



# Tcl and the Tk Toolkit

## Second Edition

---

John K. Ousterhout  
Ken Jones

With contributions by  
Eric Foster-Johnson, Donal Fellows, Brian Griffin, and David Welton

◆◆ Addison-Wesley

Upper Saddle River, NJ • Boston • Indianapolis • San Francisco  
New York • Toronto • Montreal • London • Munich • Paris • Madrid  
Capetown • Sydney • Tokyo • Singapore • Mexico City



# Contents

---

Preface	xxv	
Preface to the First Edition	xxvii	
Introduction	xxxii	
<b>PART I</b>	<b>The Tcl Language</b>	<b>1</b>
Chapter 1	An Overview of Tcl and Tk	3
1.1	Getting Started	3
1.2	“Hello, World!” with Tk	6
1.3	Script Files	8
1.3.1	Executable Scripts on Unix and Mac OS X	9
1.3.2	Executable Scripts on Windows	9
1.3.3	Executing Scripts in an Interactive Interpreter	10
1.4	Variables and Substitutions	11
1.5	Control Structures	12
1.6	On the Tcl Language	14
1.7	Event Bindings	15
1.8	Additional Features of Tcl and Tk	19

---

Chapter 2	Tcl Language Syntax	21
	2.1 Scripts, Commands, and Words	21
	2.2 Evaluating a Command	22
	2.3 Variable Substitution	24
	2.4 Command Substitution	26
	2.5 Backslash Substitution	26
	2.6 Quoting with Double Quotes	28
	2.7 Quoting with Braces	29
	2.8 Argument Expansion	30
	2.9 Comments	32
	2.10 Normal and Exceptional Returns	35
	2.11 More on Substitutions	36
Chapter 3	Variables	39
	3.1 Commands Presented in This Chapter	39
	3.2 Simple Variables and the <code>set</code> Command	41
	3.3 Tcl's Internal Storage of Data	41
	3.4 Arrays	42
	3.5 Variable Substitution	43
	3.6 Multidimensional Arrays	45
	3.7 Querying the Elements of an Array	46
	3.8 The <code>incr</code> and <code>append</code> Commands	47
	3.9 Removing Variables: <code>unset</code> and <code>array unset</code>	49
	3.10 Predefined Variables	49
	3.11 Preview of Other Variable Facilities	50
Chapter 4	Expressions	53
	4.1 Commands Presented in This Chapter	53
	4.2 Numeric Operands	54
	4.3 Operators and Precedence	55
	4.3.1 Arithmetic Operators	56
	4.3.2 Relational Operators	56
	4.3.3 Logical Operators	57
	4.3.4 Bit-wise Operators	57
	4.3.5 Choice Operator	58
	4.4 Math Functions	58

---

4.5	Substitutions	60
4.6	String Manipulation	62
4.7	List Manipulation	63
4.8	Types and Conversions	63
4.9	Precision	64
Chapter 5	String Manipulation	65
5.1	Commands Presented in This Chapter	65
5.2	Extracting Characters: <code>string</code> index and string range	69
5.3	Length, Case Conversion, Trimming, and Repeating	70
5.4	Simple Searching	70
5.5	String Comparisons	71
5.6	String Replacements	72
5.7	Determining String Types	73
5.8	Generating Strings with <code>format</code>	74
5.9	Parsing Strings with <code>scan</code>	76
5.10	Glob-Style Pattern Matching	78
5.11	Pattern Matching with Regular Expressions	79
5.11.1	Regular Expression Atoms	80
5.11.2	Regular Expression Branches and Quantifiers	84
5.11.3	Back References	85
5.11.4	Non-capturing Subexpressions	85
5.11.5	The <code>regexp</code> Command	86
5.12	Using Regular Expressions for Substitutions	87
5.13	Character Set Issues	89
5.13.1	Character Encodings and the Operating System	89
5.13.2	Encodings and Channel Input/output	90
5.13.3	Converting Strings to Different Encodings	91
5.14	Message Catalogs	91
5.14.1	Using Message Catalogs	91
5.14.2	Creating Localized Message Files	93
5.14.3	Using Conversion Specifiers in Source and Translation Strings	94
5.14.4	Using Message Catalogs with Namespaces	95
5.15	Binary Strings	95

