

Contents

About the Author	xix
Acknowledgments	xxi
Introduction	xxiii
CHAPTER 1 Programming in C	1
Creating C Programs	1
Editing	1
Compiling	2
Linking	3
Executing	3
Creating Your First Program	4
Editing Your First Program	5
Dealing with Errors	6
Dissecting a Simple Program	7
Comments	7
Preprocessing Directives	8
Defining the main() Function	9
Keywords	9
The Body of a Function	10
Outputting Information	10
Arguments	11
Control Characters	11
Developing Programs in C	13
Understanding the Problem	13
Detailed Design	14
Implementation	14
Testing	14
Functions and Modular Programming	14
Common Mistakes	18
Points to Remember	18
Summary	19
Exercises	20

CHAPTER 2 First Steps in Programming	21
Memory in Your Computer	21
What Is a Variable?	23
Variables That Store Numbers	24
Integer Variables.....	24
Naming Variables	27
Using Variables	29
Initializing Variables	30
Arithmetic Statements	31
Variables and Memory	37
Integer Variable Types	38
Unsigned Integer Types	38
Using Integer Types	39
Specifying Integer Constants.....	40
Floating-Point Values	41
Floating-Point Variables	42
Division Using Floating-Point Values	43
Controlling the Number of Decimal Places	44
Controlling the Output Field Width	44
More Complicated Expressions	45
Defining Constants	48
Knowing Your Limitations	50
Introducing the sizeof Operator.....	52
Choosing the Correct Type for the Job	54
Explicit Type Conversion	57
Automatic Conversion	57
Rules for Implicit Conversions.....	57
Implicit Conversions in Assignment Statements.....	58
More Numeric Data Types	59
The Character Type	59
Character Input and Character Output.....	60
The Wide Character Type.....	63
Enumerations	64
Variables to Store Boolean Values	66
The Complex Number Types	67

The op= Form of Assignment	70
Mathematical Functions	71
Designing a Program	72
The Problem	72
The Analysis	73
The Solution	75
Summary	79
Exercises	80
CHAPTER 3 Making Decisions	81
The Decision-Making Process	81
Arithmetic Comparisons.....	82
Expressions Involving Relational Operators.....	82
The Basic if Statement.....	82
Extending the if Statement: if-else.....	86
Using Blocks of Code in if Statements.....	88
Nested if Statements	89
More Relational Operators.....	92
Logical Operators	96
The Conditional Operator	99
Operator Precedence: Who Goes First?	102
Multiple-Choice Questions	106
Using else-if Statements for Multiple Choices	106
The switch Statement	107
The goto Statement	115
Bitwise Operators	116
The op= Use of Bitwise Operators	119
Using Bitwise Operators.....	119
Designing a Program	122
The Problem	122
The Analysis	122
The Solution	123
Summary	126
Exercises	126

CHAPTER 4 Loops	129
How Loops Work	129
Introducing the Increment and Decrement Operators	130
The for Loop	131
General Syntax of the for Loop	135
More on the Increment and Decrement Operators	136
The Increment Operator.....	136
The Prefix and Postfix Forms of the Increment Operator.....	137
The Decrement Operator	137
The for Loop Revisited	138
Modifying the for Loop Variable	140
A for Loop with No Parameters.....	141
The break Statement in a Loop.....	141
Limiting Input Using a for Loop.....	144
Generating Pseudo-Random Integers.....	146
More for Loop Control Options	148
Floating-Point Loop Control Variables	149
The while Loop	149
Nested Loops	153
Nested Loops and the goto Statement	156
The do-while Loop	157
The continue Statement	160
Designing a Program	160
The Problem	160
The Analysis	160
The Solution	162
Summary	172
Exercises	173
CHAPTER 5 Arrays	175
An Introduction to Arrays	175
Programming Without Arrays	175
What Is an Array?	177
Using Arrays	178
A Reminder About Memory	181

Arrays and Addresses	184
Initializing an Array	186
Finding the Size of an Array	186
Multidimensional Arrays	187
Initializing Multidimensional Arrays	189
Designing a Program	194
The Problem	194
The Analysis	194
The Solution	195
Summary	202
Exercises	202
CHAPTER 6 Applications with Strings and Text	203
What Is a String?	203
String- and Text-Handling Methods	205
Operations with Strings	208
Appending a String	208
Arrays of Strings	210
String Library Functions	212
Copying Strings Using a Library Function	212
Determining String Length Using a Library Function	213
Joining Strings Using a Library Function	214
Comparing Strings	215
Searching a String	218
Analyzing and Transforming Strings	221
Converting Characters	224
Converting Strings to Numerical Values	227
Working with Wide Character Strings	227
Operations on Wide Character Strings	228
Testing and Converting Wide Characters	229
Designing a Program	231
The Problem	231
The Analysis	231
The Solution	231
Summary	238
Exercises	239

CHAPTER 7 Pointers	241
A First Look at Pointers	241
Declaring Pointers	242
Accessing a Value Through a Pointer.....	243
Using Pointers.....	246
Pointers to Constants	250
Constant Pointers	251
Naming Pointers	251
Arrays and Pointers	251
Multidimensional Arrays	255
Multidimensional Arrays and Pointers	259
Accessing Array Elements.....	260
Using Memory As You Go	263
Dynamic Memory Allocation: The malloc() Function.....	263
Memory Allocation with the calloc() Function	268
Releasing Dynamically Allocated Memory.....	268
Reallocating Memory	270
Handling Strings Using Pointers	271
String Input with More Control	272
Using Arrays of Pointers.....	273
Designing a Program	283
The Problem	283
The Analysis	284
The Solution	284
Summary	294
Exercises	294
CHAPTER 8 Structuring Your Programs	295
Program Structure	295
Variable Scope and Lifetime	296
Variable Scope and Functions.....	299
Functions	299
Defining a Function.....	300
The return Statement.....	304

