

# Table of Contents

Foreword .....	xv
Introduction .....	xvii
Mac OS X: Built to Evolve .....	xvii
This Book .....	xvii
Typographical Conventions .....	xix
Online Materials .....	xix
1. C and Objective-C .....	1
C .....	1
The Compiler pipeline .....	1
The C preprocessor .....	2
Const and volatile variables .....	13
Variable argument lists .....	13
Bitwise operations .....	21
Objective-C .....	27
C callbacks in Objective-C .....	27
Objective-C 2.0 .....	29
Exercises .....	40
2. The Compiler .....	43
Handy Flags .....	43
Debugging .....	44
Warnings .....	45
Seeing Preprocessor Output .....	46
Seeing the Generated Assembly Code .....	47
Compiler Optimization .....	48
GCC Extensions .....	49
Name Mangling .....	50
Testing the compiler version .....	50
The Optimizer .....	50
Vectorization .....	51
Even More Compiler Flags .....	51
64-Bit Computing .....	53
The 64-bit programming model .....	53
New Objective-C runtime .....	56
Universally Fat Binaries .....	56
Fat binaries from the command line .....	56
Fat binaries in Xcode .....	60
Fat binary considerations .....	60
3. Blocks .....	61
Block Syntax .....	62
Return Values .....	63
Accessing Enclosing Scope .....	64
Changing Enclosing Scope .....	64
Block Variables .....	65
Variable Capture Redux .....	66
Blocks as Objects .....	67

When To Copy .....	68
Blocks in Collections .....	69
Block Retain Cycles .....	69
New API Using Blocks .....	70
For the More Curious: Blocks Internals .....	71
Implementation .....	71
Debugging .....	78
Dumping runtime information .....	79
Evolving the implementation .....	81
Compiler-generated names .....	81
Exercises .....	82
4. Command-Line Programs .....	83
The Basic Program .....	84
Inside the Central Loop .....	85
Changing Behavior By Name .....	86
Looking at the Environment .....	87
Parsing the Command Line .....	88
getopt_long() .....	92
User Defaults .....	96
5. Exceptions, Error Handling, and Signals .....	99
errno .....	99
setjmp, longjmp .....	102
Signals .....	104
Handling a signal .....	104
Blocking signals .....	106
Signal issues .....	110
Exception Handling in Cocoa .....	114
Classic exception handling .....	114
Native exception handling .....	117
Subclassing NSApplication to catch exceptions .....	119
64-bit Objective-C runtime .....	120
NSError .....	120
Logging .....	121
syslog() .....	121
ASL .....	123
For the More Curious: Assertions .....	129
Static assertions .....	130
AssertMacros.h .....	130
Exercises .....	130
6. Libraries .....	131
Static Libraries .....	131
Shared Libraries .....	135
But I included the header! .....	137
Frameworks .....	137
Libraries or Frameworks? .....	141
Writing Plug-ins .....	142
Bundles in Cocoa .....	142
Shared Libraries and dlopen .....	146

dlopen() .....	146
dlsym() .....	147
BundlePrinter .....	147
For the More Curious: libtool .....	150
For the More Curious: otool .....	151
For the More Curious: Runtime Environment Variables .....	152
Exercises .....	154
7. Memory .....	155
Virtual Memory .....	155
Program Memory Model .....	156
Memory Lifetime .....	159
Dynamic Memory Allocation .....	159
malloc() .....	160
free() .....	163
realloc() .....	163
calloc() .....	164
alloca() .....	164
Memory Ownership Issues .....	165
Nodepools .....	165
Debugging Memory Problems .....	169
Common API issues .....	169
Memory corruption .....	170
Memory leaks .....	173
Other Tools .....	175
ps .....	175
Resource limits .....	176
Miscellaneous tools .....	180
vm_stat .....	182
Objective-C Garbage Collection .....	183
How to use it .....	183
How it works .....	186
Strong and weak references .....	187
Finalize methods .....	188
Non Objective-C objects .....	188
External reference counts .....	189
The "new" collection classes .....	189
GC and threads .....	189
Debugging .....	190
Exercises .....	190
8. Debugging With GDB .....	193
What Is a Debugger? .....	193
Using GDB from the Command Line .....	193
A sample GDB session .....	194
GDB Specifics .....	206
Help .....	206
Stack Traces .....	207
Program Listings .....	207
Breakpoints .....	208

