 defun Return the Left part of an Or node	308
8.5.110 defun Return the Right part of an Or node	308
8.5.111 defun Return the part of a parenthesised expression . . .	308
8.5.112 defun pfPretend	309
8.5.113 defun Is this a Pretend node?	309
8.5.114 defun Return the Expression part of a Pretend node . . .	309
8.5.115 defun Return the Type part of a Pretend node	309
8.5.116 defun Construct a QualType node	309
8.5.117 defun Construct a Restrict node	310
8.5.118 defun Is this a Restrict node?	310
8.5.119 defun Return the Expr part of a Restrict node	310
8.5.120 defun Return the Type part of a Restrict node	310
8.5.121 defun Construct a RetractTo node	310
8.5.122 defun Construct a Return node	311
8.5.123 defun Is this a Return node?	311
8.5.124 defun Return the Expr part of a Return node	311
8.5.125 defun pfReturnNoName	311
8.5.126 defun Construct a ReturnTyped node	312
8.5.127 defun Construct a Rule node	312
8.5.128 defun Return the Lhs of a Rule node	312
8.5.129 defun Return the Rhs of a Rule node	312
8.5.130 defun Is this a Rule node?	312
8.5.131 defun pfSecond	313
8.5.132 defun Construct a Sequence node	313
8.5.133 defun Return the Args of a Sequence node	313
8.5.134 defun Is this a Sequence node?	313
8.5.135 defun Return the parts of the Args of a Sequence node . .	314
8.5.136 defun Create a Suchthat node	314
8.5.137 defun Is this a SuchThat node?	314
8.5.138 defun Return the Cond part of a SuchThat node	314
8.5.139 defun Create a Tagged node	315
8.5.140 defun Is this a Tagged node?	315
8.5.141 defun Return the Expression portion of a Tagged node . .	315
8.5.142 defun Return the Tag of a Tagged node	315
8.5.143 defun pfTaggedToTyped	316
8.5.144 defun pfTweakIf	316
8.5.145 defun Construct a Typed node	317
8.5.146 defun Is this a Typed node?	317
8.5.147 defun Return the Type of a Typed node	317
8.5.148 defun Return the Id of a Typed node	317
8.5.149 defun Construct a Typing node	317
8.5.150 defun Return a Tuple node	318
8.5.151 defun Return a Tuple from a List	318
8.5.152 defun Is this a Tuple node?	318
8.5.153 defun Return the Parts of a Tuple node	318

8.5.154	defun Return the parts of a Tuple	319
8.5.155	defun Return a list from a Sequence node	319
8.5.156	defun The comment is attached to all signatutres	319
8.5.157	defun Construct a WDeclare node	319
8.5.158	defun Construct a Where node	320
8.5.159	defun Is this a Where node?	320
8.5.160	defun Return the parts of the Context of a Where node	320
8.5.161	defun Return the Context of a Where node	320
8.5.162	defun Return the Expr part of a Where node	321
8.5.163	defun Construct a While node	321
8.5.164	defun Is this a While node?	321
8.5.165	defun Return the Cond part of a While node	321
8.5.166	defun Construct a With node	321
8.5.167	defun Create a Wrong node	322
8.5.168	defun Is this a Wrong node?	322
9	Pftree to s-expression translation	323
9.0.169	defun Pftree to s-expression translation	323
9.0.170	defun Pftree to s-expression translation inner function	324
9.0.171	defun Convert a Literal to an S-expression	329
9.0.172	defun Convert a float to an S-expression	330
9.0.173	defun Change an Application node to an S-expression	331
9.0.174	defun Convert a SuchThat node to an S-expression	333
9.0.175	defun pfOp2Sex	334
9.0.176	defun pmDontQuote?	335
9.0.177	defun hasOptArgs?	335
9.0.178	defun Convert a Sequence node to an S-expression	336
9.0.179	defun pfSequence2Sex0	337
9.0.180	defun Convert a loop node to an S-expression	339
9.0.181	defun Change a Collect node to an S-expression	342
9.0.182	defun Convert a Definition node to an S-expression	343
9.0.183	defun Convert a Lambda node to an S-expression	344
9.0.184	defun pfCollectArgTran	345
9.0.185	defun Convert a Lambda node to an S-expression	346
9.0.186	defun Convert a Rule node to an S-expression	346
9.0.187	defun Convert the Lhs of a Rule to an S-expression	347
9.0.188	defun Convert the Rhs of a Rule to an S-expression	347
9.0.189	defun Convert a Rule predicate to an S-expression	348
9.0.190	defun patternVarsOf	350
9.0.191	defun patternVarsOf1	350
9.0.192	defun pvarPredTran	350
9.0.193	defun Convert the Lhs of a Rule node to an S-expression	351
9.0.194	defvar \$dotdot	351
9.0.195	defun Translate ops into internal symbols	352

10 Keyed Message Handling 353

10.0.19	@efvar \$cacheMessages	354
10.0.19	7efvar \$msgAlist	354
10.0.19	8efvar \$msgDatabaseName	354
10.0.19	9efvar \$testingErrorPrefix	354
10.0.20	@efvar \$texFormatting	355
10.0.20	1efvar \$*msghash*	355
10.0.20	2efvar \$msgdbPrims	355
10.0.20	3efvar \$msgdbPunct	355
10.0.20	4efvar \$msgdbNoBlanksBeforeGroup	355
10.0.20	5efvar \$msgdbNoBlanksAfterGroup	355
10.0.20	@efun Fetch a message from the message database	356
10.0.20	7efun Cache messages read from message database	356
10.0.20	8efun getKeyedMsg	357
10.0.20	9efun Say a message using a keyed lookup	357
10.0.21	@efun Handle msg formatting and print to file	358
10.0.21	1efun Break a message into words	358
10.0.21	2efun Write a msg into spadmsg.listing file	359
10.0.21	3efun sayMSG	359

11 Stream Utilities 361

11.0.21	4efun npNull	361
11.0.21	5efun StreamNull	362

12 Code Piles 363

12.0.21	@efun insertpile	363
12.0.21	7efun pilePlusComment	364
12.0.21	8efun pilePlusComments	364
12.0.21	9efun pileTree	365
12.0.22	@efun pileColumn	365
12.0.22	1efun pileForests	366
12.0.22	2efun pileForest	366
12.0.22	3efun pileForest1	367
12.0.22	4efun eqpileTree	367
12.0.22	5efun pileCtree	368
12.0.22	6efun pileCforest	368
12.0.22	7efun enPile	369
12.0.22	8efun firstTokPosn	369
12.0.22	9efun lastTokPosn	369
12.0.23	@efun separatePiles	370

13 Dequeue Functions 371

13.0.23	1efun dqUnit	371
13.0.23	2efun dqConcat	371
13.0.23	3efun dqAppend	372
13.0.23	4efun dqToList	372

14 Message Handling	373
14.1 The Line Object	373
14.1.1 defun Line object creation	373
14.1.2 defun Line element 0; Extra blanks	373
14.1.3 defun Line element 1; String	373
14.1.4 defun Line element 2; Global number	374
14.1.5 defun Line element 2; Set Global number	374
14.1.6 defun Line element 3; Local number	374
14.1.7 defun Line element 4; Place of origin	374
14.1.8 defun Line element 4; Is it a filename?	374
14.1.9 defun Line element 4; Is it a filename?	374
14.1.10 defun Line element 4; Get filename	375
14.2 Messages	375
14.2.1 defun msgCreate	375
14.2.2 defun getMsgPosTagOb	376
14.2.3 defun getMsgKey	376
14.2.4 defun getMsgArgL	376
14.2.5 defun getMsgPrefix	376
14.2.6 defun setMsgPrefix	376
14.2.7 defun getMsgText	376
14.2.8 defun setMsgText	377
14.2.9 defun getMsgPrefix?	377
14.2.10 defun getMsgTag	377
14.2.11 defun getMsgTag?	377
14.2.12 defun line?	378
14.2.13 defun leader?	378
14.2.14 defun toScreen?	378
14.2.15 defun ncSoftError	378
14.2.16 defun ncHardError	379
14.2.17 defun desiredMsg	379
14.2.18 defun processKeyedError	380
14.2.19 defun msgOutputter	381
14.2.20 defun listOutputter	381
14.2.21 defun getStFromMsg	382
14.2.22 defvar \$preLength	382
14.2.23 defun getPreStL	383
14.2.24 defun getPosStL	384
14.2.25 defun ppos	385
14.2.26 defun remFile	385
14.2.27 defun showMsgPos?	386
14.2.28 defvar \$imPrGuys	386
14.2.29 defun msgImPr?	386
14.2.30 defun getMsgCatAttr	386
14.2.31 defun getMsgPos	387
14.2.32 defun getMsgFTTag?	387
14.2.33 defun decideHowMuch	387

14.2.34 defun poNopos?	388
14.2.35 defun poPosImmediate?	388
14.2.36 defun poFileName	388
14.2.37 defun poGetLineObject	388
14.2.38 defun poLinePosn	389
14.2.39 defun listDecideHowMuch	389
14.2.40 defun remLine	389
14.2.41 defun getMsgKey?	390
14.2.42 defun getMsgLitSym	390
14.2.43 defun tabbing	390
14.2.44 defvar \$toWhereGuys	390
14.2.45 defun getMsgToWhere	391
14.2.46 defun toFile?	391
14.2.47 defun alreadyOpened?	391
14.2.48 defun setMsgForcedAttrList	391
14.2.49 defun setMsgForcedAttr	392
14.2.50 defvar \$attrCats	392
14.2.51 defun whichCat	392
14.2.52 defun setMsgCatlessAttr	393
14.2.53 defun putDatabaseStuff	393
14.2.54 defun getMsgInfoFromKey	394
14.2.55 defun setMsgUnforcedAttrList	394
14.2.56 defun setMsgUnforcedAttr	395
14.2.57 defvar \$imPrTagGuys	395
14.2.58 defun initImPr	395
14.2.59 defun initToWhere	396
14.2.60 defun ncBug	396
14.2.61 defun processMsgList	397
14.2.62 defun erMsgSort	397
14.2.63 defun erMsgCompare	398
14.2.64 defun compareposns	398
14.2.65 defun erMsgSep	398
14.2.66 defun makeMsgFromLine	399
14.2.67 defun rep	399
14.2.68 defun getLinePos	399
14.2.69 defun getLineText	400
14.2.70 defun queueUpErrors	401
14.2.71 defun thisPosIsLess	402
14.2.72 defun thisPosIsEqual	403
14.2.73 defun redundant	403
14.2.74 defvar \$repGuys	404
14.2.75 defun msgNoRep?	404
14.2.76 defun sameMsg?	404
14.2.77 defun processChPosesForOneLine	405
14.2.78 defun poCharPosn	405
14.2.79 defun makeLeaderMsg	406

14.2.80 defun posPointers	407
14.2.81 defun getMsgPos2	407
14.2.82 defun insertPos	408
14.2.83 defun putFTText	409
14.2.84 defun From	409
14.2.85 defun To	409
14.2.86 defun FromTo	410
15 The Interpreter Syntax	411
15.1 syntax assignment	411
15.2 syntax blocks	415
15.3 system clef	417
15.4 syntax collection	419
15.5 syntax for	421
15.6 syntax if	426
15.7 syntax iterate	428
15.8 syntax leave	429
15.9 syntax parallel	431
15.10 syntax repeat	434
15.11 syntax suchthat	439
15.12 syntax syntax	440
15.13 syntax while	441
16 Abstract Syntax Trees (ptrees)	443
16.0.1 defun Construct a leaf token	443
16.0.2 defun Return a part of a node	444
16.0.3 defun Compare a part of a node	444
16.0.4 defun pfNoPosition?	444
16.0.5 defun poNoPosition?	445
16.0.6 defun tokType	445
16.0.7 defun tokPart	445
16.0.8 defun tokPosn	445
16.0.9 defun pfNoPosition	446
16.0.10 defun poNoPosition	446
17 Attributed Structures	447
17.0.11 defun ncTag	447
17.0.12 defun ncAlist	448
17.0.13 defun ncEltQ	448
17.0.14 defun ncPutQ	449
18 System Command Handling	451
18.1 Variables Used	453
18.1.1 defvar \$systemCommands	453
18.1.2 defvar \$syscommands	455
18.1.3 defvar \$noParseCommands	455

18.2 Functions	456
18.2.1 defun handleNoParseCommands	456
18.2.2 defun Handle a top level command	456
18.2.3 defun Split block into option block	458
18.2.4 defun Tokenize a system command	458
18.2.5 defun Handle system commands	459
18.2.6 defun Select commands matching this user level	460
18.2.7 defun No command begins with this string	460
18.2.8 defun No option begins with this string	460
18.2.9 defvar \$oldline	460
18.2.10 defun No command/option begins with this string	461
18.2.11 defun Option not available at this user level	461
18.2.12 defun Command not available at this user level	461
18.2.13 defun Command not available error message	462
18.2.14 defun satisfiesUserLevel	462
18.2.15 defun hasOption	463
18.2.16 defun terminateSystemCommand	463
18.2.17 defun Terminate a system command	463
18.2.18 defun commandAmbiguityError	464
18.2.19 defun getParserMacroNames	464
18.2.20 defun clearParserMacro	465
18.2.21 defun displayMacro	466
18.2.22 defun displayWorkspaceNames	467
18.2.23 defun getWorkspaceNames	468
18.2.24 defun fixObjectForPrinting	469
18.2.25 defun displayProperties,sayFunctionDeps	470
18.2.26 defun displayValue	473
18.2.27 defun displayType	474
18.2.28 defun getAndSay	475
18.2.29 defun displayProperties	476
18.2.30 defun displayParserMacro	479
18.2.31 defun displayCondition	480
18.2.32 defun interpFunctionDepAlists	481
18.2.33 defun displayModemap	482
18.2.34 defun displayMode	482
18.2.35 defun Split into tokens delimited by spaces	483
18.2.36 defun Convert string tokens to their proper type	483
18.2.37 defun Is the argument string an integer?	484
18.2.38 defun Handle parsed system commands	484
18.2.39 defun Parse a system command	484
18.2.40 defun Get first word in a string	485
18.2.41 defun Unabbreviate keywords in commands	485
18.2.42 defun The command is ambiguous error	486
18.2.43 defun Remove the spaces surrounding a string	488
18.2.44 defun Remove the lisp command prefix	488
18.2.45 defun Handle the)lisp command	488

18.2.46 defun The)boot command is no longer supported	488
18.2.47 defun Handle the)system command	489
18.2.48 defun Handle the)synonym command	489
18.2.49 defun Handle the synonym system command	490
18.2.50 defun printSynonyms	491
18.2.51 defun Print a list of each matching synonym	492
18.2.52 defvar \$tokenCommands	493
18.2.53 defvar \$InitialCommandSynonymAlist	494
18.2.54 defun Print the current version information	494
18.2.55 defvar \$CommandSynonymAlist	496
18.2.56 defun nloopCommand	497
18.2.57 defun nloopPrefix?	497
18.2.58 defun selectOptionLC	498
18.2.59 defun selectOption	498
19)abbreviations help page Command	499
19.1 abbreviations help page man page	499
19.2 Functions	501
19.2.1 defun abbreviations	501
19.2.2 defun abbreviationsSpad2Cmd	502
19.2.3 defun listConstructorAbbreviations	504
20)boot help page Command	505
20.1 boot help page man page	505
20.2 Functions	506
21)browse help page Command	507
21.1 browse help page man page	507
21.2 Overview	508
21.3 Browsers, MathML, and Fonts	508
21.4 The axServer/multiServ loop	510
21.5 The)browse command	510
21.6 Variables Used	511
21.7 Functions	511
21.8 The server support code	512
22)cd help page Command	513
22.1 cd help page man page	513
22.2 Variables Used	514
22.3 Functions	514
23)clear help page Command	515
23.1 clear help page man page	515
23.2 Variables Used	517
23.2.1 defvar \$clearOptions	517
23.3 Functions	517

23.3.1	defun clear	517
23.3.2	defvar \$clearExcept	517
23.3.3	defun clearSpad2Cmd	518
23.3.4	defun clearCmdSortedCaches	519
23.3.5	defvar \$functionTable	520
23.3.6	defun clearCmdCompletely	521
23.3.7	defun clearCmdAll	522
23.3.8	defun clearMacroTable	523
23.3.9	defun clearCmdExcept	523
23.3.10	defun clearCmdParts	524
24	)close help page Command	527
24.1	close help page man page	527
24.2	Functions	528
24.2.1	defun queryClients	528
24.2.2	defun close	529
25	)compile help page Command	531
25.1	compile help page man page	531
25.2	Functions	534
25.2.1	defvar \$/editfile	534
26	)copyright help page Command	535
26.1	copyright help page man page	535
26.2	Functions	541
26.2.1	defun copyright	541
26.2.2	defun trademark	541
27	)credits help page Command	543
27.1	credits help page man page	543
27.2	Variables Used	543
27.3	Functions	543
27.3.1	defun credits	543
28	)describe help page Command	545
28.1	describe help page man page	545
28.1.1	defvar \$describeOptions	546
28.2	Functions	546
28.2.1	defun Print comment strings from algebra libraries	546
28.2.2	defun describeSpad2Cmd	547
28.2.3	defun cleanline	549
28.2.4	defun flatten	550

29)display help page Command	551
29.1 display help page man page	551
29.1.1 defvar \$displayOptions	553
29.2 Functions	553
29.2.1 defun display	553
29.2.2 displaySpad2Cmd	554
29.2.3 defun abbQuery	555
29.2.4 defun displayOperations	556
29.2.5 defun yesanswer	556
29.2.6 defun displayMacros	557
29.2.7 defun sayExample	559
29.2.8 defun cleanupLine	561
30)edit help page Command	563
30.1 edit help page man page	563
30.2 Functions	564
30.2.1 defun edit	564
30.2.2 defun editSpad2Cmd	565
30.2.3 defun Implement the)edit command	566
30.2.4 defun updateSourceFiles	566
31)fin help page Command	567
31.1 fin help page man page	567
31.1.1 defun Exit from the interpreter to lisp	568
31.2 Functions	568
32)frame help page Command	569
32.1 frame help page man page	569
32.2 Variables Used	572
32.2.1 Primary variables	572
32.2.2 Used variables	572
32.3 Data Structures	573
32.3.1 Frames and the Interpreter Frame Ring	573
32.4 Accessor Functions	573
32.4.1 0th Frame Component – frameName	573
32.4.2 defun frameName	573
32.4.3 1st Frame Component – frameInteractive	573
32.4.4 2nd Frame Component – frameIOIndex	574
32.4.5 3rd Frame Component – frameHiFiAccess	574
32.4.6 4th Frame Component – frameHistList	574
32.4.7 5th Frame Component – frameHistListLen	574
32.4.8 6th Frame Component – frameHistListAct	574
32.4.9 7th Frame Component – frameHistRecord	574
32.4.10 8th Frame Component – frameHistoryTable	575
32.4.11 9th Frame Component – frameExposureData	575
32.5 Functions	575

32.5.1	Initializing the Interpreter Frame Ring	575
32.5.2	Creating a List of all of the Frame Names	576
32.5.3	Get Named Frame Environment (aka Interactive)	576
32.5.4	Create a new, empty Interpreter Frame	577
32.5.5	Collecting up the Environment into a Frame	578
32.5.6	Update from the Current Frame	579
32.5.7	Find a Frame in the Frame Ring by Name	580
32.5.8	Update the Current Interpreter Frame	580
32.5.9	Move to the next Interpreter Frame in Ring	581
32.5.10	Change to the Named Interpreter Frame	581
32.5.11	Move to the previous Interpreter Frame in Ring	582
32.5.12	Add a New Interpreter Frame	583
32.5.13	Close an Interpreter Frame	584
32.5.14	Display the Frame Names	585
32.5.15	Import items from another frame	586
32.5.16	The top level frame command	588
32.5.17	The top level frame command handler	589
32.6	Frame File Messages	591
33	)help help page Command	593
33.1	help help page man page	593
33.2	Functions	596
33.2.1	The top level help command	596
33.2.2	The top level help command handler	596
33.2.3	defun newHelpSpad2Cmd	597
34	)history help page Command	599
34.1	history help page man page	599
34.2	Initialized history variables	603
34.2.1	defvar \$oldHistoryFileName	603
34.2.2	defvar \$historyFileType	603
34.2.3	defvar \$historyDirectory	603
34.2.4	defvar \$useInternalHistoryTable	604
34.3	Data Structures	604
34.4	Functions	604
34.4.1	defun makeHistFileName	604
34.4.2	defun oldHistFileName	604
34.4.3	defun histFileName	604
34.4.4	defun histInputFileName	605
34.4.5	defun initHist	605
34.4.6	defun initHistList	606
34.4.7	The top level history command	606
34.4.8	The top level history command handler	607
34.4.9	defun setHistoryCore	610
34.4.10	defvar \$underbar	612
34.4.11	defun writeInputLines	613

34.4.12	defun resetInCoreHist	614
34.4.13	defun changeHistListLen	615
34.4.14	defun updateHist	616
34.4.15	defun updateInCoreHist	617
34.4.16	defun putHist	617
34.4.17	defun recordNewValue	617
34.4.18	defun recordNewValue0	618
34.4.19	defun recordOldValue	618
34.4.20	defun recordOldValue0	619
34.4.21	defun undoInCore	620
34.4.22	defun undoChanges	621
34.4.23	defun undoFromFile	622
34.4.24	defun saveHistory	624
34.4.25	defun restoreHistory	626
34.4.26	defun setIOindex	628
34.4.27	defun showInput	629
34.4.28	defun showInOut	630
34.4.29	defun fetchOutput	631
34.4.30	Read the history file using index n	632
34.4.31	Write information of the current step to history file	633
34.4.32	Disable history if an error occurred	634
34.4.33	defun writeHistModesAndValues	634
34.5	Lisplib output transformations	635
34.5.1	defun spadwrite0	635
34.5.2	defun Random write to a stream	635
34.5.3	defun spadwrite	636
34.5.4	defun spadread	636
34.5.5	defun Random read a key from a stream	636
34.5.6	defun unwritable?	637
34.5.7	defun writifyComplain	637
34.5.8	defun safeWritify	637
34.5.9	defun writify,writifyInner	638
34.5.10	defun writify	642
34.5.11	defun spadClosure?	642
34.5.12	defun dewritify,is?	643
34.5.13	defvar \$NonNullStream	643
34.5.14	defvar \$NullStream	643
34.5.15	defun dewritify,dewritifyInner	644
34.5.16	defun dewritify	647
34.5.17	defun ScanOrPairVec,ScanOrInner	648
34.5.18	defun ScanOrPairVec	648
34.5.19	defun gensymInt	649
34.5.20	defun charDigitVal	649
34.5.21	defun histFileErase	650
34.6	History File Messages	651

35)include help page Command	653
35.1 include help page man page	653
35.2 Functions	654
35.2.1 defun ncloopInclude1	654
35.2.2 Returns the first non-blank substring of the given string .	654
35.2.3 Open the include file and read it in	654
35.2.4 Return the include filename	655
35.2.5 Return the next token	655
36)library help page Command	657
36.1 library help page man page	657
37)lisp help page Command	659
37.1 lisp help page man page	659
37.2 Functions	660
38)load help page Command	661
38.1 load help page man page	661
38.1.1 defun The)load command (obsolete)	661
39)ltrace help page Command	663
39.1 ltrace help page man page	663
39.1.1 defun The top level)ltrace function	664
39.2 Variables Used	664
39.3 Functions	664
40)pquit help page Command	665
40.1 pquit help page man page	665
40.2 Functions	666
40.2.1 The top level pquit command	666
40.2.2 The top level pquit command handler	667
41)quit help page Command	669
41.1 quit help page man page	669
41.2 Functions	670
41.2.1 The top level quit command	670
41.2.2 The top level quit command handler	671
41.2.3 Leave the Axiom interpreter	671
42)read help page Command	673
42.1 read help page man page	673
42.1.1 defun The)read command	674
42.1.2 defun Implement the)read command	675
42.1.3 defun /read	676

43)savesystem help page Command	677
43.1 savesystem help page man page	677
43.1.1 defun The)savesystem command	678
44)set help page Command	679
44.1 set help page man page	679
44.2 Overview	681
44.3 Variables Used	681
44.4 Functions	681
44.4.1 Initialize the set variables	681
44.4.2 Reset the workspace variables	683
44.4.3 Display the set option information	685
44.4.4 Display the set variable settings	687
44.4.5 Translate options values to t or nil	689
44.4.6 Translate t or nil to option values	689
44.5 The list structure	690
44.6 breakmode	691
44.6.1 defvar \$BreakMode	691
44.7 debug	692
44.8 debug lambda type	692
44.8.1 defvar \$lambdatype	692
44.9 debug dalymode	693
44.9.1 defvar \$dalymode	693
44.10 compile	694
44.11 compile output	694
44.12 Variables Used	695
44.13 Functions	695
44.13.1 The set output command handler	695
44.13.2 Describe the set output library arguments	695
44.13.3 Open the output library	696
44.14 compile input	696
44.15 Variables Used	697
44.16 Functions	697
44.16.1 The set input library command handler	697
44.16.2 Describe the set input library arguments	698
44.16.3 Add the input library to the list	698
44.16.4 Drop an input library from the list	699
44.17 expose	700
44.18 Variables Used	701
44.18.1 defvar \$globalExposureGroupAlist	701
44.18.2 defvar \$localExposureDataDefault	729
44.18.3 defvar \$localExposureData	729
44.19 Functions	730
44.19.1 The top level set expose command handler	730
44.19.2 The top level set expose add command handler	731
44.19.3 Expose a group	732

44.19.4	The top level set expose add constructor handler	734
44.19.5	The top level set expose drop handler	735
44.19.6	The top level set expose drop group handler	736
44.19.7	The top level set expose drop constructor handler	738
44.19.8	Display exposed groups	739
44.19.9	Display exposed constructors	739
44.19.10	Display hidden constructors	740
44.20	functions	740
44.21	functions cache	741
44.22	Variables Used	741
44.22.1	defvar \$cacheAlist	741
44.23	Functions	742
44.23.1	The top level set functions cache handler	742
44.23.2	defvar \$compileDontDefineFunctions	745
44.24	functions recurrence	746
44.24.1	defvar \$compileRecurrence	746
44.25	fortran	747
44.25.1	ints2floats	748
44.25.2	defvar \$fortInts2Floats	748
44.25.3	fortindent	748
44.25.4	defvar \$fortIndent	748
44.25.5	fortlength	749
44.25.6	defvar \$fortLength	749
44.25.7	typedecs	750
44.25.8	defvar \$printFortranDecs	750
44.25.9	defaulttype	750
44.25.10	defvar \$defaultFortranType	751
44.25.11	precision	751
44.25.12	defvar \$fortranPrecision	751
44.25.13	intrinsic	752
44.25.14	defvar \$useIntrinsicFunctions	752
44.25.15	explength	753
44.25.16	defvar \$maximumFortranExpressionLength	753
44.25.17	segment	753
44.25.18	defvar \$fortranSegment	753
44.25.19	optlevel	754
44.25.20	defvar \$fortranOptimizationLevel	754
44.25.21	startindex	754
44.25.22	defvar \$fortranArrayStartingIndex	755
44.25.23	calling	755
44.25.24	defvar \$fortranTmpDir	756
44.25.25	The top level set fortran calling tempfile handler	757
44.25.26	Validate the output directory	757
44.25.27	Describe the set fortran calling tempfile	758
44.25.28	defvar \$fortranDirectory	758
44.25.29	defun setFortDir	759

44.25.30	defun describeSetFortDir	760
44.25.31	defvar \$fortranLibraries	760
44.25.32	defun setLinkerArgs	761
44.25.33	defun describeSetLinkerArgs	762
44.26	kernel	763
44.26.1	kernelwarn	763
44.26.2	defun protectedSymbolsWarning	764
44.26.3	defun describeProtectedSymbolsWarning	764
44.26.4	kernelprotect	765
44.26.5	defun protectSymbols	765
44.26.6	defun describeProtectSymbols	766
44.27	hyperdoc	766
44.27.1	fullscreen	767
44.27.2	defvar \$fullScreenSysVars	767
44.27.3	mathwidth	767
44.27.4	defvar \$historyDisplayWidth	767
44.28	help	768
44.28.1	fullscreen	769
44.28.2	defvar \$useFullScreenHelp	769
44.29	history	770
44.29.1	defvar \$HiFiAccess	770
44.30	messages	771
44.30.1	any	772
44.30.2	defvar \$printAnyIfTrue	772
44.30.3	autoload	773
44.30.4	defvar \$printLoadMsgs	773
44.30.5	bottomup	773
44.30.6	defvar \$reportBottomUpFlag	773
44.30.7	coercion	774
44.30.8	defvar \$reportCoerceIfTrue	774
44.30.9	dropmap	775
44.30.10	defvar \$displayDroppedMap	775
44.30.11	expose	776
44.30.12	defvar \$giveExposureWarning	776
44.30.13	file	777
44.30.14	defvar \$printMsgsToFile	777
44.30.15	frame	778
44.30.16	defvar \$frameMessages	778
44.30.17	highlighting	779
44.30.18	defvar \$highlightAllowed	779
44.30.19	instant	780
44.30.20	defvar \$reportInstantiations	780
44.30.21	insteach	781
44.30.22	defvar \$reportEachInstantiation—	781
44.30.23	interponly	782
44.30.24	defvar \$reportInterpOnly	782

44.30.25	naglink	783
44.30.26	defvar \$nagMessages	783
44.30.27	number	784
44.30.28	defvar \$displayMsgNumber	784
44.30.29	prompt	784
44.30.30	defvar \$inputPromptType	785
44.30.31	election	785
44.30.32	set	786
44.30.33	defvar \$displaySetValue	786
44.30.34	startup	787
44.30.35	defvar \$displayStartMsgs	787
44.30.36	summary	788
44.30.37	defvar \$printStatisticsSummaryIfTrue	788
44.30.38	testing	788
44.30.39	defvar \$testingSystem	789
44.30.40	time	789
44.30.41	defvar \$printTimeIfTrue	789
44.30.42	type	790
44.30.43	defvar \$printTypeIfTrue	790
44.30.44	void	791
44.30.45	defvar \$printVoidIfTrue	791
44.31	naglink	792
44.31.1	host	792
44.31.2	defvar \$nagHost	792
44.31.3	defun setNagHost	793
44.31.4	defun describeSetNagHost	794
44.31.5	persistence	794
44.31.6	defvar \$fortPersistence	794
44.31.7	defun setFortPers	795
44.31.8	defun describeFortPersistence	796
44.31.9	messages	797
44.31.10	double	797
44.31.11	defvar \$nagEnforceDouble	797
44.32	output	799
44.32.1	abbreviate	800
44.32.2	defvar \$abbreviateTypes	800
44.32.3	algebra	801
44.32.4	defvar \$algebraFormat	801
44.32.5	defvar \$algebraOutputFile	801
44.32.6	defvar \$algebraOutputStream	802
44.32.7	defun setOutputAlgebra	803
44.32.8	defun describeSetOutputAlgebra	806
44.32.9	characters	807
44.32.10	defun setOutputCharacters	808
44.32.11	fortran	810
44.32.12	defvar \$fortranFormat	810

44.32.13	defvar \$fortranOutputFile	810
44.32.14	defun setOutputFortran	812
44.32.15	defun describeSetOutputFortran	815
44.32.16	fraction	816
44.32.17	defvar \$fractionDisplayType	816
44.32.18	length	816
44.32.19	defvar \$margin	816
44.32.20	defvar \$linelength	817
44.32.21	mathml	818
44.32.22	defvar \$mathmlFormat	818
44.32.23	defvar \$mathmlOutputFile	818
44.32.24	defun setOutputMathml	820
44.32.25	defun describeSetOutputMathml	823
44.32.26	html	824
44.32.27	defvar \$htmlFormat	824
44.32.28	defvar \$htmlOutputFile	824
44.32.29	defun setOutputHtml	826
44.32.30	defun describeSetOutputHtml	829
44.32.31	openmath	830
44.32.32	defvar \$openMathFormat	830
44.32.33	defvar \$openMathOutputFile	830
44.32.34	defun setOutputOpenMath	832
44.32.35	defun describeSetOutputOpenMath	835
44.32.36	script	836
44.32.37	defvar \$formulaFormat	836
44.32.38	defvar \$formulaOutputFile	836
44.32.39	defun setOutputFormula	838
44.32.40	defun describeSetOutputFormula	841
44.32.41	scripts	842
44.32.42	defvar \$linearFormatScripts	842
44.32.43	showeditor	843
44.32.44	defvar \$useEditorForShowOutput	843
44.32.45	tex	844
44.32.46	defvar \$texFormat	844
44.32.47	defvar \$texOutputFile	844
44.32.48	defun setOutputTex	846
44.32.49	defun describeSetOutputTex	848
44.33	quit	849
44.33.1	defvar \$quitCommandType	849
44.34	streams	850
44.34.1	calculate	850
44.34.2	defvar \$streamCount	850
44.34.3	defun setStreamsCalculate	851
44.34.4	defun describeSetStreamsCalculate	852
44.34.5	showall	852
44.34.6	defvar \$streamsShowAll	852

44.35	system	853
44.35.1	functioncode	853
44.35.2	defvar \$reportCompilation	853
44.35.3	optimization	854
44.35.4	defvar \$reportOptimization	854
44.35.5	prettyprint	855
44.35.6	defvar \$prettyprint	855
44.36	userlevel	855
44.36.1	defvar \$UserLevel	856
44.36.2	defvar \$setOptionNames	856
44.37	Set code	857
44.37.1	defun set	857
44.37.2	defun set1	858
45	)show help page Command	863
45.1	show help page man page	863
45.1.1	defun The)show command	864
45.1.2	defun The internal)show command	865
45.1.3	defun reportOperations	866
45.1.4	defun reportOpsFromLisplib0	867
45.1.5	defun reportOpsFromLisplib1	868
45.1.6	defun reportOpsFromLisplib	869
45.1.7	defun displayOperationsFromLisplib	871
45.1.8	defun reportOpsFromUnitDirectly0	872
45.1.9	defun reportOpsFromUnitDirectly	873
45.1.10	defun reportOpsFromUnitDirectly1	876
45.1.11	defun sayShowWarning	876
46	)spool help page Command	877
46.1	spool help page man page	877
47	)summary help page Command	879
47.1	summary help page man page	879
47.1.1	defun summary	880
48	)synonym help page Command	881
48.1	synonym help page man page	881
48.1.1	defun The)synonym command	882
48.1.2	defun The)synonym command implementation	883
48.1.3	defun Return a sublist of applicable synonyms	884
48.1.4	defun Get the system command from the input line	884
48.1.5	defun Remove system keyword	885
48.1.6	defun processSynonymLine	885
49	)system help page Command	887
49.1	system help page man page	887

50)trace help page Command	889
50.1 trace help page man page	889
50.1.1 The trace global variables	894
50.1.2 defvar \$traceNoisely	894
50.1.3 defvar \$reportSpadTrace	894
50.1.4 defvar \$optionAlist	894
50.1.5 defvar \$tracedMapSignatures	894
50.1.6 defvar \$traceOptionList	895
50.1.7 defun trace	895
50.1.8 defun traceSpad2Cmd	896
50.1.9 defun trace1	897
50.1.10 defun getTraceOptions	902
50.1.11 defun saveMapSig	903
50.1.12 defun getMapSig	903
50.1.13 defun getTraceOption,hn	904
50.1.14 defun getTraceOption	905
50.1.15 defun traceOptionError	908
50.1.16 defun resetTimers	909
50.1.17 defun resetSpacers	909
50.1.18 defun resetCounters	909
50.1.19 defun ptimers	910
50.1.20 defun pspacers	910
50.1.21 defun pcounters	911
50.1.22 defun transOnlyOption	911
50.1.23 defun stackTraceOptionError	912
50.1.24 defun removeOption	912
50.1.25 defun domainToGenvar	913
50.1.26 defun genDomainTraceName	913
50.1.27 defun untrace	914
50.1.28 defun transTraceItem	915
50.1.29 defun removeTracedMapSigs	916
50.1.30 defun coerceTraceArgs2E	917
50.1.31 defun coerceSpadArgs2E	919
50.1.32 defun subTypes	920
50.1.33 defun coerceTraceFunValue2E	921
50.1.34 defun coerceSpadFunValue2E	922
50.1.35 defun isListOfIdentifiers	922
50.1.36 defun isListOfIdentifiersOrStrings	923
50.1.37 defun getMapSubNames	924
50.1.38 defun getPreviousMapSubNames	925
50.1.39 defun lassocSub	926
50.1.40 defun rassocSub	926
50.1.41 defun isUncompiledMap	926
50.1.42 defun isInterpOnlyMap	927
50.1.43 defun augmentTraceNames	927
50.1.44 defun isSubForRedundantMapName	928

50.1.45 defun untraceMapSubNames	928
50.1.46 defun funfind,LAM	929
50.1.47 defmacro funfind	929
50.1.48 defun isDomainOrPackage	930
50.1.49 defun isTraceGensym	930
50.1.50 defun spadTrace,g	930
50.1.51 defun spadTrace,isTraceable	931
50.1.52 defun spadTrace	932
50.1.53 defun traceDomainLocalOps	936
50.1.54 defun untraceDomainLocalOps	936
50.1.55 defun traceDomainConstructor	937
50.1.56 defun untraceDomainConstructor,keepTraced?	939
50.1.57 defun untraceDomainConstructor	940
50.1.58 defun flattenOperationAlist	941
50.1.59 defun mapLetPrint	942
50.1.60 defun letPrint	943
50.1.61 defun Identifier beginning with a sharpsign-number?	944
50.1.62 defun Identifier beginning with a sharpsign?	944
50.1.63 defun isgenvar	945
50.1.64 defun letPrint2	946
50.1.65 defun letPrint3	948
50.1.66 defun getAliasIfTracedMapParameter	949
50.1.67 defun getBpiNameIfTracedMap	950
50.1.68 defun hasPair	950
50.1.69 defun shortenForPrinting	951
50.1.70 defun spadTraceAlias	951
50.1.71 defun getOption	951
50.1.72 defun reportSpadTrace	952
50.1.73 defun orderBySlotNumber	953
50.1.74 defun /tracereply	954
50.1.75 defun spadReply,printName	955
50.1.76 defun spadReply	955
50.1.77 defun spadUntrace	956
50.1.78 defun prTraceNames,fn	958
50.1.79 defun prTraceNames	958
50.1.80 defvar \$constructors	959
50.1.81 defun traceReply	960
50.1.82 defun addTraceItem	963
50.1.83 defun ?t	964
50.1.84 defun tracelet	966
50.1.85 defun breaklet	968
50.1.86 defun stupidIsSpadFunction	969
50.1.87 defun break	969
50.1.88 defun compileBoot	970

