

Contents

Acknowledgments	ix
Introduction	xxiii
Chapter 1: Getting Situated	1
Choosing How to Install Lua	1
Building Lua Yourself	2
Selecting Prebuilt Lua	3
Finding Your System's Shell	3
Windows Shells	3
Shells on Unix and Unix-Like systems	3
Shell Features	4
The Environment	4
Environment Variables on Unix-Like Systems	4
Environment Variables on Windows	5
Dealing with Tarballs and Zip Files	6
Compiling Lua	7
The Lua Source Tarball	7
Compiling Lua on Linux and Other Unix-Like Systems	8
Compiling Lua on Windows	12
Building Lua with Microsoft Visual C++	13
Building Lua with the Tiny C Compiler	14
Building Lua with MinGW	16
Binary Packages	18
Selecting a Prebuilt Binary Package	18
Installing a Prebuilt Binary Package on a Unix-Type System	19
Installing a Prebuilt Binary Package on Windows	20
Additional Tools	21
Programmer's Editor	21
Revision Control System	22
Summary	22
Chapter 2: First Steps	23
Numbers and Arithmetic Operations: Basic Interpreter Usage	23
Addition, Subtraction, Multiplication, Division, and Exponentiation	24
Interacting with the Interpreter	24
Other Notations for Numbers	25

Contents

Interpreter Know-How	26
Quitting the Interpreter	26
Interpreter Shortcuts	26
Numerical Gotchas	27
Division by Zero and Overflow	27
Floating-Point Rounding	28
Variables and Assignment	28
Assignment Basics	29
Multiple Assignment	31
Variables on the Right Side of Assignments	32
Strings	32
Quoting Strings	32
Quoting Strings with Double Quotes	32
Quoting Strings with Single Quotes	33
Quoting Strings with Square Brackets	33
Backslash Escaping	35
Relational Operators and Boolean Values	37
Comparing Numbers	37
Comparing Strings	38
The nil Value	40
Boolean Operators	41
The and Operator	42
The or Operator	43
The not Unary Operator	44
The Concatenation, Length, and Modulo Operators	45
The String Concatenation Operator	45
The Length Operator	46
The Modulo Operator	47
Automatic Conversion of Operands	48
Precedence and Associativity	49
Variables and Values	51
Comments	52
Expressions and Statements	53
Compound Statements	54
The if Statement	55
The while Loop	58
The for Loop	60
The repeat Loop	62
The break and do Statements	63
Summary	66
Exercises	66

Chapter 3: Extending Lua with Functions	69
Return Values	72
Using a Function that Returns a Value	72
Defining a Function that Returns a Value	73
Using return to Alter Control Flow	74
Returning Nothing	76
Returning Multiple Values	77
Adjusting Value Lists	78
Using Multiple-Valued Functions in Value Lists	78
Using Valueless Functions in Value Lists	79
Chunks as Functions	81
Variable Scope	84
Actual and Formal Arguments	84
Local Variables	85
Understanding Side Effects	91
Ordering Side Effects	91
Short-Circuit Evaluation	93
Functions Calling Functions	95
The Call Stack	95
Recursion	97
Stack Overflow	98
Tail Calls	99
Functions as Values	102
Replacing Built-In Functions	102
Comparing and Printing Functions	103
Function Definitions as Assignments	103
Local Functions	105
Whitespace, Semicolons, and Function Calls	106
Upvalues and Closures	108
Defining Functions that Create Functions	108
Defining Functions with Private State	110
Figuring Out Tricky Scope Situations	111
Summary	113
Exercises	114
Chapter 4: Working with Tables	117
Tables Introduced	117
A Shorter Way to Write Some Keys	119
Altering a Table's Contents	120
Tables as Arrays	121
Array Length	123

Contents

Looping through Tables	124
Tables of Functions	128
The Table Library	128
table.sort	128
table.concat	131
table.remove	132
table.maxn	132
Object-Oriented Programming with Tables	133
Functions with Variable Numbers of Arguments	136
Defining Vararg Functions	136
Scripts as Vararg Functions	140
Keyword Arguments	143
Different but the Same	144
Table Equality	144
Avoiding Bugs by Understanding Mutability	145
Variables and Mutable Values	145
Tables and Functions	147
Copying Tables	148
Building Other Data Structures from Tables	152
Custom-Made Loops	158
Global Variable Environments	163
Summary	168
Exercises	169
 Chapter 5: Using Strings	 171
 Basic String Conversion Functions	 171
String Length	173
Converting Between Characters and Character Codes	173
Formatting Strings and Numbers with string.format	174
Input/Output	180
Writing to and Reading from a File	181
Pattern-Matching	185
Searching for a Specific String	186
Matching Any of Several Characters	186
Matches of Varying Lengths	193
Captures	198
Matching Balanced Delimiters	202
More on string.find, string.match, and string.gsub	202
Iterating Through All Matches	204
Tricks for the Tricky	207
Magic Characters Chart	209
Summary	210
Exercises	210