Displaying Data .....	209
Changing Data .....	211
Changing Execution Flow .....	211
Handy Tricks .....	211
Debugging Techniques .....	213
Tracking down problems .....	214
Debugger techniques .....	215
For the More Curious: Core Files .....	215
For the More Curious: Stripping .....	218
More Advanced GDB Commands .....	220
Threads .....	220
9. DTrace .....	223
Overview .....	223
The D language .....	224
Scripts .....	225
Probes .....	226
Providers .....	227
BEGIN and END providers .....	227
pid provider .....	228
syscall provider .....	228
profile provider .....	229
proc provider .....	229
fbt provider .....	230
Actions .....	230
Variables .....	230
Scoped variables .....	232
Built-in variables .....	232
Functions .....	234
Arrays .....	234
C arrays .....	235
Predicates .....	235
Aggregates .....	235
Aggregate-related functions .....	239
Random Leftovers .....	239
The C preprocessor .....	239
Pragmas .....	239
Objective-C .....	241
Exercises .....	242
10. Performance Tuning .....	243
The End of Free Performance .....	243
Approaches To Performance .....	244
Major Causes of Performance Problems .....	244
Memory .....	245
CPU .....	249
Disk .....	249
Graphics .....	250
Before using any of the profiling tools .....	251
Command-Line Tools .....	251

time .....	252
dtruss .....	252
fs_usage and sc_usage .....	253
top .....	254
Stochastic profiling .....	255
sample .....	255
Precise Timing with mach_absolute_time() .....	256
GUI Tools .....	257
Activity Monitor .....	258
Instruments .....	258
Summary .....	284
Exercises .....	284
11. Files, Part 1: I/O and Permissions .....	285
Unbuffered I/O .....	285
Opening a file .....	285
Writing to a file .....	288
Reading from a file .....	290
Closing files .....	291
Changing the read/write offset .....	291
Atomic operations .....	293
Scatter / Gather I/O .....	294
creat() .....	298
Blocking I/O .....	298
Buffered I/O .....	298
Opening files .....	299
Closing files .....	300
Text I/O .....	300
Binary I/O .....	302
Positioning .....	304
Formatted I/O .....	305
Misc Functions .....	306
Buffered I/O vs. Unbuffered I/O .....	306
Removing Files .....	307
Temporary Files .....	308
File Permissions .....	310
Users and groups .....	310
File permissions .....	312
Directory Permissions .....	318
Permission-Check Algorithms .....	319
For the More Curious: Memory-Mapped Files .....	320
12. Files, Part 2: Directories, File Systems, and Links .....	325
Directories .....	325
Creation and destruction .....	325
Directory iteration .....	325
Current working directory .....	327
Inside The File System .....	328
Links .....	330
Hard links .....	331

Symbolic links .....	331
Mac OS aliases .....	334
API for links .....	334
File Metadata .....	334
stat() .....	334
getattrlist() .....	339
Metadata in batches .....	346
Mac OS X Specific Weirdness .....	350
Resource forks .....	350
.DS_Store .....	351
Disk I/O and sleep .....	351
For The More Curious .....	351
Differences between HFS+ and UFS .....	351
Other random calls .....	352
Other random programs .....	354
Access control lists .....	354
Extended attributes .....	355
13. NSFileManager - Cocoa and the File System .....	357
Making and Manipulating Paths .....	357
NSString path utilities .....	358
NSURL path utilities .....	359
Finding Standard Directories .....	359
Path utilities .....	360
URL utilities .....	361
File Metadata .....	363
Metadata through paths .....	363
Metadata through URLs .....	364
File Operations .....	367
Path operations .....	367
URL operations .....	368
Symbolic links .....	369
Directory Enumeration .....	369
Enumeration with paths .....	369
Enumeration with URLs .....	370
File References and Bookmarks .....	372
File references .....	372
Bookmarks .....	374
Make a File Browser .....	375
Create the DirEntry class .....	376
Edit the nib file adding NSTreeController .....	379
Using NSBrowser and DirEntry .....	384
Adding deletion .....	385
NSWorkspace .....	387
Exercises .....	388
14. Network Programming With Sockets .....	389
Addresses .....	389
Sockets Address Data Structures .....	390
IPv4 address structures .....	390