The Pass-By-Value Mechanism	307
Function Declarations	309
Pointers As Arguments and Return Values	310
const Parameters	313
Returning Pointer Values from a Function	322
Incrementing Pointers in a Function.....	326
Summary	326
Exercises	327
CHAPTER 9 More on Functions	329
Pointers to Functions	329
Declaring a Pointer to a Function	329
Calling a Function Through a Function Pointer	330
Arrays of Pointers to Functions	333
Pointers to Functions As Arguments.....	335
Variables in Functions	338
Static Variables: Keeping Track Within a Function	338
Sharing Variables Between Functions	340
Functions That Call Themselves: Recursion	343
Functions with a Variable Number of Arguments	345
Copying a va_list	348
Basic Rules for Variable-Length Argument Lists.....	348
The main() Function	349
Ending a Program	350
Libraries of Functions: Header Files	351
Enhancing Performance	352
Declaring Functions inline	352
Using the restrict Keyword.....	353
Designing a Program	353
The Problem	353
The Analysis	354
The Solution	356
Summary	371
Exercises	372

CHAPTER 10 Essential Input and Output Operations	373
Input and Output Streams	373
Standard Streams	374
Input from the Keyboard	375
Formatted Keyboard Input.....	376
Input Format Control Strings.....	376
Characters in the Input Format String	382
Variations on Floating-Point Input.....	383
Reading Hexadecimal and Octal Values.....	384
Reading Characters Using scanf().....	386
Pitfalls with scanf().....	388
String Input from the Keyboard.....	388
Unformatted Input from the Keyboard	389
Output to the Screen	394
Formatted Output to the Screen Using printf().....	394
Escape Sequences	396
Integer Output.....	397
Outputting Floating-Point Values.....	400
Character Output.....	401
Other Output Functions	403
Unformatted Output to the Screen	404
Formatted Output to an Array	404
Formatted Input from an Array	405
Sending Output to the Printer	405
Summary	406
Exercises	406
CHAPTER 11 Structuring Data	409
Data Structures: Using struct	409
Defining Structure Types and Structure Variables	411
Accessing Structure Members	411
Unnamed Structures.....	414
Arrays of Structures	414
Structures in Expressions	417
Pointers to Structures	417
Dynamic Memory Allocation for Structures	418

More on Structure Members	420
Structures As Members of a Structure.....	420
Declaring a Structure Within a Structure	421
Pointers to Structures As Structure Members.....	422
Doubly Linked Lists	426
Bit-Fields in a Structure.....	429
Structures and Functions	430
Structures As Arguments to Functions.....	430
Pointers to Structures As Function Arguments	431
A Structure As a Function Return Value.....	432
An Exercise in Program Modification	436
Binary Trees	439
Sharing Memory	447
Unions	448
Pointers to Unions.....	450
Initializing Unions	450
Structures As Union Members.....	450
Defining Your Own Data Types	451
Structures and the <code>typedef</code> Facility.....	452
Simplifying Code Using <code>typedef</code>	453
Designing a Program	454
The Problem	454
The Analysis	454
The Solution	454
Summary	464
Exercises	465
CHAPTER 12 Working with Files	467
The Concept of a File	467
Positions in a File	468
File Streams	468
Accessing Files	468
Opening a File	469
Renaming a File	471
Closing a File.....	472
Deleting a File	472

Writing to a Text File	473
Reading from a Text File	474
Writing Strings to a Text File	476
Reading Strings from a Text File	477
Formatted File Input and Output	480
Formatted Output to a File.....	481
Formatted Input from a File.....	481
Dealing with Errors	483
Further Text File Operation Modes	484
Binary File Input and Output	485
Specifying Binary Mode.....	486
Writing a Binary File	486
Reading a Binary File	487
Moving Around in a File	495
File Positioning Operations	495
Finding Out Where You Are	496
Setting a Position in a File	496
Using Temporary Work Files	502
Creating a Temporary Work File	502
Creating a Unique File Name.....	502
Updating Binary Files	503
Changing the File Contents	508
Reading a Record from the Keyboard.....	509
Writing a Record to a File.....	510
Reading a Record from a File	511
Writing a File	512
Listing the File Contents	513
Updating the Existing File Contents	514
File Open Modes Summary	521
Designing a Program	521
The Problem	522
The Analysis	522
The Solution	522
Summary	527
Exercises	527

CHAPTER 13 Supporting Facilities	529
Preprocessing	529
Including Header Files in Your Programs.....	530
External Variables and Functions	530
Substitutions in Your Program Source Code	531
Macro Substitutions	532
Macros That Look Like Functions.....	532
Preprocessor Directives on Multiple Lines.....	534
Strings As Macro Arguments.....	534
Joining Two Results of a Macro Expansion.....	535
Logical Preprocessor Directives	536
Conditional Compilation	536
Directives Testing for Specific Values	537
Multiple-Choice Selections	537
Standard Preprocessing Macros.....	538
Debugging Methods	538
Integrated Debuggers.....	539
The Preprocessor in Debugging	539
Using the assert() Macro	543
Additional Library Functions	545
The Date and Time Function Library	545
Getting the Date	549
Summary	555
Exercises	555
APPENDIX A Computer Arithmetic	557
Binary Numbers	557
Hexadecimal Numbers	558
Negative Binary Numbers	560
Big-Endian and Little-Endian Systems	561
Floating-Point Numbers	562
APPENDIX B ASCII Character Code Definitions	565
APPENDIX C Reserved Words in C	571

APPENDIX D Input and Output Format Specifications	573
Output Format Specifications	573
Input Format Specifications	576
INDEX	579