

# Contents at a Glance

About the Author .....	xix
About the Technical Reviewer .....	xxi
Acknowledgments .....	xxiii
Typographical Conventions .....	xxv
<b>CHAPTER 1</b> Introduction: Why Lisp? .....	1
<b>CHAPTER 2</b> Lather, Rinse, Repeat: A Tour of the REPL .....	9
<b>CHAPTER 3</b> Practical: A Simple Database .....	19
<b>CHAPTER 4</b> Syntax and Semantics .....	37
<b>CHAPTER 5</b> Functions .....	51
<b>CHAPTER 6</b> Variables .....	65
<b>CHAPTER 7</b> Macros: Standard Control Constructs .....	79
<b>CHAPTER 8</b> Macros: Defining Your Own .....	89
<b>CHAPTER 9</b> Practical: Building a Unit Test Framework .....	103
<b>CHAPTER 10</b> Numbers, Characters, and Strings .....	115
<b>CHAPTER 11</b> Collections .....	127
<b>CHAPTER 12</b> They Called It LISP for a Reason: List Processing .....	141
<b>CHAPTER 13</b> Beyond Lists: Other Uses for Cons Cells .....	153
<b>CHAPTER 14</b> Files and File I/O .....	163
<b>CHAPTER 15</b> Practical: A Portable Pathname Library .....	179
<b>CHAPTER 16</b> Object Reorientation: Generic Functions .....	189
<b>CHAPTER 17</b> Object Reorientation: Classes .....	203
<b>CHAPTER 18</b> A Few FORMAT Recipes .....	219
<b>CHAPTER 19</b> Beyond Exception Handling: Conditions and Restarts .....	233
<b>CHAPTER 20</b> The Special Operators .....	245
<b>CHAPTER 21</b> Programming in the Large: Packages and Symbols .....	263
<b>CHAPTER 22</b> LOOP for Black Belts .....	277



<b>CHAPTER 23</b>	<b>Practical: A Spam Filter .....</b>	<b>291</b>
<b>CHAPTER 24</b>	<b>Practical: Parsing Binary Files .....</b>	<b>311</b>
<b>CHAPTER 25</b>	<b>Practical: An ID3 Parser .....</b>	<b>335</b>
<b>CHAPTER 26</b>	<b>Practical: Web Programming with AllegroServe .....</b>	<b>363</b>
<b>CHAPTER 27</b>	<b>Practical: An MP3 Database .....</b>	<b>385</b>
<b>CHAPTER 28</b>	<b>Practical: A Shoutcast Server .....</b>	<b>401</b>
<b>CHAPTER 29</b>	<b>Practical: An MP3 Browser .....</b>	<b>411</b>
<b>CHAPTER 30</b>	<b>Practical: An HTML Generation Library, the Interpreter .....</b>	<b>431</b>
<b>CHAPTER 31</b>	<b>Practical: An HTML Generation Library, the Compiler .....</b>	<b>449</b>
<b>CHAPTER 32</b>	<b>Conclusion: What's Next? .....</b>	<b>465</b>
<b>INDEX .....</b>		<b>481</b>



# Contents

About the Author .....	xix
About the Technical Reviewer .....	xxi
Acknowledgments .....	xxiii
Typographical Conventions .....	xxv
<b>CHAPTER 1 Introduction: Why Lisp? .....</b>	<b>1</b>
Why Lisp? .....	2
Where It Began .....	4
Who This Book Is For .....	7
<b>CHAPTER 2 Lather, Rinse, Repeat: A Tour of the REPL .....</b>	<b>9</b>
Choosing a Lisp Implementation .....	9
Getting Up and Running with Lisp in a Box .....	11
Free Your Mind: Interactive Programming .....	12
Experimenting in the REPL .....	12
“Hello, World,” Lisp Style .....	13
Saving Your Work .....	15
<b>CHAPTER 3 Practical: A Simple Database .....</b>	<b>19</b>
CDs and Records .....	19
Filing CDs .....	21
Looking at the Database Contents .....	21
Improving the User Interaction .....	23
Saving and Loading the Database .....	25
Querying the Database .....	27
Updating Existing Records—Another Use for WHERE .....	31
Removing Duplication and Winning Big .....	32
Wrapping Up .....	36



<b>CHAPTER 4</b>	<b>Syntax and Semantics</b>	37
	What's with All the Parentheses?	37
	Breaking Open the Black Box	38
	S-expressions	39
	S-expressions As Lisp Forms	41
	Function Calls	42
	Special Operators	43
	Macros	44
	Truth, Falsehood, and Equality	45
	Formatting Lisp Code	47
<b>CHAPTER 5</b>	<b>Functions</b>	51
	Defining New Functions	51
	Function Parameter Lists	53
	Optional Parameters	53
	Rest Parameters	55
	Keyword Parameters	56
	Mixing Different Parameter Types	57
	Function Return Values	58
	Functions As Data, a.k.a. Higher-Order Functions	59
	Anonymous Functions	61
<b>CHAPTER 6</b>	<b>Variables</b>	65
	Variable Basics	65
	Lexical Variables and Closures	68
	Dynamic, a.k.a. Special, Variables	69
	Constants	74
	Assignment	74
	Generalized Assignment	75
	Other Ways to Modify Places	76
<b>CHAPTER 7</b>	<b>Macros: Standard Control Constructs</b>	79
	WHEN and UNLESS	80
	COND	82
	AND, OR, and NOT	82