---

Chapter 6	Lists	101
6.1	Commands Presented in This Chapter	101
6.2	Basic List Structure and the <code>lindex</code> and <code>llength</code> Commands	103
6.3	Creating Lists: <code>list</code> , <code>concat</code> , and <code>lrepeat</code>	105
6.4	Modifying Lists: <code>lrange</code> , <code>linsert</code> , <code>lreplace</code> , <code>lset</code> , and <code>lappend</code>	106
6.5	Extracting List Elements: <code>lassign</code>	109
6.6	Searching Lists: <code>lsearch</code>	110
6.7	Sorting Lists: <code>lsort</code>	111
6.8	Converting between Strings and Lists: <code>split</code> and <code>join</code>	111
6.9	Creating Commands as Lists	113
Chapter 7	Dictionaries	115
7.1	Commands Presented in This Chapter	116
7.2	Basic Dictionary Structure and the <code>dict get</code> Command	118
7.3	Creating and Updating Dictionaries	120
7.4	Examining Dictionaries: The <code>size</code> , <code>exists</code> , <code>keys</code> , and <code>for</code> Subcommands	122
7.5	Updating Dictionary Values	123
7.6	Working with Nested Dictionaries	126
Chapter 8	Control Flow	131
8.1	Commands Presented in This Chapter	131
8.2	The <code>if</code> Command	132
8.3	The <code>switch</code> Command	133
8.4	Looping Commands: <code>while</code> , <code>for</code> , and <code>foreach</code>	136
8.5	Loop Control: <code>break</code> and <code>continue</code>	138
8.6	The <code>eval</code> Command	139
8.7	Executing from Files: <code>source</code>	140
Chapter 9	Procedures	143
9.1	Commands Presented in This Chapter	143
9.2	Procedure Basics: <code>proc</code> and <code>return</code>	144
9.3	Local and Global Variables	146
9.4	Defaults and Variable Numbers of Arguments	146

---

9.5	Call by Reference: upvar	148
9.6	Creating New Control Structures: uplevel	150
9.7	Applying Anonymous Procedures	151
Chapter 10	Namespaces	155
10.1	Commands Presented in This Chapter	155
10.2	Evaluating Tcl Code in a Namespace	158
10.3	Manipulating Qualified Names	161
10.4	Exporting and Importing Namespace Commands	162
10.5	Inspecting Namespaces	163
10.6	Working with Ensemble Commands	164
10.6.1	Basic Ensembles	164
10.6.2	Placing Ensembles Inside Ensembles	165
10.6.3	Controlling the Ensemble Configuration	166
10.6.4	Handling Unknown Ensemble Subcommands	167
10.7	Accessing Variables from Other Namespaces	169
10.8	Controlling the Name Resolution Path	170
Chapter 11	Accessing Files	173
11.1	Commands Presented in This Chapter	173
11.2	Manipulating File and Directory Names	176
11.3	The Current Working Directory	179
11.4	Listing Directory Contents	179
11.5	Working with Files on Disk	181
11.5.1	Creating Directories	181
11.5.2	Deleting Files	181
11.5.3	Copying Files	182
11.5.4	Renaming and Moving Files	183
11.5.5	File Information Commands	183
11.5.6	Dealing with Oddly Named Files	185
11.6	Reading and Writing Files	185
11.6.1	Basic File I/O	186
11.6.2	Output Buffering	188
11.6.3	Handling Platform End-of-Line Conventions	188
11.6.4	Handling Character Set Encoding	190
11.6.5	Working with Binary Files	190

---

11.6.6	Random Access to Files	191
11.6.7	Copying File Content	192
11.7	Virtual File Systems	194
11.8	Errors in System Calls	196
Chapter 12	Processes and Interprocess Communication	197
12.1	Commands Presented in This Chapter	197
12.2	Terminating the Tcl Process with <code>exit</code>	199
12.3	Invoking Subprocesses with <code>exec</code>	199
12.4	I/O to and from a Command Pipeline	203
12.5	Configuring Channel Options	204
12.5.1	Channel Blocking Mode	204
12.5.2	Channel Buffering Mode	205
12.6	Event-Driven Channel Interaction	206
12.6.1	Entering the Tcl Event Loop with <code>vwait</code>	206
12.6.2	Registering File Event Handlers	207
12.7	Process IDs	209
12.8	Environment Variables	210
12.9	TCP/IP Socket Communication	210
12.9.1	Creating Client Communication Sockets	210
12.9.2	Creating Server Sockets	212
12.10	Sending Commands to Tcl Programs	214
12.10.1	Basics of <code>send</code>	215
12.10.2	Application Names	216
12.10.3	Security Issues with <code>send</code>	217
Chapter 13	Errors and Exceptions	219
13.1	Commands Presented in This Chapter	219
13.2	What Happens after an Error?	220
13.3	Generating Errors from Tcl Scripts	222
13.4	Trapping Errors with <code>catch</code>	222
13.5	Exceptions in General	223
13.6	Background Errors and <code>bgerror</code>	227
Chapter 14	Creating and Using Tcl Script Libraries	229
14.1	Commands Presented in This Chapter	230
14.2	The <code>load</code> Command	232