IPv6 address structures .....	391
Network Byte Order .....	392
Address Conversions .....	393
IPv4- and IPv6-compatible functions .....	393
IPv4-specific functions .....	395
Domain Name Lookup .....	396
Simple Network Programming .....	398
Server coding .....	398
Constructing an address .....	399
bind .....	399
listen .....	400
accept .....	400
Client Coding .....	404
connect .....	404
More Advanced Issues .....	408
Multiplexing connections .....	408
Message boundaries .....	410
For the More Curious: Datagrams .....	422
Exercises .....	423
15. CFRunLoop .....	425
CFSocket .....	426
CFHost .....	428
GUI Chatter Client .....	430
RunLoop Chatter Server .....	436
The System Configuration Framework .....	438
Architecture .....	439
Basic API .....	439
Seeing all values .....	441
Creating SCFMonitor .....	443
For the More Curious: Run Loop Observers .....	448
Exercises .....	450
16. kqueue and FSEvents .....	451
kqueue() .....	452
Events .....	452
Registering and Handling Events .....	454
kqueues for Signal Handling .....	455
kqueues for Socket Monitoring .....	458
kqueues for File System Monitoring .....	459
kqueues and Runloops .....	462
fsevents .....	466
fseventsd .....	467
Watching Directories .....	467
Events .....	468
History .....	468
Visibility .....	469
FSEvents API .....	469
Creating the stream .....	469
Hook up to the runloop .....	471

Example .....	473
Exercises .....	478
17. Bonjour .....	479
Publishing an NSNetService .....	480
Make chatterserver Zeroconf-compliant .....	480
Browsing Net Services .....	481
Make ChatterClient browse for servers .....	482
For the More Curious: TXT Records .....	485
Exercises .....	486
18. Multiprocessing .....	487
Process Scheduling .....	487
Convenience Functions .....	488
fork .....	490
Parent and Child Lifetimes .....	493
exec .....	497
Pipes .....	498
fork() Gotchas .....	502
Summary .....	503
Exercises .....	503
19. Using NSTask .....	505
NSProcessInfo .....	505
NSTask .....	505
NSFileHandle .....	506
NSPipe .....	507
Creating an App that Creates a New Process .....	507
Non-blocking reads .....	510
Create the header and edit the xib file .....	511
Edit the code .....	512
Exercises .....	514
20. Multithreading .....	515
Posix Threads .....	515
Creating threads .....	515
Synchronization .....	519
Mutexes .....	520
Deadlocks .....	522
Condition variables .....	523
Cocoa and Threading .....	534
NSThread .....	534
Cocoa and thread safety .....	535
Objective-C @synchronized blocks .....	535
For the More Curious: Thread Local Storage .....	535
For the More Curious: Read/Write Locks .....	536
Exercises .....	537
21. Operations .....	539
Simple-Lifetime Operations .....	540
NSOperationQueue .....	541
Threading issues .....	541
MandelOpper .....	541



Bitmap .....	543
BitmapView .....	544
CalcOperation .....	546
MandelOppeAppDelegate .....	549
NSBlockOperation .....	551
Complex-Lifetime Operations .....	553
KVO properties .....	554
ImageSnarfer .....	555
ImageCanvas .....	556
SnarfOperation .....	558
NSURLConnection delegate methods .....	561
ImageSnarferAppDelegate .....	562
Mop-up .....	565
Exercises .....	566
22. Grand Central Dispatch .....	569
GCD Terminology .....	571
Queues .....	571
Object-Oriented Design .....	573
Dispatch API .....	574
Queues .....	574
Dispatching .....	575
Memory management .....	575
WordCounter .....	576
Iteration .....	581
Safe Global Initialization .....	582
Time, Time, Time .....	583
Dispatch Groups .....	584
Dispatch Sources .....	586
Signal sources .....	588
File read source .....	589
File write source .....	590
Timer sources .....	590
Custom sources .....	591
Under the Hood .....	591
Semaphores .....	591
GCD or NSOperation? .....	592
For the More Curious: Synchronizing Tasks .....	593
For the More Curious: The dispatch_debug() Function .....	593
Exercises .....	594
23. Accessing the Keychain .....	597
Items and Attribute Lists .....	598
Searching for Items .....	600
Reading Data From an Item .....	602
Editing the Keychain .....	604
Getting Specific Keychains .....	605
Keychain Access .....	605
Making a New Keychain Item .....	608
Convenience Functions .....	610

Code Signing ..... 611

Exercises ..... 614

Index ..... 615