51)undo help page Command	971
51.1 undo help page man page	971
51.2 Data Structures	973
51.3 Functions	973
51.3.1 Initial Undo Variables	973
51.3.2 defvar \$undoFlag	973
51.3.3 defvar \$frameRecord	973
51.3.4 defvar \$previousBindings	974
51.3.5 defvar \$reportUndo	974
51.3.6 defun undo	975
51.3.7 defun recordFrame	977
51.3.8 defun diffAlist	979
51.3.9 defun reportUndo	983
51.3.10 defun clearFrame	984
51.3.11 Undo previous n commands	985
51.3.12 defun undoSteps	986
51.3.13 defun undoSingleStep	988
51.3.14 defun undoLocalModemapHack	990
51.3.15 Remove undo lines from history write	991
52)what help page Command	995
52.1 what help page man page	995
52.1.1 defvar \$whatOptions	997
52.1.2 defun what	997
52.1.3 defun whatSpad2Cmd,fixpat	997
52.1.4 defun whatSpad2Cmd	998
52.1.5 defun Show keywords for)what command	999
52.1.6 defun The)what commands implementation	1000
52.1.7 defun Find all names contained in a pattern	1001
52.1.8 defun Find function of names contained in pattern	1001
52.1.9 defun satisfiesRegularExpressions	1001
52.1.10 defun filterAndFormatConstructors	1002
52.1.11 defun whatConstructors	1003
52.1.12 Display all operation names containing the fragment	1004
53)with help page Command	1005
53.1 with help page man page	1005
53.1.1 defun with	1005
54)workfiles help page Command	1007
54.1 workfiles help page man page	1007
54.1.1 defun workfiles	1007
54.1.2 defun workfilesSpad2Cmd	1008

55)zsystemdevelopment help page Command	1011
55.1 zsystemdevelopment help page man page	1011
55.1.1 defun zsystemdevelopment	1011
55.1.2 defun zsystemDevelopmentSpad2Cmd	1011
55.1.3 defun zsystemdevelopment1	1012
56 Handling input files	1015
56.0.4 defun Handle .axiom.input file	1015
56.0.5 defun /rq	1015
56.0.6 defun /rf	1016
56.0.7 defvar \$boot-line-stack	1016
56.0.8 defvar \$in-stream	1016
56.0.9 defvar \$out-stream	1016
56.0.10 defvar \$file-closed	1016
56.0.11 defvar \$echo-meta	1016
56.0.12 defvar \$noSubsumption	1017
56.0.13 defvar \$envHashTable	1017
56.0.14 defun Dynamically add bindings to the environment . . .	1018
56.0.15 defun Fetch a property list for a symbol from CategoryFrame	1019
56.0.16 defun Search for a binding in the environment list	1019
56.0.17 defun Search for a binding in the current environment . .	1020
56.0.18 defun searchTailEnv	1021
57 File Parsing	1023
57.0.19 defun Bind a variable in the interactive environment . . .	1023
57.0.20 defvar \$line-handler	1023
57.0.21 defvar \$spad-errors	1023
57.0.22 defvar \$xtokenreader	1024
57.0.23 defun Initialize the spad reader	1024
57.0.24 defun Set boot-line-stack to nil	1024
58 Handling output	1025
58.1 Special Character Tables	1025
58.1.1 defvar \$defaultSpecialCharacters	1025
58.1.2 defvar \$plainSpecialCharacters0	1026
58.1.3 defvar \$plainSpecialCharacters1	1026
58.1.4 defvar \$plainSpecialCharacters2	1027
58.1.5 defvar \$plainSpecialCharacters3	1027
58.1.6 defvar \$plainRTspecialCharacters	1028
58.1.7 defvar \$RTspecialCharacters	1029
58.1.8 defvar \$specialCharacters	1029
58.1.9 defvar \$specialCharacterAlist	1030
58.1.10 defun Look up a special character code for a symbol . . .	1030

59 Stream and File Handling	1031
59.0.11 defun make-instream	1031
59.0.12 defun make-outstream	1031
59.0.13 defun make-appendstream	1032
59.0.14 defun defiostream	1032
59.0.15 defun shut	1033
59.0.16 defun eofp	1033
59.0.17 defun makeStream	1033
59.0.18 defun Construct a new input file name	1034
59.0.19 defun getDirectoryList	1034
59.0.20 defun probeName	1035
59.0.21 defun makeFullNamestring	1035
59.0.22 defun Replace a file by erase and rename	1035
60 The Spad Server Mechanism	1037
60.0.23 defun openserver	1037
61 Axiom Build-time Functions	1039
61.0.24 defun spad-save	1039
62 Exposure Groups	1041
63 Databases	1043
63.1 Database structure	1043
63.1.1 kaf File Format	1043
63.1.2 Database Files	1044
63.1.3 defstruct \$database	1046
63.1.4 defvar \$*defaultdomain-list*	1047
63.1.5 defvar \$*operation-hash*	1047
63.1.6 defvar \$*hasCategory-hash*	1047
63.1.7 defvar \$*miss*	1048
63.1.8 Database streams	1048
63.1.9 defvar \$*compressvector*	1048
63.1.10 defvar \$*compressVectorLength*	1048
63.1.11 defvar \$*compress-stream*	1048
63.1.12 defvar \$*compress-stream-stamp*	1049
63.1.13 defvar \$*interp-stream*	1049
63.1.14 defvar \$*interp-stream-stamp*	1049
63.1.15 defvar \$*operation-stream*	1049
63.1.16 defvar \$*operation-stream-stamp*	1049
63.1.17 defvar \$*browse-stream*	1049
63.1.18 defvar \$*browse-stream-stamp*	1050
63.1.19 defvar \$*category-stream*	1050
63.1.20 defvar \$*category-stream-stamp*	1050
63.1.21 defvar \$*allconstructors*	1050
63.1.22 defvar \$*allOperations*	1050

63.1.23 defun	Reset all hash tables before saving system	1051
63.1.24 defun	Preload algebra into saved system	1053
63.1.25 defun	Open the interp database	1056
63.1.26 defun	Open the browse database	1058
63.1.27 defun	Open the category database	1060
63.1.28 defun	Open the operations database	1061
63.1.29 defun	Add operations from newly compiled code	1062
63.1.30 defun	Show all database attributes of a constructor	1063
63.1.31 defun	Set a value for a constructor key in the database	1064
63.1.32 defun	Delete a value for a constructor key in the database	1064
63.1.33 defun	Get constructor information for a database key	1065
63.1.34 defun	The <code>)library</code> top level command	1069
63.1.35 defun	Read a local filename and update the hash tables	1070
63.1.36 defun	Update the database from an <code>nrlib</code> index.kaf file	1072
63.1.37 defun	Make new databases	1075
63.1.38 defun	Construct the proper database full pathname	1079
63.1.39 compress.daase	. . . . .	1080
63.1.40 defun	Set up compression vectors for the databases	1080
63.1.41 defvar	<code>\$*attributes*</code>	1081
63.1.42 defun	Write out the compress database	1082
63.1.43 defun	Compress an expression using the compress vector	1083
63.1.44 defun	Uncompress an expression using the compress vector	1084
63.1.45 Building	the <code>interp.daase</code> from hash tables	1085
63.1.46 defun	Write the <code>interp</code> database	1089
63.1.47 Building	the <code>browse.daase</code> from hash tables	1091
63.1.48 defun	Write the <code>browse</code> database	1091
63.1.49 Building	the <code>category.daase</code> from hash tables	1093
63.1.50 defun	Write the <code>category</code> database	1093
63.1.51 Building	the <code>operation.daase</code> from hash tables	1093
63.1.52 defun	Write the <code>operations</code> database	1094
63.1.53 Database	support operations	1094
63.1.54 defun	Data preloaded into the image at build time	1094
63.1.55 defun	Return all constructors	1095
63.1.56 defun	Return all operations	1095

64 System Statistics**1097****65 Special Lisp Functions****1099**

65.1	Axiom control structure macros	1099
65.1.1	defmacro <code>while</code>	1099
65.1.2	defmacro <code>whileWithResult</code>	1099
65.2	Filename Handling	1100
65.2.1	defun <code>namestring</code>	1100
65.2.2	defun <code>pathnameName</code>	1100
65.2.3	defun <code>pathnameType</code>	1100
65.2.4	defun <code>pathnameTypeId</code>	1101

65.2.5	defun mergePathnames	1101
65.2.6	defun pathnameDirectory	1101
65.2.7	defun Axiom pathnames	1102
65.2.8	defun makePathname	1102
65.2.9	defun Delete a file	1102
65.2.10	defun wrap	1103
65.2.11	defun lotsof	1103
65.2.12	defmacro startsId?	1103
65.2.13	defun hput	1103
65.2.14	defmacro hget	1104
65.2.15	defun hkeys	1104
65.2.16	defun digitp	1104
65.2.17	defun size	1104
65.2.18	defun strpos	1105
65.2.19	defun strposl	1105
65.2.20	defun qenum	1105
65.2.21	defmacro identp	1105
65.2.22	defun concat	1106
65.2.23	defun functionp	1106
65.2.24	defun brightprint	1106
65.2.25	defun brightprint-0	1107
65.2.26	defun member	1107
65.2.27	defun messageprint	1107
65.2.28	defun messageprint-1	1108
65.2.29	defun messageprint-2	1108
65.2.30	defun sayBrightly1	1108
65.2.31	defmacro assq	1109
66	Common Lisp Algebra Support	1111
66.1	IndexedBits	1111
66.1.1	defmacro truth-to-bit	1111
66.1.2	defun IndexedBits new function support	1112
66.1.3	defmacro bit-to-truth	1112
66.1.4	defmacro bvec-elt	1112
66.1.5	defmacro bvec-setelt	1112
66.1.6	defmacro bvec-size	1112
66.1.7	defun IndexedBits concat function support	1112
66.1.8	defun IndexedBits copy function support	1113
66.1.9	defun IndexedBits = function support	1113
66.1.10	defun IndexedBits < function support	1113
66.1.11	defun IndexedBits And function support	1113
66.1.12	defun IndexedBits Or function support	1113
66.1.13	defun IndexedBits xor function support	1113
66.1.14	defun IndexedBits nand function support	1114
66.1.15	defun IndexedBits nor function support	1114
66.1.16	defun IndexedBits not function support	1114

66.2	KeyedAccessFile	1114
66.2.1	defun KeyedAccessFile defstream function support	1114
66.2.2	defun KeyedAccessFile defstream function support	1114
66.3	Table	1115
66.3.1	defun Table InnerTable support	1115
66.4	DoubleFloatVector	1115
66.4.1	defmacro dlen	1115
66.4.2	defmacro make-double-vector	1116
66.4.3	defmacro make-double-vector1	1116
66.4.4	defmacro delt	1116
66.4.5	defmacro dsetelt	1116
66.5	ComplexDoubleFloatVector	1116
66.5.1	defmacro make-cdouble-vector	1117
66.5.2	defmacro cdelt	1117
66.5.3	defmacro cdsetelt	1117
66.5.4	defmacro cdlen	1118
66.6	DoubleFloatMatrix	1118
66.6.1	defmacro make-double-matrix	1118
66.6.2	defmacro make-double-matrix1	1118
66.6.3	defmacro daret2	1118
66.6.4	defmacro dsetaret2	1119
66.6.5	defmacro danrows	1119
66.6.6	defmacro dancols	1119
66.7	ComplexDoubleFloatMatrix	1119
66.7.1	defmacro make-cdouble-matrix	1119
66.7.2	defmacro cdaret2	1120
66.7.3	defmacro cdsetaret2	1120
66.7.4	defmacro cdanrows	1121
66.7.5	defmacro cdancols	1121
66.8	Integer	1121
66.8.1	defun Integer divide function support	1121
66.8.2	defun Integer quo function support	1122
66.8.3	defun Integer quo function support	1122
66.9	IndexCard	1122
66.9.1	defun IndexCard origin function support	1122
66.9.2	defun IndexCard origin function support	1123
66.9.3	defun IndexCard elt function support	1123
66.10	OperationsQuery	1124
66.10.1	defun OperationQuery getDatabase function support . . .	1124
66.11	Database	1124
66.11.1	defun Database elt function support	1124
66.12	FileName	1125
66.12.1	defun FileName filename function implementation	1125
66.12.2	defun FileName filename support function	1125
66.12.3	defun FileName directory function implementation	1125
66.12.4	defun FileName directory function support	1126

66.12.5	defun FileName name function implementation	1126
66.12.6	defun FileName extension function implementation	1126
66.12.7	defun FileName exists? function implementation	1126
66.12.8	defun FileName readable? function implementation	1127
66.12.9	defun FileName writeable? function implementation	1127
66.12.10	defun FileName writeable? function support	1127
66.12.11	defun FileName new function implementation	1128
66.13	DoubleFloat	1128
66.13.1	defmacro DFLessThan	1128
66.13.2	defmacro DFUnaryMinus	1128
66.13.3	defmacro DFMinusp	1129
66.13.4	defmacro DFZerop	1129
66.13.5	defmacro DFAdd	1129
66.13.6	defmacro DFSubtract	1129
66.13.7	defmacro DFMultiply	1130
66.13.8	defmacro DFIntegerMultiply	1130
66.13.9	defmacro DFMax	1130
66.13.10	defmacro DFMin	1130
66.13.11	defmacro DFEql	1131
66.13.12	defmacro DFDivide	1131
66.13.13	defmacro DFIntegerDivide	1131
66.13.14	defmacro DFSqrt	1131
66.13.15	defmacro DFLogE	1132
66.13.16	defmacro DFLog	1132
66.13.17	defmacro DFIntegerExpt	1132
66.13.18	defmacro DFExpt	1132
66.13.19	defmacro DFExp	1133
66.13.20	defmacro DFSin	1133
66.13.21	defmacro DFCos	1133
66.13.22	defmacro DFTan	1133
66.13.23	defmacro DFAsin	1133
66.13.24	defmacro DFacos	1134
66.13.25	defmacro DFAtan	1134
66.13.26	defmacro DFAtan2	1134
66.13.27	defmacro DFSinh	1135
66.13.28	defmacro DFCosh	1135
66.13.29	defmacro DFTanh	1135
66.13.30	defmacro DFAsinh	1136
66.13.31	defmacro DFacosh	1136
66.13.32	defmacro DFAtanh	1136
66.13.33	defun Machine specific float numerator	1137
66.13.34	defun Machine specific float denominator	1137
66.13.35	defun Machine specific float sign	1137
66.13.36	defun Machine specific float bit length	1137
66.13.37	defun Decode floating-point values	1138
66.13.38	defun The cotangent routine	1138

66.13.39	defun The inverse cotangent function	1138
66.13.40	defun The secant function	1139
66.13.41	defun The inverse secant function	1139
66.13.42	defun The cosecant function	1139
66.13.43	defun The inverse cosecant function	1139
66.13.44	defun The hyperbolic cosecant function	1139
66.13.45	defun The hyperbolic cotangent function	1140
66.13.46	defun The hyperbolic secant function	1140
66.13.47	defun The inverse hyperbolic cosecant function	1140
66.13.48	defun The inverse hyperbolic cotangent function	1140
66.13.49	defun The inverse hyperbolic secant function	1140

67 Monitoring execution 1141

67.0.50	defvar <code>\$*monitor-domains*</code>	1147
67.0.51	defvar <code>\$*monitor-nrlibs*</code>	1147
67.0.52	defvar <code>\$*monitor-table*</code>	1147
67.0.53	defstruct <code>\$monitor-data</code>	1148
67.0.54	defstruct <code>\$libstream</code>	1148
67.0.55	defun Initialize the monitor statistics hashtable	1148
67.0.56	defun End the monitoring process, we cannot restart . . .	1149
67.0.57	defun Return a list of the monitor-data structures	1149
67.0.58	defun Add a function to be monitored	1150
67.0.59	defun Remove a function being monitored	1150
67.0.60	defun Enable all (or optionally one) function for monitoring	1151
67.0.61	defun Disable all (optionally one) function for monitoring	1151
67.0.62	defun Reset the table count for the table (or a function) .	1152
67.0.63	defun Incr the count of fn by 1	1152
67.0.64	defun Decr the count of fn by 1	1153
67.0.65	defun Return the monitor information for a function . . .	1153
67.0.66	defun Hang a monitor call on all of the defuns in a file . .	1154
67.0.67	defun Return a list of the functions with zero count fields	1154
67.0.68	defun Return a list of functions with non-zero counts . . .	1155
67.0.69	defun Write out a list of symbols or structures to a file . .	1155
67.0.70	defun Save the <code>*monitor-table*</code> in loadable form	1156
67.0.71	defun restore a checkpointed file	1156
67.0.72	defun Printing help documentation	1157
67.0.73	Monitoring algebra files	1159
67.0.74	defun Monitoring algebra code.lsp files	1159
67.0.75	defun Monitor autoloaded files	1160
67.0.76	defun Monitor an nrlib	1160
67.0.77	defun Given a monitor-data item, extract the nrlib name	1160
67.0.78	defun Is this an exposed algebra function?	1161
67.0.79	defun Monitor exposed domains	1161
67.0.80	defun Generate a report of the monitored domains	1162
67.0.81	defun Parse an <code>)abbrev</code> expression for the domain name .	1163
67.0.82	defun Given a spad file, report all nrlibs it creates	1163

67.0.83	defun Print percent of functions tested	1164
67.0.84	defun Find all monitored symbols containing the string	1164

68 The Interpreter 1165

69 The Global Variables 1197

69.1	Star Global Variables	1197
69.1.1	*eof*	1197
69.1.2	*features*	1197
69.1.3	*package*	1197
69.1.4	*standard-input*	1198
69.1.5	*standard-output*	1198
69.1.6	*top-level-hook*	1198
69.2	Dollar Global Variables	1200
69.2.1	\$boot	1201
69.2.2	coerceFailure	1201
69.2.3	\$currentLine	1201
69.2.4	\$displayStartMsgs	1201
69.2.5	\$e	1201
69.2.6	\$erMsgToss	1201
69.2.7	\$fn	1201
69.2.8	\$frameRecord	1201
69.2.9	\$HiFiAccess	1202
69.2.10	\$HistList	1202
69.2.11	\$HistListAct	1202
69.2.12	\$HistListLen	1202
69.2.13	\$HistRecord	1203
69.2.14	\$historyFileType	1203
69.2.15	\$internalHistoryTable	1203
69.2.16	\$interpreterFrameName	1203
69.2.17	\$interpreterFrameRing	1203
69.2.18	\$InteractiveFrame	1203
69.2.19	\$intRestart	1203
69.2.20	\$intTopLevel	1204
69.2.21	\$IOindex	1204
69.2.22	\$lastPos	1204
69.2.23	\$libQuiet	1204
69.2.24	\$msgDatabaseName	1204
69.2.25	\$ncMsgList	1204
69.2.26	\$newcompErrorCount	1204
69.2.27	\$newspad	1204
69.2.28	\$nopus	1205
69.2.29	\$oldHistoryFileName	1205
69.2.30	\$okToExecuteMachineCode	1205
69.2.31	\$options	1205
69.2.32	\$previousBindings	1205

69.2.33 \$PrintCompilerMessageIfTrue	1205
69.2.34 \$reportUndo	1205
69.2.35 \$spad	1206
69.2.36 \$SpadServer	1206
69.2.37 \$SpadServerName	1206
69.2.38 \$systemCommandFunction	1206
69.2.39 top_level	1206
69.2.40 \$quitTag	1206
69.2.41 \$useInternalHistoryTable	1206
69.2.42 \$undoFlag	1206

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]	8
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]	9
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	21
3.2.4	should_I_clef	24
3.2.5	in_X	24
3.2.6	set_up_defaults	24
3.2.7	process_options	25
3.2.8	death_handler	25
3.2.9	nagman_handler	25
3.2.10	sman_catch_signals	26
3.2.11	fix_env	27
3.2.12	init_term_io	27
3.2.13	strPrefix	28
3.2.14	check_spad_proc	28
3.2.15	clean_up_old_sockets	29
3.2.16	fork_you	30
3.2.17	exec_command_env	30
3.2.18	spawn_of_hell	31
3.2.19	start_the_spadclient	32

3.2.20	start_the_local_spadclient	33
3.2.21	start_the_nagman	33
3.2.22	start_the_session_manager	33
3.2.23	start_the_hypertext	34
3.2.24	start_the_graphics	34
3.2.25	fork_Axiom	35
3.2.26	start_the_Axiom	37
3.2.27	clean_up_sockets	38
3.2.28	read_from_spad_io	39
3.2.29	read_from_manager	40
3.2.30	manage_spad_io	41
3.2.31	init_spad_process_list	42
3.2.32	print_spad_process_list	42
3.2.33	find_child	42
3.2.34	kill_all_children	43
3.2.35	clean_up_terminal	43
3.2.36	monitor_children	44
3.2.37	main sman	45
3.2.38	sman	47
4	Support Routines	49
4.1	Command Completion	49
5	The viewman program	51
6	The nagman program	53
6.1	nag.x	54
6.2	nagman	55
6.2.1	includes	55
6.2.2	variables	56
6.2.3	term	57
6.2.4	size_of_file	58
6.2.5	rpcloop	59
6.2.6	catchSignals	66
6.2.7	main nagman	67
6.2.8	nagman	68
7	The hypertext program	69
8	The clef program	71
9	The session program	73
9.1	session	73
9.1.1	includes	73
9.1.2	variables	74
9.1.3	usr1_handler	74

9.1.4	usr2_handler	75
9.1.5	term_handler	75
9.1.6	pr	75
9.1.7	close_client	76
9.1.8	read_SpadServer_command	78
9.1.9	test_sock_for_process	78
9.1.10	read_menu_client_command	79
9.1.11	read_from_spad_io	80
9.1.12	kill_spad	81
9.1.13	accept_session_connection	82
9.1.14	read_from_session	84
9.1.15	manage_sessions	85
9.1.16	main sessionmanager	87
9.1.17	session	88
10	The spadclient program	89
10.1	spadclient	90
11	The Command Completion List	91
12	Research Topics	183
12.1	Proofs	183
12.2	Indefinites	183
12.3	Provisos	184
13	Makefile	185
13.1	Environment variables	185
13.2	The axiom command	186
13.3	session	186
13.4	nagman	187
13.5	spadclient	187
13.6	sman	188

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	89
4.1.4	pathname	91
4.1.5	htFileOpen	91
4.1.6	dbFileOpen	92
4.1.7	tempFileOpen	93
4.2	Shared Code for Hash Table Handling	94
4.2.1	halloc	94
4.2.2	hashInit	95
4.2.3	freeHash	95
4.2.4	hashInsert	96
4.2.5	hashFind	96
4.2.6	hashReplace	97
4.2.7	hashDelete	97
4.2.8	hashMap	97
4.2.9	hashCopyEntry	98
4.2.10	hashCopyTable	98
4.2.11	stringHash	99
4.2.12	stringEqual	99
4.2.13	allocString	99
4.3	Shared Code for Error Handling	100
4.3.1	jump	100
4.3.2	dumpToken	100
4.3.3	printPageAndFilename	101
4.3.4	printNextTenTokens	102

4.3.5	printToken	102
4.3.6	tokenName	103
4.3.7	htperror	105
4.4	Shared Code for Lexical Analyzer	106
4.4.1	parserInit	106
4.4.2	initScanner	107
4.4.3	saveScannerState	107
4.4.4	restoreScannerState	108
4.4.5	ungetChar	108
4.4.6	getChar	109
4.4.7	getChar1	111
4.4.8	ungetToken	112
4.4.9	getToken	113
4.4.10	pushBeStack	116
4.4.11	checkAndPopBeStack	117
4.4.12	clearBeStack	117
4.4.13	beType	118
4.4.14	beginType	120
4.4.15	endType	121
4.4.16	keywordType	122
4.4.17	getExpectedToken	123
4.4.18	spadErrorHandler	123
4.4.19	resetConnection	124
4.4.20	spadBusy	124
4.4.21	connectSpad	125
4.5	htadd shared code	126
4.6	hypertext shared code	131
5	Shared include files	137
5.1	debug.c	137
5.2	hyper.h	138
6	The spadbuf function	151
6.1	spadbuf Call Graph	151
6.2	Constants and Headers	152
6.2.1	System includes	152
6.2.2	Local includes	153
6.3	externs	153
6.4	local variables	154
6.5	Code	154
6.5.1	spadbufInterHandler	154
6.5.2	spadbufFunctionChars	155
6.5.3	interpIO	156
6.5.4	. . . . .	157
6.5.5	main	158

7	The ex2ht function	159
7.1	ex2ht Call Graph	159
7.2	ex2ht Source Code	160
7.3	Constants and Headers	160
7.3.1	System includes	160
7.3.2	Local includes	161
7.4	defines	161
7.5	local variables	161
7.6	Code	161
7.6.1	allocString	161
7.6.2	strPrefix	162
7.6.3	getExTitle	162
7.6.4	exToHt	163
7.6.5	emitHeader	164
7.6.6	emitFooter	164
7.6.7	emitMenuEntry	165
7.6.8	emitSpadCommand	165
7.6.9	openCoverPage	166
7.6.10	closeCoverPage	166
7.6.11	closeCoverFile	166
7.6.12	emitCoverLink	166
7.6.13	addFile	167
7.6.14	main	167
8	The htadd command	169
8.1	htadd Call Graph	169
8.2	Constants and Headers	174
8.2.1	System includes	174
8.2.2	structs	174
8.2.3	Local includes	174
8.2.4	extern references	175
8.2.5	defines	175
8.2.6	forward declarations	176
8.2.7	local variables	176
8.3	The Shared Code	176
8.4	Code	177
8.4.1	parseArgs	177
8.4.2	writable	178
8.4.3	buildDBFilename	179
8.4.4	addfile	181
8.4.5	updateDB	183
8.4.6	addNewPages	185
8.4.7	copyFile	186
8.4.8	getFilename	187
8.4.9	deleteFile	188
8.4.10	deleteDB	189

8.4.11	main	190
9	The hthits function	191
9.1	hthits Call Graph	191
9.2	Constants and Headers	193
9.2.1	System includes	193
9.2.2	defines	193
9.2.3	structs	193
9.2.4	Local includes	193
9.2.5	local variables	194
9.2.6	cmdline	194
9.2.7	handleHtdb	194
9.2.8	handleFile	195
9.2.9	handleFilePages	197
9.2.10	handlePage	198
9.2.11	searchPage	199
9.2.12	squirt	199
9.2.13	splitpage	200
9.2.14	untexbuf	201
9.2.15	badDB	201
9.2.16	regerr	202
9.2.17	main	202
10	The hypertext command	203
10.1	Constants and Headers	203
10.1.1	System includes	203
10.2	structs	204
10.2.1	Local includes	204
10.3	structs	205
10.4	defines	206
10.5	externs	211
10.6	local variables	214
10.7	The Shared Code	219
10.8	Code	224
10.8.1	sigusr2Handler	224
10.8.2	sigcldHandler	224
10.8.3	cleanSocket	224
10.8.4	initHash	225
10.8.5	initPageStructs	225
10.8.6	checkArguments	226
10.8.7	makeServerConnections	228
10.9	Condition Handling	230
10.9.1	insertCond	230
10.9.2	changeCond	230
10.9.3	checkMemostack	231
10.9.4	checkCondition	232

10.10	Dialog Handling	233
10.10.1	redrawWin	233
10.10.2	mystrncpy	233
10.10.3	incLineNumbers	233
10.10.4	decLineNumbers	234
10.10.5	decreaseLineNumbers	234
10.10.6	overwriteBuffer	235
10.10.7	moveSymForward	237
10.10.8	clearCursorline	238
10.10.9	insertBuffer	239
10.10.10	addBufferToSym	241
10.10.11	drawInputsymbol	241
10.10.12	updateInputsymbol	242
10.10.13	drawCursor	243
10.10.14	moveCursorHome	244
10.10.15	moveCursorEnd	244
10.10.16	void moveCursorForward	245
10.10.17	moveCursorDown	246
10.10.18	moveCursorUp	247
10.10.19	clearCursor	248
10.10.20	moveCursorBackward	249
10.10.21	moveRestBack	250
10.10.22	deleteRestOfLine	251
10.10.23	backOverEoln	253
10.10.24	moveBackOneChar	255
10.10.25	backOverChar	257
10.10.26	deleteEoln	258
10.10.27	deleteOneChar	260
10.10.28	deleteChar	261
10.10.29	oughEnter	262
10.10.30	enterNewLine	264
10.10.31	Dialog	266
10.11	Format and Display a page	268
10.11.1	showPage	269
10.11.2	exposePage	271
10.11.3	scrollPage	272
10.11.4	pastePage	273
10.12	Event Handling	274
10.12.1	mainEventLoop	275
10.12.2	handleEvent	277
10.12.3	createWindow	279
10.12.4	quitHyperDoc	280
10.12.5	findPage	281
10.12.6	downlink	281
10.12.7	memolink	282
10.12.8	killAxiomPage	282

10.12.9	killPage	282
10.12.10	returnlink	283
10.12.11	uplink	283
10.12.12	windowlinkHandler	284
10.12.13	makeWindowLink	284
10.12.14	ispwindowlinkHandler	284
10.12.15	pasteButton	285
10.12.16	helpForHyperDoc	286
10.12.17	findButtonInList	286
10.12.18	getHyperLink	287
10.12.19	handleButton	288
10.12.20	exitHyperDoc	292
10.12.21	setWindow	293
10.12.22	clearExposures	294
10.12.23	getNewWindow	295
10.12.24	setCursor	297
10.12.25	changeCursor	298
10.12.26	handleMotionEvent	298
10.12.27	initCursorState	298
10.12.28	initCursorStates	299
10.12.29	makeBusyCursor	299
10.12.30	makeBusyCursors	299
10.12.31	HyperDocErrorHandler	299
10.12.32	setErrorHandlers	300
10.13	Line Extent Computation	300
10.13.1	computeInputExtent	300
10.13.2	computePunctuationExtent	301
10.13.3	computeWordExtent	303
10.13.4	computeVerbatimExtent	304
10.13.5	computeSpadsrctxtExtent	304
10.13.6	computeDashExtent	305
10.13.7	computeTextExtent	307
10.13.8	computeBeginItemsExtent	314
10.13.9	computeItemExtent	315
10.13.10	computeMitemExtent	315
10.13.11	endifExtent	315
10.13.12	computeIfcondExtent	316
10.13.13	computeCenterExtent	317
10.13.14	computeBfExtent	318
10.13.15	computeEmExtent	318
10.13.16	computeItExtent	318
10.13.17	computeRmExtent	319
10.13.18	computeButtonExtent	319
10.13.19	endbuttonExtent	320
10.13.20	computePastebuttonExtent	321
10.13.21	endpastebuttonExtent	322

10.13.22	computePasteExtent	322
10.13.23	computeSpadcommandExtent	323
10.13.24	computeSpadsrcExtent	324
10.13.25	endSpadcommandExtent	325
10.13.26	endSpadsrcExtent	326
10.13.27	computeMboxExtent	326
10.13.28	computeBoxExtent	327
10.13.29	computeIrExtent	328
10.13.30	computeImageExtent	329
10.13.31	computeTableExtent	330
10.13.32	computeTitleExtent	331
10.13.33	computeHeaderExtent	332
10.13.34	computeFooterExtent	333
10.13.35	computeScrollingExtent	334
10.13.36	startNewline	335
10.13.37	centerNodes	335
10.13.38	punctuationWidth	336
10.13.39	inputStringWidth	336
10.13.40	wordWidth	336
10.13.41	verbatimWidth	337
10.13.42	widthOfDash	337
10.13.43	textWidth	338
10.13.44	totalWidth	343
10.13.45	initExtents	345
10.13.46	initTitleExtents	345
10.13.47	initText	346
10.13.48	textHeight	346
10.13.49	textHeight1	347
10.13.50	maxX	350
10.13.51	Kvalue	352
10.13.52	trailingSpace	353
10.13.53	insertBitmapFile	354
10.13.54	insertPixmapFile	355
10.13.55	plh	356
10.14	Handling forms	356
10.14.1	computeFormPage	356
10.14.2	windowWidth	357
10.14.3	windowHeight	357
10.14.4	formHeaderExtent	357
10.14.5	formFooterExtent	358
10.14.6	formScrollingExtent	358
10.15	Managing the HyperDoc group stack	359
10.15.1	popGroupStack	359
10.15.2	pushGroupStack	359
10.15.3	initGroupStack	360
10.15.4	emTopGroup	360

10.15.5	rmTopGroup	360
10.15.6	lineTopGroup	361
10.15.7	bfTopGroup	361
10.15.8	ttTopGroup	361
10.15.9	pushActiveGroup	362
10.15.10	pushSpadGroup	362
10.15.11	initTopGroup	362
10.15.12	enterTopGroup	362
10.15.13	copyGroupStack	363
10.15.14	freeGroupStack	363
10.16	Handle input, output, and Axiom communication	364
10.16.1	makeRecord	364
10.16.2	verifyRecord	365
10.16.3	ht2Input	365
10.16.4	makeInputFileName	366
10.16.5	makePasteFileName	366
10.16.6	makeTheInputFile	367
10.16.7	makeInputFileFromPage	368
10.16.8	strCopy	370
10.16.9	inListAndNewer	371
10.16.10	makeInputFileList	372
10.16.11	printPasteLine	373
10.16.12	getSpadOutput	374
10.16.13	getGraphOutput	374
10.16.14	sendCommand	375
10.16.15	printPaste	376
10.16.16	printGraphPaste	377
10.17	X Window window initialization code	378
10.17.1	initializeWindowSystem	378
10.17.2	initTopWindow	380
10.17.3	openFormWindow	382
10.17.4	initFormWindow	384
10.17.5	setNameAndIcon	385
10.17.6	getBorderProperties	386
10.17.7	openWindow	387
10.17.8	setSizeHints	388
10.17.9	getGCs	390
10.17.10	loadFont	391
10.17.11	ingItColorsAndFonts	392
10.17.12	changeText	396
10.17.13	getColor	397
10.17.14	mergeDatabases	399
10.17.15	isIt850	400
10.18	Handling user page interaction	400
10.18.1	fillBox	400
10.18.2	toggleInputBox	401

10.18.3 toggleRadioBox	401
10.18.4 clearRbs	402
10.18.5 changeInputFocus	402
10.18.6 nextInputFocus	403
10.18.7 prevInputFocus	404
10.18.8 returnItem	405
10.18.9 deleteItem	405
10.19 Manipulate the item stack	406
10.19.1 pushItemStack	406
10.19.2 clearItemStack	406
10.19.3 popItemStack	407
10.19.4 copyItemStack	407
10.19.5 freeItemStack	408
10.20 Keyboard handling	409
10.20.1 handleKey	409
10.20.2 getModifierMask	412
10.20.3 initKeyin	413
10.21 Handle page macros	414
10.21.1 scanHyperDoc	414
10.21.2 number	415
10.21.3 loadMacro	416
10.21.4 initParameterElem	417
10.21.5 pushParameters	418
10.21.6 popParameters	418
10.21.7 parseMacro	419
10.21.8 getParameterStrings	420
10.21.9 parseParameters	422
10.22 Memory management routines	422
10.22.1 freeIfNonNULL	422
10.22.2 allocHdWindow	423
10.22.3 freeHdWindow	424
10.22.4 allocNode	425
10.22.5 freeNode	426
10.22.6 allocIfnode	429
10.22.7 allocCondnode	430
10.22.8 freeCond	430
10.22.9 allocPage	431
10.22.10 freePage	432
10.22.11 freePaste	433
10.22.12 freePastebutton	434
10.22.13 freePastearea	435
10.22.14 freeString	435
10.22.15 freeDepend	435
10.22.16 dontFree	435
10.22.17 freeLines	436
10.22.18 freeInputItem	436

10.22.19	freeInputList	436
10.22.20	freeInputBox	437
10.22.21	freeRadioBoxes	437
10.22.22	allocInputline	437
10.22.23	allocPasteNode	438
10.22.24	allocPatchstore	438
10.22.25	freePatch	438
10.22.26	allocInputbox	439
10.22.27	allocRbs	439
10.22.28	allocButtonList	439
10.22.29	freeButtonList	440
10.22.30	resizeBuffer	440
10.23	Page parsing routines	441
10.23.1	PushMR	441
10.23.2	PopMR	441
10.23.3	loadPage	442
10.23.4	displayPage	443
10.23.5	formatPage	444
10.23.6	parseFromString	444
10.23.7	parseTitle	445
10.23.8	parseHeader	446
10.23.9	initParsePage	447
10.23.10	initParsePatch	447
10.23.11	parsePage	448
10.23.12	parseHyperDoc	449
10.23.13	parsePageFromSocket	457
10.23.14	parsePageFromUnixfd	458
10.23.15	startScrolling	459
10.23.16	startFooter	460
10.23.17	endAPage	461
10.23.18	parseReplacepage	461
10.23.19	windowEqual	462
10.23.20	windowCode	462
10.23.21	windowId	462
10.23.22	readHtDb	463
10.23.23	readHtFile	465
10.23.24	makeLinkWindow	469
10.23.25	makePasteWindow	470
10.23.26	makeSpecialPage	471
10.23.27	main	471
10.23.28	addDependencies	472
10.23.29	isNumber	473
10.23.30	parserError	473
10.23.31	getFilename	474
10.23.32	getInputString	475
10.23.33	getWhere	476

10.23.3	findFp	477
10.24	Handle InputString, SimpleBox, RadioBox input	477
10.24.1	makeInputWindow	478
10.24.2	makeBoxWindow	479
10.24.3	initializeDefault	480
10.24.4	parseInputstring	481
10.24.5	parseSimplebox	483
10.24.6	parseRadiobox	485
10.24.7	addBoxToRbList	487
10.24.8	checkOthers	487
10.24.9	insertItem	488
10.24.10	initPasteItem	488
10.24.11	repasteItem	489
10.24.12	currentItem	489
10.24.13	alreadyThere	490
10.24.14	parseRadioboxes	491
10.25	Routines for paste-in areas	493
10.25.1	parsePaste	493
10.25.2	parsePastebutton	495
10.25.3	parsePatch	497
10.25.4	loadPatch	500
10.26	parsing routines for node types	501
10.26.1	parseIfcond	501
10.26.2	parseCondnode	503
10.26.3	parseHasreturnto	504
10.26.4	parseNewcond	504
10.26.5	parseSetcond	505
10.26.6	parseBeginItems	506
10.26.7	parseItem	507
10.26.8	parseMitem	508
10.26.9	parseVerbatim	509
10.26.10	parseInputPix	510
10.26.11	parseCenterline	511
10.26.12	parseCommand	512
10.26.13	parseButton	513
10.26.14	parseSpadcommand	514
10.26.15	parseSpadsrc	515
10.26.16	parseEnv	516
10.26.17	parseValue1	517
10.26.18	parseValue2	518
10.26.19	parseTable	519
10.26.20	parseBox	520
10.26.21	parseMbox	520
10.26.22	parseFree	521
10.26.23	parseHelp	521
10.27	Reading bitmaps	522