---

14.3	Using Libraries	232
14.4	Autoloading	233
14.5	Packages	234
14.5.1	Using Packages	235
14.5.2	Creating Packages	235
14.5.3	Using <code>::pkg::create</code>	237
14.5.4	Installing Packages	238
14.5.5	Utility Package Commands	238
14.6	Tcl Modules	239
14.6.1	Using Tcl Modules	239
14.6.2	Installing Tcl Modules	240
14.7	Packaging Your Scripts as Starkits	242
14.7.1	Installing a Tclkit	243
14.7.2	Creating Starkits	243
14.7.3	Creating a Platform-Specific Executable	245
Chapter 15	Managing Tcl Internals	247
15.1	Commands Presented in This Chapter	247
15.2	Time Delays	253
15.3	Time and Date Manipulation	254
15.3.1	Generating Human-Readable Time and Date Strings	254
15.3.2	Scanning Human-Readable Time and Date Strings	257
15.3.3	Performing Clock Arithmetic	258
15.4	Timing Command Execution	259
15.5	The <code>info</code> Command	259
15.5.1	Information about Variables	260
15.5.2	Information about Procedures	261
15.5.3	Information about Commands	262
15.5.4	The Tcl Interpreter Version and Other Runtime Environment Information	264
15.6	Tracing Operations on Simple Variables	264
15.7	Tracing Array Variables	268
15.8	Renaming and Deleting Commands	269
15.9	Tracing Commands	270
15.10	Unknown Commands	272



---

15.11	Slave Interpreters	274
15.11.1	Command Aliases	276
15.11.2	Safe Slave Interpreters and Hidden Commands	277
15.11.3	Transferring Channels between Interpreters	279
15.11.4	Placing Limits on an Interpreter	280
<b>Chapter 16</b>	<b>History</b>	<b>283</b>
16.1	Commands Presented in This Chapter	283
16.2	The History List	284
16.3	Specifying Events	285
16.4	Re-executing Commands from the History List	285
16.5	Shortcuts Implemented by unknown	286
16.6	Current Event Number: history nextid	287
<b>PART II</b>	<b>Writing Scripts for Tk</b>	<b>289</b>
<b>Chapter 17</b>	<b>An Introduction to Tk</b>	<b>291</b>
17.1	A Brief Introduction to Windowing Systems	292
17.2	Widgets	294
17.3	Applications, Toplevel Widgets, and Screens	296
17.4	Scripts and Events	297
17.5	Creating and Destroying Widgets	297
17.6	Geometry Managers	298
17.7	Widget Commands	299
17.8	Commands for Interconnection	300
<b>Chapter 18</b>	<b>A Tour of the Tk Widgets</b>	<b>303</b>
18.1	Widget Basics	304
18.2	Frames	306
18.2.1	Relief Options	306
18.2.2	Screen Distance Options	307
18.3	Color Options	307
18.3.1	Synonyms	308
18.4	Toplevels	308
18.5	Labels	309
18.5.1	Text Options	309
18.5.2	Font Options	310

---

18.5.3	Image Options	311
18.5.4	Compound Options	312
18.6	Labelframes	312
18.7	Buttons	312
18.7.1	Checkbuttons	313
18.7.2	Radiobuttons	315
18.7.3	Menubuttons	316
18.8	Listboxes	317
18.9	Scrollbars	318
18.9.1	Scrolling a Single Widget	319
18.9.2	Synchronized Scrolling of Multiple Widgets	320
18.10	Scales	321
18.11	Entries	323
18.11.1	Entry Widget	323
18.11.2	Spinbox	324
18.11.3	The show Option	325
18.11.4	Validation	325
18.12	Menus	327
18.12.1	Pull-Down Menus	329
18.12.2	Cascaded Menus	331
18.12.3	Keyboard Traversal and Shortcuts	332
18.12.4	Platform-Specific Menus	333
18.12.5	Pop-up Menus	334
18.13	Panedwindow	334
18.14	Standard Dialogs	337
18.15	Other Common Options	339
18.15.1	Widget State	339
18.15.2	Widget Size Options	339
18.15.3	Anchor Options	340
18.15.4	Internal Padding	341
18.15.5	Cursor Options	341
Chapter 19	Themed Widgets	343
19.1	Comparing Classic and Themed Widgets	343
19.2	Combobox	345
19.3	Notebook	346

