Table of Contents

Preface **21**
About the Authors 23
Acknowledgments 24
How This Book is Organized 24
Who Should Buy This Book? 24
Where to Find Answers to Review Questions and Exercises 24
How to Report Errata 25
Conventions Used in This Book 26

Section 1 Introductory Knowledge **29**

Chapter 1 How a Computer Works ***31***
1.1 Introduction 32
1.2 What is Hardware? 32
1.3 What is Software? 33
1.4 How a Computer Executes (Runs) a Program 33
1.5 Compilers and Interpreters 33
1.6 What is Source Code? 34
1.7 Review Questions: True/False 34
1.8 Review Questions: Multiple Choice 35

Chapter 2 PHP ***37***
2.1 What is PHP? 38
2.2 What is the Difference Between a Script and a Program? 38
2.3 Why You Should Learn PHP 38
2.4 How PHP Works 39

Chapter 3 Software Packages to Install ***41***
3.1 XAMPP 42
3.2 How to Set Up XAMPP 42
3.3 NetBeans 44
3.4 How to Set Up NetBeans IDE 44

Review Questions in "Introductory Knowledge" ***49***

Section 2 Getting Started with PHP **51**

Chapter 4 Introduction to Basic Algorithmic Concepts ***53***
4.1 What is an Algorithm? 54
4.2 The Algorithm for Making a Cup of Tea 54
4.3 Properties of an Algorithm 54
4.4 Okay About Algorithms. But What is a Computer Program Anyway? 55
4.5 The Party of Three! 55
4.6 The Three Main Stages Involved in Creating an Algorithm 55
4.7 Flowcharts 56
Exercise 4.7-1 Finding the Average Value of Three Numbers 58

4.8 What are "Reserved Words"? 58
4.9 What is the Difference Between a Statement and a Command? 59
4.10 What is Structured Programming? 59
4.11 The Three Fundamental Control Structures 59
Exercise 4.11-1 Understanding Control Structures Using Flowcharts 60
4.12 Your First PHP Script 61
4.13 What is the Difference Between Syntax Errors and Logic Errors? 61
4.14 Commenting Your Code 61
4.15 User-Friendly Programs and Scripts 63
4.16 Review Questions: True/False 63
4.17 Review Questions: Multiple Choice 64

Chapter 5 Variables and Constants 67
5.1 What is a Variable? 68
5.2 What is a Constant? 70
5.3 How Many Types of Variables and Constants Exist in PHP? 72
5.4 Rules for Naming Variables in PHP 72
5.5 Rules for Naming Constants in PHP 73
5.6 What Does the Phrase "Declare a Variable" Mean? 73
5.7 How to Declare Variables in PHP 74
5.8 How to Declare Constants in PHP 74
5.9 Review Questions: True/False 74
5.10 Review Questions: Multiple Choice 75
5.11 Review Exercises 76

Chapter 6 Handling Input and Output 77
6.1 Which Statement Outputs Messages and Results on a User's Screen? 78
6.2 How to Output Special Characters 79
6.3 Which Statement Lets the User Enter Data? 81
6.4 Review Questions: True/False 82
6.5 Review Questions: Multiple Choice 83

Chapter 7 Operators 85
7.1 The Value Assignment Operator 86
7.2 Arithmetic Operators 88
7.3 What is the Precedence of Arithmetic Operators? 89
7.4 Compound Assignment Operators 90
Exercise 7.4-1 Which PHP Statements are Syntactically Correct? 91
Exercise 7.4-2 Finding Variable Types 91
7.5 Incrementing/Decrementing Operators 91
7.6 String Operators 93
Exercise 7.6-1 Concatenating Names 93
7.7 Review Questions: True/False 94
7.8 Review Questions: Multiple Choice 94
7.9 Review Exercises 96

Chapter 8 Trace Tables 99
8.1 What is a Trace Table? 100

Exercise 8.1-1 Creating a Trace Table 100
Exercise 8.1-2 Swapping Values of Variables 101
Exercise 8.1-3 Swapping Values of Variables – A Second Approach 103
Exercise 8.1-4 Creating a Trace Table 104
Exercise 8.1-5 Creating a Trace Table 105
8.2 Review Questions: True/False 105
8.3 Review Exercises 105

Chapter 9 Using NetBeans IDE 107
9.1 Creating a New PHP Project 108
9.2 Writing and Executing a PHP Script 110
9.3 What "Debugging" Means 113
9.4 Debugging PHP Scripts with NetBeans IDE 113
9.5 Review Exercises 119