10.27.1	HTReadBitmapFile	522
10.27.2	readHot	524
10.27.3	readWandH	525
10.27.4	insertImageStruct	526
10.28	Scrollbar handling routines	527
10.28.1	makeScrollBarWindows	528
10.28.2	drawScroller3DEffects	530
10.28.3	showScrollBars	531
10.28.4	moveScroller	532
10.28.5	drawScrollLines	533
10.28.6	calculateScrollBarMeasures	534
10.28.7	linkScrollBars	535
10.28.8	scrollUp	536
10.28.9	scrollUpPage	536
10.28.10	scrollToFirstPage	537
10.28.11	scrollDown	537
10.28.12	scrollDownPage	538
10.28.13	scrollScroller	539
10.28.14	hideScrollBars	540
10.28.15	getScrollBarMinimumSize	540
10.28.16	h	540
10.28.17	changeWindowBackgroundPixmap	540
10.29	Display text object	541
10.29.1	showText	542
10.29.2	showLink	548
10.29.3	showPaste	549
10.29.4	showPastebutton	550
10.29.5	showInput	550
10.29.6	showSimpleBox	551
10.29.7	showSpadcommand	552
10.29.8	showImage	553
10.30	Axiom communication interface	555
10.30.1	issueSpadcommand	555
10.30.2	sendPile	556
10.30.3	issueDependentCommands	557
10.30.4	markAsExecuted	558
10.30.5	startUserBuffer	559
10.30.6	clearExecutionMarks	560
10.30.7	acceptMenuConnection	561
10.30.8	acceptMenuServerConnection	562
10.30.9	printToString	563
10.30.10	printToString1	564
10.30.11	issueServerCommand	570
10.30.12	issueServerpaste	571
10.30.13	issueUnixcommand	571
10.30.14	issueUnixlink	572

10.30.15	IssueUnixpaste	572
10.30.16	ServiceSessionSocket	573
10.30.17	SwitchFrames	573
10.30.18	SendLispCommand	574
10.30.19	EscapeString	574
10.30.20	UnescapeString	574
10.30.21	CloseClient	575
10.30.22	PrintSourceToString	576
10.30.23	PrintSourceToString1	577
10.31	Produce titlebar	586
10.31.1	makeTitleBarWindows	586
10.31.2	showTitleBar	587
10.31.3	linkTitleBarWindows	589
10.31.4	readTitleBarImages	590
10.31.5	getTitleBarMinimumSize	591
10.31.6	main	592
11	The htsearch script	595
12	The presea script	597
12.1	token.h	599
13	The Bitmaps	605
13.1	ht_icon	605
13.2	exit.bitmap	606
13.3	help2.bitmap	607
13.4	return3.bitmap	608
13.5	up3.bitmap	609
13.6	noop.bitmap	610
13.7	exit3d.bitmap	611
13.8	help3d.bitmap	612
13.9	home3d.bitmap	613
13.10	up3d.bitmap	614
13.11	noop3d.bitmap	615
14	Makefile	617

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	November 2010 Release Notes	4
1.1.4	September 2010 Release Notes	7
1.1.5	July 2010 Release Notes	11
1.1.6	May 2010 Release Notes	15
1.1.7	March 2010 Release Notes	20
1.1.8	January 2010 Release Notes	24
1.1.9	November 2009 Release Notes	27
1.1.10	September 2009 Release Notes	30
1.1.11	July 2009 Release Notes	32
1.1.12	May 2009 Release Notes	35
1.1.13	March 2009 Release Notes	41
1.1.14	January 2009 Release Notes	47
1.1.15	November 23, 2008 Release Notes	53
1.1.16	September 23, 2008 Release Notes	55
1.1.17	July 23, 2008 Release Notes	59
1.1.18	May 27, 2008 Release Notes	63
1.1.19	March 25, 2008 Release Notes	65
1.1.20	January 25, 2008 Release Notes	68
1.1.21	November 23, 2007 Release Notes	75
1.1.22	Feature Complete Release Feb 2005	80
2	Special hyperdoc pages	81
2.1	util.ht	81
2.1.1	Names of software and facilities	81
2.1.2	Special hooks to Unix	82
2.1.3	HyperDoc menu macros	83
2.1.4	Bitmaps and bitmap manipulation macros	84
2.1.5	HyperDoc button objects	84
2.1.6	Standard HyperDoc button configurations	85
2.1.7	HyperDoc graphics macros	85
2.1.8	TeX and LaTeX compatibility macros	86
2.1.9	Book and .ht page macros	89
2.1.10	Browse macros	92
2.1.11	Support for output and graph paste-ins	93
2.1.12	Hook for including a local menu item on the rootpage	93
2.1.13	Not Connected to Axiom	94
2.1.14	Do You Really Want to Exit?	94
2.1.15	Missing Page	94
2.1.16	Something is Wrong	95

2.1.17	Sorry!	95
--------	--------	----

3 Hyperdoc pages 97

3.1	rootpage.ht	97
3.1.1	Axiom HyperDoc Top Level	97
3.1.2	Axiom – The Scientific Computation System	100
3.1.3	System Commands	101
3.1.4	Axiom Examples	102
3.1.5	Axiom Reference	104
3.1.6	NAG Documentation	106
3.2	algebra.ht	112
3.2.1	Abstract Algebra	112
3.2.2	Number Theory	113
3.3	alist.ht	114
3.3.1	AssociationList	114
3.4	array1.ht	120
3.4.1	OneDimensionalArray	120
3.5	array2.ht	126
3.5.1	TwoDimensionalArray	126
3.6	basic.ht	139
3.6.1	Basic Commands	139
3.6.2	Calculus	141
3.7	bbtree.ht	142
3.7.1	BalancedBinaryTree	142
3.8	binary.ht	149
3.8.1	BinaryExpansion	149
3.9	bmcat.ht	154
3.9.1	Bit Map Catalog	154
3.10	bop.ht	156
3.10.1	BasicOperator	156
3.11	bstree.ht	166
3.11.1	BinarySearchTree	166
3.12	card.ht	173
3.12.1	CardinalNumber	173
3.13	carten.ht	184
3.13.1	CartesianTensor	184
3.14	cclass.ht	212
3.14.1	CharacterClass	212
3.15	char.ht	220
3.15.1	Character	220
3.15.2	CliffordAlgebra	227
3.15.3	The Complex Numbers as a Clifford Algebra	229
3.15.4	The Quaternion Numbers as a Clifford Algebra	233
3.15.5	The Exterior Algebra on a Three Space	239
3.15.6	The Dirac Spin Algebra	245
3.16	complex.ht	250

3.16.1	Complex	250
3.17	contfrac.ht	259
3.17.1	ContinuedFraction	259
3.18	cphelp.ht	277
3.18.1	Control Panel Bits	277
3.19	cycles.ht	278
3.19.1	CycleIndicators	278
3.20	coverex.ht	305
3.20.1	Examples Of Axiom Commands	305
3.20.2	Differentiation	306
3.20.3	Integration	312
3.20.4	Laplace Transforms	320
3.20.5	Limits	324
3.20.6	Matrices	330
3.20.7	2-D Graphics	339
3.20.8	3-D Graphics	341
3.20.9	Series	343
3.20.10	Summations	349
3.21	decimal.ht	355
3.21.1	Decimal Expansion	355
3.22	derham.ht	360
3.22.1	DeRhamComplex	360
3.23	dfloat.ht	378
3.23.1	DoubleFloat	378
3.24	dmp.ht	385
3.24.1	DistributedMultivariatePoly	385
3.25	eq.ht	391
3.25.1	Equation	391
3.26	eqtbl.ht	397
3.26.1	EqTable	397
3.27	evalex.ht	401
3.27.1	Example of Standard Evaluation	401
3.27.2	Example of Standard Evaluation	403
3.28	exdiff.ht	405
3.28.1	Computing Derivatives	405
3.28.2	Derivatives of Functions of Several Variables	406
3.28.3	Derivatives of Higher Order	408
3.28.4	Multiple Derivatives I	409
3.28.5	Multiple Derivatives II	411
3.28.6	Derivatives of Functions Involving Formal Integrals	412
3.28.7	Exit	414
3.29	exlap.ht	418
3.29.1	Laplace transform with a single pole	418
3.29.2	Laplace transform of a trigonometric function	419
3.29.3	Laplace transform requiring a definite integration	420
3.29.4	Laplace transform of exponentials	421

3.29.5	Laplace transform of an exponential integral	422
3.29.6	Laplace transform of special functions	423
3.30	exint.ht	424
3.30.1	Integral of a Rational Function	424
3.30.2	Integral of a Rational Function with a Real Parameter . .	427
3.30.3	Integral of a Rational Function with a Complex Parameter	428
3.30.4	Two Similar Integrands Producing Very Different Results	429
3.30.5	An Integral Which Does Not Exist	431
3.30.6	A Trigonometric Function of a Quadratic	433
3.30.7	Integrating a Function with a Hidden Algebraic Relation	434
3.30.8	Details for integrating a function with a Hidden Algebraic Relation	435
3.30.9	An Integral Involving a Root of a Transcendental Function	436
3.30.10	An Integral of a Non-elementary Function	437
3.31	exlimit.ht	438
3.31.1	Computing Limits	438
3.31.2	Limits of Functions with Parameters	439
3.31.3	One-sided Limits	440
3.31.4	Two-sided Limits	442
3.31.5	Limits at Infinity	444
3.31.6	Real Limits vs. Complex Limits	446
3.31.7	Complex Limits at Infinity	448
3.32	exmatrix.ht	450
3.32.1	Basic Arithmetic Operations on Matrices	450
3.32.2	Constructing new Matrices	454
3.32.3	Trace of a Matrix	458
3.32.4	Determinant of a Matrix	459
3.32.5	Inverse of a Matrix	460
3.32.6	Rank of a Matrix	461
3.33	expr.ht	462
3.33.1	Expression	462
3.34	explot2d.ht	476
3.34.1	Plotting Functions of One Variable	476
3.34.2	Plotting Parametric Curves	477
3.34.3	Plotting Using Polar Coordinates	478
3.34.4	Plotting Plane Algebraic Curves	479
3.35	explot3d.ht	480
3.35.1	Plotting Functions of Two Variables	480
3.35.2	Plotting Parametric Surfaces	481
3.35.3	Plotting Parametric Curves	482
3.36	expose.ht	483
3.36.1	Exposure	483
3.36.2	System Defined Exposure Groups	484
3.36.3	What is an Exposure Group?	485
3.36.4	Details on Exposure	486
3.37	exseries.ht	487

3.37.1	Converting Expressions to Series	487
3.37.2	Manipulating Power Series	490
3.37.3	Functions on Power Series	492
3.37.4	Substituting Numerical Values in Power Series	494
3.38	exsum.ht	496
3.38.1	Summing the Entries of a List I	496
3.38.2	Summing the Entries of a List II	498
3.38.3	Approximating e	499
3.38.4	Closed Form Summations	500
3.38.5	Sums of Cubes	502
3.38.6	Sums of Polynomials	504
3.38.7	Sums of General Functions	505
3.38.8	Infinite Sums	506
3.39	farray.ht	507
3.39.1	FlexibleArray	507
3.40	file.ht	516
3.40.1	File	516
3.41	float.ht	523
3.41.1	Float	523
3.41.2	Introduction to Float	525
3.41.3	Conversion Functions	527
3.41.4	Output Functions	536
3.41.5	An Example: Determinant of a Hilbert Matrix	541
3.42	fname.ht	547
3.42.1	FileName	547
3.43	fr.ht	557
3.43.1	Factored	557
3.43.2	Decomposing Factored Objects	559
3.43.3	Expanding Factored Objects	565
3.43.4	Arithmetic with Factored Objects	567
3.43.5	Creating New Factored Objects	575
3.43.6	Factored Objects with Variables	580
3.44	fr2.ht	583
3.44.1	FactoredFunctions2	583
3.45	frac.ht	588
3.45.1	Fraction	588
3.46	fparfrac.ht	596
3.46.1	FullPartialFracExpansion	596
3.47	function.ht	608
3.47.1	Functions in Axiom	608
3.47.2	Rational Functions	610
3.47.3	Algebraic Functions	613
3.47.4	Elementary Functions	617
3.47.5	Simplification	619
3.48	gbf.ht	626
3.48.1	GroebnerFactorizationPkg	626

3.49	gloss.ht	631
3.49.1	Glossary	631
3.50	graphics.ht	655
3.50.1	Graphics	655
3.50.2	Graphics Examples	656
3.50.3	Assorted Graphics Examples	657
3.50.4	Three Dimensional Graphics	660
3.50.5	Functions of One Variable	665
3.50.6	Parametric Curves	667
3.50.7	Polar Coordinates	670
3.50.8	Implicit Curves	673
3.50.9	Lists of Points	676
3.50.10	Three Dimensional Graphing	687
3.50.11	Functions of Two Variables	688
3.50.12	Parametric Space Curves	690
3.50.13	Parametric Tube Plots	693
3.50.14	Parametric Surfaces	696
3.50.15	Building 3D Objects	699
3.50.16	Two Dimensional Graphics	704
3.50.17	Functions of One Variable	705
3.50.18	Parametric Curves	708
3.50.19	Polar Coordinates	711
3.50.20	Implicit Curves	714
3.50.21	Lists of Points	716
3.50.22	Stand-alone Viewport	727
3.51	grptheory.ht	730
3.51.1	Group Theory	730
3.51.2	Representations of A_6	732
3.51.3	Representation Theory	753
3.51.4	Group Theory	754
3.52	gstbl.ht	756
3.52.1	GeneralSparseTable	756
3.53	heap.ht	760
3.53.1	Heap	760
3.54	hexadec.ht	762
3.54.1	HexadecimalExpansion	762
3.55	int.ht	767
3.55.1	Integer	767
3.55.2	Basic Functions	769
3.55.3	Primes and Factorization	785
3.55.4	Some Number Theoretic Functions	790
3.56	intheory.ht	796
3.56.1	IntegerNumberTheoryFunctions	796
3.57	kafile.ht	809
3.57.1	KeyedAccessFile	809
3.58	kernel.ht	820

3.58.1	Kernel	820
3.59	lasm3pk.ht	830
3.59.1	LazardSetSolvingPackage	830
3.60	lexp.ht	858
3.60.1	LieExponentials	858
3.61	lextripk.ht	865
3.61.1	LexTriangularPackage	865
3.62	lib.ht	927
3.62.1	Library	927
3.63	link.ht	931
3.63.1	The Axiom Link to NAG Software	931
3.63.2	Use of the Link from HyperDoc	932
3.63.3	C02 Zeros of Polynomials	933
3.63.4	C05 Roots of One or More Transcendental Equations	934
3.63.5	C06 Summation of Series	935
3.63.6	D01 Quadrature	937
3.63.7	D02 Ordinary Differential Equations	939
3.63.8	D03 Partial Differential Equations	941
3.63.9	E01 Interpolation	942
3.63.10	E02 Curve and Surface Fitting	944
3.63.11	E04 Minimizing or Maximizing a Function	946
3.63.12	F01 Matrix Operations - Including Inversion	948
3.63.13	F02 Eigenvalues and Eigenvectors	950
3.63.14	F04 Simultaneous Linear Equations	952
3.63.15	F07 Linear Equations (LAPACK)	954
3.63.16	S – Approximations of Special Functions	955
3.64	list.ht	959
3.64.1	List	959
3.64.2	Creating Lists	960
3.64.3	Accessing List Elements	963
3.64.4	Changing List Elements	969
3.64.5	Other Functions	974
3.64.6	Dot, Dot	978
3.65	lodo.ht	980
3.65.1	LinearOrdinaryDifferentialOperator	980
3.65.2	Differential Operators with Series Coefficients	981
3.66	lodo1.ht	992
3.66.1	LinearOrdinaryDifferentialOperator1	992
3.66.2	Differential Operators with Rational Function Coefficients	993
3.67	lodo2.ht	1005
3.67.1	LinearOrdinaryDifferentialOperator2	1005
3.67.2	Differential Operators with Constant Coefficients	1006
3.67.3	Differential Operators with Matrix Coefficients Operating on Vectors	1012
3.68	lpoly.ht	1021
3.68.1	LiePolynomial	1021

3.69	lword.ht	1034
3.69.1	LyndonWord	1034
3.70	magma.ht	1045
3.70.1	Magma	1045
3.71	man0.ht	1056
3.71.1	Reference Search	1056
3.71.2	Lisp Functions	1057
3.71.3	Axiom Browser	1068
3.71.4	The Hyperdoc Browse Facility	1069
3.72	mapping.ht	1070
3.72.1	Domain Mapping(T,S,...)	1070
3.72.2	Domain Constructor Mapping	1071
3.73	mappkg1.ht	1072
3.73.1	MappingPackage1	1072
3.74	mset.ht	1086
3.74.1	MultiSet	1086
3.75	matrix.ht	1092
3.75.1	Matrix	1092
3.75.2	Creating Matrices	1093
3.75.3	Operations on Matrices	1107
3.76	mkfunc.ht	1118
3.76.1	MakeFunction	1118
3.77	mpoly.ht	1124
3.77.1	MultivariatePolynomial	1124
3.78	newuser.ht	1130
3.78.1	No More Help :-(.	1130
3.78.2	You Tried It!	1131
3.79	none.ht	1132
3.79.1	None	1132
3.80	numbers.ht	1134
3.80.1	Axiom Number Types	1134
3.80.2	Fraction	1137
3.80.3	Rational Number	1140
3.80.4	Integers	1143
3.80.5	Integer Examples	1148
3.80.6	Integer Example Proof	1151
3.80.7	Integer Problems	1152
3.80.8	Integer Problem Proof	1153
3.80.9	Solution to Problem #1	1154
3.80.10	Solution to Problem #2	1159
3.81	oct.ht	1161
3.81.1	Octonion	1161
3.82	odpol.ht	1172
3.82.1	OrderlyDifferentialPolynomial	1172
3.83	op.ht	1192
3.83.1	Operator	1192

3.84	ovar.ht	1204
3.84.1	OrderedVariableList	1204
3.85	perman.ht	1207
3.85.1	Permanent	1207
3.86	pfr.ht	1210
3.86.1	PartialFraction	1210
3.87	poly.ht	1218
3.87.1	Polynomials	1218
3.87.2	The Specific Polynomial Types	1219
3.87.3	Basic Operations On Polynomials	1220
3.87.4	Polynomial Evaluation and Substitution	1229
3.87.5	Greatest Common Divisors, Resultants, and Discriminants	1233
3.87.6	Roots of Polynomials	1235
3.88	poly1.ht	1236
3.88.1	Polynomial	1236
3.89	quat.ht	1261
3.89.1	Quaternion	1261
3.90	radix.ht	1268
3.90.1	RadixExpansion	1268
3.91	reclos.ht	1278
3.91.1	RealClosure	1278
3.92	record.ht	1314
3.92.1	Domain Record(a:A,...,b:B)	1314
3.92.2	Domain Constructor Record	1315
3.93	regset.ht	1316
3.93.1	RegularTriangularSet	1316
3.94	roman.ht	1348
3.94.1	RomanNumeral	1348
3.95	seg.ht	1355
3.95.1	Segment	1355
3.96	segbind.ht	1361
3.96.1	SegmentBinding	1361
3.97	set.ht	1365
3.97.1	Set	1365
3.98	sint.ht	1375
3.98.1	SingleInteger	1375
3.99	sqmatrix.ht	1382
3.99.1	SquareMatrix	1382
3.100	sregset.ht	1386
3.100.1	SquareFreeRegularTriangularSet	1386
3.101	stbl.ht	1400
3.101.1	SparseTable	1400
3.102	stream.ht	1404
3.102.1	Stream	1404
3.103	string.ht	1411
3.103.1	String	1411

3.104strtbl.ht	1428
3.104.1 StringTable	1428
3.105symbol.ht	1431
3.105.1 Symbol	1431
3.106table.ht	1443
3.106.1 Table	1443
3.107textfile.ht	1453
3.107.1 TextFile	1453
3.108topics.ht	1459
3.108.1 Axiom Topics	1459
3.108.2 Solving Equations	1461
3.108.3 Linear Algebra	1463
3.108.4 Calculus	1465
3.109type.ht	1466
3.109.1 Category Type	1466
3.110union.ht	1467
3.110.1 Domain Union(a:A,...,b:B)	1467
3.110.2 Domain Constructor Union	1468
3.110.3 Domain Union(A,...,B)	1469
3.110.4 Domain Constructor Union	1470
3.111uniseg.ht	1471
3.111.1 UniversalSegment	1471
3.112up.ht	1476
3.112.1 UnivariatePolynomial	1476
3.113oreup.ht	1496
3.113.1 UnivariateSkewPolynomial	1496
3.114vector.ht	1503
3.114.1 Vector	1503
3.115void.ht	1510
3.115.1 Void	1510
3.116wutset.ht	1514
3.116.1 WuWenTsunTriangularSet	1514
3.117xmpexp.ht	1523
3.117.1 Some Examples of Domains and Packages	1523
3.118xpbwpoly.ht	1529
3.118.1 XPBWPolynomial	1529
3.119xpoly.ht	1552
3.119.1 XPolynomial	1552
3.120xpr.ht	1560
3.120.1 XPolynomialRing	1560
3.121zdsolve.ht	1570
3.121.1 ZeroDimensionalSolvePackage	1570
3.122zlindep.ht	1626
3.122.1 IntegerLinearDependence	1626

4	Users Guide Pages (ug.ht)	1631
4.0.2	Users Guide	1632
5	Users Guide Chapter 0 (ug00.ht)	1635
5.0.3	What's New for May 2008	1635
5.0.4	New polynomial domains and algorithms	1637
5.0.5	Enhancements to HyperDoc and Graphics	1638
5.0.6	Enhancements to NAGLink	1639
5.0.7	Enhancements to the Lisp system	1640
6	Users Guide Chapter 1 (ug01.ht)	1647
6.0.8	An Overview of Axiom	1647
6.0.9	Starting Up and Winding Down	1649
6.0.10	Clef	1651
6.0.11	Typographic Conventions	1653
6.0.12	The Axiom Language	1655
6.0.13	Arithmetic Expressions	1656
6.0.14	Previous Results	1658
6.0.15	Some Types	1661
6.0.16	Symbols, Variables, Assignments, and Declarations	1664
6.0.17	Conversion	1672
6.0.18	Calling Functions	1674
6.0.19	Some Predefined Macros	1677
6.0.20	Long Lines	1678
6.0.21	Comments	1679
6.0.22	Graphics	1680
6.0.23	Numbers	1683
6.0.24	Data Structures	1704
6.0.25	Expanding to Higher Dimensions	1723
6.0.26	Writing Your Own Functions	1729
6.0.27	Polynomials	1743
6.0.28	Limits	1747
6.0.29	Series	1752
6.0.30	Derivatives	1760
6.0.31	Integration	1768
6.0.32	Differential Equations	1777
6.0.33	Solution of Equations	1785
6.0.34	System Commands	1790
7	Users Guide Chapter 2 (ug02.ht)	1797
7.0.35	Using Types and Modes	1797
7.0.36	The Basic Idea	1799
7.0.37	Domain Constructors	1804
7.0.38	Writing Types and Modes	1816
7.0.39	Types with No Arguments	1820
7.0.40	Types with One Argument	1821

7.0.41	Types with More Than One Argument	1825
7.0.42	Modes	1826
7.0.43	Abbreviations	1828
7.0.44	Declarations	1831
7.0.45	Records	1839
7.0.46	Unions	1848
7.0.47	Unions Without Selectors	1849
7.0.48	Unions With Selectors	1858
7.0.49	The “Any” Domain	1862
7.0.50	Conversion	1866
7.0.51	Subdomains Again	1876
7.0.52	Package Calling and Target Types	1884
7.0.53	Resolving Types	1894
7.0.54	Exposing Domains and Packages	1898
7.0.55	Commands for Snooping	1903
8	Users Guide Chapter 3 (ug03.ht)	1907
8.0.56	Using Hyperdoc	1907
8.0.57	Headings	1909
8.0.58	Key Definitions	1910
8.0.59	Scroll Bars	1911
8.0.60	Input Areas	1913
8.0.61	Radio Buttons and Toggles	1915
8.0.62	Search Strings	1917
8.0.63	Logical Searches	1919
8.0.64	Example Pages	1920
8.0.65	X Window Resources for Hyperdoc	1922
9	Users Guide Chapter 4 (ug04.ht)	1925
9.0.66	Input Files and Output Styles	1925
9.0.67	Input Files	1927
9.0.68	The .axiom.input File	1929
9.0.69	Common Features of Using Output Formats	1930
9.0.70	Monospace 2D Mathematical Format	1934
9.0.71	TeX Format	1937
9.0.72	IBM Script Formula Format	1939
9.0.73	FORTRAN Format	1941
9.0.74	HTML Format	1951
9.0.75	Immediate and Delayed Assignments	1954
9.0.76	Blocks	1963
9.0.77	if-then-else	1973
9.0.78	Loops	1977
9.0.79	Compiling vs. Interpreting Loops	1979
9.0.80	return in Loops	1980
9.0.81	break in Loops	1984
9.0.82	break vs. => in Loop Bodies	1988

9.0.83	More Examples of break	1989
9.0.84	iterate in Loops	1998
9.0.85	while Loops	2000
9.0.86	for Loops	2008
9.0.87	for i in n..m repeat	2009
9.0.88	for i in n..m by s repeat	2014
9.0.89	for i in n.. repeat	2016
9.0.90	for x in l repeat	2017
9.0.91	“Such that” Predicates	2020
9.0.92	Parallel Iteration	2022
9.0.93	Creating Lists and Streams with Iterators	2029
9.0.94	An Example: Streams of Primes	2037
10	Users Guide Chapter 6 (ug06.ht)	2045
10.0.95	User-Defined Functions, Macros and Rules	2045
10.0.96	Functions vs. Macros	2047
10.0.97	Macros	2050
10.0.98	Introduction to Functions	2059
10.0.99	Declaring the Type of Functions	2063
10.0.100	One-Line Functions	2067
10.0.101	Declared vs. Undeclared Functions	2072
10.0.102	Functions vs. Operations	2077
10.0.103	Delayed Assignments vs. Functions with No Arguments	2079
10.0.104	How Axiom Determines What Function to Use	2082
10.0.105	Compiling vs. Interpreting	2087
10.0.106	Piece-Wise Function Definitions	2090
10.0.107	A Basic Example	2091
10.0.108	Picking Up the Pieces	2099
10.0.109	Predicates	2107
10.0.110	Caching Previously Computed Results	2112
10.0.111	Recurrence Relations	2116
10.0.112	Making Functions from Objects	2122
10.0.113	Functions Defined with Blocks	2132
10.0.114	Free and Local Variables	2142
10.0.115	Anonymous Functions	2159
10.0.116	Some Examples	2160
10.0.117	Declaring Anonymous Functions	2166
10.0.118	Example: A Database	2171
10.0.119	Example: A Famous Triangle	2179
10.0.120	Example: Testing for Palindromes	2185
10.0.121	Rules and Pattern Matching	2191

11 Users Guide Chapter 7 (ug07.ht)	2209
11.0.12Graphics	2210
11.0.12Two-Dimensional Graphics	2211
11.0.12Plotting Two-Dimensional Functions of One Variable	2213
11.0.12Plotting 2D Parametric Plane Curves	2216
11.0.12Plotting Plane Algebraic Curves	2220
11.0.12Two-Dimensional Options	2222
11.0.12Color	2229
11.0.12Palette	2231
11.0.13Two-Dimensional Control-Panel	2234
11.0.13Operations for Two-Dimensional Graphics	2238
11.0.13Addendum: Building Two-Dimensional Graphs	2243
11.0.13Addendum: Appending a Graph to a Viewport Window Containing a Graph	2265
11.0.13Three-Dimensional Graphics	2268
11.0.13Plotting Three-Dimensional Functions of Two Variables	2270
11.0.13Plotting Three-Dimensional Parametric Space Curves	2273
11.0.13Plotting 3D Parametric Surfaces	2277
11.0.13Three-Dimensional Options	2281
11.0.13The makeObject Command	2292
11.0.14Building 3D Objects From Primitives	2295
11.0.14Coordinate System Transformations	2309
11.0.14Three-Dimensional Clipping	2317
11.0.14Three-Dimensional Control-Panel	2319
11.0.14Operations for Three-Dimensional Graphics	2326
11.0.14Customization using .Xdefaults	2333
12 Users Guide Chapter 8 (ug08.ht)	2337
12.0.14Advanced Problem Solving	2337
12.0.14Numeric Functions	2339
12.0.14Polynomial Factorization	2364
12.0.14Integer and Rational Number Coefficients	2365
12.0.15Finite Field Coefficients	2368
12.0.15Simple Algebraic Extension Field Coefficients	2371
12.0.15Factoring Rational Functions	2376
12.0.15Manipulating Symbolic Roots of a Polynomial	2378
12.0.15Using a Single Root of a Polynomial	2379
12.0.15Using All Roots of a Polynomial	2384
12.0.15Computation of Eigenvalues and Eigenvectors	2390
12.0.15Solution of Linear and Polynomial Equations	2399
12.0.15Solution of Systems of Linear Equations	2400
12.0.15Solution of a Single Polynomial Equation	2405
12.0.16Solution of Systems of Polynomial Equations	2410
12.0.16Limits	2416
12.0.16Laplace Transforms	2424
12.0.16Integration	2429

12.0.16	Working with Power Series	2438
12.0.16	Creation of Power Series	2440
12.0.16	Coefficients of Power Series	2447
12.0.16	Power Series Arithmetic	2451
12.0.16	Functions on Power Series	2455
12.0.16	Converting to Power Series	2464
12.0.17	Power Series from Formulas	2473
12.0.17	Substituting Numerical Values in Power Series	2481
12.0.17	Example: Bernoulli Polynomials and Sums of Powers	2483
12.0.17	Solution of Differential Equations	2493
12.0.17	Closed-Form Solutions of Linear Differential Equations	2494
12.0.17	Closed-Form Solutions of Non-Linear DEs	2503
12.0.17	Power Series Solutions of Differential Equations	2515
12.0.17	Finite Fields	2521
12.0.17	Modular Arithmetic and Prime Fields	2524
12.0.17	Extensions of Finite Fields	2535
12.0.18	Irreducible Mod Polynomial Representations	2538
12.0.18	Cyclic Group Representations	2548
12.0.18	Normal Basis Representations	2556
12.0.18	Conversion Operations for Finite Fields	2564
12.0.18	Utility Operations for Finite Fields	2574
12.0.18	Primary Decomposition of Ideals	2593
12.0.18	Computation of Galois Groups	2602
12.0.18	Non-Associative Algebras and Genetic Laws	2624
13	Users Guide Chapter 10 (ug10.ht)	2637
13.0.18	Interactive Programming	2637
13.0.18	Drawing Ribbons Interactively	2639
13.0.19	A Ribbon Program	2645
13.0.19	Coloring and Positioning Ribbons	2648
13.0.19	Points, Lines, and Curves	2650
13.0.19	A Bouquet of Arrows	2657
13.0.19	Drawing Complex Vector Fields	2659
13.0.19	Drawing Complex Functions	2664
13.0.19	Functions Producing Functions	2668
13.0.19	Automatic Newton Iteration Formulas	2670
14	Users Guide Chapter 11 (ug11.ht)	2679
14.0.19	Packages	2679
14.0.19	Names, Abbreviations, and File Structure	2682
14.0.20	Syntax	2684
14.0.20	Abstract Datatypes	2685
14.0.20	Capsules	2687
14.0.20	Input Files vs. Packages	2689
14.0.20	Compiling Packages	2690
14.0.20	Parameters	2694

14.0.20	Conditionals	2698
14.0.20	Testing	2701
14.0.20	How Packages Work	2709
15	Users Guide Chapter 12 (ug12.ht)	2711
15.0.20	Categories	2711
15.0.21	Definitions	2714
15.0.21	Exports	2716
15.0.21	Documentation	2718
15.0.21	Hierarchies	2720
15.0.21	Membership	2721
15.0.21	Defaults	2723
15.0.21	Axioms	2725
15.0.21	Correctness	2727
15.0.21	Attributes	2729
15.0.21	Parameters	2732
15.0.22	Conditionals	2734
15.0.22	Anonymous Categories	2736
16	Users Guide Chapter 13 (ug13.ht)	2739
16.0.22	Domains	2739
16.0.22	Domains vs. Packages	2741
16.0.22	Definitions	2742
16.0.22	Category Assertions	2745
16.0.22	A Demo	2747
16.0.22	Browse	2752
16.0.22	Representation	2754
16.0.22	Multiple Representations	2756
16.0.23	Add Domain	2758
16.0.23	Defaults	2759
16.0.23	Origins	2761
16.0.23	Short Forms	2762
16.0.23	Example 1: Clifford Algebra	2763
16.0.23	Example 2: Building A Query Facility	2766
16.0.23	A Little Query Language	2768
16.0.23	The Database Constructor	2771
16.0.23	Query Equations	2774
16.0.23	DataLists	2776
16.0.24	Index Cards	2777
16.0.24	Creating a Database	2778
16.0.24	Putting It All Together	2779
16.0.24	Example Queries	2780

17 Users Guide Chapter 14 (ug14.ht)	2795
17.0.24Browse	2795
17.0.245The Front Page: Searching the Library	2796
17.0.246The Constructor Page	2799
17.0.247Constructor Page Buttons	2801
17.0.248Cross Reference	2804
17.0.249Views Of Constructors	2809
17.0.250Giving Parameters to Constructors	2811
17.0.251Miscellaneous Features of Browse	2812
17.0.252The Description Page for Operations	2813
17.0.253Views of Operations	2815
17.0.254Capitalization Convention	2818
18 Users Guide Chapter 15 (ug15.ht)	2819
18.0.255What's New in Axiom Version 2.0	2819
18.0.256Important Things to Read First	2820
18.0.257The NAG Library Link	2821
18.0.258Interpreting NAG Documentation	2823
18.0.259Using the Link	2826
18.0.260Providing values for Argument Subprograms	2831
18.0.261General Fortran-generation utilities in Axiom	2835
18.0.262Some technical information	2862
18.0.263Interactive Front-end and Language	2864
18.0.264Library	2866
18.0.265HyperDoc	2869
18.0.266Documentation	2870
19 Users Guide Chapter 16 (ug16.ht)	2873
19.0.267Axiom System Commands	2874
19.0.268Introduction	2877
19.0.269abbreviation	2880
19.0.270boot	2882
19.0.271cd	2883
19.0.272close	2885
19.0.273clear	2887
19.0.274compile	2890
19.0.275display	2893
19.0.276edit	2895
19.0.277fin	2897
19.0.278frame	2898
19.0.279help	2901
19.0.280history	2902
19.0.281library	2907
19.0.282lisp	2909
19.0.283load	2910
19.0.284ltrace	2911

19.0.285	pquit	2912
19.0.286	quit	2914
19.0.287	read	2916
19.0.288	set	2918
19.0.289	show	2920
19.0.290	spool	2922
19.0.291	synonym	2923
19.0.292	system	2925
19.0.293	trace	2927
19.0.294	undo	2934
19.0.295	what	2936
20	Users Guide Chapter 21 (ug21.ht)	2939
20.0.296	Programs for Axiom Images	2939
20.0.297	images1.input	2940
20.0.298	images2.input	2941
20.0.299	images3.input	2942
20.0.300	images5.input	2943
20.0.301	images6.input	2946
20.0.302	images7.input	2947
20.0.303	images8.input	2948
20.0.304	onformal.input	2949
20.0.305	knot.input	2953
20.0.306	tube.input	2954
20.0.307	lhtri.input	2957
20.0.308	etra.input	2959
20.0.309	antoine.input	2961
20.0.310	cherk.input	2963
21	Hypertext Language Pages	2965
21.0.311	Creating Hyperdoc Pages	2965
21.1	htxadvpage1.ht	2966
21.1.1	Input Areas	2966
21.1.2	HTXAdvPage1xPatch1 patch	2967
21.1.3	HTXAdvPage1xPatch1A patch	2968
21.1.4	HTXAdvPage1xPatch2 patch	2968
21.1.5	HTXAdvPage1xPatch2A patch	2968
21.2	htxadvpage2.ht	2969
21.2.1	Radio buttons	2969
21.3	htxadvpage3.ht	2973
21.3.1	Macros	2973
21.4	htxadvpage4.ht	2975
21.4.1	Patch and Paste	2975
21.4.2	patch1 patch	2978
21.4.3	Patch1 patch	2978
21.4.4	Patch2 patch	2978

21.5	htxadvpage5.ht	2979
21.5.1	Axiom paste-ins	2979
21.6	htxadvpage6.ht	2982
21.6.1	Miscellaneous	2982
21.6.2	HTXAdvPage6xPatch1 patch	2984
21.6.3	HTXAdvPage6xPatch1A patch	2984
21.6.4	HTXAdvPage6xPatch2 patch	2984
21.6.5	HTXAdvPage6xPatch2A patch	2985
21.6.6	HTXAdvPage6xPatch3 patch	2985
21.6.7	HTXAdvPage6xPatch3A patch	2985
21.7	htxadvtoppage.ht	2986
21.7.1	Advanced features in Hyperdoc	2986
21.8	htxformatpage1.ht	2987
21.8.1	Using the special characters	2987
21.8.2	HTXFormatPage1xPatch1 patch	2988
21.8.3	HTXFormatPage1xPatch2 patch	2988
21.9	htxformatpage2.ht	2989
21.9.1	Formatting without commands	2989
21.9.2	HTXFormatPage2xPatch1 patch	2991
21.9.3	HTXFormatPage2xPatch2 patch	2991
21.9.4	HTXFormatPage2xPatch2A patch	2992
21.9.5	HTXFormatPage2xPatch3 patch	2992
21.9.6	HTXFormatPage2xPatch3A patch	2993
21.9.7	HTXFormatPage2xPatch4 patch	2993
21.9.8	HTXFormatPage2xPatch4A patch	2994
21.10	htxformatpage3.ht	2995
21.10.1	Using different fonts	2995
21.10.2	HTXFormatPage3xPatch1 patch	2997
21.10.3	HTXFormatPage3xPatch2 patch	2997
21.10.4	HTXFormatPage3xPatch3 patch	2998
21.10.5	HTXFormatPage3xPatch4 patch	2998
21.11	htxformatpage4.ht	2999
21.11.1	Indentation	2999
21.11.2	HTXFormatPage4xPatch1 patch	3001
21.11.3	HTXFormatPage4xPatch1A patch	3001
21.11.4	HTXFormatPage4xPatch2 patch	3002
21.11.5	HTXFormatPage4xPatch2A patch	3002
21.11.6	HTXFormatPage4xPatch3 patch	3002
21.11.7	HTXFormatPage4xPatch3A patch	3003
21.11.8	HTXFormatPage4xPatch4 patch	3003
21.11.9	HTXFormatPage4xPatch5 patch	3004
21.11.10	HTXFormatPage4xPatch5A patch	3004
21.12	htxformatpage5.ht	3005
21.12.1	Creating Lists and Tables	3005
21.12.2	HTXFormatPage5xPatch1 patch	3008
21.12.3	HTXFormatPage5xPatch1A patch	3008