Chapter 6: Handling and Avoiding Errors	213
Kinds of Errors	213
Syntax Errors	213
Runtime Errors	217
Handling Errors	218
Default Error Behavior	218
Checking Assumptions	219
Code Errors	220
Data Errors	220
The assert and error Functions	220
Defining Your Own Error Condition	221
Anticipating Error Conditions	222
Working with Return Values	222
Structuring Code	224
Error-Containment Functions	227
The pcall Function	227
The xpcall Function	229
User-Written Scripts	230
Locating Errors	230
Summary	230
Exercises	231
 Chapter 7: Using Modules	 233
Interfaces and Implementations	233
The require Function	234
Where to Put Modules	235
Creating a Module Directory	235
Setting Lua's Environment Variable	236
Preserving a Module's Interface	236
Module Bookkeeping	240
Bytecode	241
Namespaces	242
Creating and Reusing Namespaces	242
Avoiding Global Variables	244
Using the strict Module	244
Reporting All Global Assignments	244
The module Function	245
C Modules	247
Summary	247
Exercises	247

Contents

Chapter 8: Extending Lua's Behavior with Metamethods **249**

Using Concatenation and Arithmetical Operators on Tables	249
Relational Metamethods	257
Indexing and Call Metamethods	258
Non-Tables with Metamethods	265
Non-Syntactical Metamethods	267
Metamethod Applicability	268
Summary	268
Exercises	269

Chapter 9: Handling Events Naturally with Coroutines **271**

Coroutines and Program Control	271
Coroutines Are Not Functions	272
How Coroutines Are Like Programs	272
Coroutines Transfer Control	273
Wrapping a Coroutine	273
Coroutines Are Cooperative	273
Outside Looking In	275
Coroutines Have Status	278
Rules of Conduct	279
Work Shoulder-to-Shoulder	279
Trust the Dispatcher	280
Expect the Best, Prepare for the Worst	280
Play on Your Side of the Fence	280
Avoid the Deep End	281
Managing Concurrent Tasks	281
Retaining State	282
Exercising a Coroutine's Memory	282
Iterating with Coroutines	286
Handling Events Simply	287
The Event Loop	288
Yielding to Another Coroutine	296
Summary	297
Exercises	297

Chapter 10: Looking Under the Hood **299**

Bytecode and luac	299
Garbage Collection	303
The Implementation of Tables and Strings	307

The Debug Library	308
Inspecting and Manipulating Running Code	308
Hooks	315
Other Functions in the Debug Library	321
Summary	321
Exercises	322
Chapter 11: Exploring Lua's Libraries	325
Core Library	325
Environment Functions	326
Metatable Functions	326
Chunk-Loading Functions	328
Error-Containment Functions	330
Module Functions	331
The Garbage-Collection Function	332
Type and Conversion Functions	333
Basic Output	333
Error-Condition Functions	333
Table Traversal Functions	334
Vararg-Related Functions	335
Coroutine Library	336
Package Library	338
String Library	340
Pattern-Based String Functions	340
String-Conversion Functions	342
Table Library	344
Math Library	345
Trigonometric Functions	345
Inverse Trigonometric Functions	348
Hyperbolic Functions	351
Exponent Functions	354
Logarithm Functions	356
Adjustment Functions	358
Floating Point Representation	360
Angle Conversion Functions	361
Pseudo-Random Number Functions	362
Modulus Functions	362
Minimum and Maximum Functions	363
Constants	363
Input/Output Library	364

Contents

Operating System Library	368
CPU Timing	368
Time and Date Functions	368
Filesystem Functions	369
Other Operating System Functions	370
Debugging Library	370
Summary	373
Chapter 12: Using Community Libraries	375
Library Overview	375
Dynamically Linked Libraries	376
Resolving External References	376
Configuration Options	376
Libraries Built from Source Code	377
Building Libraries on Unix-Like Systems	378
Building Libraries on Windows	378
Limits to Portability	379
How Lua Interacts with Libraries	379
The Variable Registration Process	379
Calling a C Function from Lua	380
The pack Binary Structuring Library	383
Building the pack Library on Unix-type Systems	383
Building and Installing the pack Library on Windows	384
Testing the pack Library	384
Installing the pack Library	385
Using the pack Library	385
The cURL File Transfer Library	389
Building libcurl	389
Building libcurl on Unix-Like Systems	390
Building libcurl on Windows	391
Building luacurl	392
Building luacurl on Unix-Like Systems	392
Building luacurl on Windows	393
Using luacurl	393
The gd Graphics Library	395
Building gd	395
Building gd on Unix-Like Systems	396
Installing gd on Windows	396
Building lua-gd	397
Building lua-gd on Unix-Like Systems	397
Building lua-gd on Windows	398
Using lua-gd	399