---

19.4	Progressbar	349
19.5	Separator	350
19.6	Sizegrip	350
19.7	Treeview	350
19.7.1	Manipulating Treeview Items	350
19.7.2	Managing Treeview Columns and Headings	353
19.7.3	Treeview Item Selection Management	355
19.7.4	Treeview Item Tags	356
19.8	Themed Widget States	358
19.9	Themed Widget Styles	360
19.9.1	Using Themes	360
19.9.2	The Elements of Style	361
19.9.3	Creating and Configuring Styles	362
19.10	Other Standard Themed Widget Options	364
Chapter 20	Fonts, Bitmaps, and Images	367
20.1	Commands Presented in This Chapter	367
20.2	The font Command	369
20.2.1	Manipulating and Using Named Fonts	370
20.2.2	Other Font Utilities	373
20.2.3	Font Descriptions	374
20.3	The image Command	375
20.3.1	Bitmap Images	376
20.3.2	Photo Images	377
20.3.3	Images and Namespaces	383
Chapter 21	Geometry Managers	385
21.1	Commands Presented in This Chapter	386
21.2	An Overview of Geometry Management	387
21.3	The Gridder	389
21.3.1	The grid Command and the -sticky Options	392
21.3.2	Spanning Rows and Columns	393
21.3.3	Stretch Behavior and the -weight and -uniform Options	394
21.3.4	Relative Placement Characters	395
21.4	The Packer	396
21.4.1	The pack Command and -side Options	399

---

21.4.2	Filling	400
21.4.3	Expansion	401
21.4.4	Anchors	403
21.4.5	Packing Order	404
21.5	Padding	404
21.6	The Placer	405
21.7	Hierarchical Geometry Management	405
21.8	Widget Stacking Order	407
21.9	Other Geometry Manager Options	408
21.10	Other Geometry Managers in Tk	409
Chapter 22	Events and Bindings	413
22.1	Commands Presented in This Chapter	413
22.2	Events	414
22.3	An Overview of the bind Command	416
22.4	Event Patterns	417
22.5	Sequences of Events	419
22.6	Substitutions in Scripts	419
22.7	Conflict Resolution	421
22.8	Event-Binding Hierarchy	422
22.9	When Are Events Processed?	423
22.10	Named Virtual Events	425
22.11	Generating Events	427
22.12	Logical Actions	428
22.13	Other Uses of Bindings	431
Chapter 23	The Canvas Widget	433
23.1	Canvas Basics: Items and Types	433
23.2	Manipulating Items with Identifiers and Tags	436
23.3	Bindings	439
23.4	Canvas Scrolling	444
23.5	PostScript Generation	445
Chapter 24	The Text Widget	447
24.1	Text Widget Basics	447
24.2	Text Indices and Marks	450
24.3	Search and Replace	451

---

24.4	Text Tags	453
24.4.1	Tag Options	454
24.4.2	Tag Priorities	457
24.4.3	Tag Bindings	457
24.5	Virtual Events	458
24.6	Embedded Windows	459
24.7	Embedded Images	460
24.8	Undo	462
24.9	Peer Text Widgets	464
Chapter 25	Selection and the Clipboard	467
25.1	Commands Presented in This Chapter	468
25.2	Selections, Retrievals, and Types	469
25.3	Locating and Clearing the Selection	470
25.4	Supplying the Selection with Tcl Scripts	471
25.5	The clipboard Command	473
25.6	Drag and Drop	474
Chapter 26	Window Managers	477
26.1	Commands Presented in This Chapter	478
26.2	Window Sizes	481
26.3	Window Positions	482
26.4	Gridded Windows	483
26.5	Window States	484
26.6	Decorations	485
26.7	Special Handling: Transients, Groups, and Override-Redirect	486
26.8	System-Specific Window Attributes	487
26.9	Dockable Windows	488
26.10	Window Close	489
26.11	Session Management	490
Chapter 27	Focus, Modal Interaction, and Custom Dialogs	491
27.1	Commands Presented in This Chapter	491
27.2	Input Focus	493
27.2.1	Focus Model: Explicit versus Implicit	493

