Contents

Preface (First Edition) 7
Preface 11
Acknowledgements 13
Part I — Introduction
Compilers 17
How Does a Compiler Work? 19
Phases of Compilation 21
A Simplified Model 28
The Peculiarities of C 31
Rules of the Game 35
The Source Language 35
The Object Language 38
The Runtime Library 39
Part II — The Tour
Definitions and Data Structures 43
Definitions 43
Global Data 50
Function Prototypes 56
Utility Functions 59
Error Handling 63
Lexical Analysis 67
A Brief Theory of Scanning 77
The Implementation of the Scanner 81
Symbol Table Management 91
Syntactic and Semantic Analysis 103
A Brief Theory of Parsing 104
Mapping Grammars to Parsers 109
Expression Parsing 114
Constant Expression Parsing 147
Statement Parsing 152
Declaration Parsing 169
Preprocessing 189
Code Generation 197
A Brief Theory of Code Generation 197
The Code Generator 200
Framework 204
Load Operations 206
Binary Operators 207
Unary Operators 214
Jumps and Function Calls 216
Data Definitions 219
Increment Operators 221
Switch Table Generation 226
Store Operations 227
Rvalue Computation 230
Target Description 233
The 386 Target 236
Framework 237
Load Operations 238
Stack Operations 241
Binary Operations 241
Unary Operations 245
Increment Operations 246
Jumps and Branches 252
Store Operations 253
Functions and Function Calls 255
Data Definitions 256
The Compiler Controller 259
## Part III — The Runtime Environment

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Runtime Startup Module</td>
<td>273</td>
</tr>
<tr>
<td>The System Calls</td>
<td>278</td>
</tr>
<tr>
<td>Header Files</td>
<td>289</td>
</tr>
<tr>
<td>The System Call Header</td>
<td>289</td>
</tr>
<tr>
<td>The Setjmp Header</td>
<td>290</td>
</tr>
<tr>
<td>The Signal Header</td>
<td>290</td>
</tr>
<tr>
<td>The Runtime Library</td>
<td>293</td>
</tr>
<tr>
<td>Library Initialization</td>
<td>293</td>
</tr>
<tr>
<td>Standard I/O</td>
<td>294</td>
</tr>
<tr>
<td>The stdio.h Header</td>
<td>295</td>
</tr>
<tr>
<td>Required Stdio Functions</td>
<td>301</td>
</tr>
<tr>
<td>Utility Library</td>
<td>330</td>
</tr>
<tr>
<td>The stdlib.h Header</td>
<td>330</td>
</tr>
<tr>
<td>Required Stdlib Functions</td>
<td>331</td>
</tr>
<tr>
<td>String Library</td>
<td>340</td>
</tr>
<tr>
<td>The string.h Header</td>
<td>340</td>
</tr>
<tr>
<td>Required String Functions</td>
<td>341</td>
</tr>
<tr>
<td>Character Types</td>
<td>345</td>
</tr>
<tr>
<td>The ctype.h Header</td>
<td>345</td>
</tr>
<tr>
<td>The Ctype Functions</td>
<td>345</td>
</tr>
<tr>
<td>The errno.h Header</td>
<td>347</td>
</tr>
</tbody>
</table>

## Part IV — Beyond SubC

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code Synthesis</td>
<td>351</td>
</tr>
<tr>
<td>Instruction Queuing</td>
<td>352</td>
</tr>
<tr>
<td>CISC versus RISC</td>
<td>362</td>
</tr>
<tr>
<td>Comparisons and Conditional Jumps</td>
<td>363</td>
</tr>
<tr>
<td>Register Allocation</td>
<td>365</td>
</tr>
<tr>
<td>Cyclic Register Allocation</td>
<td>371</td>
</tr>
<tr>
<td>Optimization</td>
<td>375</td>
</tr>
</tbody>
</table>
Peephole Optimization 375
Expression Rewriting 379
Constant Expression Folding 385
Strength Reduction 388
Common Subexpression Elimination 393
Emitting Code from an AST 399

Part V — Conclusion

Bootstrapping a Compiler 403
Design 403
Implementation 404
Testing 407
Having Some Fun 409

Appendix

Where Do We Go from Here? 415
Piece of Cake 415
This May Hurt a Bit 416
Bring 'Em On! 418

(Sub)C Primer 421
Data Objects and Declarations 421
Void Pointers 424
Expressions 425
Pointer Arithmetics 428
Statements 429
Functions 432
Prototypes and External Declarations 433
Preprocessor 434
Library Functions 436

386 Assembly Primer 437
Registers 437
Assembler Syntax 439