The SQLite Database Library	405
Building SQLite3	405
Building SQLite3 on Unix-Like Systems	405
Building SQLite3 on Windows	406
Building lua-sqlite3	407
Building lua-sqlite3 on Unix-Like Systems	407
Building lua-sqlite3 on Windows	408
Using lua-sqlite3	409
Summary	411
Exercises	412
 Chapter 13: Interfacing Lua with Other Languages	 413
 How C Programs Use Lua	 413
Embedding Lua	414
Extending Lua	414
Embedding or Extending: Which Is Best?	414
Communicating Between Lua and C	415
Calling Lua from C	421
Obtaining a Lua Function	421
Calling a Lua Function	421
Protected Calls	422
Working with Userdata	423
Indexing Values in C	436
Retrieving Indexed Values	436
Setting Indexed Values	437
Retaining Values in C	438
The Registry	438
C Function Environments	439
Upvalues in C	439
Referencing Values	440
The Thread Environment	441
Layering Your Extension Library	441
Summary	447
Exercises	448
 Chapter 14: Managing Information with Databases	 449
Some Basic Relational Database Concepts	449
SQL, LuaSQL, and MySQL	458
Summary	466
Exercises	466

Contents

Chapter 15: Programming for the Web **467**

A Web Server Primer	467
Dynamic Web Content	468
Embedded Web Server	468
Extended Web Server	469
Creating Content at Run Time with Lua	469
Executing CGI Scripts	469
CGI Scripts on Unix-Type Systems	470
CGI Scripts on Windows	470
Installing a Web Server	471
Apache	471
TinyWeb	472
Testing Your Web Server with Static Content	474
Serving Dynamic Web Content	474
Problems with CGI Scripts	475
Asynchronous Calls to the Server	476
Producing a Calendar Dynamically	478
Producing Charts Dynamically	481
Interactive CGI Applications	489
CGI Helper Routines	489
Developing CGI Scripts	498
Security Issues	498
The Kepler Project	498
CGI the Kepler Way	499
Lua Pages	500
Summary	501
Exercises	501

Chapter 16: Connecting to a Larger World **503**

Installing LuaSocket	503
Compiling LuaSocket	504
Compiling on Linux and Other Unix-Like Systems	504
Compiling on Windows	504
Installing Windows Binaries	505
Network Overview	506
Routed Packets	506
Addresses	507
Domain Names	507
Identifying Internet Resources	508
Transport Protocols	509
Sockets: Streams and Datagrams	510
TCP Socket Sociology	511

Using LuaSocket for Network Communication	512
Handling Multiple Persistent Connections	518
Using Lua Coroutines with the select Function	518
Multiple Connections on the Server Side	522
Setting Timeout Values for the Server Socket	523
The Application Protocols	524
Filtering the Flow of Data	524
Accessing Web Pages	527
Sending and Receiving E-mail Messages	529
Networking with Lua and Streams	536
On the Server Side: inetd and Friends	536
On the Client Side: ssh and Friends	538
Summary	541
Exercises	542
 Chapter 17: Programming Games with Lua	 543
Understanding Why and When to Use Lua	543
Simple 2-D Action Game Using SDL	544
Installing SDL and LuaCheia	544
Using SDL	546
Summary	562
Exercise	562
 Chapter 18: Carrying Lua with You	 565
Getting Started with Plua	565
Obtaining Plua	566
Examining the Distribution Contents	566
Exploring Plua's Features	567
Running the Plua Application	567
Saving Plua Programs	569
Reading the Online Documentation	570
Using Palm OS Streams	571
Compiling Applications	572
Compiling Libraries	573
Plua on the Mothership	576
The Command-Line Compiler	576
The Palm OS Emulator	577
Obtaining the Emulator	577
Installing on Windows	578
Configuring POSE	578
Running Plua in the Emulator	578

Contents

Compiling a Program in the Emulator	580
Exiting the Emulator	580
The Palm OS Simulator	581
Obtaining the Simulator	581
Using the Simulator	581
Programming with Plua	581
Generating Graphics	582
Programming the User Interface	583
Accessing Databases	590
Summary	592
Exercises	593
 Chapter 19: Fitting into the Lua Community	 595
 The Lua Web Site	 596
The Lua Reference Manual	596
Framing Questions	597
The Lua Mailing List	597
Viewing and Searching the Archives	597
Downloading the Archives	598
Using a Web Browser to Access the List	599
Using a Newsreader to Access the List	599
Subscribing to the List Server	599
Posting Messages	600
The Lua Chat Room	601
Forums	601
The Lua Wiki	601
LuaForge	602
Annual Workshops	603
Summary	603
 Appendix A: Answers	 605
 Index	 629