---

27.2.2	Setting the Input Focus	494
27.2.3	Querying the Input Focus	494
27.3	Modal Interactions	495
27.3.1	Grabs	495
27.3.2	Local versus Global Grabs	496
27.3.3	Keyboard Handling during Grabs	497
27.3.4	Waiting: The <code>tkwait</code> Command	497
27.4	Custom Dialogs	499
<b>Chapter 28</b>	<b>More on Configuration Options</b>	<b>505</b>
28.1	Commands Presented in This Chapter	505
28.2	The Option Database	506
28.3	Option Database Entries	507
28.4	The <code>RESOURCE_MANAGER</code> Property and <code>.xdefaults</code> File	508
28.5	Priorities in the Option Database	509
28.6	The <code>option</code> Command	510
28.7	The <code>configure</code> Widget Command	511
28.8	The <code>cget</code> Widget Command	512
<b>Chapter 29</b>	<b>Odds and Ends</b>	<b>513</b>
29.1	Commands Presented in This Chapter	513
29.2	Destroying Widgets	514
29.3	The <code>update</code> Command	514
29.4	Information about Widgets	516
29.5	The <code>tk</code> Command	516
29.6	Variables Managed by Tk	517
29.7	Ringling the Bell	518
<b>PART III</b>	<b>Writing Tcl Applications in C</b>	<b>519</b>
<b>Chapter 30</b>	<b>Tcl and C Integration Philosophy</b>	<b>521</b>
30.1	Tcl versus C: Where to Draw the Line	523
30.2	Resource Names—Connecting C Constructs to Tcl	524
30.3	“Action-Oriented” versus “Object-Oriented”	525
30.4	Representing Information	526

---

Chapter 31	Interpreters	527
31.1	Functions Presented in This Chapter	527
31.2	Interpreters	529
31.3	A Simple Tcl Application	530
31.4	Deleting Interpreters	531
31.5	Multiple Interpreters	531
Chapter 32	Tcl Objects	533
32.1	Functions Presented in This Chapter	534
32.2	String Objects	537
32.3	Numerical Objects	537
32.4	Fetching C Values from Objects	538
32.5	The Dynamic Nature of a Tcl Object	539
32.6	Byte Arrays	540
32.7	Composite Objects	540
32.8	Reference Counting	540
32.9	Shared Objects	541
32.10	New Object Types	542
32.11	Parsing Strings	543
32.12	Memory Allocation	544
Chapter 33	Evaluating Tcl Code	545
33.1	Functions Presented in This Chapter	545
33.2	Evaluating Tcl Code	546
33.3	Dynamically Building Scripts	548
33.4	Tcl Expressions	549
Chapter 34	Accessing Tcl Variables	551
34.1	Functions Presented in This Chapter	551
34.2	Setting Variable Values	553
34.3	Reading Variables	555
34.4	Unsetting Variables	556
34.5	Linking Tcl and C Variables	556
34.6	Setting and Unsetting Variable Traces	558
34.7	Trace Callbacks	559
34.8	Whole-Array Traces	561

---

34.9	Multiple Traces	561
34.10	Unset Callbacks	562
Chapter 35	Creating New Tcl Commands	563
35.1	Functions Presented in This Chapter	563
35.2	Command Functions	566
35.3	Registering Commands	567
35.4	The Result Protocol	569
35.5	Tcl_AppendResult	569
35.6	Tcl_SetResult and interp->result	570
35.7	clientData and Deletion Callbacks	572
35.8	Deleting Commands	575
35.9	Fetching and Setting Command Parameters	576
35.10	How Tcl Procedures Work	578
35.11	Command Traces	579
Chapter 36	Extensions	581
36.1	Functions Presented in This Chapter	581
36.2	The Init Function	582
36.3	Packages	583
36.4	Namespaces	584
36.5	Tcl Stubs	584
36.6	The ifconfig Extension	585
Chapter 37	Embedding Tcl	593
37.1	Functions Presented in This Chapter	593
37.2	Adding Tcl to an Application	594
37.3	Initialize Tcl	595
37.4	Creating New Tcl Shells	596
Chapter 38	Exceptions	599
38.1	Functions Presented in This Chapter	599
38.2	Completion Codes	600
38.3	Setting errorCode	603
38.4	Managing the Return Options Dictionary	604
38.5	Adding to the Stack Trace in errorInfo	605
38.6	Tcl_Panic	608



