

# Table of Contents

30 Smuggling Data Structures Across the Boundary of Two Programs	114
31 Linking	
34 Python Host	
35 Compiling and Linking	
35 The Conditional Subdirectory for Automake	
35 Distutils Backed with Autotools	
35	
35	Coverages
<b>Part II. The Language</b>	
38	Minor Corrections
39 What Is This User’s Involvement in the Project	
40 Your Pal the Pointer	125
41 How Should the Block Indication Be Returned?	125
42 Automatic, Static, and Manual Memory	130
43 Persistent State Variables	130
44 Pointers Without malloc	131
<b>Preface</b>	ix
<hr/>	
<b>Part I. The Environment</b>	
<b>1. Set Yourself Up for Easy Compilation</b>	3
Use a Package Manager	4
Compiling C with Windows	6
POSIX for Windows	6
Compiling C with POSIX	8
Compiling C Without POSIX	9
Which Way to the Library?	10
A Few of My Favorite Flags	12
Paths	13
Runtime Linking	16
Using Makefiles	17
Setting Variables	17
The Rules	20
Using Libraries from Source	24
Using Libraries from Source (Even if Your Sysadmin Doesn’t Want You To)	25
Compiling C Programs via Here Document	27
Include Header Files from the Command Line	27
The Unified Header	28
Here Documents	29
Compiling from stdin	30
<b>2. Debug, Test, Document</b>	33
Using a Debugger	33

A Debugging Detective Story	36
GDB Variables	45
Print Your Structures	46
Using Valgrind to Check for Errors	50
Unit Testing	52
Using a Program as a Library	55
Coverage	57
Error Checking	58
What is the User's Involvement in the Error?	58
The Context in Which the User is Working	59
How Should the Error Indication Be Returned?	61
Interweaving Documentation	62
Doxygen	62
Literate Code with CWEB	64
<b>3. Packaging Your Project.....</b>	<b>67</b>
The Shell	68
Replacing Shell Commands with Their Outputs	69
Use the Shell's for Loops to Operate on a Set of Files	70
Test for Files	72
fc	75
Makefiles vs. Shell Scripts	77
Packaging Your Code with Autotools	79
An Autotools Demo	81
Describing the Makefile with Makefile.am	84
The configure Script	89
<b>4. Version Control.....</b>	<b>95</b>
Changes via diff	96
Git's Objects	97
The Stash	102
Trees and Their Branches	102
Merging	104
The Rebase	105
Remote Repositories	106
<b>5. Playing Nice with Others.....</b>	<b>109</b>
Dynamic Loading	109
The Limits of Dynamic Loading	112
The Process	112
Writing to Be Read by Nonnatives	113
The Wrapper Function	113

181	Smuggling Data Structures Across the Border	114
182	Linking	116
183	Python Host	116
	Compiling and Linking	118
184	The Conditional Subdirectory for Automake	118
185	Distutils Backed with Autotools	120

---

## Part II. The Language

<b>6. Your Pal the Pointer.....</b>	<b>125</b>
Automatic, Static, and Manual Memory	125
Persistent State Variables	130
Pointers Without malloc	131
Structures Get Copied, Arrays Get Aliased	133
malloc and Memory-Twiddling	136
The Fault Is in Our Stars	137
All the Pointer Arithmetic You Need to Know	138
Typedef as a teaching tool	141
<b>7. Inessential C Syntax that Textbooks Spend a Lot of Time Covering.....</b>	<b>143</b>
Don't Bother Explicitly Returning from main	143
Let Declarations Flow	144
Set Array Size at Runtime	146
Cast Less	147
Enums and Strings	149
Labels, gotos, switches, and breaks	150
goto Considered	151
switch	154
Deprecate Float	155
Comparing Unsigned Integers	158
Safely Parse Strings to Numbers	158
<b>8. Important C Syntax that Textbooks Often Do Not Cover.....</b>	<b>163</b>
Cultivate Robust and Flourishing Macros	163
The Preprocessor	168
Test Macros	172
Header Guards	174
Linkage with static and extern	176
Externally Linked Variables in Header Files	177
The const Keyword	179
Noun-Adjective Form	180