	Looping .....	83
	DOLIST and DOTIMES .....	84
	DO .....	85
	The Mighty LOOP .....	87
<b>CHAPTER 8</b>	<b>Macros: Defining Your Own .....</b>	<b>89</b>
	The Story of Mac: A Just-So Story .....	89
	Macro Expansion Time vs. Runtime .....	90
	DEFMACRO .....	91
	A Sample Macro: do-primes .....	92
	Macro Parameters .....	93
	Generating the Expansion .....	95
	Plugging the Leaks .....	96
	Macro-Writing Macros .....	100
	Beyond Simple Macros .....	102
<b>CHAPTER 9</b>	<b>Practical: Building a Unit Test Framework .....</b>	<b>103</b>
	Two First Tries .....	103
	Refactoring .....	105
	Fixing the Return Value .....	106
	Better Result Reporting .....	108
	An Abstraction Emerges .....	109
	A Hierarchy of Tests .....	110
	Wrapping Up .....	112
<b>CHAPTER 10</b>	<b>Numbers, Characters, and Strings .....</b>	<b>115</b>
	Numbers .....	116
	Numeric Literals .....	117
	Basic Math .....	119
	Numeric Comparisons .....	121
	Higher Math .....	122
	Characters .....	122
	Character Comparisons .....	122
	Strings .....	123
	String Comparisons .....	124



<b>CHAPTER 11</b>	<b>Collections</b>	127
	Vectors	127
	Subtypes of Vector	129
	Vectors As Sequences	130
	Sequence Iterating Functions	130
	Higher-Order Function Variants	133
	Whole Sequence Manipulations	134
	Sorting and Merging	135
	Subsequence Manipulations	136
	Sequence Predicates	137
	Sequence Mapping Functions	137
	Hash Tables	138
	Hash Table Iteration	140
<b>CHAPTER 12</b>	<b>They Called It LISP for a Reason: List Processing</b>	141
	“There Is No List”	141
	Functional Programming and Lists	144
	“Destructive” Operations	145
	Combining Recycling with Shared Structure	147
	List-Manipulation Functions	149
	Mapping	151
	Other Structures	152
<b>CHAPTER 13</b>	<b>Beyond Lists: Other Uses for Cons Cells</b>	153
	Trees	153
	Sets	155
	Lookup Tables: Alists and Plists	157
	DESTRUCTURING-BIND	161
<b>CHAPTER 14</b>	<b>Files and File I/O</b>	163
	Reading File Data	163
	Reading Binary Data	165
	Bulk Reads	165
	File Output	165
	Closing Files	167



Filename	168
How Pathnames Represent Filenames	169
Constructing New Pathnames	171
Two Representations of Directory Names	173
Interacting with the File System	173
Other Kinds of I/O	175

**CHAPTER 15 Practical: A Portable Pathname Library ..... 179**

The API .....	179
*FEATURES* and Read-Time Conditionalization.....	180
Listing a Directory .....	182
Testing a File's Existence .....	185
Walking a Directory Tree.....	187

**CHAPTER 16 Object Reorientation: Generic Functions** ..... 189

Generic Functions and Classes .....	190
Generic Functions and Methods.....	191
DEFGENERIC.....	193
DEFMETHOD.....	194
Method Combination .....	196
The Standard Method Combination.....	197
Other Method Combinations.....	198
Multimethods .....	200
To Be Continued .....	202

**CHAPTER 17 Object Reorientation: Classes** ..... 203

DEFCLASS.....	203
Slot Specifiers .....	205
Object Initialization .....	206
Accessor Functions .....	209
WITH-SLOTS and WITH-ACCESSORS .....	212
Class-Allocated Slots.....	213
Slots and Inheritance.....	214
Multiple Inheritance.....	215
Good Object-Oriented Design.....	218



<b>CHAPTER 18</b>	<b>A Few FORMAT Recipes</b>	219
	The FORMAT Function	220
	FORMAT Directives	221
	Basic Formatting	222
	Character and Integer Directives	223
	Floating-Point Directives	225
	English-Language Directives	226
	Conditional Formatting	227
	Iteration	228
	Hop, Skip, Jump	230
	And More	231
<b>CHAPTER 19</b>	<b>Beyond Exception Handling: Conditions and Restarts</b>	233
	The Lisp Way	234
	Conditions	235
	Condition Handlers	235
	Restarts	238
	Providing Multiple Restarts	240
	Other Uses for Conditions	241
<b>CHAPTER 20</b>	<b>The Special Operators</b>	245
	Controlling Evaluation	245
	Manipulating the Lexical Environment	246
	Local Flow of Control	248
	Unwinding the Stack	252
	Multiple Values	256
	EVAL-WHEN	258
	Other Special Operators	260
<b>CHAPTER 21</b>	<b>Programming in the Large: Packages and Symbols</b>	263
	How the Reader Uses Packages	263
	A Bit of Package and Symbol Vocabulary	265
	Three Standard Packages	266
	Defining Your Own Packages	267
	Packaging Reusable Libraries	270