21.12.4 HTXFormatPage5xPatch2 patch	3009
21.12.5 HTXFormatPage5xPatch2A patch	3010
21.12.6 HTXFormatPage5xPatch3 patch	3011
21.12.7 HTXFormatPage5xPatch3A patch	3011
21.13 htxformatpage6	3012
21.13.1 Boxes and Lines	3012
21.13.2 HTXFormatPage6xPatch1 patch	3013
21.13.3 HTXFormatPage6xPatch2 patch	3013
21.14 htxformatpage7	3014
21.14.1 Micro-Spacing	3014
21.14.2 HTXFormatPage7xPatch1 patch	3016
21.14.3 HTXFormatPage7xPatch2 patch	3016
21.14.4 HTXFormatPage7xPatch2A patch	3017
21.14.5 HTXFormatPage7xPatch3 patch	3017
21.14.6 HTXFormatPage7xPatch3A patch	3018
21.15 htxformatpage8	3019
21.15.1 Bitmaps and Images	3019
21.15.2 HTXFormatPage8xPatch1 patch	3020
21.15.3 HTXFormatPage8xPatch2 patch	3021
21.15.4 HTXFormatPage8xPatch2A patch	3021
21.16 htxformattoppage.ht	3022
21.16.1 Formatting in Hyperdoc	3022
21.17 htxintropage1.ht	3023
21.17.1 What Hyperdoc does	3023
21.18 htxintropage2.ht	3025
21.18.1 How Hyperdoc does it	3025
21.19 htxintropage3.ht	3027
21.19.1 A simple text page	3027
21.20 htxintrotoppage.ht	3030
21.20.1 First Steps	3030
21.21 htxlinkpage1.ht	3031
21.21.1 Linking to a named page	3031
21.21.2 HTXLinkPage1xPatch1 patch	3033
21.21.3 HTXLinkPage1xPatch1A patch	3033
21.21.4 Test Help Page	3034
21.22 htxlinkpage2.ht	3035
21.22.1 Standard Pages	3035
21.22.2 HTXLinkPage2xPatch1 patch	3037
21.22.3 HTXLinkPage2xPatch1A patch	3037
21.23 htxlinkpage3.ht	3038
21.23.1 Active Axiom commands	3038
21.23.2 HTXLinkPage3xPatch1 patch	3041
21.23.3 HTXLinkPage3xPatch1A patch	3042
21.23.4 HTXLinkPage3xPatch2 patch	3042
21.23.5 HTXLinkPage3xPatch2A patch	3042
21.23.6 HTXLinkPage3xPatch3 patch	3043

21.23.7 HTXLinkPage3xPatch3A patch	3043
21.24htxlinkpage4.ht	3044
21.24.1 Linking to Lisp	3044
21.24.2 HTXLinkPage4xPatch1 patch	3049
21.24.3 HTXLinkPage4xPatch1A patch	3049
21.24.4 HTXLinkPage4xPatch2 patch	3050
21.24.5 HTXLinkPage4xPatch2A patch	3050
21.24.6 HTXLinkPage4xPatch3 patch	3051
21.24.7 HTXLinkPage4xPatch3A patch	3051
21.24.8 HTXLinkPage4xPatch4 patch	3051
21.24.9 HTXLinkPage4xPatch4A patch	3052
21.24.10 HTXLinkPage4xPatch5 patch	3052
21.24.11 HTXLinkPage4xPatch5A patch	3053
21.25htxlinkpage5.ht	3054
21.25.1 Linking to Unix	3054
21.25.2 HTXLinkPage5xPatch1 patch	3055
21.25.3 HTXLinkPage5xPatch1A patch	3056
21.25.4 HTXLinkPage5xPatch2 patch	3056
21.25.5 HTXLinkPage5xPatch2A patch	3056
21.26htxlinkpage6.ht	3057
21.26.1 How to use your pages with Hyperdoc	3057
21.26.2 HTXLinkPage6xPatch1 patch	3060
21.26.3 HTXLinkPage6xPatch1A patch	3061
21.26.4 HTXLinkPage6xPatch2 patch	3062
21.26.5 HTXLinkPage6xPatch2A patch	3062
21.27htxlinktoppage.ht	3063
21.27.1 Actions in Hyperdoc	3063
21.28htxtoppage.ht	3064
21.28.1 Extending Hyperdoc	3064
21.29htxtrypage.ht	3066
21.29.1 Try out Hyperdoc	3066
22 NAG Library Routines	3069
22.1 nagaux.ht	3069
22.1.1 NAG On-line Documentation	3069
22.1.2 NAG Documentation: summary	3072
22.1.3 NAG Documentation: introduction	3096
22.1.4 NAG Documentation: keyword in context	3115
22.1.5 NAG Documentation: conversion	3221
22.2 nagc.ht	3225
22.2.1 Zeros of Polynomials	3225
22.2.2 Roots of a complex polynomial equation	3229
22.2.3 Roots of a real polynomial equation	3235
22.2.4 Roots of One or More Transcendental Equations	3241
22.2.5 Zero of a continuous function in a given interval	3246
22.2.6 Solution of a system of nonlinear equations	3250

22.2.7	Solution of a system of nonlinear equations	3255
22.2.8	Checks the gradients of a set of non-linear functions . . .	3261
22.2.9	Discrete Fourier transform of real or complex data values	3264
22.2.10	Discrete Fourier transform of n real data values	3273
22.2.11	Discrete Fourier transform of a Hermitian sequence . . .	3277
22.2.12	Discrete Fourier transform of n complex data values . . .	3281
22.2.13	Circular convolution or correlation of two real vectors . .	3285
22.2.14	Discrete Fourier transforms of m sequences	3290
22.2.15	Discrete Fourier transforms of m Hermitian sequences . .	3295
22.2.16	Discrete Fourier transforms of m complex sequences . . .	3300
22.2.17	Discrete Fourier transform of bivariate complex data . .	3305
22.2.18	Summation of Series	3310
22.2.19	Complex conjugate of a sequence of n data values	3313
22.2.20	Complex conjugates of m Hermitian sequences	3315
22.2.21	Form real and imaginary parts of m Hermitian sequences	3318
22.3	naagd.ht	3321
22.3.1	Quadrature	3321
22.3.2	Approximation of the integral over a finite interval . . .	3336
22.3.3	Adaptive integration over a finite integral	3343
22.3.4	Approximate integration with local singular points	3349
22.3.5	Approximate integration over a (semi-)infinite interval .	3356
22.3.6	Approximate sine or cosine transform over finite interval	3363
22.3.7	Adaptive integration of weighted function over an interval	3370
22.3.8	Hilbert transform over finite interval	3377
22.3.9	Approximate Sine or Cosine over $[a, \infty]$	3383
22.3.10	Weights and abscissae for Gaussian quadrature formula .	3391
22.3.11	Multidimensional integrals with finite limits	3398
22.3.12	Third-order finite-difference integration	3404
22.3.13	Monte Carlo integration over hyper-rectangular regions .	3408
22.3.14	Ordinary Differential Equations	3414
22.3.15	First-order ODE over an interval with initial conditions .	3421
22.3.16	First-order ODE with initial conditions and user function	3430
22.3.17	First-order ODE with variable-order, variable-step	3439
22.3.18	Stiff First-order ODE with variable order and step	3449
22.3.19	Two-point boundary-value ODE	3460
22.3.20	Two-point boundary value ODE with deferred correction	3468
22.3.21	Eigenvalue of regular singular 2nd-order Sturm-Liouville	3477
22.3.22	Two-point boundary-value ODE equation systems	3503
22.3.23	Partial differential equations	3518
22.3.24	Discrete elliptic PDE on rectangular region	3526
22.3.25	Discrete 2nd-order elliptic PDE on rectangular regions .	3535
22.3.26	Helmholtz equation in 3 dimensions	3549
22.4	nage.ht	3560
22.4.1	Interpolation	3560
22.4.2	Cubic spline interpolant	3567
22.4.3	Monotonicity-preserving piecewise cubic Hermite interpolant	3572

22.4.4	Piecewise cubic Hermite interpolant	3576
22.4.5	Piecewise cubic Hermite interpolant and 1st deriv	3579
22.4.6	Definite integral of piecewise cubic Hermite interpolant .	3582
22.4.7	Bicubic spline interpolated surface	3585
22.4.8	Two-D surface interpolating a set of scattered data points	3592
22.4.9	Evaluate 2D interpolant function from E01SAF	3596
22.4.10	Generate 2D surface interpolating a scattered data points	3600
22.4.11	Evaluate 2D interpolating function from E01SEF	3606
22.4.12	Curve and Surface Fitting	3610
22.4.13	Least-squares polynomial approximations	3638
22.4.14	Evaluate polynomial from Chebyshev-series representation	3644
22.4.15	Constrained weighted least-squares polynomial	3649
22.4.16	Coefficients of polynomial derivative	3658
22.4.17	Find coefficients of indefinite integral of polynomial . . .	3664
22.4.18	Evaluate polynomial in Chebyshev-series representation .	3670
22.4.19	Weighted least-squares approx to data points	3675
22.4.20	Evaluates a cubic spline from its B-spline representation	3683
22.4.21	Evaluate cubic spline and 3 derivatives from B-spline . .	3688
22.4.22	Definite integral of cubic spline from B-spline	3694
22.4.23	Cubic spline approximation to an arbitrary set points . .	3699
22.4.24	Minimal, weighted least-squares bicubic spline fit	3709
22.4.25	Bicubic spline approximation to a set of data values . . .	3719
22.4.26	Bicubic spline approximation to a set of scattered data .	3731
22.4.27	Calculates values of a bicubic spline from B-spline	3744
22.4.28	Calculates values of a bicubic spline from B-spline	3749
22.4.29	Calculates l_1 solution to over-determined system equations	3754
22.4.30	Sorts two-dimensional data into rectangular panels	3760
22.4.31	Minimizing or Maximizing a Function	3764
22.4.32	Minimizes a nonlinear function of several variable	3792
22.4.33	Supply optional parameters to E04DGF from file	3809
22.4.34	Supply individual optional params to E04DGF	3813
22.4.35	Finding an unconstrained minimum of a sum of squares .	3816
22.4.36	Finding an unconstrained minimum of a sum of squares .	3823
22.4.37	Finding a minimum of a function	3830
22.4.38	Solving linear programming problems	3837
22.4.39	Solving linear or quadratic problems	3847
22.4.40	Minimize an arbitrary smooth constrained function	3869
22.4.41	Supply optional parameters to E04UCF from file	3925
22.4.42	Supply individual optional params to E04UCF	3929
22.4.43	Estimates of elements of the variance-covariance matrix .	3932
22.5	nagf.ht	3940
22.5.1	Linear Algebra	3940
22.5.2	Matrix Factorization	3945
22.5.3	Factorizes a real sparse matrix	3949
22.5.4	Factorizes a real sparse matrix	3960
22.5.5	Incomplete Cholesky factorization	3967

22.5.6	Cholesky factor of a symmetric positive-definite matrix .	3976
22.5.7	QR factorization of the real m by n matrix A	3981
22.5.8	$B := QB$ or $B := Q^T B$	3987
22.5.9	First n_{colq} columns of the real m by m orthogonal matrix	3993
22.5.10	QR factorization of the complex m by n matrix A	3998
22.5.11	$B := QB$ or $B := Q^H B$	4004
22.5.12	First n_{colq} columns of the complex m by m unitary matrix	4010
22.5.13	Eigenvalues and Eigenvectors	4015
22.5.14	Calculates all the eigenvalues of a real symmetric matrix	4022
22.5.15	Eigenvalues and eigenvectors of a real symmetric matrix	4025
22.5.16	Calculates all the eigenvalues of $Ax = \lambda Bx$	4028
22.5.17	Eigenvalues and eigenvectors of $Ax = \lambda Bx$	4032
22.5.18	Calculates all the eigenvalues of a real unsymmetric matrix	4036
22.5.19	Eigenvalues and eigenvectors of a real unsymmetric matrix	4039
22.5.20	Calculates all the eigenvalues of a complex matrix	4043
22.5.21	Eigenvalues and eigenvectors of a complex matrix	4046
22.5.22	Eigenvalues of a complex Hermitian matrix	4050
22.5.23	Eigenvalues/eigenvectors complex Hermitian matrix . . .	4053
22.5.24	Eigenvalues and eigenvectors of a real symmetric matrix	4057
22.5.25	Eigenvalues of generalized eigenproblem $Ax = \lambda Bx$. . .	4061
22.5.26	Eigenvalues and eigenvectors of real sparse symmetric problem	4067
22.5.27	Singular value decomposition of a general real matrix . .	4082
22.5.28	Singular value decomposition of a general complex matrix	4091
22.5.29	Simultaneous Linear Equations	4099
22.5.30	Approximate solution of a set of complex linear equations	4105
22.5.31	Approximate solution of a set of real linear equations . .	4109
22.5.32	Real symmetric positive-definite linear equations	4113
22.5.33	Set of real linear equations with a single right-hand side .	4117
22.5.34	Solution of a set of real sparse linear equations	4121
22.5.35	Real symmetric positive-definite tridiagonal linear equa- tions	4125
22.5.36	Solution of a linear least-squares problem, $Ax = b$	4131
22.5.37	Sparse symmetric positive-definite system linear equations	4138
22.5.38	Solves a system of real sparse symmetric linear equations	4145
22.5.39	Solution of a system of real linear equations	4158
22.5.40	Solves sparse unsymmetric equations	4164
22.5.41	Linear Algebra Support Routines	4180
22.5.42	Linear Equations (LAPACK)	4216
22.5.43	Computes the LU factorization of a real m by n matrix .	4218
22.5.44	Solves a real system of linear equations	4222
22.5.45	Factorization of a real symmetric positive-definite matrix	4227
22.5.46	Real symmetric positive-definite system of linear equations	4231
22.5.47	Sort vector of double precision numbers	4240
22.5.48	Ranks a vector of double precision numbers	4243
22.5.49	Ranks the rows of a matrix of double precision numbers .	4246

22.5.50	Ranks the columns of a matrix of double precision numbers	4250
22.5.51	Rearranges a vector of double precision numbers	4254
22.5.52	Inverts a permutation	4257
22.6	nags.ht	4260
22.6.1	Approximations of Special Functions	4260
22.6.2	Exponential function e^z , for complex z	4275
22.6.3	Returns the value of the exponential integral $E(x)$	4279
22.6.4	Returns the value of the cosine integral	4283
22.6.5	Returns the value of the sine integral	4287
22.6.6	Returns the value of the Gamma function	4290
22.6.7	Returns a value for the logarithm of the Gamma function	4294
22.6.8	Incomplete gamma functions $P(a,x)$ and $Q(a,x)$	4299
22.6.9	Returns the value of the complementary error function .	4303
22.6.10	Returns the value of the error function $\operatorname{erf} x$	4307
22.6.11	Returns the value of the Bessel Function $Y_0(x)$	4310
22.6.12	Returns the value of the Bessel Function $Y_1(x)$	4315
22.6.13	Returns the value of the Bessel Function $J_0(x)$	4320
22.6.14	Returns the value of the Bessel Function $J_1(x)$	4325
22.6.15	Returns a value for the Airy function, $Ai(x)$	4330
22.6.16	Returns a value of the Airy function, $Bi(x)$	4335
22.6.17	Value of the derivative of the Airy function $Ai(x)$	4340
22.6.18	Value for the derivative of the Airy function $Bi(x)$	4345
22.6.19	Values for the Bessel functions $Y_{\nu+n}(z)$	4350
22.6.20	Values for the Bessel functions $J_{\nu+n}(z)$	4356
22.6.21	Value of the Airy function $Ai(z)$ or derivative $Ai'(z)$. .	4362
22.6.22	Value of the Airy function $Bi(z)$ or derivative $Bi'(z)$. .	4367
22.6.23	Returns a sequence of values for the Hankel functions . .	4372
22.6.24	Returns the value of the modified Bessel Function $K_0(x)$	4378
22.6.25	Returns the value of the modified Bessel Function $K_1(x)$	4382
22.6.26	Returns the value of the modified Bessel Function $I_0(x)$.	4387
22.6.27	Returns a value for the modified Bessel Function $I_1(x)$.	4391
22.6.28	Sequence of values for the modified Bessel $K_{\nu_n}(z)$	4395
22.6.29	Sequence of values for the modified Bessel $I_{\nu+n}$	4401
22.6.30	Returns a value for the Kelvin function $\operatorname{ber} x$	4406
22.6.31	Returns a value for the Kelvin function $\operatorname{bei} x$	4410
22.6.32	Returns a value for the Kelvin function $\operatorname{ker} x$	4414
22.6.33	Returns a value for the Kelvin function $\operatorname{kei} x$	4419
22.6.34	Returns a value for the Fresnel Integral $S(x)$	4423
22.6.35	Returns a value for the Fresnel Integral $C(x)$	4428
22.6.36	Returns a value of an elementary integral	4433
22.6.37	Value of the symmetrised elliptic integral of first kind . .	4437
22.6.38	Value of the symmetrised elliptic integral of second kind	4442
22.6.39	Value of the symmetrised elliptic integral of third kind .	4447
22.7	nagx.ht	4453
22.7.1	Mathematical Constants	4453
22.7.2	Machine Constants	4455

22.7.3	Input/Output Utilities	4463
22.7.4	Value of the current error message unit number	4466
22.7.5	Value of the current advisory message unit number	4469
22.7.6	Print a real matrix stored in a two-dimensional array	4472
22.7.7	Print a complex matrix stored in a 2D array	4476
22.7.8	Date and Time Utilities	4481
22.7.9	Returns the current date and time	4483
22.7.10	From seven-integer format time and date to character string	4485
22.7.11	Compares two date/time character strings	4488
22.7.12	Amount of processor time used	4491

23 NAG ASP Example Code 4493

23.1	aspex.ht	4493
23.1.1	Asp1 Example Code	4493
23.1.2	Asp10 Example Code	4494
23.1.3	Asp12 Example Code	4494
23.1.4	Asp19 Example Code	4495
23.1.5	Asp20 Example Code	4497
23.1.6	Asp24 Example Code	4498
23.1.7	Asp27 Example Code	4498
23.1.8	Asp28 Example Code	4499
23.1.9	Asp29 Example Code	4502
23.1.10	Asp30 Example Code	4503
23.1.11	Asp31 Example Code	4504
23.1.12	Asp33 Example Code	4504
23.1.13	Asp34 Example Code	4505
23.1.14	Asp35 Example Code	4506
23.1.15	Asp4 Example Code	4506
23.1.16	Asp41 Example Code	4507
23.1.17	Asp42 Example Code	4508
23.1.18	Asp49 Example Code	4509
23.1.19	Asp50 Example Code	4510
23.1.20	Asp55 Example Code	4511
23.1.21	Asp6 Example Code	4512
23.1.22	Asp7 Example Code	4513
23.1.23	Asp73 Example Code	4513
23.1.24	Asp74 Example Code	4514
23.1.25	Asp77 Example Code	4515
23.1.26	Asp78 Example Code	4515
23.1.27	Asp8 Example Code	4516
23.1.28	Asp80 Example Code	4517
23.1.29	Asp9 Example Code	4517

24 NAG ANNA Expert System	4519
24.1 annaex.ht	4519
24.1.1 Axiom/NAG Expert System	4519
24.1.2 Integration	4520
24.1.3 Ordinary Differential Equations	4521
24.1.4 Optimization	4522
24.1.5 Partial Differential Equations	4523
24.1.6 Examples Using the Axiom/NAG Expert System	4524
24.1.7 Examples Using the Axiom/NAG Expert System	4525
24.1.8 Examples Using the Axiom/NAG Expert System	4526
24.1.9 Examples Using the Axiom/NAG Expert System	4528
24.1.10 About the Axiom/NAG Expert System	4529
24.1.11 Introduction to the Axiom/NAG Expert System	4530
24.1.12 Example using the Axiom/NAG Expert System	4532
24.1.13 Example using the Axiom/NAG Expert System	4538
24.1.14 Example using the Axiom/NAG Expert System	4539
24.1.15 Decision Agents	4541
24.1.16 Inference Mechanisms	4542
24.1.17 Method Domains	4543
24.1.18 Measure Functions	4545
24.1.19 Computational Agents	4547
25 ANNA Algebra Code	4549
26 Page hierarchy layout	4551
27 Makefile	4585

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	54
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	83
5.2.1	System includes	83
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	250

7.3.1	initButtons	250
7.3.2	closeViewport	257
7.3.3	scaleComponents	258
7.3.4	makeTriangle	260
7.3.5	triangulate	261
7.3.6	readComponentsFromViewman	264
7.3.7	calcNormData	266
7.3.8	make3DComponents	268
7.3.9	draw3DComponents	269
7.3.10	drawColorMap	278
7.3.11	writeControlTitle	279
7.3.12	clearControlMessage	280
7.3.13	writeControlMessage	280
7.3.14	drawControlPanel	281
7.3.15	getControlXY	293
7.3.16	makeControlPanel	295
7.3.17	putControlPanelSomewhere	297
7.3.18	phong	298
7.3.19	hueValue	299
7.3.20	getHue	299
7.3.21	Value	300
7.3.22	hlsTOrgb	300
7.3.23	initLightButtons	301
7.3.24	makeLightingPanel	303
7.3.25	drawLightingAxes	305
7.3.26	drawLightTransArrow	307
7.3.27	drawLightingPanel	309
7.3.28	theHandler	313
7.3.29	mergeDatabases	314
7.3.30	getMeshNormal	315
7.3.31	normalizeVector	315
7.3.32	dotProduct	316
7.3.33	merge	317
7.3.34	msort	318
7.3.35	getPotValue	319
7.3.36	getLinearPotValue	319
7.3.37	buttonAction	320
7.3.38	processEvents	336
7.3.39	project	352
7.3.40	projectAPoint	353
7.3.41	projectAllPoints	354
7.3.42	projectAllPolys	355
7.3.43	projectAPoly	357
7.3.44	projectStuff	359
7.3.45	makeQuitPanel	360
7.3.46	drawQuitPanel	362

7.3.47	initQuitButtons	363
7.3.48	makeSavePanel	364
7.3.49	drawSavePanel	365
7.3.50	initSaveButtons	366
7.3.51	getCBufferAxes	367
7.3.52	putCBufferAxes	367
7.3.53	getCBufferIndx	367
7.3.54	putCBufferIndx	367
7.3.55	putZBuffer	368
7.3.56	getZBuffer	368
7.3.57	putImageX	368
7.3.58	drawPhongSpan	369
7.3.59	scanPhong	371
7.3.60	boxTObuffer	374
7.3.61	clipboxTObuffer	376
7.3.62	axesTObuffer	378
7.3.63	scanLines	380
7.3.64	freePolyList	383
7.3.65	showAxesLabels	384
7.3.66	makeTriangle	386
7.3.67	drawPhong	388
7.3.68	readViewman	391
7.3.69	scalePoint	391
7.3.70	spadAction	392
7.3.71	traverse	398
7.3.72	absolute	398
7.3.73	getRandom	398
7.3.74	normDist	399
7.3.75	goodbye	399
7.3.76	drawLineComponent	400
7.3.77	drawOpaquePolygon	401
7.3.78	copyPolygons	403
7.3.79	minMaxPolygons	405
7.3.80	polyCompare	406
7.3.81	makeTriangle	406
7.3.82	makeTriangle	407
7.3.83	freePointReservoir	410
7.3.84	freeListOfPolygons	410
7.3.85	drawPolygons	411
7.3.86	lessThan	414
7.3.87	greaterThan	414
7.3.88	isNaN	414
7.3.89	isNaNPoint	414
7.3.90	equal	415
7.3.91	matrixMultiply4x4	416
7.3.92	vectorMatrix4	417

7.3.93	ROTATE	417
7.3.94	ROTATE1	418
7.3.95	SCALE	418
7.3.96	TRANSLATE	418
7.3.97	writeTitle	419
7.3.98	drawPreViewport	420
7.3.99	drawTheViewport	426
7.3.100	makeViewport	428
7.3.101	postMakeViewport	433
7.3.102	keepDrawingViewport	435
7.3.103	initVolumeButtons	436
7.3.104	makeVolumePanel	439
7.3.105	drawClipXBut	441
7.3.106	drawClipYBut	443
7.3.107	drawClipZBut	445
7.3.108	drawClipVolume	446
7.3.109	drawHitherControl	448
7.3.110	drawEyeControl	449
7.3.111	drawFrustrum	450
7.3.112	drawVolumePanel	451
7.3.113	writeViewport	454
7.3.114	main	458
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	492
8.1.24	centerX	492
8.1.25	centerY	493
8.1.26	PSColorPolygon	494
8.1.27	PSColorwOutline	495
8.1.28	PSDrawColor	496
8.1.29	PSFillPolygon	497
8.1.30	PSFillwOutline	498
8.1.31	TrivEqual	498
8.1.32	TrivHashCode	499
8.1.33	XCreateAssocTable	499
8.1.34	XMakeAssoc	499
8.1.35	XLookUpAssoc	499
8.1.36	XDeleteAssoc	500
8.2	The postscript command definitions	500
8.2.1	colorpoly	500
8.2.2	colorwol	501
8.2.3	drawarc	502
8.2.4	drawcolor	503
8.2.5	drawIstr	504
8.2.6	drawline	505
8.2.7	drawlines	506
8.2.8	drawpoint	506
8.2.9	draw	507
8.2.10	drawrect	507
8.2.11	drawstr	508
8.2.12	drwfilled	508
8.2.13	end	509
8.2.14	fillarc	510
8.2.15	fillpoly	511
8.2.16	fillwol	512
8.2.17	header	513
8.2.18	setup	516
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

9.1.8	XSetBackground	522
9.1.9	XSetLineAttributes	523
9.1.10	DefaultScreen	523
9.1.11	RootWindow	523
9.1.12	XCreateAssocTable	523
9.1.13	XOpenDisplay	524
9.2	X11 API calls	525
10	Makefile	531

Volume 9: Axiom Compiler

0.1	Makefile	1
1	Compiler top level	3
1.1	)compile	3
1.1.1	Spad compiler	6
2	The Parser	9
2.1	EQ.spad	9
2.2	Parsing routines	14
2.2.1	defun initialize-prepare	14
2.2.2	defun prepare	18
2.2.3	defun Build the lines from the input for piles	23
2.2.4	defun parsepiles	26
2.2.5	defun add-parens-and-semis-to-line	27
2.2.6	defun prepareReadLine	28
2.2.7	defun prepareReadLine1	29
2.3	I/O Handling	30
2.3.1	defun prepare-echo	30
2.3.2	defun read-a-line	31
2.4	Line Handling	32
2.4.1	Line Buffer	32
2.4.2	defstruct \$Line	32
2.4.3	defun Line-New-Line	32
2.4.4	defun next-line	33
2.4.5	defun storeblanks	33
2.4.6	defun initial-substring	33
2.4.7	defun get-a-line	33
2.4.8	defun make-string-adjustable	34
3	Parse Transformers	35
3.1	Direct called parse routines	35
3.1.1	defun parseTransform	35
3.1.2	defun parseTran	36
3.1.3	defun parseAtom	37
3.1.4	defun parseTranList	37
3.1.5	defun parseConstruct	37
3.1.6	defun parseConstruct	38
3.2	Indirect called parse routines	39
3.2.1	defun parseAnd	40
3.2.2	defun parseAnd	40
3.2.3	defun parseAtSign	40
3.2.4	defun parseAtSign	41
3.2.5	defun parseCategory	41
3.2.6	defun parseCategory	41

3.2.7	defun parseCoerce	41
3.2.8	defun parseCoerce	42
3.2.9	defun parseColon	42
3.2.10	defun parseColon	42
3.2.11	defun parseDEF	43
3.2.12	defun parseDEF	43
3.2.13	defun parseDollarGreaterthan	43
3.2.14	defun parseDollarGreaterThan	44
3.2.15	defun parseDollarGreaterEqual	44
3.2.16	defun parseDollarGreaterEqual	44
3.2.17	defun parseDollarLessEqual	44
3.2.18	defun parseDollarLessEqual	45
3.2.19	defun parseDollarNotEqual	45
3.2.20	defun parseDollarNotEqual	45
3.2.21	defun parseEquivalence	45
3.2.22	defun parseEquivalence	46
3.2.23	defun parseExit	46
3.2.24	defun parseExit	46
3.2.25	defun parseGreaterEqual	47
3.2.26	defun parseGreaterEqual	47
3.2.27	defun parseGreaterthan	47
3.2.28	defun parseGreaterthan	47
3.2.29	defun parseHas	48
3.2.30	defun parseIf,ifTran	51
3.2.31	defun parseIf	53
3.2.32	defun parseIf	53
3.2.33	defun parseImplies	53
3.2.34	defun parseImplies	54
3.2.35	defun parseIn	54
3.2.36	defun parseIn	55
3.2.37	defun parseInBy	56
3.2.38	defun parseInBy	56
3.2.39	defun parseIs	56
3.2.40	defun parseIs	57
3.2.41	defun parseIsnt	57
3.2.42	defun parseIsnt	57
3.2.43	defun parseJoin	57
3.2.44	defun parseJoin	58
3.2.45	defun parseLeave	58
3.2.46	defun parseLeave	59
3.2.47	defun parseLessEqual	59
3.2.48	defun parseLessEqual	59
3.2.49	defun parseLET	59
3.2.50	defun parseLET	60
3.2.51	defun parseLETD	60
3.2.52	defun parseLETD	60

3.2.53	defun parseMDEF	60
3.2.54	defun parseMDEF	61
3.2.55	defun parseNot	61
3.2.56	defun parseNot	61
3.2.57	defun parseNot	62
3.2.58	defun parseNotEqual	62
3.2.59	defun parseNotEqual	62
3.2.60	defun parseOr	62
3.2.61	defun parseOr	63
3.2.62	defun parsePretend	63
3.2.63	defun parsePretend	64
3.2.64	defun parseReturn	64
3.2.65	defun parseReturn	64
3.2.66	defun parseSegment	65
3.2.67	defun parseSegment	65
3.2.68	defun parseSeq	65
3.2.69	defun parseSeq	65
3.2.70	defun parseVCONS	66
3.2.71	defun parseVCONS	66
3.2.72	defun parseWhere	66
3.2.73	defun parseWhere	66
4	Compile Transformers	67
4.1	Direct called comp routines	67
4.2	Indirect called comp routines	67
4.2.1	defun compAtSign	68
4.2.2	defun compAdd	69
4.2.3	defun compAtSign	70
4.2.4	defun compAtSign	71
4.2.5	defun compCapsule	71
4.2.6	defun compCapsule	71
4.2.7	defun compCapsuleInner	72
4.2.8	defun compCase	72
4.2.9	defun compCase	73
4.2.10	defun compCase1	74
4.2.11	defun compCat	74
4.2.12	defun compCat	75
4.2.13	defun compCat	75
4.2.14	defun compCat	75
4.2.15	defun compCategory	76
4.2.16	defun compCategory	76
4.2.17	defun compCoerce	77
4.2.18	defun compCoerce	77
4.2.19	defun compCoerce1	78
4.2.20	defun compColon	78
4.2.21	defun compColon	79

4.2.22	defun compCons	82
4.2.23	defun compCons	83
4.2.24	defun compCons1	84
4.2.25	defun compConstructorCategory	85
4.2.26	defun compConstructorCategory	85
4.2.27	defun compConstructorCategory	85
4.2.28	defun compConstructorCategory	85
4.2.29	defun compConstructorCategory	85
4.2.30	defun compConstruct	86
4.2.31	defun compConstruct	86
4.2.32	defun compDefine	87
4.2.33	defun compDefine	87
4.2.34	defun compDefine1	88
4.2.35	defun compElt	90
4.2.36	defun compElt	91
4.2.37	defun compExit	92
4.2.38	defun compExit	93
4.2.39	defun compHas	93
4.2.40	defun compHas	94
4.2.41	defun compIf	94
4.2.42	defun compIf	95
4.2.43	defun compImport	96
4.2.44	defun compImport	96
4.2.45	defun compIs	96
4.2.46	defun compIs	97
4.2.47	defun compJoin	97
4.2.48	defun compJoin	98
4.2.49	defun compLambda	99
4.2.50	defun compLambda	100
4.2.51	defun compLeave	101
4.2.52	defun compLeave	101
4.2.53	defun compMacro	101
4.2.54	defun compMacro	102
4.2.55	defun compPretend	103
4.2.56	defun compPretend	103
4.2.57	defun compQuote	104
4.2.58	defun compQuote	104
4.2.59	defun compReduce	104
4.2.60	defun compReduce	104
4.2.61	defun compReduce1	105
4.2.62	defun compSeq	107
4.2.63	defun compSeq	107
4.2.64	defun compSeq1	108
4.2.65	defun compSeqItem	108
4.2.66	defun compVector	109
4.2.67	defun compVector	109

4.2.68	defun compWhere	109
4.2.69	defun compWhere	110
5	Post Transformers	111
5.1	Direct called postparse routines	111
5.1.1	defun postTransform	111
5.1.2	defun postTran	113
5.1.3	defun postOp	114
5.1.4	defun postAtom	114
5.1.5	defun postTranList	114
5.1.6	defun postScriptsForm	115
5.1.7	defun postTranScripts	115
5.1.8	defun postTransformCheck	116
5.1.9	defun postcheck	116
5.1.10	defun postError	117
5.1.11	defun postForm	118
5.2	Indirect called postparse routines	120
5.2.1	defun postAdd	120
5.2.2	defun postAdd	121
5.2.3	defun postAtSign	121
5.2.4	defun postAtSign	121
5.2.5	defun postBigFloat	121
5.2.6	defun postBigFloat	122
5.2.7	defun postBlock	122
5.2.8	defun postBlock	122
5.2.9	defun postCategory	123
5.2.10	defun postCategory	123
5.2.11	defun postCollect,finish	124
5.2.12	defun postCollect	124
5.2.13	defun postCollect	125
5.2.14	defun postColon	125
5.2.15	defun postColon	126
5.2.16	defun postColonColon	126
5.2.17	defun postColonColon	126
5.2.18	defun postComma	126
5.2.19	defun postComma	127
5.2.20	defun comma2Tuple	127
5.2.21	defun postConstruct	127
5.2.22	defun postConstruct	128
5.2.23	defun postDef	129
5.2.24	defun postDef	130
5.2.25	defun postExit	131
5.2.26	defun postExit	131
5.2.27	defun postIf	132
5.2.28	defun postIf	132
5.2.29	defun postin	132

5.2.30	defun postin	133
5.2.31	defun postIn	133
5.2.32	defun postIn	133
5.2.33	defun postJoin	133
5.2.34	defun postJoin	134
5.2.35	defun postMapping	134
5.2.36	defun postMapping	134
5.2.37	defun postMDef	135
5.2.38	defun postMDef	136
5.2.39	defun postPretend	137
5.2.40	defun postPretend	137
5.2.41	defun postQUOTE	137
5.2.42	defun postQUOTE	137
5.2.43	defun postReduce	137
5.2.44	defun postReduce	138
5.2.45	defun postRepeat	138
5.2.46	defun postRepeat	138
5.2.47	defun postScripts	139
5.2.48	defun postScripts	139
5.2.49	defun postSemiColon	139
5.2.50	defun postSemiColon	139
5.2.51	defun postSignature	139
5.2.52	defun postSignature	140
5.2.53	defun postSlash	140
5.2.54	defun postSlash	140
5.2.55	defun postTuple	140
5.2.56	defun postTuple	141
5.2.57	defun postTupleCollect	141
5.2.58	defun postTupleCollect	141
5.2.59	defun postWhere	141
5.2.60	defun postWhere	142
5.2.61	defun postWith	142
5.2.62	defun postWith	142
5.3	Support routines	143
5.3.1	defun setDefOp	143
5.3.2	defun aplTran	143
5.3.3	defun aplTran1	144
5.3.4	defun aplTranList	145
5.3.5	defun hasAplExtension	146
5.3.6	defun deepestExpression	146
5.3.7	defun containsBang	147
5.3.8	defun getScriptName	147
5.3.9	defun decodeScripts	148

6	DEF forms	149
6.0.10	defun def	149
6.0.11	defun deftran	150
6.0.12	defun def-process	151
6.0.13	defun def-rename	151
6.0.14	defun def-rename1	152
6.0.15	defun def-insert-let	152
6.0.16	defun def-let	153
6.0.17	defun defLET	153
6.0.18	defun defLET1	154
6.0.19	defun defLET2	156
6.0.20	defun defLetForm	158
6.0.21	defvar \$defstack	158
6.0.22	defun def-where	158
6.0.23	defun def-whereclauselist	159
6.0.24	defun def-whereclause	159
6.0.25	defun def-message	159
6.0.26	defun def-message1	160
6.0.27	defun def-in2on	160
6.0.28	defun def-cond	161
6.0.29	defvar \$is-spill	161
6.0.30	defvar \$is-spill-list	161
6.0.31	defun def-is-eqlist	162
6.0.32	defvar \$v1	163
6.0.33	defun def-is-remdup	163
6.0.34	defun def-is-remdup1	164
6.0.35	defun addCARorCDR	165
6.0.36	IS	166
6.0.37	defun def-is	166
6.0.38	defvar \$is-eqlist	166
6.0.39	defun def-is2	167
6.0.40	defun defIS	168
6.0.41	defun defIS1	169
6.0.42	defun def-is-rev	171
6.0.43	defun defISReverse	172
6.0.44	defun def-collect	172
6.0.45	defun def-it	173
6.0.46	defun def-repeat	173
6.0.47	defun def-string	174
6.0.48	defun def-stringtoquote	174
6.0.49	defun def-addlet	174
6.0.50	defun def-inner	175
6.0.51	defun hackforis	175
6.0.52	defun hackforis1	175
6.0.53	defun unTuple	176
6.0.54	defun errhuh	176

7	PARSE forms	177
7.1	The original meta specification	177
7.2	The PARSE code	182
7.2.1	defvar \$tmptok	182
7.2.2	defvar \$tok	182
7.2.3	defvar \$ParseMode	182
7.2.4	defvar \$definition-name	183
7.2.5	defvar \$lablasoc	183
7.2.6	defun PARSE-NewExpr	183
7.2.7	defun PARSE-Command	184
7.2.8	defun PARSE-SpecialKeyWord	184
7.2.9	defun PARSE-SpecialCommand	185
7.2.10	defun PARSE-TokenCommandTail	186
7.2.11	defun PARSE-TokenOption	186
7.2.12	defun PARSE-TokenList	187
7.2.13	defun PARSE-CommandTail	187
7.2.14	defun PARSE-PrimaryOrQM	188
7.2.15	defun PARSE-Option	188
7.2.16	defun PARSE-Statement	189
7.2.17	defun PARSE-InfixWith	189
7.2.18	defun PARSE-With	190
7.2.19	defun PARSE-Category	191
7.2.20	defun PARSE-Expression	192
7.2.21	defun PARSE-Import	193
7.2.22	defun PARSE-Expr	193
7.2.23	defun PARSE-LedPart	194
7.2.24	defun PARSE-NudPart	194
7.2.25	defun PARSE-Operation	195
7.2.26	defun PARSE-leftBindingPowerOf	195
7.2.27	defun PARSE-rightBindingPowerOf	196
7.2.28	defun PARSE-getSemanticForm	196
7.2.29	defun PARSE-Prefix	197
7.2.30	defun PARSE-Infix	197
7.2.31	defun PARSE-TokTail	198
7.2.32	defun PARSE-Qualification	198
7.2.33	defun PARSE-Reduction	199
7.2.34	defun PARSE-ReductionOp	199
7.2.35	defun PARSE-Form	200
7.2.36	defun PARSE-Application	201
7.2.37	defun PARSE-Label	201
7.2.38	defun PARSE-Selector	202
7.2.39	defun PARSE-PrimaryNoFloat	203
7.2.40	defun PARSE-Primary	203
7.2.41	defun PARSE-Primary1	204
7.2.42	defun PARSE-Float	205
7.2.43	defun PARSE-FloatBase	206