Review Questions in "Getting Started with PHP" 121

Section 3 Sequence Control Structures 123

Chapter 10 Introduction to Sequence Control Structures 125
10.1 What is the Sequence Control Structure? 126
Exercise 10.1-1 Calculating the Area of a Parallelogram 126
Exercise 10.1-2 Calculating the Area of a Circle 126
Exercise 10.1-3 Calculating Fuel Economy 127
Exercise 10.1-4 Where is the Car? Calculating Distance Traveled 128
Exercise 10.1-5 Kelvin to Fahrenheit 129
Exercise 10.1-6 Calculating Sales Tax 129
Exercise 10.1-7 Calculating a Sales Discount 130
Exercise 10.1-8 Calculating the Sales Tax Rate and Discount 131
10.2 Review Exercises 131

Chapter 11 Manipulating Numbers 133
11.1 Introduction 134
11.2 Useful Mathematical Functions 134
Exercise 11.2-1 Calculating the Distance Between Two Points 137
Exercise 11.2-2 How Far Did the Car Travel? 138
11.3 Review Questions: True/False 139
11.4 Review Questions: Multiple Choice 140
11.5 Review Exercises 141

Chapter 12 Complex Mathematical Expressions 143
12.1 Writing Complex Mathematical Expressions 144
Exercise 12.1-1 Representing Mathematical Expressions in PHP 144
Exercise 12.1-2 Writing a Mathematical Expression in PHP 145
Exercise 12.1-3 Writing a Complex Mathematical Expression in PHP 145
12.2 Review Exercises 147

Chapter 13 Exercises With a Quotient and a Remainder 149
13.1 Introduction 150
Exercise 13.1-1 Calculating the Quotient and Remainder of Integer Division 150
Exercise 13.1-2 Finding the Sum of Digits 151

Exercise 13.1-3 Displaying an Elapsed Time 155
Exercise 13.1-4 Reversing a Number 157
13.2 Review Exercises 157

Chapter 14 Manipulating Strings *159*
14.1 Introduction 160
14.2 The Position of a Character in a String 160
14.3 Retrieving an Individual Character From a String 161
Exercise 14.3-1 Displaying a String Backwards 162
14.4 Useful String Functions 162
Exercise 14.4-1 Switching the Order of Names 166
Exercise 14.4-2 Creating a Login ID 167
Exercise 14.4-3 Creating a Random Word 167
14.5 Review Questions: True/False 168
14.6 Review Questions: Multiple Choice 169
14.7 Review Exercises 170

Review Questions in "Sequence Control Structures" *173*

Section 4 Decision Control Structures **175**

Chapter 15 Introduction to Decision Control Structures *177*
15.1 What is a Decision Control Structure? 178
15.2 What is a Boolean Expression? 178
15.3 How to Write Boolean Expressions 178
Exercise 15.3-1 Filling in the Table 179
15.4 Logical Operators and Complex Boolean Expressions 180
15.5 What is the Order of Precedence of Logical Operators? 181
15.6 What is the Order of Precedence of Arithmetic, Comparison, and Logical Operators? 181
Exercise 15.6-1 Filling in the Truth Table 181
Exercise 15.6-2 Calculating the Results of Complex Boolean Expressions 183
Exercise 15.6-3 Converting English Sentences to Boolean Expressions 183
15.7 How to Negate Boolean Expressions 185
Exercise 15.7-1 Negating Boolean Expressions 186
15.8 Review Questions: True/False 186
15.9 Review Questions: Multiple Choice 188
15.10 Review Exercises 189

Chapter 16 The Single-Alternative Decision Structure *191*
16.1 The Single-Alternative Decision Structure 192
Exercise 16.1-1 Trace Tables and Single-Alternative Decision Structures 193
Exercise 16.1-2 The Absolute Value of a Number 194
16.2 Review Questions: True/False 195
16.3 Review Questions: Multiple Choice 196
16.4 Review Exercises 197

Chapter 17 The Dual-Alternative Decision Structure *201*
17.1 The Dual-Alternative Decision Structure 202
Exercise 17.1-1 Finding the Output Message 202

Exercise 17.1-2 Trace Tables and Dual-Alternative Decision Structures 203
Exercise 17.1-3 Who is the Greatest? 204
Exercise 17.1-4 Finding Odd and Even Numbers 206
Exercise 17.1-5 Weekly Wages 207
17.2 Review Questions: True/False 208
17.3 Review Questions: Multiple Choice 208
17.4 Review Exercises 209

Chapter 18 The Multiple-Alternative Decision Structure 213
18.1 The Multiple-Alternative Decision Structure 214
Exercise 18.1-1 Trace Tables and Multiple-Alternative Decision Structures 215
Exercise 18.1-2 Counting the Digits 217
18.2 Review Questions: True/False 218
18.3 Review Exercises 218

Chapter 19 The Case Decision Structure 221
19.1 The Case Decision Structure 222
Exercise 19.1-1 The Days of the Week 224
19.2 Review Questions: True/False 226
19.3 Review Exercises 227