Importing Individual Names .....	271
Packaging Mechanics .....	272
Package Gotchas .....	273
<b>CHAPTER 22 LOOP for Black Belts .....</b>	<b>277</b>
The Parts of a LOOP .....	277
Iteration Control .....	278
Counting Loops .....	278
Looping Over Collections and Packages .....	280
Equals-Then Iteration .....	281
Local Variables .....	282
Destructuring Variables .....	282
Value Accumulation .....	283
Unconditional Execution .....	285
Conditional Execution .....	285
Setting Up and Tearing Down .....	287
Termination Tests .....	288
Putting It All Together .....	290
<b>CHAPTER 23 Practical: A Spam Filter .....</b>	<b>291</b>
The Heart of a Spam Filter .....	291
Training the Filter .....	295
Per-Word Statistics .....	297
Combining Probabilities .....	299
Inverse Chi Square .....	301
Training the Filter .....	302
Testing the Filter .....	303
A Couple of Utility Functions .....	305
Analyzing the Results .....	306
What's Next .....	309
<b>CHAPTER 24 Practical: Parsing Binary Files .....</b>	<b>311</b>
Binary Files .....	311
Binary Format Basics .....	312
Strings in Binary Files .....	314
Composite Structures .....	316



Designing the Macros .....	317
Making the Dream a Reality .....	318
Reading Binary Objects .....	320
Writing Binary Objects .....	322
Adding Inheritance and Tagged Structures .....	323
Keeping Track of Inherited Slots .....	325
Tagged Structures .....	327
Primitive Binary Types .....	329
The Current Object Stack .....	332
<b>CHAPTER 25 Practical: An ID3 Parser .....</b>	<b>335</b>
Structure of an ID3v2 Tag .....	336
Defining a Package .....	337
Integer Types .....	338
String Types .....	339
ID3 Tag Header .....	343
ID3 Frames .....	344
Detecting Tag Padding .....	346
Supporting Multiple Versions of ID3 .....	348
Versioned Frame Base Classes .....	350
Versioned Concrete Frame Classes .....	351
What Frames Do You Actually Need? .....	352
Text Information Frames .....	354
Comment Frames .....	356
Extracting Information from an ID3 Tag .....	357
<b>CHAPTER 26 Practical: Web Programming with AllegroServe .....</b>	<b>363</b>
A 30-Second Intro to Server-Side Web Programming .....	363
AllegroServe .....	365
Generating Dynamic Content with AllegroServe .....	368
Generating HTML .....	370
HTML Macros .....	373
Query Parameters .....	374
Cookies .....	377
A Small Application Framework .....	379
The Implementation .....	380



<b>CHAPTER 27</b>	<b>Practical: An MP3 Database</b>	385
	The Database	385
	Defining a Schema	388
	Inserting Values	390
	Querying the Database	392
	Matching Functions	394
	Getting at the Results	397
	Other Database Operations	398
<b>CHAPTER 28</b>	<b>Practical: A Shoutcast Server</b>	401
	The Shoutcast Protocol	401
	Song Sources	402
	Implementing Shoutcast	405
<b>CHAPTER 29</b>	<b>Practical: An MP3 Browser</b>	411
	Playlists	411
	Playlists As Song Sources	413
	Manipulating the Playlist	417
	Query Parameter Types	420
	Boilerplate HTML	422
	The Browse Page	423
	The Playlist	426
	Finding a Playlist	429
	Running the App	430
<b>CHAPTER 30</b>	<b>Practical: An HTML Generation Library, the Interpreter</b>	431
	Designing a Domain-Specific Language	431
	The FOO Language	433
	Character Escaping	435
	Indenting Printer	437
	HTML Processor Interface	438
	The Pretty Printer Backend	439
	The Basic Evaluation Rule	443
	What's Next?	447



<b>CHAPTER 31</b>	<b>Practical: An HTML Generation Library, the Compiler</b>	<b>449</b>
	The Compiler	449
	FOO Special Operators	454
	FOO Macros	459
	The Public API	462
	The End of the Line	463
<b>CHAPTER 32</b>	<b>Conclusion: What's Next?</b>	<b>465</b>
	Finding Lisp Libraries	465
	Interfacing with Other Languages	467
	Make It Work, Make It Right, Make It Fast	467
	Delivering Applications	475
	Where to Go Next	477
<b>INDEX</b>		<b>481</b>