7.2.44	defun PARSE-FloatBasePart	207
7.2.45	defun PARSE-FloatExponent	208
7.2.46	defun PARSE-Enclosure	209
7.2.47	defun PARSE-IntegerTok	209
7.2.48	defun PARSE-FormalParameter	209
7.2.49	defun PARSE-FormalParameterTok	210
7.2.50	defun PARSE-Quad	210
7.2.51	defun PARSE-String	210
7.2.52	defun PARSE-VarForm	211
7.2.53	defun PARSE-Scripts	211
7.2.54	defun PARSE-ScriptItem	212
7.2.55	defun PARSE-Name	212
7.2.56	defun PARSE-Data	213
7.2.57	defun PARSE-Sexpr	213
7.2.58	defun PARSE-Sexpr1	214
7.2.59	defun PARSE-NBGlyphTok	215
7.2.60	defun PARSE-GlyphTok	215
7.2.61	defun PARSE-AnyId	216
7.2.62	defun PARSE-Sequence	216
7.2.63	defun PARSE-Sequence1	217
7.2.64	defun PARSE-OpenBracket	217
7.2.65	defun PARSE-OpenBrace	218
7.2.66	defun PARSE-IteratorTail	218
7.2.67	defun PARSE-Iterator	219
7.2.68	The PARSE implicit routines	220
7.2.69	defun PARSE-Suffix	220
7.2.70	defun PARSE-SemiColon	221
7.2.71	defun PARSE-Return	221
7.2.72	defun PARSE-Exit	222
7.2.73	defun PARSE-Leave	222
7.2.74	defun PARSE-Seg	223
7.2.75	defun PARSE-Conditional	223
7.2.76	defun PARSE-ElseClause	224
7.2.77	defun PARSE-Loop	224
7.2.78	defun PARSE-LabelExpr	225
7.2.79	defun PARSE-FloatTok	225
7.3	The PARSE support routines	226
7.3.1	String grabbing	226
7.3.2	defun match-string	226
7.3.3	defun match-advance-string	227
7.3.4	defun initial-substring-p	228
7.3.5	defun quote-if-string	229
7.3.6	defun escape-keywords	230
7.3.7	defun underscore	230
7.3.8	Token Handling	230
7.3.9	defun getToken	230

7.3.10	defun unget-tokens	231
7.3.11	defun match-current-token	232
7.3.12	defun match-token	232
7.3.13	defun match-next-token	232
7.3.14	defun current-symbol	233
7.3.15	defun make-symbol-of	233
7.3.16	defun current-token	233
7.3.17	defun try-get-token	234
7.3.18	defun next-token	234
7.3.19	defun advance-token	235
7.3.20	defvar \$XTokenReader	235
7.3.21	defun get-token	235
7.3.22	Character handling	236
7.3.23	defun current-char	236
7.3.24	defun next-char	236
7.3.25	defun char-eq	236
7.3.26	defun char-ne	237
7.3.27	Error handling	237
7.3.28	defvar \$meta-error-handler	237
7.3.29	defun meta-syntax-error	237
7.3.30	Floating Point Support	238
7.3.31	defun floatexpid	238
7.3.32	Dollar Translation	238
7.3.33	defun dollarTran	238
7.3.34	Applying metagrammatical elements of a production (e.g., Star).	239
7.3.35	defmacro Bang	239
7.3.36	defmacro must	239
7.3.37	defun action	239
7.3.38	defun optional	240
7.3.39	defmacro star	240
7.3.40	Stacking and retrieving reductions of rules.	241
7.3.41	defun push-reduction	241
8	The Compiler	243
8.1	Compiling EQ.spad	243
8.1.1	The top level compiler command	246
8.1.2	The Spad compiler top level function	249
8.1.3	defun compilerDoit	253
8.1.4	defun /RQ,LIB	254
8.1.5	defun /rf-1	255
8.1.6	defun spad	264
8.1.7	defun Interpreter interface to the compiler	267
8.1.8	defun compTopLevel	270
8.1.9	defun compOrCroak	271
8.1.10	defun compOrCroak1	272

8.1.11	defun comp	273
8.1.12	defun compNoStacking	274
8.1.13	defun compNoStacking1	274
8.1.14	defun comp2	275
8.1.15	defun comp3	276
8.1.16	defun compTypeOf	278
8.1.17	defun compColonInside	279
8.1.18	defun compAtom	280
8.1.19	defun convert	281
8.1.20	defun primitiveType	282
8.1.21	defun compSymbol	283
8.1.22	defun compList	284
8.1.23	defun compExpression	285
8.1.24	defun compForm	285
8.1.25	defun compForm1	286
8.1.26	defun compForm2	289
8.1.27	defun compArgumentsAndTryAgain	291
8.1.28	defun compWithMappingMode	291
8.1.29	defun compWithMappingModel	292
8.1.30	defun extractCodeAndConstructTriple	300
8.1.31	defun hasFormalMapVariable	300
8.1.32	defun argsToSig	301
8.1.33	defun compMakeDeclaration	302
8.1.34	defun modifyModeStack	302
8.1.35	defun Create a list of unbound symbols	303
8.1.36	defun compOrCroak1,compactify	304
8.1.37	defun Compiler/Interpreter interface	304
8.1.38	defun compileSpadLispCmd	305
8.1.39	defun recompile-lib-file-if-necessary	306
8.1.40	defun spad-fixed-arg	306
8.1.41	defun compile-lib-file	307
8.1.42	defun compileFileQuietly	307
8.1.43	defvar \$byConstructors	307
8.1.44	defvar \$constructorsSeen	307

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	6
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	13
1.2.5	The logarithmic part	14
1.3	Elementary Functions	17
1.3.1	Differential algebra	17
1.3.2	The Hermite reduction	19
1.3.3	The polynomial reduction	20
1.3.4	The residue criterion	21
1.3.5	The transcendental logarithmic case	23
1.3.6	The transcendental exponential case	24
1.3.7	The transcendental tangent case	25
1.3.8	The algebraic logarithmic case	26
1.3.9	The algebraic exponential case	29
2	Singular Value Decomposition	33
2.1	Singular Value Decomposition Tutorial	33
3	Quaternions	39
	Preface	39
3.1	Quaternions	40
3.2	Vectors, and their Composition	40
3.3	Examples To Chapter 1.	69
3.4	Products And Quotients of Vectors	71
3.5	Examples To Chapter 2.	99
3.6	Interpretations And Transformations	100
3.7	Examples to Chapter 3	131
3.8	Axiom Examples	137
4	Clifford Algebra[?]	141
4.1	Introduction	141
4.2	Clifford Basis Matrix Theory	142
4.3	Calculation of the inverse of a Clifford number	144
4.3.1	Example 1: Clifford (2)	145
4.3.2	Example 2: Clifford (3)	146
4.3.3	Example 3: Clifford (2,2)	148

4.3.4 Conclusion	151
5 Package for Algebraic Function Fields	153
6 Groebner Basis	155
7 Greatest Common Divisor	157
8 Polynomial Factorization	159
9 Cylindrical Algebraic Decomposition	161
10 Pade approximant	163
11 Schwartz-Zippel lemma and testing polynomial identities	165
12 Chinese Remainder Theorem	167
13 Gaussian Elimination	169
14 Diophantine Equations	171
15 Index	177

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)	8
2.0.4	AttributeRegistry (ATTREG)	12
2.0.5	BasicType (BASTYPE)	16
2.0.6	CoercibleTo (KOERCE)	19
2.0.7	CombinatorialFunctionCategory (CFCAT)	22
2.0.8	ConvertibleTo (KONVERT)	25
2.0.9	ElementaryFunctionCategory (ELEMFUN)	29
2.0.10	Eltable (ELTAB)	32
2.0.11	HyperbolicFunctionCategory (HYPCAT)	35
2.0.12	InnerEvalable (IEVALAB)	39
2.0.13	OpenMath (OM)	43
2.0.14	PartialTranscendentalFunctions (PTRANFN)	47
2.0.15	Patternable (PATAB)	53
2.0.16	PrimitiveFunctionCategory (PRIMCAT)	56
2.0.17	RadicalCategory (RADCAT)	59
2.0.18	RetractableTo (RETRACT)	62
2.0.19	SpecialFunctionCategory (SPFCAT)	67
2.0.20	TrigonometricFunctionCategory (TRIGCAT)	71
2.0.21	Type (TYPE)	75
3	Category Layer 2	77
3.0.22	Aggregate (AGG)	77
3.0.23	CombinatorialOpsCategory (COMBOPC)	82
3.0.24	EltableAggregate (ELTAGG)	86
3.0.25	Evalable (EVALAB)	91
3.0.26	FortranProgramCategory (FORTCAT)	96
3.0.27	FullyRetractableTo (FRETRCT)	100
3.0.28	FullyPatternMatchable (FPATMAB)	105
3.0.29	Logic (LOGIC)	110
3.0.30	PlottablePlaneCurveCategory (PPCURVE)	114
3.0.31	PlottableSpaceCurveCategory (PSCURVE)	118
3.0.32	RealConstant (REAL)	122
3.0.33	SegmentCategory (SEGCAT)	125
3.0.34	SetCategory (SETCAT)	130
3.0.35	TranscendentalFunctionCategory (TRANFUN)	135

4	Category Layer 3	141
4.0.36	AbelianSemiGroup (ABELSG)	141
4.0.37	BlowUpMethodCategory (BLMETCT)	146
4.0.38	DesingTreeCategory (DSTRCAT)	150
4.0.39	FortranFunctionCategory (FORTFN)	155
4.0.40	FortranMatrixCategory (FMC)	160
4.0.41	FortranMatrixFunctionCategory (FMFUN)	164
4.0.42	FortranVectorCategory (FVC)	169
4.0.43	FortranVectorFunctionCategory (FVFUN)	173
4.0.44	FullyEvaluableOver (FEVALAB)	178
4.0.45	FileCategory (FILECAT)	183
4.0.46	Finite (FINITE)	188
4.0.47	FileNameCategory (FNCAT)	193
4.0.48	GradedModule (GRMOD)	198
4.0.49	HomogeneousAggregate (HOAGG)	203
4.0.50	IndexedDirectProductCategory (IDPC)	210
4.0.51	LiouvillianFunctionCategory (LFCAT)	215
4.0.52	Monad (MONAD)	221
4.0.53	NumericalIntegrationCategory (NUMINT)	226
4.0.54	NumericalOptimizationCategory (OPTCAT)	232
4.0.55	OrdinaryDifferentialEquationsSolverCategory (ODECAT)	237
4.0.56	OrderedSet (ORDSET)	242
4.0.57	PartialDifferentialEquationsSolverCategory (PDECAT)	247
4.0.58	PatternMatchable (PATMAB)	253
4.0.59	RealRootCharacterizationCategory (RRCC)	258
4.0.60	SegmentExpansionCategory (SEGXCAT)	264
4.0.61	SemiGroup (SGROUP)	269
4.0.62	SetCategoryWithDegree (SETCATD)	274
4.0.63	SExpressionCategory (SEXCAT)	277
4.0.64	StepThrough (STEP)	283
4.0.65	ThreeSpaceCategory (SPACEC)	288
5	Category Layer 4	301
5.0.66	AbelianMonoid (ABELMON)	301
5.0.67	AffineSpaceCategory (AFSPCAT)	306
5.0.68	BagAggregate (BGAGG)	312
5.0.69	CachableSet (CACHSET)	318
5.0.70	Collection (CLAGG)	322
5.0.71	DifferentialVariableCategory (DVARCAT)	330
5.0.72	ExpressionSpace (ES)	337
5.0.73	GradedAlgebra (GRALG)	351
5.0.74	IndexedAggregate (IXAGG)	356
5.0.75	MonadWithUnit (MONADWU)	365
5.0.76	Monoid (MONOID)	371
5.0.77	OrderedFinite (ORDFIN)	376
5.0.78	PlacesCategory (PLACESC)	380

5.0.79	ProjectiveSpaceCategory (PRSPCAT)	386
5.0.80	RecursiveAggregate (RCAGG)	392
5.0.81	TwoDimensionalArrayCategory (ARR2CAT)	399
6	Category Layer 5	413
6.0.82	BinaryRecursiveAggregate (BRAGG)	414
6.0.83	CancellationAbelianMonoid (CABMON)	423
6.0.84	DictionaryOperations (DIOPS)	428
6.0.85	DoublyLinkedAggregate (DLAGG)	436
6.0.86	Group (GROUP)	443
6.0.87	LinearAggregate (LNAGG)	449
6.0.88	MatrixCategory (MATCAT)	458
6.0.89	OrderedAbelianSemiGroup (OASGP)	507
6.0.90	OrderedMonoid (ORDMON)	512
6.0.91	PolynomialSetCategory (PSETCAT)	518
6.0.92	PriorityQueueAggregate (PRQAGG)	534
6.0.93	QueueAggregate (QUAGG)	540
6.0.94	SetAggregate (SETAGG)	547
6.0.95	StackAggregate (SKAGG)	556
6.0.96	UnaryRecursiveAggregate (URAGG)	563
7	Category Layer 6	575
7.0.97	AbelianGroup (ABELGRP)	576
7.0.98	BinaryTreeCategory (BTCAT)	582
7.0.99	Dictionary (DIAGG)	589
7.0.100	DequeueAggregate (DQAGG)	597
7.0.101	ExtensibleLinearAggregate (ELAGG)	604
7.0.102	FiniteLinearAggregate (FLAGG)	613
7.0.103	FreeAbelianMonoidCategory (FAMONC)	622
7.0.104	MultiDictionary (MDAGG)	629
7.0.105	OrderedAbelianMonoid (OAMON)	636
7.0.106	PermutationCategory (PERMCAT)	640
7.0.107	StreamAggregate (STAGG)	647
7.0.108	TriangularSetCategory (TSETCAT)	657
8	Category Layer 7	677
8.0.109	FiniteDivisorCategory (FDIVCAT)	678
8.0.110	FiniteSetAggregate (FSAGG)	685
8.0.111	KeyedDictionary (KDAGG)	694
8.0.112	LazyStreamAggregate (LZSTAGG)	702
8.0.113	LeftModule (LMODULE)	722
8.0.114	ListAggregate (LSAGG)	727
8.0.115	MultisetAggregate (MSETAGG)	742
8.0.116	NonAssociativeRng (NARNG)	749
8.0.117	OneDimensionalArrayAggregate (A1AGG)	754
8.0.118	OrderedCancellationAbelianMonoid (OCAMON)	767

8.0.119 RegularTriangularSetCategory (RSETCAT)	772
8.0.120 RightModule (RMODULE)	788
8.0.121 Rng (RNG)	793
9 Category Layer 8	799
9.0.122 BiModule (BMODULE)	800
9.0.123 BitAggregate (BTAGG)	806
9.0.124 NonAssociativeRing (NASRING)	816
9.0.125 NormalizedTriangularSetCategory (NTSCAT)	823
9.0.126 OrderedAbelianGroup (OAGROUP)	836
9.0.127 OrderedAbelianMonoidSup (OAMONS)	841
9.0.128 OrderedMultisetAggregate (OMSAGG)	846
9.0.129 Ring (RING)	854
9.0.130 SquareFreeRegularTriangularSetCategory (SFRTCAT)	860
9.0.131 StringAggregate (SRAGG)	872
9.0.132 TableAggregate (TBAGG)	884
9.0.133 VectorCategory (VECTCAT)	897
10 Category Layer 9	907
10.0.134 AssociationListAggregate (ALAGG)	907
10.0.135 CharacteristicNonZero (CHARNZ)	922
10.0.136 CharacteristicZero (CHARZ)	927
10.0.137 CommutativeRing (COMRING)	932
10.0.138 DifferentialRing (DIFRING)	938
10.0.139 EntireRing (ENTIRER)	944
10.0.140 FreeModuleCat (FMCAT)	950
10.0.141 LeftAlgebra (LALG)	956
10.0.142 LinearlyExplicitRingOver (LINEXP)	961
10.0.143 Module (MODULE)	966
10.0.144 OrderedRing (ORDRING)	971
10.0.145 PartialDifferentialRing (PDRING)	977
10.0.146 PointCategory (PTCAT)	985
10.0.147 RectangularMatrixCategory (RMATCAT)	994
10.0.148 SquareFreeNormalizedTriangularSetCategory (SNTSCAT)	1004
10.0.149 StringCategory (STRICAT)	1014
10.0.150 UnivariateSkewPolynomialCategory (OREPCAT)	1024
10.0.151 KAlgebra (XALG)	1038
11 Category Layer 10	1045
11.0.152 Algebra (ALGEBRA)	1045
11.0.153 DifferentialExtension (DIFEXT)	1053
11.0.154 FullyLinearlyExplicitRingOver (FLINEXP)	1060
11.0.155 LieAlgebra (LIECAT)	1067
11.0.156 LinearOrdinaryDifferentialOperatorCategory (LODOCAT)	1072
11.0.157 NonAssociativeAlgebra (NAALG)	1082
11.0.158 VectorSpace (VSPACE)	1089

11.0.15	XFreeAlgebra (XFALG)	1094
12	Category Layer 11	1103
12.0.16	DirectProductCategory (DIRPCAT)	1103
12.0.16	DivisionRing (DIVRING)	1116
12.0.16	FiniteRankNonAssociativeAlgebra (FINAALG)	1122
12.0.16	FreeLieAlgebra (FLALG)	1146
12.0.16	IntegralDomain (INTDOM)	1153
12.0.16	MonogenicLinearOperator (MLO)	1160
12.0.16	OctonionCategory (OC)	1167
12.0.16	QuaternionCategory (QUATCAT)	1180
12.0.16	SquareMatrixCategory (SMATCAT)	1192
12.0.16	XPolynomialsCat (XPOLYC)	1205
13	Category Layer 12	1213
13.0.17	AbelianMonoidRing (AMR)	1213
13.0.17	FortranMachineTypeCategory (FMTC)	1223
13.0.17	FramedNonAssociativeAlgebra (FRNAALG)	1230
13.0.17	GcdDomain (GCDDOM)	1246
13.0.17	OrderedIntegralDomain (OINTDOM)	1253
14	Category Layer 13	1259
14.0.17	FiniteAbelianMonoidRing (FAMR)	1259
14.0.17	IntervalCategory (INTCAT)	1270
14.0.17	PowerSeriesCategory (PSCAT)	1280
14.0.17	PrincipalIdealDomain (PID)	1288
14.0.17	UniqueFactorizationDomain (UFD)	1294
15	Category Layer 14	1301
15.0.18	DivisorCategory (DIVCAT)	1301
15.0.18	EuclideanDomain (EUCDOM)	1307
15.0.18	MultivariateTaylorSeriesCategory (MTSCAT)	1316
15.0.18	PolynomialFactorizationExplicit (PFECAT)	1325
15.0.18	UnivariatePowerSeriesCategory (UPSCAT)	1334
16	Category Layer 15	1347
16.0.18	Field (FIELD)	1347
16.0.18	IntegerNumberSystem (INS)	1355
16.0.18	LocalPowerSeriesCategory (LOCPOWC)	1368
16.0.18	pAdicIntegerCategory (PADICCT)	1377
16.0.18	PolynomialCategory (POLYCAT)	1385
16.0.19	UnivariateTaylorSeriesCategory (UTSCAT)	1408

17 Category Layer 16	1425
17.0.19AlgebraicallyClosedField (ACF)	1425
17.0.19DifferentialPolynomialCategory (DPOLCAT)	1439
17.0.19FieldOfPrimeCharacteristic (FPC)	1457
17.0.19FiniteRankAlgebra (FINRALG)	1465
17.0.19FunctionSpace (FS)	1472
17.0.19InfinitelyClosePointCategory (INFCLCT)	1503
17.0.19PseudoAlgebraicClosureOfPerfectFieldCategory (PACPERC)	1509
17.0.19QuotientFieldCategory (QFCAT)	1516
17.0.19RealClosedField (RCFIELD)	1531
17.0.20RealNumberSystem (RNS)	1543
17.0.20RecursivePolynomialCategory (RPOLCAT)	1552
17.0.20UnivariateLaurentSeriesCategory (ULSCAT)	1595
17.0.20UnivariatePuisseuxSeriesCategory (UPXSCAT)	1608
17.0.20UnivariatePolynomialCategory (UPOLYC)	1620
18 Category Layer 17	1645
18.0.20AlgebraicallyClosedFunctionSpace (ACFS)	1645
18.0.20ExtensionField (XF)	1662
18.0.20FiniteFieldCategory (FFIELDC)	1671
18.0.20FloatingPointSystem (FPS)	1684
18.0.20FramedAlgebra (FRAMALG)	1694
18.0.21PseudoAlgebraicClosureOfFiniteFieldCategory (PACFFC)	1701
18.0.21UnivariateLaurentSeriesConstructorCategory (ULSCCAT)	1709
18.0.21UnivariatePuisseuxSeriesConstructorCategory (UPXSCCA)	1728
19 Category Layer 18	1741
19.0.21FiniteAlgebraicExtensionField (FAXF)	1741
19.0.21MonogenicAlgebra (MONOGEN)	1758
19.0.21PseudoAlgebraicClosureOfRationalNumberCategory (PACRATC)	1771
20 Category Layer 19	1779
20.0.21ComplexCategory (COMPCAT)	1779
20.0.21FunctionFieldCategory (FFCAT)	1804
20.0.21PseudoAlgebraicClosureOfAlgExtOfRationalNumberCategory (PACEXTC)	1829
21 The bootstrap code	1839
21.1 ABELGRP.lsp BOOTSTRAP	1839
21.2 ABELGRP-.lsp BOOTSTRAP	1841
21.3 ABELMON.lsp BOOTSTRAP	1843
21.4 ABELMON-.lsp BOOTSTRAP	1845
21.5 ABELSG.lsp BOOTSTRAP	1847
21.6 ABELSG-.lsp BOOTSTRAP	1848
21.7 ALAGG.lsp BOOTSTRAP	1850
21.8 CABMON.lsp BOOTSTRAP	1852

21.9	CLAGG.lsp BOOTSTRAP	1854
21.10	CLAGG-.lsp BOOTSTRAP	1856
21.11	COMRING.lsp BOOTSTRAP	1861
21.12	DIFRING.lsp BOOTSTRAP	1862
21.13	DIFRING-.lsp BOOTSTRAP	1863
21.14	DIVRING.lsp BOOTSTRAP	1865
21.15	DIVRING-.lsp BOOTSTRAP	1867
21.16	ES.lsp BOOTSTRAP	1870
21.17	ES-.lsp BOOTSTRAP	1873
21.18	EUCDOM.lsp BOOTSTRAP	1890
21.18.1	The Lisp Implementation	1890
21.19	EUCDOM-.lsp BOOTSTRAP	1893
21.19.1	The Lisp Implementation	1893
21.20	ENTIRER.lsp BOOTSTRAP	1910
21.21	FFIELDC.lsp BOOTSTRAP	1911
21.22	FFIELDC-.lsp BOOTSTRAP	1913
21.23	FPS.lsp BOOTSTRAP	1926
21.24	FPS-.lsp BOOTSTRAP	1928
21.25	GCDDOM.lsp BOOTSTRAP	1930
21.26	GCDDOM-.lsp BOOTSTRAP	1932
21.27	HOAGG.lsp BOOTSTRAP	1938
21.28	HOAGG-.lsp BOOTSTRAP	1940
21.29	INS.lsp BOOTSTRAP	1947
21.30	INS-.lsp BOOTSTRAP	1949
21.31	INTDOM.lsp BOOTSTRAP	1958
21.32	INTDOM-.lsp BOOTSTRAP	1960
21.33	LNAGG.lsp BOOTSTRAP	1963
21.34	LNAGG-.lsp BOOTSTRAP	1965
21.35	LSAGG.lsp BOOTSTRAP	1968
21.36	LSAGG-.lsp BOOTSTRAP	1970
21.37	MONOID.lsp BOOTSTRAP	1989
21.38	MONOID-.lsp BOOTSTRAP	1990
21.39	MTSCAT.lsp BOOTSTRAP	1992
21.40	OINTDOM.lsp BOOTSTRAP	1994
21.41	ORDRING.lsp BOOTSTRAP	1995
21.42	ORDRING-.lsp BOOTSTRAP	1997
21.43	POLYCAT.lsp BOOTSTRAP	1999
21.44	POLYCAT-.lsp BOOTSTRAP	2002
21.45	PSETCAT.lsp BOOTSTRAP	2036
21.46	PSETCAT-.lsp BOOTSTRAP	2039
21.47	QFCAT.lsp BOOTSTRAP	2058
21.48	QFCAT-.lsp BOOTSTRAP	2060
21.49	RCAGG.lsp BOOTSTRAP	2069
21.50	RCAGG-.lsp BOOTSTRAP	2071
21.51	RING.lsp BOOTSTRAP	2073
21.52	RING-.lsp BOOTSTRAP	2074

21.53RNG.lsp BOOTSTRAP	2075
21.54RNS.lsp BOOTSTRAP	2076
21.55RNS-.lsp BOOTSTRAP	2078
21.56SETAGG.lsp BOOTSTRAP	2083
21.57SETAGG-.lsp BOOTSTRAP	2085
21.58SETCAT.lsp BOOTSTRAP	2087
21.59SETCAT-.lsp BOOTSTRAP	2089
21.60STAGG.lsp BOOTSTRAP	2091
21.61STAGG-.lsp BOOTSTRAP	2093
21.62TSETCAT.lsp BOOTSTRAP	2100
21.63TSETCAT-.lsp BOOTSTRAP	2104
21.64UFD.lsp BOOTSTRAP	2126
21.65UFD-.lsp BOOTSTRAP	2128
21.66ULSCAT.lsp BOOTSTRAP	2131
21.67UPOLYC.lsp BOOTSTRAP	2133
21.68UPOLYC-.lsp BOOTSTRAP	2137
21.69URAGG.lsp BOOTSTRAP	2168
21.70URAGG-.lsp BOOTSTRAP	2170
22 Chunk collections	2185

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)	5
2.2	domain AFFPLPS AffinePlaneOverPseudoAlgebraicClosureOfFiniteField	6
2.2.1	AffinePlaneOverPseudoAlgebraicClosureOfFiniteField (AFFPLPS)	7
2.3	domain AFFSP AffineSpace	8
2.3.1	AffineSpace (AFFSP)	10
2.4	domain ALGSC AlgebraGivenByStructuralConstants	13
2.4.1	AlgebraGivenByStructuralConstants (ALGSC)	16
2.5	domain ALGFF AlgebraicFunctionField	27
2.5.1	AlgebraicFunctionField (ALGFF)	31
2.6	domain AN AlgebraicNumber	36
2.6.1	AlgebraicNumber (AN)	39
2.7	domain ANON AnonymousFunction	41
2.7.1	AnonymousFunction (ANON)	42
2.8	domain ANTISYM AntiSymm	43
2.8.1	AntiSymm (ANTISYM)	45
2.9	domain ANY Any	50
2.9.1	Any (ANY)	56
2.10	domain ASTACK ArrayStack	59
2.10.1	ArrayStack (ASTACK)	73
2.11	domain ASP1 Asp1	78
2.11.1	Asp1 (ASP1)	79
2.12	domain ASP10 Asp10	82
2.12.1	Asp10 (ASP10)	84
2.13	domain ASP12 Asp12	88
2.13.1	Asp12 (ASP12)	89
2.14	domain ASP19 Asp19	91
2.14.1	Asp19 (ASP19)	93
2.15	domain ASP20 Asp20	100
2.15.1	Asp20 (ASP20)	102
2.16	domain ASP24 Asp24	106
2.16.1	Asp24 (ASP24)	107
2.17	domain ASP27 Asp27	110
2.17.1	Asp27 (ASP27)	111
2.18	domain ASP28 Asp28	114
2.18.1	Asp28 (ASP28)	115
2.19	domain ASP29 Asp29	120
2.19.1	Asp29 (ASP29)	121

2.20	domain ASP30 Asp30	123
2.20.1	Asp30 (ASP30)	124
2.21	domain ASP31 Asp31	128
2.21.1	Asp31 (ASP31)	130
2.22	domain ASP33 Asp33	134
2.22.1	Asp33 (ASP33)	135
2.23	domain ASP34 Asp34	137
2.23.1	Asp34 (ASP34)	138
2.24	domain ASP35 Asp35	141
2.24.1	Asp35 (ASP35)	143
2.25	domain ASP4 Asp4	147
2.25.1	Asp4 (ASP4)	149
2.26	domain ASP41 Asp41	152
2.26.1	Asp41 (ASP41)	154
2.27	domain ASP42 Asp42	160
2.27.1	Asp42 (ASP42)	162
2.28	domain ASP49 Asp49	168
2.28.1	Asp49 (ASP49)	169
2.29	domain ASP50 Asp50	173
2.29.1	Asp50 (ASP50)	175
2.30	domain ASP55 Asp55	179
2.30.1	Asp55 (ASP55)	181
2.31	domain ASP6 Asp6	186
2.31.1	Asp6 (ASP6)	188
2.32	domain ASP7 Asp7	192
2.32.1	Asp7 (ASP7)	194
2.33	domain ASP73 Asp73	198
2.33.1	Asp73 (ASP73)	200
2.34	domain ASP74 Asp74	204
2.34.1	Asp74 (ASP74)	206
2.35	domain ASP77 Asp77	211
2.35.1	Asp77 (ASP77)	213
2.36	domain ASP78 Asp78	217
2.36.1	Asp78 (ASP78)	219
2.37	domain ASP8 Asp8	222
2.37.1	Asp8 (ASP8)	223
2.38	domain ASP80 Asp80	227
2.38.1	Asp80 (ASP80)	229
2.39	domain ASP9 Asp9	233
2.39.1	Asp9 (ASP9)	234
2.40	domain JORDAN AssociatedJordanAlgebra	238
2.40.1	AssociatedJordanAlgebra (JORDAN)	241
2.41	domain LIE AssociatedLieAlgebra	245
2.41.1	AssociatedLieAlgebra (LIE)	248
2.42	domain ALIST AssociationList	252
2.42.1	AssociationList (ALIST)	257

2.43	domain ATTRBUT AttributeButtons	260
2.43.1	AttributeButtons (ATTRBUT)	261
2.44	domain AUTOMOR Automorphism	266
2.44.1	Automorphism (AUTOMOR)	268
3	Chapter B	271
3.1	domain BBTREE BalancedBinaryTree	271
3.1.1	BalancedBinaryTree (BBTREE)	276
3.2	domain BPADIC BalancedPAdicInteger	281
3.2.1	BalancedPAdicInteger (BPADIC)	283
3.3	domain BPADICRT BalancedPAdicRational	285
3.3.1	BalancedPAdicRational (BPADICRT)	289
3.4	domain BFUNCT BasicFunctions	291
3.4.1	BasicFunctions (BFUNCT)	293
3.5	domain BOP BasicOperator	295
3.5.1	BasicOperator (BOP)	303
3.6	domain BINARY BinaryExpansion	308
3.6.1	BinaryExpansion (BINARY)	312
3.7	domain BINFILE BinaryFile	314
3.7.1	BinaryFile (BINFILE)	315
3.8	domain BSTREE BinarySearchTree	318
3.8.1	BinarySearchTree (BSTREE)	324
3.9	domain BTOURN BinaryTournament	327
3.9.1	BinaryTournament (BTOURN)	329
3.10	domain BTREE BinaryTree	331
3.10.1	BinaryTree (BTREE)	333
3.11	domain BITS Bits	335
3.11.1	Bits (BITS)	338
3.12	domain BLHN BlowUpWithHamburgerNoether	340
3.12.1	BlowUpWithHamburgerNoether (BLHN)	341
3.13	domain BLQT BlowUpWithQuadTrans	343
3.13.1	BlowUpWithQuadTrans (BLQT)	344
3.14	domain BOOLEAN Boolean	346
3.14.1	Boolean (BOOLEAN)	348
4	Chapter C	351
4.1	domain CARD CardinalNumber	351
4.1.1	CardinalNumber (CARD)	360
4.2	domain CARTEN CartesianTensor	365
4.2.1	CartesianTensor (CARTEN)	387
4.3	domain CHAR Character	401
4.3.1	Character (CHAR)	406
4.4	domain CCLASS CharacterClass	410
4.4.1	CharacterClass (CCLASS)	415
4.5	domain CLIF CliffordAlgebra[?, ?]	419
4.5.1	Vector (linear) spaces	419

4.5.2	Quadratic Forms[?]	420
4.5.3	Quadratic spaces, Clifford Maps[?, ?]	420
4.5.4	Universal Clifford algebras[?]	421
4.5.5	Real Clifford algebras $\mathbb{R}_{p,q}$ [?]	421
4.5.6	Notation for integer sets	421
4.5.7	Frames for Clifford algebras[?, ?, ?]	421
4.5.8	Real frame groups[?, ?]	422
4.5.9	Canonical products[?, ?, ?]	422
4.5.10	Clifford algebra of frame group[?, ?, ?, ?]	422
4.5.11	Neutral matrix representations[?, ?, ?]	423
4.5.12	CliffordAlgebra (CLIF)	438
4.6	domain COLOR Color	443
4.6.1	Color (COLOR)	445
4.7	domain COMM Commutator	448
4.7.1	Commutator (COMM)	449
4.8	domain COMPLEX Complex	451
4.8.1	Complex (COMPLEX)	458
4.9	domain CDFMAT ComplexDoubleFloatMatrix	462
4.9.1	ComplexDoubleFloatMatrix (CDFMAT)	466
4.10	domain CDFVEC ComplexDoubleFloatVector	468
4.10.1	ComplexDoubleFloatVector (CDFVEC)	473
4.11	domain CONTFRAC ContinuedFraction	475
4.11.1	ContinuedFraction (CONTFRAC)	488
5	Chapter D	497
5.1	domain DBASE Database	497
5.1.1	Database (DBASE)	499
5.2	domain DLIST DataList	501
5.2.1	DataList (DLIST)	505
5.3	domain DECIMAL DecimalExpansion	507
5.3.1	DecimalExpansion (DECIMAL)	511
5.4	Denavit-Hartenberg Matrices	513
5.4.1	Homogeneous Transformations	513
5.4.2	Notation	513
5.4.3	Vectors	514
5.4.4	Planes	516
5.4.5	Transformations	517
5.4.6	Translation Transformation	518
5.4.7	Rotation Transformations	520
5.4.8	Coordinate Frames	523
5.4.9	Relative Transformations	524
5.4.10	Objects	525
5.4.11	Inverse Transformations	526
5.4.12	General Rotation Transformation	527
5.4.13	Equivalent Angle and Axis of Rotation	529
5.4.14	Example 1.1	533

5.4.15	Stretching and Scaling	534
5.4.16	Perspective Transformations	535
5.4.17	Transform Equations	537
5.4.18	Summary	537
5.4.19	DenavitHartenbergMatrix (DHMATRIX)	538
5.5	domain DEQUEUE Dequeue	541
5.5.1	Dequeue (DEQUEUE)	562
5.6	domain DERHAM DeRhamComplex	569
5.6.1	DeRhamComplex (DERHAM)	583
5.7	domain DSTREE DesingTree	587
5.7.1	DesingTree (DSTREE)	589
5.8	domain DSMP DifferentialSparseMultivariatePolynomial	592
5.8.1	DifferentialSparseMultivariatePolynomial (DSMP)	596
5.9	domain DIRPROD DirectProduct	599
5.9.1	DirectProduct (DIRPROD)	602
5.10	domain DPMM DirectProductMatrixModule	605
5.10.1	DirectProductMatrixModule (DPMM)	608
5.11	domain DPMO DirectProductModule	610
5.11.1	DirectProductModule (DPMO)	613
5.12	domain DIRRING DirichletRing	615
5.12.1	DirichletRing (DIRRING)	621
5.13	domain DMP DistributedMultivariatePolynomial	625
5.13.1	DistributedMultivariatePolynomial (DMP)	631
5.14	domain DIV Divisor	633
5.14.1	Divisor (DIV)	635
5.15	domain DFLOAT DoubleFloat	639
5.15.1	DoubleFloat (DFLOAT)	648
5.16	domain DFMAT DoubleFloatMatrix	657
5.16.1	DoubleFloatMatrix (DFMAT)	661
5.17	domain DFVEC DoubleFloatVector	663
5.17.1	DoubleFloatVector (DFVEC)	667
5.18	domain DROPT DrawOption	669
5.18.1	DrawOption (DROPT)	671
5.19	domain D01AJFA d01ajfAnnaType	676
5.19.1	d01ajfAnnaType (D01AJFA)	678
5.20	domain D01AKFA d01akfAnnaType	680
5.20.1	d01akfAnnaType (D01AKFA)	681
5.21	domain D01ALFA d01alfAnnaType	683
5.21.1	d01alfAnnaType (D01ALFA)	684
5.22	domain D01AMFA d01amfAnnaType	686
5.22.1	d01amfAnnaType (D01AMFA)	688
5.23	domain D01ANFA d01anfAnnaType	690
5.23.1	d01anfAnnaType (D01ANFA)	691
5.24	domain D01APFA d01apfAnnaType	693
5.24.1	d01apfAnnaType (D01APFA)	694
5.25	domain D01AQFA d01aqfAnnaType	696

5.25.1	d01aqfAnnaType (D01AQFA)	698
5.26	domain D01ASFA d01asfAnnaType	700
5.26.1	d01asfAnnaType (D01ASFA)	702
5.27	domain D01FCFA d01fcfAnnaType	704
5.27.1	d01fcfAnnaType (D01FCFA)	706
5.28	domain D01GBFA d01gbfAnnaType	708
5.28.1	d01gbfAnnaType (D01GBFA)	709
5.29	domain D01TRNS d01TransformFunctionType	711
5.29.1	d01TransformFunctionType (D01TRNS)	713
5.30	domain D02BBFA d02bbfAnnaType	717
5.30.1	d02bbfAnnaType (D02BBFA)	718
5.31	domain D02BHFA d02bhfAnnaType	721
5.31.1	d02bhfAnnaType (D02BHFA)	722
5.32	domain D02CJFA d02cjfAnnaType	725
5.32.1	d02cjfAnnaType (D02CJFA)	726
5.33	domain D02EJFA d02ejfAnnaType	728
5.33.1	d02ejfAnnaType (D02EJFA)	730
5.34	domain D03EEFA d03eefAnnaType	733
5.34.1	d03eefAnnaType (D03EEFA)	734
5.35	domain D03FAFA d03fafAnnaType	736
5.35.1	d03fafAnnaType (D03FAFA)	737
6	Chapter E	739
6.1	domain EQ Equation	739
6.1.1	Equation (EQ)	744
6.2	domain EQTBL EqTable	750
6.2.1	EqTable (EQTBL)	753
6.3	domain EMR EuclideanModularRing	755
6.3.1	EuclideanModularRing (EMR)	757
6.4	domain EXIT Exit	760
6.4.1	Exit (EXIT)	763
6.5	domain EXPEXPAN ExponentialExpansion	765
6.5.1	ExponentialExpansion (EXPEXPAN)	769
6.6	domain EXPR Expression	774
6.6.1	Expression (EXPR)	783
6.7	domain EXPUPXS ExponentialOfUnivariatePuisseuxSeries	797
6.7.1	ExponentialOfUnivariatePuisseuxSeries (EXPUPXS)	801
6.8	domain EAB ExtAlgBasis	804
6.8.1	ExtAlgBasis (EAB)	805
6.9	domain E04DGFA e04dgmAnnaType	808
6.9.1	e04dgmAnnaType (E04DGFA)	809
6.10	domain E04FDFA e04fdfAnnaType	811
6.10.1	e04fdfAnnaType (E04FDFA)	813
6.11	domain E04GCFA e04gcfAnnaType	816
6.11.1	e04gcfAnnaType (E04GCFA)	817
6.12	domain E04JAFA e04jafAnnaType	820