---

Chapter 39	String Utilities	611
39.1	Functions Presented in This Chapter	611
39.2	Dynamic Strings	617
39.3	String Matching	621
39.4	Regular Expression Matching	622
39.5	Working with Character Encodings	624
39.6	Handling Unicode and UTF-8 Strings	625
39.7	Command Completeness	627
Chapter 40	Hash Tables	629
40.1	Functions Presented in This Chapter	630
40.2	Keys and Values	631
40.3	Creating and Deleting Hash Tables	632
40.4	Creating Entries	633
40.5	Finding Existing Entries	635
40.6	Searching	636
40.7	Deleting Entries	637
40.8	Statistics	638
Chapter 41	List and Dictionary Objects	639
41.1	Functions Presented in This Chapter	639
41.2	Lists	642
41.3	Dictionaries	644
Chapter 42	Channels	649
42.1	Functions Presented in This Chapter	649
42.1.1	Basic Channel Operations	650
42.1.2	Channel Registration Functions	653
42.1.3	Channel Attribute Functions	654
42.1.4	Channel Query Functions	655
42.1.5	Channel Type Definition Functions	655
42.2	Channel Operations	656
42.3	Registering Channels	658
42.4	Standard Channels	660
42.5	Creating a New Channel Type	661
42.5.1	Creating a Custom Channel Instance	662

---

42.5.2	Stacked Channels	662
42.5.3	ROT13 Channel	663
Chapter 43	Handling Events	671
43.1	Functions Presented in This Chapter	671
43.2	Channel Events	672
43.3	Timer Events	676
43.4	Idle Callbacks	677
43.5	Invoking the Event Dispatcher	678
Chapter 44	File System Interaction	681
44.1	Tcl File System Functions	681
44.2	Virtual File Systems	683
Chapter 45	Operating System Utilities	685
45.1	Functions Presented in This Chapter	685
45.2	Processes	687
45.3	Reaping Child Processes	689
45.4	Asynchronous Events	690
45.5	Signal Names	693
45.6	Exiting and Cleanup	693
45.7	Miscellaneous	694
Chapter 46	Threads	695
46.1	Functions Presented in This Chapter	695
46.2	Thread Safety	697
46.3	Building Threaded Tcl	697
46.4	Creating Threads	697
46.5	Terminating Threads	698
46.6	Mutexes	698
46.7	Condition Variables	699
46.8	Miscellaneous	701
Chapter 47	Building Tcl and Extensions	703
47.1	Building Tcl and Tk	703
47.1.1	Building Tcl and Tk on Unix	704
47.1.2	Building Tcl and Tk on Mac OS	705

---

47.1.3	Building Tcl and Tk on Windows	707
47.2	The Tcl Extension Architecture (TEA)	707
47.2.1	TEA Standard Configure Options	708
47.2.2	Directory Layout for TEA Extensions	709
47.2.3	Customizing the <code>aclocal.m4</code> File	710
47.2.4	Customizing the <code>configure.in</code> File	711
47.2.5	Customizing the <code>Makefile.in</code> File	714
47.2.6	Building an Extension on Windows	714
47.3	Building Embedded Tcl	714
<b>Appendixes</b>		<b>715</b>
Appendix A	Installing Tcl and Tk	717
A.1	Versions	717
A.2	Bundled Tcl Distributions	718
A.3	ActiveTcl	718
A.4	Telkits	719
A.5	Compiling Tcl/Tk from Source Distributions	719
Appendix B	Extensions and Applications	721
B.1	Obtaining and Installing Extensions	721
B.1.1	Installing Extensions Manually	722
B.1.2	Installing Extensions from ActiveState TEApot Repositories	722
B.2	TkCon Extended Console	724
B.3	The Standard Tcl Library, Tcllib	725
B.4	Additional Image Formats with Img	725
B.5	Sound Support with Snack	725
B.6	Object-Oriented Tcl	726
B.7	Multithreaded Tcl Scripting	727
B.8	XML Programming	727
B.9	Database Programming	728
B.10	Integrating Tcl and Java	728
B.11	SWIG	729
B.12	Expect	729
B.13	Extended Tcl	730

Appendix C Tcl Resources	731
C.1 Online Resources	731
C.2 Books	732
Appendix D Tcl Source Distribution License	735
<b>Index</b>	<b>737</b>