Tension	181
Depth	181
The <code>char const **</code> Issue	182
<b>9. Easier Text Handling.....</b>	<b>187</b>
Making String Handling Less Painful with <code>asprintf</code>	187
Security	190
Constant Strings	191
Extending Strings with <code>asprintf</code>	193
A Pæan to <code>strtok</code>	194
Unicode	199
The Encoding for C Code	201
Unicode Libraries	202
The Sample Code	203
<b>10. Better Structures.....</b>	<b>207</b>
Compound Literals	208
Initialization via Compound Literals	209
Variadic Macros	210
Safely Terminated Lists	211
Multiple Lists	212
Foreach	214
Vectorize a Function	214
Designated Initializers	216
Initialize Arrays and Structs with Zeros	218
Typedefs Save the Day	219
A Style Note	221
Return Multiple Items from a Function	222
Reporting Errors	223
Flexible Function Inputs	225
Declare Your Function as <code>printf</code> -Style	226
Optional and Named Arguments	228
Polishing a Dull Function	231
The Void Pointer and the Structures It Points To	236
Functions with Generic Inputs	237
Generic Structures	241
<b>11. Object-Oriented Programming in C.....</b>	<b>247</b>
Extending Structures and Dictionaries	249
Implementing a Dictionary	251
C, with fewer seams	255
Functions in Your Structs	260

Vtables	264
Scope	269
Private Struct Elements	271
Overload	272
_Generic	274
Count References	277
Example: A Substring Object	277
Example: An Agent-Based Model of Group Formation	282
Conclusion	288
<b>12. Parallel Threads.....</b>	<b>291</b>
The Environment	292
The Ingredients	293
OpenMP	294
Compiling OpenMP, pthreads, and C atoms	296
Interference	297
Map-reduce	298
Multiple Tasks	299
Thread Local	300
Localizing Nonstatic Variables	302
Shared Resources	302
Atoms	307
Pthreads	310
C atoms	314
Atomic structs	317
<b>13. Libraries.....</b>	<b>323</b>
GLib	323
POSIX	324
Parsing Regular Expressions	324
Using mmap for Gigantic Data Sets	329
The GNU Scientific Library	332
SQLite	334
The Queries	336
libxml and cURL	337
<b>Epilogue.....</b>	<b>343</b>
<b>A. C 101.....</b>	<b>345</b>

<b>Glossary.....</b>	<b>365</b>
<b>References.....</b>	<b>369</b>
<b>Index.....</b>	<b>373</b>
<b>    775String Handling Less Painful with <code>asprintf</code></b>	<b>1867</b>
<b>    775Security</b>	<b>191</b>
<b>    285Constant Strings</b>	<b>191</b>
<b>    285Extending Strings with <code>asprintf</code></b>	<b>193</b>
<b>    A Pseudocode for <code>strtok</code></b>	<b>194</b>
<b>    195Unicode</b>	<b>195</b>
<b>    295The Encoding for C Code</b>	<b>195</b>
<b>    295Unicode Libraries</b>	<b>196</b>
<b>    395The Sample Code</b>	<b>196</b>
<b>    395</b>	<b>197</b>
<b>    105getter Structures</b>	<b>197</b>
<b>    89Compound Literals</b>	<b>208</b>
<b>    99Initialization via Compound Literals</b>	<b>209</b>
<b>    99Arbitrary Macros</b>	<b>209</b>
<b>    205Safely Terminated Lists</b>	<b>209</b>
<b>    205Multiple Lists</b>	<b>209</b>
<b>    205</b>	<b>209</b>
<b>    205foreach</b>	<b>209</b>
<b>    215Factorize a Function</b>	<b>210</b>
<b>    215Designated Initializers</b>	<b>210</b>
<b>    215Initialize Arrays and Structs with Zeros</b>	<b>210</b>
<b>    215    Typedefs Save the Day</b>	<b>210</b>
<b>    225A Style Note</b>	<b>210</b>
<b>    225Return Multiple Items from a Function</b>	<b>210</b>
<b>    225Reporting Errors</b>	<b>210</b>
<b>    225Flexible Function Inputs</b>	<b>210</b>
<b>    225Declare Your Function as <code>printf</code>-Style</b>	<b>225</b>
<b>    225Optional and Named Arguments</b>	<b>226</b>
<b>    225Polishing a Dull Function</b>	<b>226</b>
<b>    225The Void Pointer and the Structures It Points To</b>	<b>226</b>
<b>    225Functions with Generic Inputs</b>	<b>226</b>
<b>    225        Generic Structures</b>	<b>226</b>
<b>    225</b>	<b>226</b>
<b>    11. Object-Oriented Programming in C.....</b>	<b>247</b>
<b>    245Creating Structures and Dictionaries.....</b>	<b>247</b>
<b>    245        Implementing a Dictionary</b>	<b>248</b>
<b>    245            C, with fewer macros</b>	<b>248</b>
<b>    245            Functions in Their Structs</b>	<b>249</b>