6.12.1	e04jafAnnaType (E04JAFA)	822
6.13	domain E04MBFA e04mbfAnnaType	825
6.13.1	e04mbfAnnaType (E04MBFA)	826
6.14	domain E04NAFA e04nafAnnaType	828
6.14.1	e04nafAnnaType (E04NAFA)	830
6.15	domain E04UCFA e04ucfAnnaType	833
6.15.1	e04ucfAnnaType (E04UCFA)	834
7	Chapter F	837
7.1	domain FR Factored	837
7.1.1	Factored (FR)	852
7.2	domain FILE File	865
7.2.1	File (FILE)	870
7.3	domain FNAME FileName	873
7.3.1	FileName (FNAME)	880
7.4	domain FDIV FiniteDivisor	882
7.4.1	FiniteDivisor (FDIV)	884
7.5	domain FF FiniteField	888
7.5.1	FiniteField (FF)	891
7.6	domain FFCG FiniteFieldCyclicGroup	894
7.6.1	FiniteFieldCyclicGroup (FFCG)	897
7.7	domain FFCGX FiniteFieldCyclicGroupExtension	900
7.7.1	FiniteFieldCyclicGroupExtension (FFCGX)	903
7.8	domain FFCGP FiniteFieldCyclicGroupExtensionByPolynomial	906
7.8.1	FiniteFieldCyclicGroupExtensionByPolynomial (FFCGP)	909
7.9	domain FFX FiniteFieldExtension	918
7.9.1	FiniteFieldExtension (FFX)	921
7.10	domain FFP FiniteFieldExtensionByPolynomial	924
7.10.1	FiniteFieldExtensionByPolynomial (FFP)	927
7.11	domain FFNB FiniteFieldNormalBasis	934
7.11.1	FiniteFieldNormalBasis (FFNB)	937
7.12	domain FFNBX FiniteFieldNormalBasisExtension	940
7.12.1	FiniteFieldNormalBasisExtension (FFNBX)	943
7.13	domain FFNBP FiniteFieldNormalBasisExtensionByPolynomial	946
7.13.1	FiniteFieldNormalBasisExtensionByPolynomial (FFNBP)	949
7.14	domain FARRAY FlexibleArray	959
7.14.1	FlexibleArray (FARRAY)	965
7.15	domain FLOAT Float	967
7.15.1	Float (FLOAT)	990
7.16	domain FC FortranCode	1013
7.16.1	FortranCode (FC)	1015
7.17	domain FEXPR FortranExpression	1029
7.17.1	FortranExpression (FEXPR)	1032
7.18	domain FORTRAN FortranProgram	1041
7.18.1	FortranProgram (FORTRAN)	1042
7.19	domain FST FortranScalarType	1048

7.19.1	FortranScalarType (FST)	1049
7.20	domain FTEM FortranTemplate	1053
7.20.1	FortranTemplate (FTEM)	1054
7.21	domain FT FortranType	1057
7.21.1	FortranType (FT)	1058
7.22	domain FCOMP FourierComponent	1061
7.22.1	FourierComponent (FCOMP)	1062
7.23	domain FSERIES FourierSeries	1064
7.23.1	FourierSeries (FSERIES)	1066
7.24	domain FRAC Fraction	1069
7.24.1	Fraction (FRAC)	1075
7.25	domain FRIDEAL FractionalIdeal	1084
7.25.1	FractionalIdeal (FRIDEAL)	1086
7.26	domain FRMOD FramedModule	1091
7.26.1	FramedModule (FRMOD)	1092
7.27	domain FAGROUP FreeAbelianGroup	1095
7.27.1	FreeAbelianGroup (FAGROUP)	1097
7.28	domain FAMONOID FreeAbelianMonoid	1099
7.28.1	FreeAbelianMonoid (FAMONOID)	1101
7.29	domain FGROUPE FreeGroup	1103
7.29.1	FreeGroup (FGROUPE)	1105
7.30	domain FM FreeModule	1107
7.30.1	FreeModule (FM)	1109
7.31	domain FM1 FreeModule1	1112
7.31.1	FreeModule1 (FM1)	1114
7.32	domain FMONOID FreeMonoid	1117
7.32.1	FreeMonoid (FMONOID)	1119
7.33	domain FNLA FreeNilpotentLie	1124
7.33.1	FreeNilpotentLie (FNLA)	1126
7.34	domain FPARFRAC FullPartialFractionExpansion	1130
7.34.1	FullPartialFractionExpansion (FPARFRAC)	1141
7.35	domain FUNCTION FunctionCalled	1146
7.35.1	FunctionCalled (FUNCTION)	1147
8	Chapter G	1149
8.1	domain GDMP GeneralDistributedMultivariatePolynomial	1149
8.1.1	GeneralDistributedMultivariatePolynomial (GDMP)	1155
8.2	domain GMODPOL GeneralModulePolynomial	1162
8.2.1	GeneralModulePolynomial (GMODPOL)	1164
8.3	domain GCNAALG GenericNonAssociativeAlgebra	1167
8.3.1	GenericNonAssociativeAlgebra (GCNAALG)	1170
8.4	domain GPOLSET GeneralPolynomialSet	1179
8.4.1	GeneralPolynomialSet (GPOLSET)	1181
8.5	domain GSTBL GeneralSparseTable	1184
8.5.1	GeneralSparseTable (GSTBL)	1186
8.6	domain GTSET GeneralTriangularSet	1188

8.6.1	GeneralTriangularSet (GTSET)	1191
8.7	domain GSERIES GeneralUnivariatePowerSeries	1196
8.7.1	GeneralUnivariatePowerSeries (GSERIES)	1200
8.8	domain GRIMAGE GraphImage	1204
8.8.1	GraphImage (GRIMAGE)	1206
8.9	domain GOPT GuessOption	1216
8.9.1	GuessOption (GOPT)	1218
8.10	domain GOPT0 GuessOptionFunctions0	1223
8.10.1	GuessOptionFunctions0 (GOPT0)	1225
9	Chapter H	1233
9.1	domain HASHTBL HashTable	1233
9.1.1	HashTable (HASHTBL)	1236
9.2	domain HEAP Heap	1238
9.2.1	Heap (HEAP)	1252
9.3	domain HEXADEC HexadecimalExpansion	1258
9.3.1	HexadecimalExpansion (HEXADEC)	1262
9.4	package HTMLFORM HTMLFormat	1264
9.4.1	Overview	1265
9.4.2	Why output to HTML?	1265
9.5	Using the formatter	1265
9.6	Form of the output	1266
9.7	Matrix Formatting	1266
9.8	Programmers Guide	1267
9.8.1	Future Developments	1267
9.8.2	HTMLFormat (HTMLFORM)	1273
9.9	domain HDP HomogeneousDirectProduct	1292
9.9.1	HomogeneousDirectProduct (HDP)	1295
9.10	domain HDMP HomogeneousDistributedMultivariatePolynomial	1297
9.10.1	HomogeneousDistributedMultivariatePolynomial (HDMP)	1303
9.11	domain HELLFDIV HyperellipticFiniteDivisor	1306
9.11.1	HyperellipticFiniteDivisor (HELLFDIV)	1308
10	Chapter I	1313
10.1	domain ICP InfClsPt	1313
10.1.1	InfClsPt (ICP)	1315
10.2	domain ICARD IndexCard	1317
10.2.1	IndexCard (ICARD)	1318
10.3	domain IBITS IndexedBits	1320
10.3.1	IndexedBits (IBITS)	1325
10.4	domain IDPAG IndexedDirectProductAbelianGroup	1327
10.4.1	IndexedDirectProductAbelianGroup (IDPAG)	1329
10.5	domain IDPAM IndexedDirectProductAbelianMonoid	1332
10.5.1	IndexedDirectProductAbelianMonoid (IDPAM)	1333
10.6	domain IDPO IndexedDirectProductObject	1336
10.6.1	IndexedDirectProductObject (IDPO)	1337

10.7 domain IDPOAM IndexedDirectProductOrderedAbelianMonoid .	1339
10.7.1 IndexedDirectProductOrderedAbelianMonoid (IDPOAM)	1340
10.8 domain IDPOAMS IndexedDirectProductOrderedAbelianMonoid-	
Sup	1342
10.8.1 IndexedDirectProductOrderedAbelianMonoidSup (IDPOAMS)	1344
10.9 domain INDE IndexedExponents	1346
10.9.1 IndexedExponents (INDE)	1348
10.10 domain IFARRAY IndexedFlexibleArray	1350
10.10.1 IndexedFlexibleArray (IFARRAY)	1353
10.11 domain ILIST IndexedList	1360
10.11.1 IndexedList (ILIST)	1364
10.12 domain IMATRIX IndexedMatrix	1370
10.12.1 IndexedMatrix (IMATRIX)	1373
10.13 domain IARRAY1 IndexedOneDimensionalArray	1376
10.13.1 IndexedOneDimensionalArray (IARRAY1)	1379
10.14 domain ISTRING IndexedString	1382
10.14.1 IndexedString (ISTRING)	1385
10.15 domain IARRAY2 IndexedTwoDimensionalArray	1391
10.15.1 IndexedTwoDimensionalArray (IARRAY2)	1393
10.16 domain IVECTOR IndexedVector	1395
10.16.1 IndexedVector (IVECTOR)	1398
10.17 domain ITUPLE InfiniteTuple	1399
10.17.1 InfiniteTuple (ITUPLE)	1401
10.18 domain INFCLSPT InfinitelyClosePoint	1403
10.18.1 InfinitelyClosePoint (INFCLSPT)	1405
10.19 domain INFCLSPS InfinitelyClosePointOverPseudoAlgebraicClo-	
sureOffFiniteField	1410
10.19.1 InfinitelyClosePointOverPseudoAlgebraicClosureOffFiniteField	
(INFCLSPS)	1412
10.20 domain IAN InnerAlgebraicNumber	1414
10.20.1 InnerAlgebraicNumber (IAN)	1417
10.21 domain IFF InnerFiniteField	1422
10.21.1 InnerFiniteField (IFF)	1425
10.22 domain IFAMON InnerFreeAbelianMonoid	1428
10.22.1 InnerFreeAbelianMonoid (IFAMON)	1430
10.23 domain IIARRAY2 InnerIndexedTwoDimensionalArray	1432
10.23.1 InnerIndexedTwoDimensionalArray (IIARRAY2)	1434
10.24 domain IPADIC InnerPAdicInteger	1437
10.24.1 InnerPAdicInteger (IPADIC)	1439
10.25 domain IPF InnerPrimeField	1446
10.25.1 InnerPrimeField (IPF)	1449
10.26 domain ISUPS InnerSparseUnivariatePowerSeries	1454
10.26.1 InnerSparseUnivariatePowerSeries (ISUPS)	1457
10.27 domain INTABL InnerTable	1482
10.27.1 InnerTable (INTABL)	1485
10.28 domain ITAYLOR InnerTaylorSeries	1487

10.28.1 InnerTaylorSeries (ITAYLOR)	1489
10.29domain INFORM InputForm	1493
10.29.1 InputForm (INFORM)	1495
10.30domain INT Integer	1500
10.30.1 Integer (INT)	1515
10.31domain ZMOD IntegerMod	1520
10.31.1 IntegerMod (ZMOD)	1522
10.32domain INTFTBL IntegrationFunctionsTable	1525
10.32.1 IntegrationFunctionsTable (INTFTBL)	1526
10.33domain IR IntegrationResult	1529
10.33.1 IntegrationResult (IR)	1531
10.34domain INTRVL Interval	1536
10.34.1 Interval (INTRVL)	1541
11 Chapter J	1553
12 Chapter K	1555
12.1 domain KERNEL Kernel	1555
12.1.1 Kernel (KERNEL)	1563
12.2 domain KAFILE KeyedAccessFile	1567
12.2.1 KeyedAccessFile (KAFILE)	1574
13 Chapter L	1579
13.1 domain LAUPOL LaurentPolynomial	1579
13.1.1 LaurentPolynomial (LAUPOL)	1582
13.2 domain LIB Library	1587
13.2.1 Library (LIB)	1590
13.3 domain LEXP LieExponentials	1592
13.3.1 LieExponentials (LEX)	1597
13.4 domain LPOLY LiePolynomial	1601
13.4.1 LiePolynomial (LPOLY)	1611
13.5 domain LSQM LieSquareMatrix	1616
13.5.1 LieSquareMatrix (LSQM)	1620
13.6 domain LODO LinearOrdinaryDifferentialOperator	1624
13.6.1 LinearOrdinaryDifferentialOperator (LODO)	1636
13.7 domain LODO1 LinearOrdinaryDifferentialOperator1	1638
13.7.1 LinearOrdinaryDifferentialOperator1 (LODO1)	1648
13.8 domain LODO2 LinearOrdinaryDifferentialOperator2	1650
13.8.1 LinearOrdinaryDifferentialOperator2 (LODO2)	1662
13.9 domain LIST List	1664
13.9.1 List (LIST)	1678
13.10domain LMOPS ListMonoidOps	1682
13.10.1 ListMonoidOps (LMOPS)	1684
13.11domain LMDICT ListMultiDictionary	1689
13.11.1 ListMultiDictionary (LMDICT)	1691
13.12domain LA LocalAlgebra	1695

13.12.1	LocalAlgebra (LA)	1697
13.13	domain LO Localize	1699
13.13.1	Localize (LO)	1701
13.14	domain LWORD LyndonWord	1704
13.14.1	LyndonWord (LWORD)	1712
14	Chapter M	1717
14.1	domain MCMPLX MachineComplex	1717
14.1.1	MachineComplex (MCMPLX)	1723
14.2	domain MFLOAT MachineFloat	1727
14.2.1	MachineFloat (MFLOAT)	1730
14.3	domain MINT MachineInteger	1738
14.3.1	MachineInteger (MINT)	1741
14.4	domain MAGMA Magma	1744
14.4.1	Magma (MAGMA)	1752
14.5	domain MKCHSET MakeCachableSet	1756
14.5.1	MakeCachableSet (MKCHSET)	1757
14.6	domain MMLFORM MathMLFormat	1759
14.6.1	Introduction to Mathematical Markup Language	1760
14.6.2	Displaying MathML	1760
14.6.3	Test Cases	1761
14.6.4	)set output mathml on	1761
14.6.5	File src/interp/setvars.boot.pamphlet	1762
14.6.6	File setvar.boot.pamphlet	1762
14.6.7	File src/algebra/Makefile.pamphlet	1763
14.6.8	File src/algebra/exposed.lsp.pamphlet	1763
14.6.9	File src/algebra/Lattice.pamphlet	1763
14.6.10	File src/doc/axiom.bib.pamphlet	1763
14.6.11	File interp/i-output.boot.pamphlet	1764
14.6.12	Public Declarations	1764
14.6.13	Private Constant Declarations	1767
14.6.14	Private Function Declarations	1769
14.6.15	Public Function Definitions	1771
14.6.16	Private Function Definitions	1773
14.6.17	Mathematical Markup Language Form	1792
14.6.18	MathMLForm (MMLFORM)	1796
14.7	domain MATRIX Matrix	1797
14.7.1	Matrix (MATRIX)	1818
14.8	domain MODMON ModMonic	1823
14.8.1	ModMonic (MODMON)	1828
14.9	domain MODFIELD ModularField	1834
14.9.1	ModularField (MODFIELD)	1836
14.10	domain MODRING ModularRing	1838
14.10.1	ModularRing (MODRING)	1840
14.11	domain MODMONOM ModuleMonomial	1843
14.11.1	ModuleMonomial (MODMONOM)	1844

14.12domain MODOP ModuleOperator	1846
14.12.1 ModuleOperator (MODOP)	1848
14.13domain MOEBIUS MoebiusTransform	1854
14.13.1 MoebiusTransform (MOEBIUS)	1856
14.14domain MRING MonoidRing	1859
14.14.1 MonoidRing (MRING)	1861
14.15domain MSET Multiset	1869
14.15.1 Multiset (MSET)	1875
14.16domain MPOLY MultivariatePolynomial	1882
14.16.1 MultivariatePolynomial (MPOLY)	1888
14.17domain MYEXPR MyExpression	1891
14.17.1 MyExpression (MYEXPR)	1896
14.18domain MYUP MyUnivariatePolynomial	1899
14.18.1 MyUnivariatePolynomial (MYUP)	1904
15 Chapter N	1907
15.1 domain NSDPS NeitherSparseOrDensePowerSeries	1907
15.1.1 NeitherSparseOrDensePowerSeries (NSDPS)	1912
15.2 domain NSMP NewSparseMultivariatePolynomial	1920
15.2.1 NewSparseMultivariatePolynomial (NSMP)	1925
15.3 domain NSUP NewSparseUnivariatePolynomial	1936
15.3.1 NewSparseUnivariatePolynomial (NSUP)	1941
15.4 domain NONE None	1949
15.4.1 None (NONE)	1951
15.5 domain NNI NonNegativeInteger	1952
15.5.1 NonNegativeInteger (NNI)	1954
15.6 domain NOTTING NottinghamGroup	1956
15.6.1 NottinghamGroup (NOTTING)	1960
15.7 domain NIPROB NumericalIntegrationProblem	1961
15.7.1 NumericalIntegrationProblem (NIPROB)	1963
15.8 domain ODEPROB NumericalODEProblem	1965
15.8.1 NumericalODEProblem (ODEPROB)	1966
15.9 domain OPTPROB NumericalOptimizationProblem	1968
15.9.1 NumericalOptimizationProblem (OPTPROB)	1969
15.10domain PDEPROB NumericalPDEProblem	1971
15.10.1 NumericalPDEProblem (PDEPROB)	1972
16 Chapter O	1975
16.1 domain OCT Octonion	1975
16.1.1 Octonion (OCT)	1983
16.2 domain ODEIFTBL ODEIntensityFunctionsTable	1985
16.2.1 ODEIntensityFunctionsTable (ODEIFTBL)	1987
16.3 domain ARRAY1 OneDimensionalArray	1990
16.3.1 OneDimensionalArray (ARRAY1)	1994
16.4 domain ONECOMP OnePointCompletion	1996
16.4.1 OnePointCompletion (ONECOMP)	1998

16.5	domain OMCONN OpenMathConnection	2001
16.5.1	OpenMathConnection (OMCONN)	2002
16.6	domain OMDEV OpenMathDevice	2004
16.6.1	OpenMathDevice (OMDEV)	2006
16.7	domain OMENC OpenMathEncoding	2011
16.7.1	OpenMathEncoding (OMENC)	2012
16.8	domain OMERR OpenMathError	2014
16.8.1	OpenMathError (OMERR)	2015
16.9	domain OMERRK OpenMathErrorKind	2017
16.9.1	OpenMathErrorKind (OMERRK)	2018
16.10	domain OP Operator	2020
16.10.1	Operator (OP)	2029
16.11	domain OMLO OppositeMonogenicLinearOperator	2030
16.11.1	OppositeMonogenicLinearOperator (OMLO)	2032
16.12	domain ORDCOMP OrderedCompletion	2034
16.12.1	OrderedCompletion (ORDCOMP)	2036
16.13	domain ODP OrderedDirectProduct	2040
16.13.1	OrderedDirectProduct (ODP)	2043
16.14	domain OFMONOID OrderedFreeMonoid	2045
16.14.1	OrderedFreeMonoid (OFMONOID)	2057
16.15	domain OVAR OrderedVariableList	2063
16.15.1	OrderedVariableList (OVAR)	2066
16.16	domain ODPOL OrderlyDifferentialPolynomial	2068
16.16.1	OrderlyDifferentialPolynomial (ODPOL)	2083
16.17	domain ODVAR OrderlyDifferentialVariable	2086
16.17.1	OrderlyDifferentialVariable (ODVAR)	2087
16.18	domain ODR OrdinaryDifferentialRing	2089
16.18.1	OrdinaryDifferentialRing (ODR)	2091
16.19	domain OWP OrdinaryWeightedPolynomials	2093
16.19.1	OrdinaryWeightedPolynomials (OWP)	2095
16.20	domain OSI OrdSetInts	2097
16.20.1	OrdSetInts (OSI)	2098
16.21	domain OUTFORM OutputForm	2100
16.21.1	OutputForm (OUTFORM)	2102
17	Chapter P	2113
17.1	domain PADIC PAdicInteger	2113
17.1.1	PAdicInteger (PADIC)	2115
17.2	domain PADICRAT PAdicRational	2117
17.2.1	PAdicRational (PADICRAT)	2121
17.3	domain PADICRC PAdicRationalConstructor	2124
17.3.1	PAdicRationalConstructor (PADICRC)	2128
17.4	domain PALETTE Palette	2134
17.4.1	Palette (PALETTE)	2135
17.5	domain PARPCURV ParametricPlaneCurve	2137
17.5.1	ParametricPlaneCurve (PARPCURV)	2138

17.6 domain PARSCURV ParametricSpaceCurve	2139
17.6.1 ParametricSpaceCurve (PARSCURV)	2141
17.7 domain PARSURF ParametricSurface	2143
17.7.1 ParametricSurface (PARSURF)	2144
17.8 domain PFR PartialFraction	2146
17.8.1 PartialFraction (PFR)	2156
17.9 domain PRITITION Partition	2165
17.9.1 Partition (PRITITION)	2166
17.10domain PATTERN Pattern	2170
17.10.1 Pattern (PATTERN)	2172
17.11domain PATLRES PatternMatchListResult	2181
17.11.1 PatternMatchListResult (PATLRES)	2182
17.12domain PATRES PatternMatchResult	2184
17.12.1 PatternMatchResult (PATRES)	2185
17.13domain PENDTREE PendantTree	2188
17.13.1 PendantTree (PENDTREE)	2190
17.14domain PERM Permutation	2192
17.14.1 Permutation (PERM)	2195
17.15domain PERMGRP PermutationGroup	2205
17.15.1 PermutationGroup (PERMGRP)	2207
17.16domain HACKPI Pi	2225
17.16.1 Pi (HACKPI)	2227
17.17domain ACPLLOT PlaneAlgebraicCurvePlot	2230
17.17.1 PlaneAlgebraicCurvePlot (ACPLLOT)	2245
17.18domain PLACES Places	2272
17.18.1 Places (PLACES)	2273
17.19domain PLACESPS PlacesOverPseudoAlgebraicClosureOfFinite- Field	2275
17.19.1 PlacesOverPseudoAlgebraicClosureOfFiniteField (PLACE- SPS)	2277
17.20domain PLCS Plcs	2278
17.20.1 Plcs (PLCS)	2280
17.21domain PLOT Plot	2284
17.21.1 Plot (PLOT)	2287
17.22domain PLOT3D Plot3D	2300
17.22.1 Plot3D (PLOT3D)	2302
17.23domain PBWLB PoincareBirkhoffWittLyndonBasis	2314
17.23.1 PoincareBirkhoffWittLyndonBasis (PBWLB)	2316
17.24domain POINT Point	2319
17.24.1 Point (POINT)	2322
17.25domain POLY Polynomial	2324
17.25.1 Polynomial (POLY)	2342
17.26domain IDEAL PolynomialIdeals	2345
17.26.1 PolynomialIdeals (IDEAL)	2347
17.27domain PR PolynomialRing	2357
17.27.1 PolynomialRing (PR)	2359

17.28	domain PI PositiveInteger	2367
17.28.1	PositiveInteger (PI)	2368
17.29	domain PF PrimeField	2370
17.29.1	PrimeField (PF)	2373
17.30	domain PRIMARR PrimitiveArray	2376
17.30.1	PrimitiveArray (PRIMARR)	2379
17.31	domain PRODUCT Product	2381
17.31.1	Product (PRODUCT)	2383
17.32	domain PROJPL ProjectivePlane	2386
17.32.1	ProjectivePlane (PROJPL)	2387
17.33	domain PROJPLPS ProjectivePlaneOverPseudoAlgebraicClosure- OfFiniteField	2389
17.33.1	ProjectivePlaneOverPseudoAlgebraicClosureOfFiniteField (PROJPLPS)	2390
17.34	domain PROJSP ProjectiveSpace	2392
17.34.1	ProjectiveSpace (PROJSP)	2394
17.35	domain PACEXT PseudoAlgebraicClosureOfAlgExtOfRational- Number	2397
17.35.1	PseudoAlgebraicClosureOfAlgExtOfRationalNumber (PACEXT)	2398
17.36	domain PACOFF PseudoAlgebraicClosureOfFiniteField	2406
17.36.1	PseudoAlgebraicClosureOfFiniteField (PACOFF)	2409
17.37	domain PACRAT PseudoAlgebraicClosureOfRationalNumber	2418
17.37.1	PseudoAlgebraicClosureOfRationalNumber (PACRAT)	2421
18	Chapter Q	2429
18.1	domain QFORM QuadraticForm	2429
18.1.1	QuadraticForm (QFORM)	2431
18.2	domain QALGSET QuasiAlgebraicSet	2433
18.2.1	QuasiAlgebraicSet (QALGSET)	2434
18.3	domain QUAT Quaternion	2439
18.3.1	Quaternion (QUAT)	2445
18.4	domain QEQUAT QueryEquation	2447
18.4.1	QueryEquation (QEQUAT)	2448
18.5	domain QUEUE Queue	2450
18.5.1	Queue (QUEUE)	2466
19	Chapter R	2471
19.1	domain RADFF RadicalFunctionField	2471
19.1.1	RadicalFunctionField (RADFF)	2476
19.2	domain RADIX RadixExpansion	2483
19.2.1	RadixExpansion (RADIX)	2490
19.3	domain RECLOS RealClosure	2498
19.3.1	RealClosure (RECLOS)	2526
19.4	domain RMATRIX RectangularMatrix	2534
19.4.1	RectangularMatrix (RMATRIX)	2536
19.5	domain REF Reference	2539

19.5.1	Reference (REF)	2540
19.6	domain RGCHAIN RegularChain	2542
19.6.1	RegularChain (RGCHAIN)	2546
19.7	domain REGSET RegularTriangularSet	2549
19.7.1	RegularTriangularSet (REGSET)	2579
19.8	domain RESRING ResidueRing	2590
19.8.1	ResidueRing (RESRING)	2592
19.9	domain RESULT Result	2594
19.9.1	Result (RESULT)	2597
19.10	domain RULE RewriteRule	2600
19.10.1	RewriteRule (RULE)	2601
19.11	domain ROIRC RightOpenIntervalRootCharacterization	2605
19.11.1	RightOpenIntervalRootCharacterization (ROIRC)	2607
19.12	domain ROMAN RomanNumeral	2618
19.12.1	RomanNumeral (ROMAN)	2625
19.13	domain ROUTINE RoutinesTable	2627
19.13.1	RoutinesTable (ROUTINE)	2630
19.14	domain RULECOLD RuleCalled	2640
19.14.1	RuleCalled (RULECOLD)	2641
19.15	domain RULESET Ruleset	2642
19.15.1	Ruleset (RULESET)	2643
20	Chapter S	2645
20.1	domain FORMULA ScriptFormulaFormat	2645
20.1.1	ScriptFormulaFormat (FORMULA)	2647
20.2	domain SEG Segment	2657
20.2.1	Segment (SEG)	2661
20.3	domain SEGBIND SegmentBinding	2664
20.3.1	SegmentBinding (SEGBIND)	2668
20.4	domain SET Set	2670
20.4.1	Set (SET)	2677
20.5	domain SETMN SetOfMIntegersInOneToN	2682
20.5.1	SetOfMIntegersInOneToN (SETMN)	2683
20.6	domain SDPOL SequentialDifferentialPolynomial	2687
20.6.1	SequentialDifferentialPolynomial (SDPOL)	2692
20.7	domain SDVAR SequentialDifferentialVariable	2695
20.7.1	SequentialDifferentialVariable (SDVAR)	2696
20.8	domain SEX SExpression	2698
20.8.1	SExpression (SEX)	2699
20.9	domain SEXOF SExpressionOf	2701
20.9.1	SExpressionOf (SEXOF)	2703
20.10	domain SAE SimpleAlgebraicExtension	2706
20.10.1	SimpleAlgebraicExtension (SAE)	2710
20.11	domain SFORT SimpleFortranProgram	2715
20.11.1	SimpleFortranProgram (SFORT)	2716
20.12	domain SINT SingleInteger	2719

20.12.1 SingleInteger (SINT)	2724
20.13domain SAOS SingletonAsOrderedSet	2729
20.13.1 SingletonAsOrderedSet (SAOS)	2731
20.14domain SMP SparseMultivariatePolynomial	2732
20.14.1 SparseMultivariatePolynomial (SMP)	2736
20.15domain SMTS SparseMultivariateTaylorSeries	2751
20.15.1 SparseMultivariateTaylorSeries (SMTS)	2757
20.16domain STBL SparseTable	2764
20.16.1 SparseTable (STBL)	2768
20.17domain SULS SparseUnivariateLaurentSeries	2770
20.17.1 SparseUnivariateLaurentSeries (SULS)	2775
20.18domain SUP SparseUnivariatePolynomial	2782
20.18.1 SparseUnivariatePolynomial (SUP)	2787
20.19domain SUEXPR SparseUnivariatePolynomialExpressions	2797
20.19.1 SparseUnivariatePolynomialExpressions (SUEXPR)	2803
20.20domain SUPXS SparseUnivariatePuisseuxSeries	2807
20.20.1 SparseUnivariatePuisseuxSeries (SUPXS)	2811
20.21domain ORESUP SparseUnivariateSkewPolynomial	2814
20.21.1 SparseUnivariateSkewPolynomial (ORESUP)	2816
20.22domain SUTS SparseUnivariateTaylorSeries	2818
20.22.1 SparseUnivariateTaylorSeries (SUTS)	2821
20.23domain SHDP SplitHomogeneousDirectProduct	2831
20.23.1 SplitHomogeneousDirectProduct (SHDP)	2834
20.24domain SPLNODE SplittingNode	2836
20.24.1 SplittingNode (SPLNODE)	2837
20.25domain SPLTREE SplittingTree	2841
20.25.1 SplittingTree (SPLTREE)	2843
20.26domain SREGSET SquareFreeRegularTriangularSet	2851
20.26.1 SquareFreeRegularTriangularSet (SREGSET)	2862
20.27domain SQMATRIX SquareMatrix	2873
20.27.1 SquareMatrix (SQMATRIX)	2877
20.28domain STACK Stack	2881
20.28.1 Stack (STACK)	2894
20.29domain STREAM Stream	2899
20.29.1 Stream (STREAM)	2904
20.30domain STRING String	2920
20.30.1 String (STRING)	2932
20.31domain STRTBL StringTable	2934
20.31.1 StringTable (STRTBL)	2936
20.32domain SUBSPACE SubSpace	2938
20.32.1 SubSpace (SUBSPACE)	2941
20.33domain COMPPROP SubSpaceComponentProperty	2951
20.33.1 SubSpaceComponentProperty (COMPPROP)	2952
20.34domain SUCH SuchThat	2954
20.34.1 SuchThat (SUCH)	2955
20.35domain SWITCH Switch	2956

20.35.1 Switch (SWITCH)	2958
20.36domain SYMBOL Symbol	2961
20.36.1 Symbol (SYMBOL)	2970
20.37domain SYMTAB SymbolTable	2978
20.37.1 SymbolTable (SYMTAB)	2979
20.38domain SYMPOLY SymmetricPolynomial	2984
20.38.1 SymmetricPolynomial (SYMPOLY)	2986
21 Chapter T	2989
21.1 domain TABLE Table	2989
21.1.1 Table (TABLE)	2997
21.2 domain TABLEAU Tableau	2999
21.2.1 Tableau (TABLEAU)	3000
21.3 domain TS TaylorSeries	3002
21.3.1 TaylorSeries (TS)	3005
21.4 domain TEX TexFormat	3007
21.4.1 product(product(i*j,i=a..b),j=c..d) fix	3007
21.4.2 TexFormat (TEX)	3012
21.5 domain TEXTFILE TextFile	3026
21.5.1 TextFile (TEXTFILE)	3030
21.6 domain SYMS TheSymbolTable	3033
21.6.1 TheSymbolTable (SYMS)	3035
21.7 domain M3D ThreeDimensionalMatrix	3041
21.7.1 ThreeDimensionalMatrix (M3D)	3043
21.8 domain VIEW3D ThreeDimensionalViewport	3050
21.8.1 ThreeDimensionalViewport (VIEW3D)	3052
21.9 domain SPACE3 ThreeSpace	3074
21.9.1 ThreeSpace (SPACE3)	3076
21.10domain TREE Tree	3085
21.10.1 Tree (TREE)	3087
21.11domain TUBE TubePlot	3095
21.11.1 TubePlot (TUBE)	3096
21.12domain TUPLE Tuple	3098
21.12.1 Tuple (TUPLE)	3099
21.13domain ARRAY2 TwoDimensionalArray	3101
21.13.1 TwoDimensionalArray (ARRAY2)	3112
21.14domain VIEW2D TwoDimensionalViewport	3114
21.14.1 TwoDimensionalViewport (VIEW2D)	3120
22 Chapter U	3135
22.1 domain UFPS UnivariateFormalPowerSeries	3135
22.1.1 UnivariateFormalPowerSeries (UFPS)	3139
22.2 domain ULS UnivariateLaurentSeries	3141
22.2.1 UnivariateLaurentSeries (ULS)	3146
22.3 domain ULSCONS UnivariateLaurentSeriesConstructor	3150
22.3.1 UnivariateLaurentSeriesConstructor (ULSCONS)	3155

22.4	domain UP UnivariatePolynomial	3167
22.4.1	UnivariatePolynomial (UP)	3182
22.5	domain UPXS UnivariatePuisseuxSeries	3185
22.5.1	UnivariatePuisseuxSeries (UPXS)	3189
22.6	domain UPXSCONS UnivariatePuisseuxSeriesConstructor	3194
22.6.1	UnivariatePuisseuxSeriesConstructor (UPXSCONS)	3198
22.7	domain UPXSING UnivariatePuisseuxSeriesWithExponentialSingularity	3207
22.7.1	UnivariatePuisseuxSeriesWithExponentialSingularity (UPXSING)	3209
22.8	domain OREUP UnivariateSkewPolynomial	3216
22.8.1	UnivariateSkewPolynomial (OREUP)	3232
22.9	domain UTS UnivariateTaylorSeries	3234
22.9.1	UnivariateTaylorSeries (UTS)	3238
22.10	domain UTSZ UnivariateTaylorSeriesCZero	3245
22.10.1	UnivariateTaylorSeriesCZero (UTSZ)	3249
22.11	domain UNISEG UniversalSegment	3256
22.11.1	UniversalSegment (UNISEG)	3260
22.12	domain U32VEC U32Vector	3264
22.12.1	U32Vector (U32VEC)	3267
23	Chapter V	3269
23.1	domain VARIABLE Variable	3269
23.1.1	Variable (VARIABLE)	3270
23.2	domain VECTOR Vector	3272
23.2.1	Vector (VECTOR)	3278
23.3	domain VOID Void	3280
23.3.1	Void (VOID)	3283
24	Chapter W	3285
24.1	domain WP WeightedPolynomials	3285
24.1.1	WeightedPolynomials (WP)	3287
24.2	domain WUTSET WuWenTsunTriangularSet	3290
24.2.1	WuWenTsunTriangularSet (WUTSET)	3298
25	Chapter X	3307
25.1	domain XDPOLY XDistributedPolynomial	3307
25.1.1	XDistributedPolynomial (XDPOLY)	3310
25.2	domain XPBWPOLY XPBWPolynomial	3313
25.2.1	XPBWPolynomial (XPBWPOLY)	3332
25.3	domain XPOLY XPolynomial	3338
25.3.1	XPolynomial (XPOLY)	3344
25.4	domain XPR XPolynomialRing	3346
25.4.1	XPolynomialRing (XPR)	3356
25.5	domain XRPOLY XRecursivePolynomial	3361
25.5.1	XRecursivePolynomial (XRPOLY)	3363

<i>CONTENTS</i>	161
26 Chapter Y	3371
27 Chapter Z	3373
28 The bootstrap code	3375
28.1 BOOLEAN.lsp	3375
28.2 CHAR.lsp BOOTSTRAP	3381
28.3 DFLOAT.lsp BOOTSTRAP	3385
28.4 ILIST.lsp BOOTSTRAP	3403
28.5 INT.lsp BOOTSTRAP	3417
28.6 ISTRING.lsp BOOTSTRAP	3429
28.7 LIST.lsp BOOTSTRAP	3449
28.8 NNI.lsp BOOTSTRAP	3456
28.9 OUTFORM.lsp BOOTSTRAP	3460
28.10PI.lsp BOOTSTRAP	3475
28.11PRIMARR.lsp BOOTSTRAP	3478
28.12REF.lsp BOOTSTRAP	3482
28.13SINT.lsp BOOTSTRAP	3485
28.14SYMBOL.lsp BOOTSTRAP	3500
28.15VECTOR.lsp BOOTSTRAP	3518
29 Chunk collections	3521
30 Index	3531

Volume 10.4: Axiom Algebra: Packages

1	Chapter Overview	1
2	Chapter A	3
2.1	package AFALGGRO AffineAlgebraicSetComputeWithGroebner- Basis	3
2.1.1	AffineAlgebraicSetComputeWithGroebnerBasis (AFALGGRO)	5
2.2	package AFALGRES AffineAlgebraicSetComputeWithResultant .	9
2.2.1	AffineAlgebraicSetComputeWithResultant (AFALGRES)	11
2.3	package AF AlgebraicFunction	15
2.3.1	AlgebraicFunction (AF)	15
2.4	package INTHERAL AlgebraicHermiteIntegration	21
2.4.1	AlgebraicHermiteIntegration (INTHERAL)	21
2.5	package INTALG AlgebraicIntegrate	24
2.5.1	AlgebraicIntegrate (INTALG)	24
2.6	package INTAF AlgebraicIntegration	32
2.6.1	AlgebraicIntegration (INTAF)	32
2.7	package ALGMANIP AlgebraicManipulations	35
2.7.1	AlgebraicManipulations (ALGMANIP)	35
2.8	package ALGMFACT AlgebraicMultFact	40
2.8.1	AlgebraicMultFact (ALGMFACT)	40
2.9	package ALGPKG AlgebraPackage	42
2.9.1	AlgebraPackage (ALGPKG)	42
2.10	package ALGFACT AlgFactor	53
2.10.1	AlgFactor (ALGFACT)	53
2.11	package INTPACK AnnaNumericalIntegrationPackage	56
2.11.1	AnnaNumericalIntegrationPackage (INTPACK)	56
2.12	package OPTPACK AnnaNumericalOptimizationPackage	68
2.12.1	AnnaNumericalOptimizationPackage (OPTPACK)	68
2.13	package ODEPACK AnnaOrdinaryDifferentialEquationPackage .	78
2.13.1	AnnaOrdinaryDifferentialEquationPackage (ODEPACK)	78
2.14	package PDEPACK AnnaPartialDifferentialEquationPackage . .	88
2.14.1	AnnaPartialDifferentialEquationPackage (PDEPACK)	88
2.15	package ANY1 AnyFunctions1	95
2.15.1	AnyFunctions1 (ANY1)	95
2.16	package API ApplicationProgramInterface	97
2.16.1	ApplicationProgramInterface (API)	102
2.17	package APPRULE ApplyRules	104
2.17.1	ApplyRules (APPRULE)	104
2.18	package APPLYORE ApplyUnivariateSkewPolynomial	108
2.18.1	ApplyUnivariateSkewPolynomial (APPLYORE)	108
2.19	package ASSOCEQ AssociatedEquations	110
2.19.1	AssociatedEquations (ASSOCEQ)	110
2.20	package PMPRED AttachPredicates	113

2.20.1	AttachPredicates (PMPRED)	113
2.21	package AXSERV AxiomServer	115
2.21.1	AxiomServer (AXSERV)	115
3	Chapter B	135
3.1	package BALFACT BalancedFactorisation	135
3.1.1	BalancedFactorisation (BALFACT)	135
3.2	package BOP1 BasicOperatorFunctions1	137
3.2.1	BasicOperatorFunctions1 (BOP1)	137
3.3	package BEZIER Bezier	141
3.3.1	Bezier (BEZIER)	146
3.4	package BEZOUT BezoutMatrix	148
3.4.1	BezoutMatrix (BEZOUT)	148
3.5	package BLUPPACK BlowUpPackage	152
3.5.1	BlowUpPackage (BLUPPACK)	153
3.6	package BOUNDZRO BoundIntegerRoots	159
3.6.1	BoundIntegerRoots (BOUNDZRO)	159
3.7	package BRILL BrillhartTests	162
3.7.1	BrillhartTests (BRILL)	162
4	Chapter C	165
4.1	package CARTEN2 CartesianTensorFunctions2	165
4.1.1	CartesianTensorFunctions2 (CARTEN2)	165
4.2	package CHVAR ChangeOfVariable	167
4.2.1	ChangeOfVariable (CHVAR)	167
4.3	package CPIMA CharacteristicPolynomialInMonogenicalAlgebra	171
4.3.1	CharacteristicPolynomialInMonogenicalAlgebra (CPIMA)	171
4.4	package CHARPOL CharacteristicPolynomialPackage	173
4.4.1	CharacteristicPolynomialPackage (CHARPOL)	173
4.5	package IBACHIN ChineseRemainderToolsForIntegralBases	175
4.5.1	ChineseRemainderToolsForIntegralBases (IBACHIN)	175
4.6	package CVMP CoerceVectorMatrixPackage	180
4.6.1	CoerceVectorMatrixPackage (CVMP)	180
4.7	package COMBF CombinatorialFunction	182
4.7.1	CombinatorialFunction (COMBF)	186
4.8	package CDEN CommonDenominator	199
4.8.1	CommonDenominator (CDEN)	199
4.9	package COMMONOP CommonOperators	201
4.9.1	CommonOperators (COMMONOP)	201
4.10	package COMMUPC CommuteUnivariatePolynomialCategory	206
4.10.1	CommuteUnivariatePolynomialCategory (COMMUPC)	206
4.11	package COMPFAC ComplexFactorization	208
4.11.1	ComplexFactorization (COMPFAC)	208
4.12	package COMPLEX2 ComplexFunctions2	211
4.12.1	ComplexFunctions2 (COMPLEX2)	211

4.13	package CINTSLPE ComplexIntegerSolveLinearPolynomialEquation	212
4.13.1	ComplexIntegerSolveLinearPolynomialEquation (CINTSLPE)	212
4.14	package COMPLPAT ComplexPattern	214
4.14.1	ComplexPattern (COMPLPAT)	214
4.15	package CPMATCH ComplexPatternMatch	216
4.15.1	ComplexPatternMatch (CPMATCH)	216
4.16	package CRFP ComplexRootFindingPackage	218
4.16.1	ComplexRootFindingPackage (CRFP)	218
4.17	package CMPLXRT ComplexRootPackage	232
4.17.1	ComplexRootPackage (CMPLXRT)	232
4.18	package CTRIGMNP ComplexTrigonometricManipulations	234
4.18.1	ComplexTrigonometricManipulations (CTRIGMNP)	234
4.19	package ODECONST ConstantLODE	237
4.19.1	ConstantLODE (ODECONST)	237
4.20	package COORDSYS CoordinateSystems	240
4.20.1	CoordinateSystems (COORDSYS)	240
4.21	package CRAPACK CRApackage	245
4.21.1	CRApackage (CRAPACK)	245
4.22	package CYCLES CycleIndicators	248
4.22.1	CycleIndicators (CYCLES)	269
4.23	package CSTTOOLS CyclicStreamTools	275
4.23.1	CyclicStreamTools (CSTTOOLS)	275
4.24	package CYCLOTOM CyclotomicPolynomialPackage	277
4.24.1	CyclotomicPolynomialPackage (CYCLOTOM)	277
5	Chapter D	279
5.1	package DFINTTLS DefiniteIntegrationTools	279
5.1.1	DefiniteIntegrationTools (DFINTTLS)	279
5.2	package DEGRED DegreeReductionPackage	286
5.2.1	DegreeReductionPackage (DEGRED)	286
5.3	package DTP DesingTreePackage	288
5.3.1	DesingTreePackage (DTP)	289
5.4	package DIOSP DiophantineSolutionPackage	299
5.4.1	DiophantineSolutionPackage (DIOSP)	299
5.5	package DIRPROD2 DirectProductFunctions2	304
5.5.1	DirectProductFunctions2 (DIRPROD2)	304
5.6	package DLP DiscreteLogarithmPackage	306
5.6.1	DiscreteLogarithmPackage (DLP)	306
5.7	package DISPLAY DisplayPackage	309
5.7.1	DisplayPackage (DISPLAY)	309
5.8	package DDFACT DistinctDegreeFactorize	313
5.8.1	DistinctDegreeFactorize (DDFACT)	313
5.9	package DFSFUN DoubleFloatSpecialFunctions	319
5.9.1	DoubleFloatSpecialFunctions (DFSFUN)	335
5.9.2	The Exponential Integral	340

5.9.3	En:(PI,R)→OPR	346
5.9.4	The Ei Function	347
5.9.5	The Fresnel Integral[?, ?]	374
5.10	package DBLRESP DoubleResultantPackage	379
5.10.1	DoubleResultantPackage (DBLRESP)	379
5.11	package DRAWCX DrawComplex	381
5.11.1	DrawComplex (DRAWCX)	381
5.12	package DRAWHACK DrawNumericHack	386
5.12.1	DrawNumericHack (DRAWHACK)	386
5.13	package DROPT0 DrawOptionFunctions0	388
5.13.1	DrawOptionFunctions0 (DROPT0)	388
5.14	package DROPT1 DrawOptionFunctions1	393
5.14.1	DrawOptionFunctions1 (DROPT1)	393
5.15	package D01AGNT d01AgentsPackage	395
5.15.1	d01AgentsPackage (D01AGNT)	395
5.16	package D01WGTS d01WeightsPackage	402
5.16.1	d01WeightsPackage (D01WGTS)	402
5.17	package D02AGNT d02AgentsPackage	409
5.17.1	d02AgentsPackage (D02AGNT)	409
5.18	package D03AGNT d03AgentsPackage	416
5.18.1	d03AgentsPackage (D03AGNT)	416
6	Chapter E	419
6.1	package EP EigenPackage	419
6.1.1	EigenPackage (EP)	419
6.2	package EF ElementaryFunction	426
6.2.1	ElementaryFunction (EF)	441
6.3	package DEFINTEF ElementaryFunctionDefiniteIntegration	461
6.3.1	ElementaryFunctionDefiniteIntegration (DEFINTEF)	461
6.4	package LODEEF ElementaryFunctionLODESolver	467
6.4.1	ElementaryFunctionLODESolver (LODEEF)	467
6.5	package ODEEF ElementaryFunctionODESolver	474
6.5.1	ElementaryFunctionODESolver (ODEEF)	474
6.6	package SIGNEF ElementaryFunctionSign	481
6.6.1	ElementaryFunctionSign (SIGNEF)	481
6.7	package EFSTRUC ElementaryFunctionStructurePackage	486
6.7.1	ElementaryFunctionStructurePackage (EFSTRUC)	486
6.8	package EFULS ElementaryFunctionsUnivariateLaurentSeries	496
6.8.1	ElementaryFunctionsUnivariateLaurentSeries (EFULS)	496
6.9	package EFUPXS ElementaryFunctionsUnivariatePuisseuxSeries	505
6.9.1	ElementaryFunctionsUnivariatePuisseuxSeries (EFUPXS)	505
6.10	package INTEF ElementaryIntegration	512
6.10.1	ElementaryIntegration (INTEF)	512
6.11	package RDEEF ElementaryRischDE	523
6.11.1	ElementaryRischDE (RDEEF)	523
6.12	package RDEEFS ElementaryRischDESystem	532

6.12.1	ElementaryRischDESystem (RDEEFS)	532
6.13	package ELFUTS EllipticFunctionsUnivariateTaylorSeries	535
6.13.1	EllipticFunctionsUnivariateTaylorSeries (ELFUTS)	535
6.14	package EQ2 EquationFunctions2	537
6.14.1	EquationFunctions2 (EQ2)	537
6.15	package ERROR ErrorFunctions	538
6.15.1	ErrorFunctions (ERROR)	538
6.16	package GBEUCLID EuclideanGroebnerBasisPackage	541
6.16.1	EuclideanGroebnerBasisPackage (GBEUCLID)	567
6.17	package EVALCYC EvaluateCycleIndicators	580
6.17.1	EvaluateCycleIndicators (EVALCYC)	580
6.18	package ESCONT ExpertSystemContinuityPackage	582
6.18.1	ExpertSystemContinuityPackage (ESCONT)	582
6.19	package ESCONT1 ExpertSystemContinuityPackage1	589
6.19.1	ExpertSystemContinuityPackage1 (ESCONT1)	589
6.20	package ESTOOLS ExpertSystemToolsPackage	591
6.20.1	ExpertSystemToolsPackage (ESTOOLS)	591
6.21	package ESTOOLS1 ExpertSystemToolsPackage1	600
6.21.1	ExpertSystemToolsPackage1 (ESTOOLS1)	600
6.22	package ESTOOLS2 ExpertSystemToolsPackage2	601
6.22.1	ExpertSystemToolsPackage2 (ESTOOLS2)	601
6.23	package EXPR2 ExpressionFunctions2	603
6.23.1	ExpressionFunctions2 (EXPR2)	603
6.24	package EXPRSOL ExpressionSolve	605
6.24.1	Bugs	605
6.24.2	ExpressionSolve (EXPRSOL)	605
6.25	package ES1 ExpressionSpaceFunctions1	609
6.25.1	ExpressionSpaceFunctions1 (ES1)	609
6.26	package ES2 ExpressionSpaceFunctions2	610
6.26.1	ExpressionSpaceFunctions2 (ES2)	610
6.27	package EXPRODE ExpressionSpaceODESolver	612
6.27.1	ExpressionSpaceODESolver (EXPRODE)	612
6.28	package OMEXPR ExpressionToOpenMath	617
6.28.1	ExpressionToOpenMath (OMEXPR)	617
6.29	package EXPR2UPS ExpressionToUnivariatePowerSeries	624
6.29.1	ExpressionToUnivariatePowerSeries (EXPR2UPS)	624
6.30	package EXPRTUBE ExpressionTubePlot	632
6.30.1	ExpressionTubePlot (EXPRTUBE)	632
6.31	package EXP3D Export3D	636
6.31.1	Export3D (EXP3D)	638
6.32	package E04AGNT e04AgentsPackage	641
6.32.1	e04AgentsPackage (E04AGNT)	641

7 Chapter F	649
7.1 package FACTFUNC FactoredFunctions	649
7.1.1 FactoredFunctions (FACTFUNC)	649
7.2 package FR2 FactoredFunctions2	651
7.2.1 FactoredFunctions2 (FR2)	655
7.3 package FRUTIL FactoredFunctionUtilities	657
7.3.1 FactoredFunctionUtilities (FRUTIL)	657
7.4 package FACUTIL FactoringUtilities	659
7.4.1 FactoringUtilities (FACUTIL)	659
7.5 package FACTEXT FactorisationOverPseudoAlgebraicClosureOfAlgExtOfRationalNumber	662
7.5.1 FactorisationOverPseudoAlgebraicClosureOfAlgExtOfRationalNumber (FACTEXT)	663
7.6 package FACTRN FactorisationOverPseudoAlgebraicClosureOfRationalNumber	666
7.6.1 FactorisationOverPseudoAlgebraicClosureOfRationalNumber (FACTRN)	668
7.7 package FGLMICPK FGLMIfCanPackage	672
7.7.1 FGLMIfCanPackage (FGLMICPK)	672
7.8 package FORDER FindOrderFinite	675
7.8.1 FindOrderFinite (FORDER)	675
7.9 package FAMR2 FiniteAbelianMonoidRingFunctions2	677
7.9.1 FiniteAbelianMonoidRingFunctions2 (FAMR2)	677
7.10 package FDIV2 FiniteDivisorFunctions2	679
7.10.1 FiniteDivisorFunctions2 (FDIV2)	679
7.11 package FFFACTSE FiniteFieldFactorizationWithSizeParseBySideEffect	680
7.11.1 FiniteFieldFactorizationWithSizeParseBySideEffect (FFFACTSE)	682
7.12 package FFF FiniteFieldFunctions	688
7.12.1 FiniteFieldFunctions (FFF)	688
7.13 package FFHOM FiniteFieldHomomorphisms	694
7.13.1 FiniteFieldHomomorphisms (FFHOM)	694
7.14 package FFPOLY FiniteFieldPolynomialPackage	703
7.14.1 FiniteFieldPolynomialPackage (FFPOLY)	703
7.15 package FFPOLY2 FiniteFieldPolynomialPackage2	725
7.15.1 FiniteFieldPolynomialPackage2 (FFPOLY2)	725
7.16 package FFSLPE FiniteFieldSolveLinearPolynomialEquation	729
7.16.1 FiniteFieldSolveLinearPolynomialEquation (FFSLPE)	729
7.17 package FFSQFR FiniteFieldSquareFreeDecomposition	731
7.17.1 FiniteFieldSquareFreeDecomposition (FFSQFR)	732
7.18 package FLAGG2 FiniteLinearAggregateFunctions2	735
7.18.1 FiniteLinearAggregateFunctions2 (FLAGG2)	735
7.19 package FLASORT FiniteLinearAggregateSort	738
7.19.1 FiniteLinearAggregateSort (FLASORT)	738
7.20 package FSAGG2 FiniteSetAggregateFunctions2	741

7.20.1	FiniteSetAggregateFunctions2 (FSAGG2)	741
7.21	package FLOATCP FloatingComplexPackage	743
7.21.1	FloatingComplexPackage (FLOATCP)	743
7.22	package FLOATRP FloatingRealPackage	747
7.22.1	FloatingRealPackage (FLOATRP)	747
7.23	package FCPAK1 FortranCodePackage1	751
7.23.1	FortranCodePackage1 (FCPAK1)	751
7.24	package FOP FortranOutputStackPackage	755
7.24.1	FortranOutputStackPackage (FOP)	755
7.25	package FORT FortranPackage	758
7.25.1	FortranPackage (FORT)	758
7.26	package FRIDEAL2 FractionalIdealFunctions2	761
7.26.1	FractionalIdealFunctions2 (FRIDEAL2)	761
7.27	package FFFG FractionFreeFastGaussian	763
7.27.1	FractionFreeFastGaussian (FFFG)	763
7.28	package FFFGF FractionFreeFastGaussianFractions	776
7.28.1	FractionFreeFastGaussianFractions (FFFGF)	776
7.29	package FRAC2 FractionFunctions2	779
7.29.1	FractionFunctions2 (FRAC2)	779
7.30	package FRNAAF2 FramedNonAssociativeAlgebraFunctions2	781
7.30.1	FramedNonAssociativeAlgebraFunctions2 (FRNAAF2)	781
7.31	package FSPECF FunctionalSpecialFunction	783
7.31.1	FunctionalSpecialFunction (FSPECF)	783
7.31.2	differentiation of special functions	789
7.32	package FFCAT2 FunctionFieldCategoryFunctions2	793
7.32.1	FunctionFieldCategoryFunctions2 (FFCAT2)	793
7.33	package FFINTBAS FunctionFieldIntegralBasis	795
7.33.1	FunctionFieldIntegralBasis (FFINTBAS)	795
7.34	package PMASSFS FunctionSpaceAssertions	799
7.34.1	FunctionSpaceAssertions (PMASSFS)	799
7.35	package PMPREDFS FunctionSpaceAttachPredicates	802
7.35.1	FunctionSpaceAttachPredicates (PMPREDFS)	802
7.36	package FSCINT FunctionSpaceComplexIntegration	804
7.36.1	FunctionSpaceComplexIntegration (FSCINT)	804
7.37	package FS2 FunctionSpaceFunctions2	807
7.37.1	FunctionSpaceFunctions2 (FS2)	807
7.38	package FSINT FunctionSpaceIntegration	809
7.38.1	FunctionSpaceIntegration (FSINT)	809
7.39	package FSPRMELT FunctionSpacePrimitiveElement	813
7.39.1	FunctionSpacePrimitiveElement (FSPRMELT)	813
7.40	package FSRED FunctionSpaceReduce	816
7.40.1	FunctionSpaceReduce (FSRED)	816
7.41	package SUMFS FunctionSpaceSum	818
7.41.1	FunctionSpaceSum (SUMFS)	818
7.42	package FS2EXPXP FunctionSpaceToExponentialExpansion	820
7.42.1	FunctionSpaceToExponentialExpansion (FS2EXPXP)	820

7.43	package FS2UPS FunctionSpaceToUnivariatePowerSeries	833
7.43.1	FunctionSpaceToUnivariatePowerSeries (FS2UPS)	833
7.44	package FSUPFACT FunctionSpaceUnivariatePolynomialFactor	851
7.44.1	FunctionSpaceUnivariatePolynomialFactor (FSUPFACT)	851
8	Chapter G	855
8.1	package GALFACTU GaloisGroupFactorizationUtilities	855
8.1.1	GaloisGroupFactorizationUtilities (GALFACTU)	855
8.2	package GALFACT GaloisGroupFactorizer	860
8.2.1	GaloisGroupFactorizer (GALFACT)	860
8.3	package GALPOLYU GaloisGroupPolynomialUtilities	879
8.3.1	GaloisGroupPolynomialUtilities (GALPOLYU)	879
8.4	package GALUTIL GaloisGroupUtilities	882
8.4.1	GaloisGroupUtilities (GALUTIL)	882
8.5	package GAUSSFAC GaussianFactorizationPackage	886
8.5.1	GaussianFactorizationPackage (GAUSSFAC)	886
8.6	package GHENSEL GeneralHenselPackage	891
8.6.1	GeneralHenselPackage (GHENSEL)	891
8.7	package GENMFACT GeneralizedMultivariateFactorize	895
8.7.1	GeneralizedMultivariateFactorize (GENMFACT)	895
8.8	package GPAFF GeneralPackageForAlgebraicFunctionField	897
8.8.1	GeneralPackageForAlgebraicFunctionField (GPAFF)	899
8.9	package GENPGCD GeneralPolynomialGcdPackage	915
8.9.1	GeneralPolynomialGcdPackage (GENPGCD)	915
8.10	package GENUPS GenerateUnivariatePowerSeries	930
8.10.1	GenerateUnivariatePowerSeries (GENUPS)	930
8.11	package GENEEZ GenExEuclid	935
8.11.1	GenExEuclid (GENEEZ)	935
8.12	package GENUFACT GenUFactorize	940
8.12.1	GenUFactorize (GENUFACT)	940
8.13	package INTG0 GenusZeroIntegration	942
8.13.1	GenusZeroIntegration (INTG0)	942
8.14	package GDRAW GnuDraw	948
8.14.1	GnuDraw (GDRAW)	950
8.15	package GOSPER GosperSummationMethod	953
8.15.1	GosperSummationMethod (GOSPER)	953
8.16	package GRDEF GraphicsDefaults	959
8.16.1	GraphicsDefaults (GRDEF)	959
8.17	package GRAY GrayCode	962
8.17.1	GrayCode (GRAY)	962
8.18	package GBF GroebnerFactorizationPackage	965
8.18.1	GroebnerFactorizationPackage (GBF)	970
8.19	package GBINTERN GroebnerInternalPackage	978
8.19.1	GroebnerInternalPackage (GBINTERN)	978
8.20	package GB GroebnerPackage	989
8.20.1	GroebnerPackage (GB)	1019

8.21	package GROEB SOL GroebnerSolve	1023
8.21.1	GroebnerSolve (GROEB SOL)	1023
8.22	package GUESS Guess	1028
8.22.1	Guess (GUESS)	1028
8.22.2	general utilities	1036
8.22.3	guessing rational functions with an exponential term . . .	1036
8.22.4	guessing rational functions with a binomial term	1049
8.22.5	Hermite Padé interpolation	1056
8.22.6	<code>guess</code> – applying operators recursively	1083
8.23	package GUESSAN GuessAlgebraicNumber	1085
8.23.1	GuessAlgebraicNumber (GUESSAN)	1085
8.24	package GUESSF GuessFinite	1086
8.24.1	GuessFinite (GUESSF)	1086
8.25	package GUESSF1 GuessFiniteFunctions	1087
8.25.1	GuessFiniteFunctions (GUESSF1)	1087
8.26	package GUESSINT GuessInteger	1088
8.26.1	GuessInteger (GUESSINT)	1088
8.27	package GUESSP GuessPolynomial	1089
8.27.1	GuessPolynomial (GUESSP)	1089
8.28	package GUESSUP GuessUnivariatePolynomial	1090
8.28.1	GuessUnivariatePolynomial (GUESSUP)	1090
9	Chapter H	1097
9.1	package HB HallBasis	1097
9.1.1	HallBasis (HB)	1097
9.2	package HEUGCD HeuGcd	1100
9.2.1	HeuGcd (HEUGCD)	1100
10	Chapter I	1107
10.1	package IDECOMP IdealDecompositionPackage	1107
10.1.1	IdealDecompositionPackage (IDECOMP)	1107
10.2	package INCRMAPS IncrementingMaps	1117
10.2.1	IncrementingMaps (INCRMAPS)	1117
10.3	package INFPROD0 InfiniteProductCharacteristicZero	1119
10.3.1	InfiniteProductCharacteristicZero (INFPROD0)	1119
10.4	package INPRODFF InfiniteProductFiniteField	1121
10.4.1	InfiniteProductFiniteField (INPRODFF)	1121
10.5	package INPRODPF InfiniteProductPrimeField	1124
10.5.1	InfiniteProductPrimeField (INPRODPF)	1124
10.6	package ITFUN2 InfiniteTupleFunctions2	1126
10.6.1	InfiniteTupleFunctions2 (ITFUN2)	1126
10.7	package ITFUN3 InfiniteTupleFunctions3	1127
10.7.1	InfiniteTupleFunctions3 (ITFUN3)	1127
10.8	package INFINITY Infinity	1129
10.8.1	Infinity (INFINITY)	1129
10.9	package IALGFACT InnerAlgFactor	1131

10.9.1 InnerAlgFactor (IALGFACT)	1131
10.10package ICDEN InnerCommonDenominator	1134
10.10.1 InnerCommonDenominator (ICDEN)	1134
10.11package IMATLIN InnerMatrixLinearAlgebraFunctions	1136
10.11.1 InnerMatrixLinearAlgebraFunctions (IMATLIN)	1136
10.12package IMATQF InnerMatrixQuotientFieldFunctions	1142
10.12.1 InnerMatrixQuotientFieldFunctions (IMATQF)	1142
10.13package INMODGCD InnerModularGcd	1144
10.13.1 InnerModularGcd (INMODGCD)	1144
10.14package INNMFACT InnerMultFact	1151
10.14.1 InnerMultFact (INNMFACT)	1151
10.15package INBFF InnerNormalBasisFieldFunctions	1161
10.15.1 InnerNormalBasisFieldFunctions (INBFF)	1161
10.16package INEP InnerNumericEigenPackage	1170
10.16.1 InnerNumericEigenPackage (INEP)	1170
10.17package INFSP InnerNumericFloatSolvePackage	1175
10.17.1 InnerNumericFloatSolvePackage (INFSP)	1175
10.18package INPSIGN InnerPolySign	1180
10.18.1 InnerPolySign (INPSIGN)	1180
10.19package ISUMP InnerPolySum	1182
10.19.1 InnerPolySum (ISUMP)	1182
10.20package ITRIGMNP InnerTrigonometricManipulations	1184
10.20.1 InnerTrigonometricManipulations (ITRIGMNP)	1184
10.21package INFORM1 InputFormFunctions1	1189
10.21.1 InputFormFunctions1 (INFORM1)	1189
10.22package INTERGB InterfaceGroebnerPackage	1190
10.22.1 InterfaceGroebnerPackage (INTERGB)	1191
10.23package INTBIT IntegerBits	1193
10.23.1 IntegerBits (INTBIT)	1193
10.24package COMBINAT IntegerCombinatoricFunctions	1195
10.24.1 IntegerCombinatoricFunctions (COMBINAT)	1199
10.25package INTFACT IntegerFactorizationPackage	1203
10.25.1 IntegerFactorizationPackage (INTFACT)	1203
10.25.2 squareFree	1204
10.25.3 PollardSmallFactor	1205
10.25.4 BasicSieve	1208
10.25.5 BasicMethod	1209
10.25.6 factor	1210
10.26package ZLINDEP IntegerLinearDependence	1212
10.26.1 IntegerLinearDependence (ZLINDEP)	1216
10.27package INTHEORY IntegerNumberTheoryFunctions	1218
10.27.1 IntegerNumberTheoryFunctions (INTHEORY)	1233
10.28package PRIMES IntegerPrimesPackage	1239
10.28.1 IntegerPrimesPackage (PRIMES)	1239
10.28.2 smallPrimes	1241
10.28.3 primes	1246

10.28.4 rabinProvesCompositeSmall	1247
10.28.5 rabinProvesComposite	1247
10.28.6 prime?	1248
10.28.7 nextPrime	1249
10.28.8 prevPrime	1249
10.29 package INTRET IntegerRetractions	1250
10.29.1 IntegerRetractions (INTRET)	1250
10.30 package IROOT IntegerRoots	1251
10.30.1 IntegerRoots (IROOT)	1251
10.30.2 perfectSquare?	1252
10.30.3 perfectNthPower?	1252
10.30.4 perfectNthRoot	1253
10.30.5 approxNthRoot	1253
10.30.6 perfectNthRoot	1254
10.30.7 perfectSqrt	1254
10.30.8 approxSqrt	1254
10.31 package INTSLPE IntegerSolveLinearPolynomialEquation	1255
10.31.1 IntegerSolveLinearPolynomialEquation (INTSLPE)	1255
10.32 package IBATool IntegralBasisTools	1257
10.32.1 IntegralBasisTools (IBATool)	1257
10.33 package IBPTOOLS IntegralBasisPolynomialTools	1261
10.33.1 IntegralBasisPolynomialTools (IBPTOOLS)	1261
10.34 package IR2 IntegrationResultFunctions2	1264
10.34.1 IntegrationResultFunctions2 (IR2)	1264
10.35 package IRRF2F IntegrationResultRFToFunction	1266
10.35.1 IntegrationResultRFToFunction (IRRF2F)	1266
10.36 package IR2F IntegrationResultToFunction	1268
10.36.1 IntegrationResultToFunction (IR2F)	1268
10.37 package INTTOOLS IntegrationTools	1274
10.37.1 IntegrationTools (INTTOOLS)	1274
10.38 package IPRNTPK InternalPrintPackage	1278
10.38.1 InternalPrintPackage (IPRNTPK)	1278
10.39 package IRURPK InternalRationalUnivariateRepresentationPack- age	1280
10.39.1 InternalRationalUnivariateRepresentationPackage (IRURPK)	1280
10.40 package INTFRSP InterpolateFormsPackage	1285
10.40.1 InterpolateFormsPackage (INTFRSP)	1286
10.41 package INTDIVP IntersectionDivisorPackage	1293
10.41.1 IntersectionDivisorPackage (INTDIVP)	1295
10.42 package IRREDFFX IrredPolyOverFiniteField	1298
10.42.1 IrredPolyOverFiniteField (IRREDFFX)	1298
10.43 package IRSN IrrRepSymNatPackage	1300
10.43.1 IrrRepSymNatPackage (IRSN)	1300
10.44 package INVLAPLA InverseLaplaceTransform	1308
10.44.1 InverseLaplaceTransform (INVLAPLA)	1308

<i>CONTENTS</i>	173
-----------------	-----

11 Chapter J	1311
---------------------	-------------

12 Chapter K	1313
---------------------	-------------

12.1 package KERNEL2 KernelFunctions2	1313
12.1.1 KernelFunctions2 (KERNEL2)	1313
12.2 package KOVACIC Kovacic	1315
12.2.1 Kovacic (KOVACIC)	1315

13 Chapter L	1319
---------------------	-------------

13.1 package LAPLACE LaplaceTransform	1319
13.1.1 LaplaceTransform (LAPLACE)	1319
13.2 package LAZM3PK LazardSetSolvingPackage	1325
13.2.1 LazardSetSolvingPackage (LAZM3PK)	1347
13.3 package LEADCDET LeadingCoefDetermination	1351
13.3.1 LeadingCoefDetermination (LEADCDET)	1351
13.4 package LEXTRIPK LexTriangularPackage	1354
13.4.1 LexTriangularPackage (LEXTRIPK)	1430
13.5 package LINDEP LinearDependence	1436
13.5.1 LinearDependence (LINDEP)	1436
13.6 package LODOF LinearOrdinaryDifferentialOperatorFactorizer .	1439
13.6.1 LinearOrdinaryDifferentialOperatorFactorizer (LODOF) .	1439
13.7 package LODOOPS LinearOrdinaryDifferentialOperatorsOps . .	1443
13.7.1 LinearOrdinaryDifferentialOperatorsOps (LODOOPS) . .	1443
13.8 package LPEFRAC LinearPolynomialEquationByFractions . . .	1446
13.8.1 LinearPolynomialEquationByFractions (LPEFRAC) . . .	1446
13.9 package LISYSER LinearSystemFromPowerSeriesPackage	1448
13.9.1 LinearSystemFromPowerSeriesPackage (LISYSER)	1449
13.10package LSMP LinearSystemMatrixPackage	1451
13.10.1 LinearSystemMatrixPackage (LSMP)	1451
13.11package LSMP1 LinearSystemMatrixPackage1	1454
13.11.1 LinearSystemMatrixPackage1 (LSMP1)	1454
13.12package LSPP LinearSystemPolynomialPackage	1456
13.12.1 LinearSystemPolynomialPackage (LSPP)	1456
13.13package LGROBP LinGroebnerPackage	1458
13.13.1 LinGroebnerPackage (LGROBP)	1458
13.14package LOP LinesOpPack	1465
13.14.1 LinesOpPack (LOP)	1467
13.15package LF LiouvillianFunction	1470
13.15.1 LiouvillianFunction (LF)	1470
13.16package LIST2 ListFunctions2	1475
13.16.1 ListFunctions2 (LIST2)	1475
13.17package LIST3 ListFunctions3	1477
13.17.1 ListFunctions3 (LIST3)	1477
13.18package LIST2MAP ListToMap	1479
13.18.1 ListToMap (LIST2MAP)	1479
13.19package LPARSPT LocalParametrizationOfSimplePointPackage .	1482

13.19.1 LocalParametrizationOfSimplePointPackage (LPARSPT)	1483
--	------

14 Chapter M	1489
14.1 package MKBCFUNC MakeBinaryCompiledFunction	1489
14.1.1 MakeBinaryCompiledFunction (MKBCFUNC)	1489
14.2 package MKFLCFN MakeFloatCompiledFunction	1491
14.2.1 MakeFloatCompiledFunction (MKFLCFN)	1491
14.3 package MKFUNC MakeFunction	1495
14.3.1 MakeFunction (MKFUNC)	1500
14.4 package MKRECORD MakeRecord	1501
14.4.1 MakeRecord (MKRECORD)	1501
14.5 package MKUCFUNC MakeUnaryCompiledFunction	1503
14.5.1 MakeUnaryCompiledFunction (MKUCFUNC)	1503
14.6 package MAPHACK1 MappingPackageInternalHacks1	1505
14.6.1 MappingPackageInternalHacks1 (MAPHACK1)	1505
14.7 package MAPHACK2 MappingPackageInternalHacks2	1507
14.7.1 MappingPackageInternalHacks2 (MAPHACK2)	1507
14.8 package MAPHACK3 MappingPackageInternalHacks3	1508
14.8.1 MappingPackageInternalHacks3 (MAPHACK3)	1508
14.9 package MAPPKG1 MappingPackage1	1510
14.9.1 MappingPackage1 (MAPPKG1)	1520
14.10 package MAPPKG2 MappingPackage2	1523
14.10.1 MappingPackage2 (MAPPKG2)	1533
14.11 package MAPPKG3 MappingPackage3	1535
14.11.1 MappingPackage3 (MAPPKG3)	1545
14.12 package MAPPKG4 MappingPackage4	1547
14.12.1 MappingPackage4 (MAPPKG4)	1553
14.13 package MATCAT2 MatrixCategoryFunctions2	1555
14.13.1 MatrixCategoryFunctions2 (MATCAT2)	1555
14.14 package MCDEN MatrixCommonDenominator	1557
14.14.1 MatrixCommonDenominator (MCDEN)	1557
14.15 package MATLIN MatrixLinearAlgebraFunctions	1559
14.15.1 MatrixLinearAlgebraFunctions (MATLIN)	1559
14.16 package MTHING MergeThing	1567
14.16.1 MergeThing (MTHING)	1567
14.17 package MESH MeshCreationRoutinesForThreeDimensions	1569
14.17.1 MeshCreationRoutinesForThreeDimensions (MESH)	1569
14.18 package MDDFACT ModularDistinctDegreeFactorizer	1573
14.18.1 ModularDistinctDegreeFactorizer (MDDFACT)	1573
14.19 package MHROWRED ModularHermitianRowReduction	1579
14.19.1 ModularHermitianRowReduction (MHROWRED)	1579
14.20 package MRF2 MonoidRingFunctions2	1585
14.20.1 MonoidRingFunctions2 (MRF2)	1585
14.21 package MONOTOOL MonomialExtensionTools	1587
14.21.1 MonomialExtensionTools (MONOTOOL)	1587
14.22 package MSYSCMD MoreSystemCommands	1590

14.22.1	MoreSystemCommands (MSYSCMD)	1590
14.23	package MPCPF MPolyCatPolyFactorizer	1592
14.23.1	MPolyCatPolyFactorizer (MPCPF)	1592
14.24	package MPRFF MPolyCatRationalFunctionFactorizer	1594
14.24.1	MPolyCatRationalFunctionFactorizer (MPRFF)	1594
14.25	package MPC2 MPolyCatFunctions2	1598
14.25.1	MPolyCatFunctions2 (MPC2)	1598
14.26	package MPC3 MPolyCatFunctions3	1600
14.26.1	MPolyCatFunctions3 (MPC3)	1600
14.27	package MRATFAC MRationalFactorize	1602
14.27.1	MRationalFactorize (MRATFAC)	1602
14.28	package MFINFAC MultFiniteFactorize	1604
14.28.1	MultFiniteFactorize (MFINFAC)	1604
14.29	package MMAP MultipleMap	1616
14.29.1	MultipleMap (MMAP)	1616
14.30	package MCALCFN MultiVariableCalculusFunctions	1618
14.30.1	MultiVariableCalculusFunctions (MCALCFN)	1618
14.31	package MULTFACT MultivariateFactorize	1623
14.31.1	MultivariateFactorize (MULTFACT)	1623
14.32	package MLIFT MultivariateLifting	1625
14.33	package MULTSQFR MultivariateSquareFree	1630
14.33.1	MultivariateSquareFree (MULTSQFR)	1630

15 Chapter N**1639**

15.1	package NAGF02 NagEigenPackage	1639
15.1.1	NagEigenPackage (NAGF02)	1712
15.2	package NAGE02 NagFittingPackage	1725
15.2.1	NagFittingPackage (NAGE02)	1866
15.3	package NAGF04 NagLinearEquationSolvingPackage	1880
15.3.1	NagLinearEquationSolvingPackage (NAGF04)	1951
15.4	package NAGSP NAGLinkSupportPackage	1961
15.4.1	NAGLinkSupportPackage (NAGSP)	1961
15.5	package NAGD01 NagIntegrationPackage	1964
15.5.1	NagIntegrationPackage (NAGD01)	2048
15.6	package NAGE01 NagInterpolationPackage	2058
15.6.1	NagInterpolationPackage (NAGE01)	2100
15.7	package NAGF07 NagLapack	2107
15.7.1	NagLapack (NAGF07)	2122
15.8	package NAGF01 NagMatrixOperationsPackage	2126
15.8.1	NagMatrixOperationsPackage (NAGF01)	2187
15.9	package NAGE04 NagOptimisationPackage	2195
15.9.1	NagOptimisationPackage (NAGE04)	2360
15.10	package NAGD02 NagOrdinaryDifferentialEquationsPackage	2370
15.10.1	NagOrdinaryDifferentialEquationsPackage (NAGD02)	2468
15.11	package NAGD03 NagPartialDifferentialEquationsPackage	2480
15.11.1	NagPartialDifferentialEquationsPackage (NAGD03)	2519

15.12package NAGC02 NagPolynomialRootsPackage	2523
15.12.1 NagPolynomialRootsPackage (NAGC02)	2538
15.13package NAGC05 NagRootFindingPackage	2541
15.13.1 NagRootFindingPackage (NAGC05)	2559
15.14package NAGC06 NagSeriesSummationPackage	2563
15.14.1 NagSeriesSummationPackage (NAGC06)	2612
15.15package NAGS NagSpecialFunctionsPackage	2619
15.15.1 NagSpecialFunctionsPackage (NAGS)	2778
15.16package NSUP2 NewSparseUnivariatePolynomialFunctions2	2796
15.16.1 NewSparseUnivariatePolynomialFunctions2 (NSUP2)	2796
15.17package NEWTON NewtonInterpolation	2798
15.17.1 NewtonInterpolation (NEWTON)	2798
15.18package NPOLYGON NewtonPolygon	2800
15.18.1 NewtonPolygon (NPOLYGON)	2801
15.19package NCODIV NonCommutativeOperatorDivision	2806
15.19.1 NonCommutativeOperatorDivision (NCODIV)	2806
15.20package NONE1 NoneFunctions1	2809
15.20.1 NoneFunctions1 (NONE1)	2809
15.21package NODE1 NonLinearFirstOrderODESolver	2811
15.21.1 NonLinearFirstOrderODESolver (NODE1)	2811
15.22package NLINSOL NonLinearSolvePackage	2815
15.22.1 NonLinearSolvePackage (NLINSOL)	2815
15.23package NORMPK NormalizationPackage	2818
15.23.1 NormalizationPackage (NORMPK)	2818
15.24package NORMMA NormInMonogenicAlgebra	2823
15.24.1 NormInMonogenicAlgebra (NORMMA)	2823
15.25package NORMRETR NormRetractPackage	2825
15.25.1 NormRetractPackage (NORMRETR)	2825
15.26package NPCOEF NPCoef	2827
15.26.1 NPCoef (NPCOEF)	2827
15.27package NFINTBAS NumberFieldIntegralBasis	2831
15.27.1 NumberFieldIntegralBasis (NFINTBAS)	2831
15.28package NUMFMT NumberFormats	2837
15.28.1 NumberFormats (NUMFMT)	2837
15.29package NTPOLFN NumberTheoreticPolynomialFunctions	2842
15.29.1 NumberTheoreticPolynomialFunctions (NTPOLFN)	2842
15.30package NUMERIC Numeric	2845
15.30.1 Numeric (NUMERIC)	2845
15.31package NUMODE NumericalOrdinaryDifferentialEquations	2855
15.31.1 NumericalOrdinaryDifferentialEquations (NUMODE)	2855
15.32package NUMQUAD NumericalQuadrature	2864
15.32.1 NumericalQuadrature (NUMQUAD)	2864
15.33package NCEP NumericComplexEigenPackage	2877
15.33.1 NumericComplexEigenPackage (NCEP)	2877
15.34package NCNTFRAC NumericContinuedFraction	2880
15.34.1 NumericContinuedFraction (NCNTFRAC)	2880

15.35	package NREP NumericRealEigenPackage	2882
15.35.1	NumericRealEigenPackage (NREP)	2882
15.36	package NUMTUBE NumericTubePlot	2885
15.36.1	NumericTubePlot (NUMTUBE)	2885
16	Chapter O	2889
16.1	package OCTCT2 OctonionCategoryFunctions2	2889
16.1.1	OctonionCategoryFunctions2 (OCTCT2)	2889
16.2	package ODEINT ODEIntegration	2891
16.2.1	ODEIntegration (ODEINT)	2891
16.3	package ODETOOLS ODETools	2894
16.3.1	ODETools (ODETOOLS)	2894
16.4	package ARRAY12 OneDimensionalArrayFunctions2	2896
16.4.1	OneDimensionalArrayFunctions2 (ARRAY12)	2896
16.5	package ONECOMP2 OnePointCompletionFunctions2	2898
16.5.1	OnePointCompletionFunctions2 (ONECOMP2)	2898
16.6	package OMPKG OpenMathPackage	2900
16.6.1	OpenMathPackage (OMPKG)	2900
16.7	package OMSERVER OpenMathServerPackage	2903
16.7.1	OpenMathServerPackage (OMSERVER)	2903
16.8	package OPQUERY OperationsQuery	2905
16.8.1	OperationsQuery (OPQUERY)	2905
16.9	package ORDCOMP2 OrderedCompletionFunctions2	2906
16.9.1	OrderedCompletionFunctions2 (ORDCOMP2)	2906
16.10	package ORDFUNS OrderingFunctions	2908
16.10.1	OrderingFunctions (ORDFUNS)	2908
16.11	package ORTHPOL OrthogonalPolynomialFunctions	2911
16.11.1	OrthogonalPolynomialFunctions (ORTHPOL)	2911
16.12	package OUT OutputPackage	2914
16.12.1	OutputPackage (OUT)	2914
17	Chapter P	2917
17.1	package PAFF PackageForAlgebraicFunctionField	2917
17.1.1	PackageForAlgebraicFunctionField (PAFF)	2919
17.2	package PAFFFF PackageForAlgebraicFunctionFieldOverFinite- Field	2926
17.2.1	PackageForAlgebraicFunctionFieldOverFiniteField (PAFFFF)	2928
17.3	package PFORP PackageForPoly	2937
17.3.1	PackageForPoly (PFORP)	2939
17.4	package PADEPAC PadeApproximantPackage	2946
17.4.1	PadeApproximantPackage (PADEPAC)	2946
17.5	package PADE PadeApproximants	2948
17.5.1	PadeApproximants (PADE)	2948
17.6	package PWFFINTB PAdicWildFunctionFieldIntegralBasis	2952
17.6.1	PAdicWildFunctionFieldIntegralBasis (PWFFINTB)	2952
17.7	package YSTREAM ParadoxicalCombinatorsForStreams	2958

17.7.1	ParadoxicalCombinatorsForStreams (YSTREAM)	2958
17.8	package PLEQN ParametricLinearEquations	2960
17.8.1	ParametricLinearEquations (PLEQN)	2960
17.9	package PARPC2 ParametricPlaneCurveFunctions2	2975
17.9.1	ParametricPlaneCurveFunctions2 (PARPC2)	2975
17.10	package PARSC2 ParametricSpaceCurveFunctions2	2976
17.10.1	ParametricSpaceCurveFunctions2 (PARSC2)	2976
17.11	package PARSU2 ParametricSurfaceFunctions2	2977
17.11.1	ParametricSurfaceFunctions2 (PARSU2)	2977
17.12	package PARAMP ParametrizationPackage	2978
17.12.1	ParametrizationPackage (PARAMP)	2979
17.13	package PFRPAC PartialFractionPackage	2982
17.13.1	PartialFractionPackage (PFRPAC)	2984
17.14	package PARTPERM PartitionsAndPermutations	2986
17.14.1	PartitionsAndPermutations (PARTPERM)	2986
17.15	package PATTERN1 PatternFunctions1	2990
17.15.1	PatternFunctions1 (PATTERN1)	2990
17.16	package PATTERN2 PatternFunctions2	2992
17.16.1	PatternFunctions2 (PATTERN2)	2992
17.17	package PATMATCH PatternMatch	2994
17.17.1	PatternMatch (PATMATCH)	2994
17.18	package PMASS PatternMatchAssertions	2997
17.18.1	PatternMatchAssertions (PMASS)	2997
17.19	package PMFS PatternMatchFunctionSpace	2999
17.19.1	PatternMatchFunctionSpace (PMFS)	2999
17.20	package PMINS PatternMatchIntegerNumberSystem	3002
17.20.1	PatternMatchIntegerNumberSystem (PMINS)	3002
17.21	package INTPM PatternMatchIntegration	3005
17.21.1	PatternMatchIntegration (INTPM)	3005
17.22	package PMKERNEL PatternMatchKernel	3013
17.22.1	PatternMatchKernel (PMKERNEL)	3013
17.23	package PMLSAGG PatternMatchListAggregate	3016
17.23.1	PatternMatchListAggregate (PMLSAGG)	3016
17.24	package PMPLCAT PatternMatchPolynomialCategory	3018
17.24.1	PatternMatchPolynomialCategory (PMPLCAT)	3018
17.25	package PMDOWN PatternMatchPushDown	3021
17.25.1	PatternMatchPushDown (PMDOWN)	3021
17.26	package PMQFCAT PatternMatchQuotientFieldCategory	3024
17.26.1	PatternMatchQuotientFieldCategory (PMQFCAT)	3024
17.27	package PATRES2 PatternMatchResultFunctions2	3026
17.27.1	PatternMatchResultFunctions2 (PATRES2)	3026
17.28	package PMSYM PatternMatchSymbol	3028
17.28.1	PatternMatchSymbol (PMSYM)	3028
17.29	package PMTOOLS PatternMatchTools	3030
17.29.1	PatternMatchTools (PMTOOLS)	3030
17.30	package PERMAN Permanent	3035

17.30.1 Permanent (PERMAN)	3037
17.31package PGE PermutationGroupExamples	3042
17.31.1 PermutationGroupExamples (PGE)	3042
17.32package PICOERCE PiCoercions	3051
17.32.1 PiCoercions (PICOERCE)	3051
17.33package PLOT1 PlotFunctions1	3053
17.33.1 PlotFunctions1 (PLOT1)	3053
17.34package PLOTTOOL PlotTools	3055
17.34.1 PlotTools (PLOTTOOL)	3055
17.35package PRJALGPK ProjectiveAlgebraicSetPackage	3057
17.35.1 ProjectiveAlgebraicSetPackage (PRJALGPK)	3059
17.36package PTFUNC2 PointFunctions2	3063
17.36.1 PointFunctions2 (PTFUNC2)	3063
17.37package PTPACK PointPackage	3064
17.37.1 PointPackage (PTPACK)	3064
17.38package PFO PointsOfFiniteOrder	3067
17.38.1 PointsOfFiniteOrder (PFO)	3067
17.39package PFOQ PointsOfFiniteOrderRational	3074
17.39.1 PointsOfFiniteOrderRational (PFOQ)	3074
17.40package PFOTOOLS PointsOfFiniteOrderTools	3077
17.40.1 PointsOfFiniteOrderTools (PFOTOOLS)	3077
17.41package PLPKCRV PolynomialPackageForCurve	3079
17.41.1 PolynomialPackageForCurve (PLPKCRV)	3080
17.42package POLTOPOL PolToPol	3083
17.42.1 PolToPol (POLTOPOL)	3083
17.43package PGROEB PolyGroebner	3086
17.43.1 PolyGroebner (PGROEB)	3086
17.44package PAN2EXPR PolynomialAN2Expression	3088
17.44.1 PolynomialAN2Expression (PAN2EXPR)	3088
17.45package POLYLIFT PolynomialCategoryLifting	3090
17.45.1 PolynomialCategoryLifting (POLYLIFT)	3090
17.46package POLYCATQ PolynomialCategoryQuotientFunctions	3092
17.46.1 PolynomialCategoryQuotientFunctions (POLYCATQ)	3092
17.47package PCOMP PolynomialComposition	3096
17.47.1 PolynomialComposition (PCOMP)	3096
17.48package PDECOMP PolynomialDecomposition	3097
17.48.1 PolynomialDecomposition (PDECOMP)	3097
17.49package PFBR PolynomialFactorizationByRecursion	3099
17.49.1 PolynomialFactorizationByRecursion (PFBR)	3099
17.50package PFBRU PolynomialFactorizationByRecursionUnivariate	3106
17.50.1 PolynomialFactorizationByRecursionUnivariate (PFBRU)	3106
17.51package POLY2 PolynomialFunctions2	3112
17.51.1 PolynomialFunctions2 (POLY2)	3112
17.52package PGCD PolynomialGcdPackage	3114
17.52.1 PolynomialGcdPackage (PGCD)	3114
17.53package PINTERP PolynomialInterpolation	3123

17.53.1 PolynomialInterpolation (PINTERP)	3123
17.54package PINTERPA PolynomialInterpolationAlgorithms	3125
17.54.1 PolynomialInterpolationAlgorithms (PINTERPA)	3125
17.55package PNTHEORY PolynomialNumberTheoryFunctions	3127
17.55.1 PolynomialNumberTheoryFunctions (PNTHEORY)	3127
17.56package POLYROOT PolynomialRoots	3133
17.56.1 PolynomialRoots (POLYROOT)	3133
17.57package PSETPK PolynomialSetUtilitiesPackage	3137
17.57.1 PolynomialSetUtilitiesPackage (PSETPK)	3137
17.58package SOLVEFOR PolynomialSolveByFormulas	3156
17.58.1 PolynomialSolveByFormulas (SOLVEFOR)	3156
17.59package PSQFR PolynomialSquareFree	3163
17.59.1 PolynomialSquareFree (PSQFR)	3163
17.60package POLY2UP PolynomialToUnivariatePolynomial	3167
17.60.1 PolynomialToUnivariatePolynomial (POLY2UP)	3167
17.61package LIMITPS PowerSeriesLimitPackage	3169
17.61.1 PowerSeriesLimitPackage (LIMITPS)	3169
17.62package PREASSOC PrecomputedAssociatedEquations	3181
17.62.1 PrecomputedAssociatedEquations (PREASSOC)	3181
17.63package PRIMARR2 PrimitiveArrayFunctions2	3184
17.63.1 PrimitiveArrayFunctions2 (PRIMARR2)	3184
17.64package PRIMELT PrimitiveElement	3186
17.64.1 PrimitiveElement (PRIMELT)	3186
17.65package ODEPRIM PrimitiveRatDE	3189
17.65.1 PrimitiveRatDE (ODEPRIM)	3189
17.66package ODEPRRIC PrimitiveRatRicDE	3194
17.66.1 PrimitiveRatRicDE (ODEPRRIC)	3194
17.67package PRINT PrintPackage	3201
17.67.1 PrintPackage (PRINT)	3201
17.68package PSEUDLIN PseudoLinearNormalForm	3202
17.68.1 PseudoLinearNormalForm (PSEUDLIN)	3202
17.69package PRS PseudoRemainderSequence	3206
17.69.1 PseudoRemainderSequence (PRS)	3206
17.70package INTPAF PureAlgebraicIntegration	3227
17.70.1 PureAlgebraicIntegration (INTPAF)	3227
17.71package ODEPAL PureAlgebraicLODE	3236
17.71.1 PureAlgebraicLODE (ODEPAL)	3236
17.72package PUSHVAR PushVariables	3238
17.72.1 PushVariables (PUSHVAR)	3238
18 Chapter Q	3241
18.1 package QALGSET2 QuasiAlgebraicSet2	3241
18.1.1 QuasiAlgebraicSet2 (QALGSET2)	3241
18.2 package QCMPACK QuasiComponentPackage	3245
18.2.1 QuasiComponentPackage (QCMPACK)	3245
18.3 package QFCAT2 QuotientFieldCategoryFunctions2	3255

18.3.1	QuotientFieldCategoryFunctions2 (QFCAT2)	3255
18.4	package QUATCT2 QuaternionCategoryFunctions2	3257
18.4.1	QuaternionCategoryFunctions2 (QUATCT2)	3259

19	Chapter R	3261
19.1	package REP RadicalEigenPackage	3261
19.1.1	RadicalEigenPackage (REP)	3261
19.2	package SOLVERAD RadicalSolvePackage	3266
19.2.1	RadicalSolvePackage (SOLVERAD)	3277
19.3	package RADUTIL RadixUtilities	3285
19.3.1	RadixUtilities (RADUTIL)	3285
19.4	package RDIST RandomDistributions	3287
19.4.1	RandomDistributions (RDIST)	3287
19.5	package RFDIST RandomFloatDistributions	3289
19.5.1	RandomFloatDistributions (RFDIST)	3289
19.6	package RIDIST RandomIntegerDistributions	3292
19.6.1	RandomIntegerDistributions (RIDIST)	3292
19.7	package RANDSRC RandomNumberSource	3294
19.7.1	RandomNumberSource (RANDSRC)	3294
19.8	package RATFACT RationalFactorize	3296
19.8.1	RationalFactorize (RATFACT)	3296
19.9	package RF RationalFunction	3298
19.9.1	RationalFunction (RF)	3298
19.10	package DEFINTRF RationalFunctionDefiniteIntegration	3301
19.10.1	RationalFunctionDefiniteIntegration (DEFINTRF)	3301
19.11	package RFFACT RationalFunctionFactor	3304
19.11.1	RationalFunctionFactor (RFFACT)	3304
19.12	package RFFACTOR RationalFunctionFactorizer	3306
19.12.1	RationalFunctionFactorizer (RFFACTOR)	3306
19.13	package INTRF RationalFunctionIntegration	3308
19.13.1	RationalFunctionIntegration (INTRF)	3308
19.14	package LIMITRF RationalFunctionLimitPackage	3310
19.14.1	RationalFunctionLimitPackage (LIMITRF)	3310
19.15	package SIGNRF RationalFunctionSign	3314
19.15.1	RationalFunctionSign (SIGNRF)	3314
19.16	package SUMRF RationalFunctionSum	3317
19.16.1	RationalFunctionSum (SUMRF)	3324
19.17	package INTRAT RationalIntegration	3327
19.17.1	RationalIntegration (INTRAT)	3327
19.18	package RINTERP RationalInterpolation	3329
19.18.1	Introduction	3329
19.18.2	Questions and Outlook	3329
19.18.3	RationalInterpolation (RINTERP)	3329
19.19	package ODERAT RationalLODE	3333
19.19.1	RationalLODE (ODERAT)	3333
19.20	package RATRET RationalRetractions	3339

19.20.1 RationalRetractions (RATRET)	3339
19.21package ODERTRIC RationalRicDE	3341
19.21.1 RationalRicDE (ODERTRIC)	3341
19.22package RURPK RationalUnivariateRepresentationPackage . . .	3348
19.22.1 RationalUnivariateRepresentationPackage (RURPK) . . .	3348
19.23package POLUTIL RealPolynomialUtilitiesPackage	3352
19.23.1 RealPolynomialUtilitiesPackage (POLUTIL)	3353
19.24package REALSOLV RealSolvePackage	3356
19.24.1 RealSolvePackage (REALSOLV)	3360
19.25package REAL0 RealZeroPackage	3362
19.25.1 RealZeroPackage (REAL0)	3362
19.26package REAL0Q RealZeroPackageQ	3369
19.26.1 RealZeroPackageQ (REAL0Q)	3369
19.27package RMCAT2 RectangularMatrixCategoryFunctions2	3372
19.27.1 RectangularMatrixCategoryFunctions2 (RMCAT2)	3372
19.28package RECOP RecurrenceOperator	3374
19.28.1 RecurrenceOperator (RECOP)	3374
19.28.2 Defining new operators	3376
19.28.3 Recurrences	3378
19.28.4 Functional Equations	3382
19.29package RDIV ReducedDivisor	3387
19.29.1 ReducedDivisor (RDIV)	3387
19.30package ODERED ReduceLODE	3389
19.30.1 ReduceLODE (ODERED)	3389
19.31package REDORDER ReductionOfOrder	3391
19.31.1 ReductionOfOrder (REDORDER)	3391
19.32package RSDCMPK RegularSetDecompositionPackage	3393
19.32.1 RegularSetDecompositionPackage (RSDCMPK)	3393
19.33package RSETGCD RegularTriangularSetGcdPackage	3400
19.33.1 RegularTriangularSetGcdPackage (RSETGCD)	3400
19.34package REPDB RepeatedDoubling	3409
19.34.1 RepeatedDoubling (REPDB)	3409
19.35package REPSQ RepeatedSquaring	3411
19.35.1 RepeatedSquaring (REPSQ)	3411
19.36package REP1 RepresentationPackage1	3413
19.36.1 RepresentationPackage1 (REP1)	3413
19.37package REP2 RepresentationPackage2	3421
19.37.1 RepresentationPackage2 (REP2)	3421
19.38package RESLATC ResolveLatticeCompletion	3439
19.38.1 ResolveLatticeCompletion (RESLATC)	3439
19.39package RETSOL RetractSolvePackage	3441
19.39.1 RetractSolvePackage (RETSOL)	3441
19.40package RFP RootsFindingPackage	3443
19.40.1 RootsFindingPackage (RFP)	3444

20 Chapter S	3449
20.1 package SAERFFC SAERationalFunctionAlgFactor	3449
20.1.1 SAERationalFunctionAlgFactor (SAERFFC)	3449
20.2 package FORMULA1 ScriptFormulaFormat1	3451
20.2.1 ScriptFormulaFormat1 (FORMULA1)	3451
20.3 package SEGBIND2 SegmentBindingFunctions2	3453
20.3.1 SegmentBindingFunctions2 (SEGBIND2)	3453
20.4 package SEG2 SegmentFunctions2	3455
20.4.1 SegmentFunctions2 (SEG2)	3455
20.5 package SAEFACT SimpleAlgebraicExtensionAlgFactor	3457
20.5.1 SimpleAlgebraicExtensionAlgFactor (SAEFACT)	3457
20.6 package SIMPAN SimplifyAlgebraicNumberConvertPackage	3458
20.6.1 SimplifyAlgebraicNumberConvertPackage (SIMPAN)	3458
20.7 package SMITH SmithNormalForm	3460
20.7.1 SmithNormalForm (SMITH)	3460
20.8 package SCACHE SortedCache	3466
20.8.1 SortedCache (SCACHE)	3466
20.9 package SORTPAK SortPackage	3469
20.9.1 SortPackage (SORTPAK)	3469
20.10 package SUP2 SparseUnivariatePolynomialFunctions2	3471
20.10.1 SparseUnivariatePolynomialFunctions2 (SUP2)	3471
20.11 package SPECOUT SpecialOutputPackage	3473
20.11.1 SpecialOutputPackage (SPECOUT)	3473
20.12 package SFQCMCK SquareFreeQuasiComponentPackage	3476
20.12.1 SquareFreeQuasiComponentPackage (SFQCMCK)	3476
20.13 package SRDCMPK SquareFreeRegularSetDecompositionPackage	3486
20.13.1 SquareFreeRegularSetDecompositionPackage (SRDCMPK)	3486
20.14 package SFRGCD SquareFreeRegularTriangularSetGcdPackage	3493
20.14.1 SquareFreeRegularTriangularSetGcdPackage (SFRGCD)	3493
20.15 package MATSTOR StorageEfficientMatrixOperations	3504
20.15.1 StorageEfficientMatrixOperations (MATSTOR)	3504
20.16 package STREAM1 StreamFunctions1	3509
20.16.1 StreamFunctions1 (STREAM1)	3509
20.17 package STREAM2 StreamFunctions2	3511
20.17.1 StreamFunctions2 (STREAM2)	3511
20.18 package STREAM3 StreamFunctions3	3514
20.18.1 StreamFunctions3 (STREAM3)	3514
20.19 package STINPROD StreamInfiniteProduct	3516
20.19.1 StreamInfiniteProduct (STINPROD)	3516
20.20 package STTAYLOR StreamTaylorSeriesOperations	3519
20.20.1 StreamTaylorSeriesOperations (STTAYLOR)	3519
20.21 package STNSR StreamTensor	3530
20.21.1 StreamTensor (STNSR)	3531
20.22 package STTF StreamTranscendentalFunctions	3532
20.22.1 StreamTranscendentalFunctions (STTF)	3532

20.23package STTFNC StreamTranscendentalFunctionsNonCommutative	3543
20.23.1 StreamTranscendentalFunctionsNonCommutative (STTFNC)	3543
20.24package SCPKG StructuralConstantsPackage	3549
20.24.1 StructuralConstantsPackage (SCPKG)	3549
20.25package SHP SturmHabichtPackage	3553
20.25.1 SturmHabichtPackage (SHP)	3553
20.26package SUBRESP SubResultantPackage	3562
20.26.1 SubResultantPackage (SUBRESP)	3562
20.27package SUPFRACF SupFractionFactorizer	3566
20.27.1 SupFractionFactorizer (SUPFRACF)	3566
20.28package ODESYS SystemODESolver	3568
20.28.1 SystemODESolver (ODESYS)	3568
20.29package SYSSOLP SystemSolvePackage	3574
20.29.1 SystemSolvePackage (SYSSOLP)	3574
20.30package SGCF SymmetricGroupCombinatoricFunctions	3580
20.30.1 SymmetricGroupCombinatoricFunctions (SGCF)	3580
20.31package SYMFUNC SymmetricFunctions	3591
20.31.1 SymmetricFunctions (SYMFUNC)	3591
21 Chapter T	3593
21.1 package TABLBUMP TableauxBumpers	3593
21.1.1 TableauxBumpers (TABLBUMP)	3593
21.2 package TBCMPPK TabulatedComputationPackage	3597
21.2.1 TabulatedComputationPackage (TBCMPPK)	3597
21.3 package TANEXP TangentExpansions	3601
21.3.1 TangentExpansions (TANEXP)	3601
21.4 package UTSSOL TaylorSolve	3603
21.4.1 TaylorSolve (UTSSOL)	3603
21.5 package TEMUTL TemplateUtilities	3607
21.5.1 TemplateUtilities (TEMUTL)	3607
21.6 package TEX1 TexFormat1	3609
21.6.1 TexFormat1 (TEX1)	3609
21.7 package TOOLSIGN ToolsForSign	3611
21.7.1 ToolsForSign (TOOLSIGN)	3611
21.8 package DRAW TopLevelDrawFunctions	3613
21.8.1 TopLevelDrawFunctions (DRAW)	3613
21.9 package DRAWCURV TopLevelDrawFunctionsForAlgebraicCurves	3621
21.9.1 TopLevelDrawFunctionsForAlgebraicCurves (DRAWCURV)	3621
21.10package DRAWCFUN TopLevelDrawFunctionsForCompiledFunc-	
tions	3625
21.10.1 TopLevelDrawFunctionsForCompiledFunctions (DRAWCFUN)	3625
21.11package DRAWPT TopLevelDrawFunctionsForPoints	3642
21.11.1 TopLevelDrawFunctionsForPoints (DRAWPT)	3642
21.12package TOPSP TopLevelThreeSpace	3645

21.12.1 TopLevelThreeSpace (TOPSP)	3645
21.13package INTHERTR TranscendentalHermiteIntegration	3646
21.13.1 TranscendentalHermiteIntegration (INTHERTR)	3646
21.14package INTTR TranscendentalIntegration	3648
21.14.1 TranscendentalIntegration (INTTR)	3648
21.15package TRMANIP TranscendentalManipulations	3659
21.15.1 TranscendentalManipulations (TRMANIP)	3659
21.16package RDETR TranscendentalRischDE	3669
21.16.1 TranscendentalRischDE (RDETR)	3669
21.17package RDETRS TranscendentalRischDESystem	3674
21.17.1 TranscendentalRischDESystem (RDETRS)	3674
21.18package SOLVETRA TransSolvePackage	3680
21.18.1 TransSolvePackage (SOLVETRA)	3686
21.19package SOLVESER TransSolvePackageService	3699
21.19.1 TransSolvePackageService (SOLVESER)	3699
21.20package TRIMAT TriangularMatrixOperations	3702
21.20.1 TriangularMatrixOperations (TRIMAT)	3702
21.21package TRIGMNIP TrigonometricManipulations	3704
21.21.1 TrigonometricManipulations (TRIGMNIP)	3704
21.22package TUBETOOL TubePlotTools	3708
21.22.1 TubePlotTools (TUBETOOL)	3708
21.23package CLIP TwoDimensionalPlotClipping	3712
21.23.1 TwoDimensionalPlotClipping (CLIP)	3712
21.24package TWOFACT TwoFactorize	3719
21.24.1 TwoFactorize (TWOFACT)	3719

22 Chapter U**3725**

22.1 package UNIFACT UnivariateFactorize	3725
22.1.1 UnivariateFactorize (UNIFACT)	3725
22.2 package UFPS1 UnivariateFormalPowerSeriesFunctions	3733
22.2.1 UnivariateFormalPowerSeriesFunctions (UFPS1)	3733
22.3 package ULS2 UnivariateLaurentSeriesFunctions2	3735
22.3.1 UnivariateLaurentSeriesFunctions2 (ULS2)	3735
22.4 package UPOLYC2 UnivariatePolynomialCategoryFunctions2	3737
22.4.1 UnivariatePolynomialCategoryFunctions2 (UPOLYC2)	3737
22.5 package UPCDEN UnivariatePolynomialCommonDenominator	3739
22.5.1 UnivariatePolynomialCommonDenominator (UPCDEN)	3739
22.6 package UPDECOMP UnivariatePolynomialDecompositionPack-	
age	3741
22.6.1 UnivariatePolynomialDecompositionPackage (UPDECOMP)	3741
22.7 package UPDIVP UnivariatePolynomialDivisionPackage	3745
22.7.1 UnivariatePolynomialDivisionPackage (UPDIVP)	3745
22.8 package UP2 UnivariatePolynomialFunctions2	3747
22.8.1 UnivariatePolynomialFunctions2 (UP2)	3747
22.9 package UPMP UnivariatePolynomialMultiplicationPackage	3749
22.9.1 UnivariatePolynomialMultiplicationPackage (UPMP)	3749

22.10	package UPSQFREE UnivariatePolynomialSquareFree	3752
22.10.1	UnivariatePolynomialSquareFree (UPSQFREE)	3752
22.11	package UPXS2 UnivariatePuisseuxSeriesFunctions2	3756
22.11.1	UnivariatePuisseuxSeriesFunctions2 (UPXS2)	3756
22.12	package OREPCTO UnivariateSkewPolynomialCategoryOps	3758
22.12.1	UnivariateSkewPolynomialCategoryOps (OREPCTO)	3758
22.13	package UTS2 UnivariateTaylorSeriesFunctions2	3762
22.13.1	UnivariateTaylorSeriesFunctions2 (UTS2)	3762
22.14	package UTSODE UnivariateTaylorSeriesODESolver	3764
22.14.1	UnivariateTaylorSeriesODESolver (UTSODE)	3764
22.15	package UNISEG2 UniversalSegmentFunctions2	3768
22.15.1	UniversalSegmentFunctions2 (UNISEG2)	3768
22.16	package UDPO UserDefinedPartialOrdering	3770
22.16.1	UserDefinedPartialOrdering (UDPO)	3770
22.17	package UDVO UserDefinedVariableOrdering	3773
22.17.1	UserDefinedVariableOrdering (UDVO)	3773
22.18	package UTSODETL UTSodetools	3775
22.18.1	UTSodetools (UTSODETL)	3775
23	Chapter V	3777
23.1	package VECTOR2 VectorFunctions2	3777
23.1.1	VectorFunctions2 (VECTOR2)	3777
23.2	package VIEWDEF ViewDefaultsPackage	3780
23.2.1	ViewDefaultsPackage (VIEWDEF)	3780
23.3	package VIEW ViewportPackage	3786
23.3.1	ViewportPackage (VIEW)	3786
24	Chapter W	3789
24.1	package WEIER WeierstrassPreparation	3789
24.1.1	WeierstrassPreparation (WEIER)	3789
24.2	package WFFINTBS WildFunctionFieldIntegralBasis	3794
24.2.1	WildFunctionFieldIntegralBasis (WFFINTBS)	3794
25	Chapter X	3799
25.1	package XEXPPKG XExponentialPackage	3799
25.1.1	XExponentialPackage (XEXPPKG)	3799
26	Chapter Y	3803
27	Chapter Z	3805
27.1	package ZDSOLVE ZeroDimensionalSolvePackage	3805
27.1.1	ZeroDimensionalSolvePackage (ZDSOLVE)	3875
28	Chunk collections	3887
29	Index	3901

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)	9
3.2	dcabs1 BLAS	11
3.3	lsame BLAS	14
3.4	xerbla BLAS	14
4	BLAS Level 1	15
4.1	dasum BLAS	15
4.2	daxpy BLAS	26
4.3	dcopy BLAS	36
4.4	ddot BLAS	43
4.5	dnrm2 BLAS	48
4.6	drotg BLAS	52
4.7	drot BLAS	56
4.8	dscal BLAS	60
4.9	dswap BLAS	64
4.10	dzasum BLAS	69
4.11	dznrm2 BLAS	73
4.12	icamax BLAS	77
4.13	idamax BLAS	81
4.14	isamax BLAS	85
4.15	izamax BLAS	89
4.16	zaxpy BLAS	93
4.17	zcopy BLAS	97
4.18	zdotc BLAS	101
4.19	zdotu BLAS	105
4.20	zdscal BLAS	109
4.21	zrotg BLAS	112
4.22	zscal BLAS	116
4.23	zswap BLAS	119
5	BLAS Level 2	123
5.1	dgbmv BLAS	123
5.2	dgemv BLAS	133
5.3	dger BLAS	142
5.4	dsbmv BLAS	147
5.5	dspmv BLAS	158
5.6	dspr2 BLAS	168
5.7	dspr BLAS	177

5.8	dsymv BLAS	184
5.9	dsyr2 BLAS	194
5.10	dsyr BLAS	203
5.11	dtbmv BLAS	210
5.12	dtbsv BLAS	223
5.13	dtpmv BLAS	237
5.14	dtpsv BLAS	251
5.15	dtrmv BLAS	265
5.16	dtrsv BLAS	277
5.17	zgbmv BLAS	289
5.18	zgemv BLAS	300
5.19	zgerc BLAS	310
5.20	zgeru BLAS	315
5.21	zhbmvl BLAS	320
5.22	zhemv BLAS	331
5.23	zher2 BLAS	341
5.24	zher BLAS	354
5.25	zhpmv BLAS	364
5.26	zhpr2 BLAS	375
5.27	zhpr BLAS	392
5.28	ztbmv BLAS	402
5.29	ztbsv BLAS	419
5.30	ztpmv BLAS	436
5.31	ztpsv BLAS	452
5.32	ztrmv BLAS	469
5.33	ztrsv BLAS	484
6	BLAS Level 3	501
6.1	dgemm BLAS	501
6.2	dsymm BLAS	511
6.3	dsyr2k BLAS	522
6.4	dsyrk BLAS	534
6.5	dtrmm BLAS	545
6.6	dtrsm BLAS	559
6.7	zgemm BLAS	575
6.8	zhemm BLAS	590
6.9	zher2k BLAS	602
6.10	zherk BLAS	620
6.11	zsymm BLAS	635
6.12	zsyr2k BLAS	646
6.13	zsyrk BLAS	658
6.14	ztrmm BLAS	669
6.15	ztrsm BLAS	686

7 LAPACK	705
7.1 dbdsdc LAPACK	705
7.2 dbdsqr LAPACK	720
7.3 ddisna LAPACK	749
7.4 dgebak LAPACK	755
7.5 dgebal LAPACK	761
7.6 dgebd2 LAPACK	769
7.7 dgebrd LAPACK	778
7.8 dgeev LAPACK	786
7.9 dgeevx LAPACK	801
7.10 dgehd2 LAPACK	821
7.11 dgehrd LAPACK	826
7.12 dgelq2 LAPACK	834
7.13 dgelqf LAPACK	838
7.14 dgeqr2 LAPACK	843
7.15 dgeqrf LAPACK	847
7.16 dgesdd LAPACK	852
7.17 dgesvd LAPACK	899
7.18 dgesv LAPACK	1042
7.19 dgetf2 LAPACK	1046
7.20 dgetrf LAPACK	1051
7.21 dgetrs LAPACK	1056
7.22 dhseqr LAPACK	1060
7.23 dlabad LAPACK	1075
7.24 dlabrd LAPACK	1077
7.25 dlacon LAPACK	1092
7.26 dlacpy LAPACK	1098
7.27 dladiv LAPACK	1102
7.28 dlaed6 LAPACK	1104
7.29 dlaexc LAPACK	1114
7.30 dlahqr LAPACK	1127
7.31 dlahrd LAPACK	1145
7.32 dlaln2 LAPACK	1152
7.33 dlamch LAPACK	1171
7.34 dlamc1 LAPACK	1175
7.35 dlamc2 LAPACK	1181
7.36 dlamc3 LAPACK	1189
7.37 dlamc4 LAPACK	1191
7.38 dlamc5 LAPACK	1194
7.39 dlamrg LAPACK	1198
7.40 dlange LAPACK	1202
7.41 dlanhs LAPACK	1207
7.42 dlanst LAPACK	1212
7.43 dlanv2 LAPACK	1217
7.44 dlapy2 LAPACK	1222
7.45 dlaqtr LAPACK	1224

7.46	dlarfb LAPACK	1253
7.47	dlarfg LAPACK	1269
7.48	dlarf LAPACK	1273
7.49	dlarft LAPACK	1276
7.50	dlarfx LAPACK	1285
7.51	dlartg LAPACK	1332
7.52	dlas2 LAPACK	1337
7.53	dlascl LAPACK	1341
7.54	dlasd0 LAPACK	1349
7.55	dlasd1 LAPACK	1357
7.56	dlasd2 LAPACK	1364
7.57	dlasd3 LAPACK	1379
7.58	dlasd4 LAPACK	1394
7.59	dlasd5 LAPACK	1430
7.60	dlasd6 LAPACK	1437
7.61	dlasd7 LAPACK	1446
7.62	dlasd8 LAPACK	1459
7.63	dlasda LAPACK	1469
7.64	dlasdq LAPACK	1485
7.65	dlasdt LAPACK	1495
7.66	dlaset LAPACK	1500
7.67	dlasq1 LAPACK	1504
7.68	dlasq2 LAPACK	1509
7.69	dlasq3 LAPACK	1531
7.70	dlasq4 LAPACK	1547
7.71	dlasq5 LAPACK	1561
7.72	dlasq6 LAPACK	1573
7.73	dlasr LAPACK	1584
7.74	dlasrt LAPACK	1600
7.75	dlasq LAPACK	1608
7.76	dlasv2 LAPACK	1612
7.77	dlaswp LAPACK	1618
7.78	dlasy2 LAPACK	1623
7.79	dorg2r LAPACK	1641
7.80	dorgbr LAPACK	1645
7.81	dorghr LAPACK	1653
7.82	dorgl2 LAPACK	1658
7.83	dorglq LAPACK	1663
7.84	dorgqr LAPACK	1669
7.85	dorm2r LAPACK	1675
7.86	dormbr LAPACK	1680
7.87	dorml2 LAPACK	1688
7.88	dormlq LAPACK	1693
7.89	dormqr LAPACK	1700
7.90	dtrevc LAPACK	1707
7.91	dtrexcl LAPACK	1753

<i>CONTENTS</i>	191
7.92 dtrsna LAPACK	1763
7.93 ieeck LAPACK	1781
7.94 ilaenv LAPACK	1786
7.95 zlange LAPACK	1799
7.96 zlassq LAPACK	1804
8 Chunk collections	1809
9 Index	1817

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	alggrouptheory.xhtml	100
1.9.5	alggrouptheorygroup.xhtml	101
1.9.6	alggrouptheoryrepa6.xhtml	102
1.9.7	alggrouptheoryrepththeory.xhtml	106
1.9.8	algnumberttheory.xhtml	107
1.9.9	algnumberttheorygalois.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 dboplagerrel.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 dboplength.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 dbopsingleintegerand.xhtml	289
1.9.253 dbopsingleintegernot.xhtml	289
1.9.254 dbopsingleintegeror.xhtml	289
1.9.255 dbopsingleintegerxor.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 txttoppage.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 menucalculuscalculussum.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 menusimplifyevaluatounform.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 polyspecificitytypes.xhtml	1117
1.9.534 polyspecificitytypes1.xhtml	1119
1.9.535 polyspecificitytypes2.xhtml	1131
1.9.536 polyspecificitytypes3.xhtml	1140
1.9.537 polyspecificitytypes4.xhtml	1144
1.9.538 polysubstitutions.xhtml	1147
1.9.539 puisieuxseries.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 solvelinearatrix.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

Bibliography: Axiom Bibliography

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