Chapter 20 Nested Decision Control Structures 231
20.1 What are Nested Decision Control Structures? 232
Exercise 20.1-1 Trace Tables and Nested Decision Control Structures 233
Exercise 20.1-2 Positive, Negative or Zero? 235
20.2 A Mistake That You Will Probably Make! 236
20.3 Review Questions: True/False 239
20.4 Review Exercises 239

Chapter 21 Tips and Tricks with Decision Control Structures 243
21.1 Introduction 244
21.2 Choosing a Decision Control Structure 244
21.3 Streamlining the Decision Control Structure 244
Exercise 21.3-1 "Shrinking" the Algorithm 245
Exercise 21.3-2 "Shrinking" the PHP Script 246
Exercise 21.3-3 "Shrinking" the Algorithm 247
21.4 Logical Operators – to Use, or not to Use: That is the Question! 249
Exercise 21.4-1 Rewriting the Code 251
Exercise 21.4-2 Rewriting the Code 252
21.5 Merging Two or More Single-Alternative Decision Structures 253
Exercise 21.5-1 Merging the Decision Control Structures 254
Exercise 21.5-2 Merging the Decision Control Structures 254
21.6 Replacing Two Single-Alternative Decision Structures with a Dual-Alternative One 256
Exercise 21.6-1 "Merging" the Decision Control Structures 256
21.7 Put the Boolean Expressions Most Likely to be True First 258
Exercise 21.7-1 Rearranging the Boolean Expressions 259
21.8 Converting a Case Decision Structure to a Multiple-Alternative Decision Structure, and Vice Versa 260

Exercise 21.8-1 Converting the PHP Script 261
Exercise 21.8-2 Converting the PHP Script 262
Exercise 21.8-3 Converting the PHP Script 263
21.9 Converting a Multiple-Alternative Decision Structure to Nested Decision Control Structures, and Vice Versa 263
Exercise 21.9-1 Converting the PHP Script 264
Exercise 21.9-2 Converting the PHP Script 266
21.10 Converting a Case Decision Structure to Nested Decision Control Structures, and Vice Versa 267
Exercise 21.10-1 Converting the PHP Script 268
Exercise 21.10-2 Converting the PHP Script 269
21.11 What is Code Indentation and Why is it so Important? 269
21.12 Using the "From Inner to Outer" Method in Decision Control Structures 271
21.13 Review Questions: True/False 272
21.14 Review Questions: Multiple Choice 273
21.15 Review Exercises 276

Chapter 22 Flowcharts with Decision Control Structures 283
22.1 Introduction 284
22.2 Converting PHP Scripts to Flowcharts 284
Exercise 22.2-1 Designing the Flowchart 285
Exercise 22.2-2 Designing the Flowchart 286
Exercise 22.2-3 Designing the Flowchart 287
Exercise 22.2-4 Designing the Flowchart 288
22.3 Converting Flowcharts to PHP Scripts 289
Exercise 22.3-1 Writing the PHP Script 290
Exercise 22.3-2 Writing the PHP Script 291
Exercise 22.3-3 Writing the PHP Script 293
Exercise 22.3-4 Writing the PHP Script 294
Exercise 22.3-5 Writing the PHP Script 296
22.4 Review Exercises 297

Chapter 23 More Exercises with Decision Control Structures 303
23.1 Simple Exercises with Decision Control Structures 304
Exercise 23.1-1 Both Odds or Both Evens? 304
Exercise 23.1-2 Validating Data Input and Finding if a Number is Exactly Divisible by both 5 and 8? 304
Exercise 23.1-3 Is it an Integer? 306
Exercise 23.1-4 Converting Gallons to Liters, and Vice Versa 308
Exercise 23.1-5 Converting Gallons to Liters, and Vice Versa (with Data Validation) 308
Exercise 23.1-6 Where is the Tollkeeper? 310
Exercise 23.1-7 The Most Scientific Calculator Ever! 311
23.2 Decision Control Structures in Solving Mathematical Problems 312
Exercise 23.2-1 Finding the Value of y 312
Exercise 23.2-2 Finding the Values of y 313
Exercise 23.2-3 Validating Data Input and Finding the Values of y 314
Exercise 23.2-4 Solving the Linear Equation $ax + b = 0$ 315
Exercise 23.2-5 Solving the Quadratic Equation $ax^2 + bx + c = 0$ 317
23.3 Finding Minimum and Maximum Values with Decision Control Structures 319

Exercise 23.3-1 Finding the Name of the Heaviest Person 320
23.4 Exercises with Series of Consecutive Ranges of Values 322
Exercise 23.4-1 Calculating the Discount 322
Exercise 23.4-2 Validating Data Input and Calculating the Discount 324
Exercise 23.4-3 Sending a Parcel 325
Exercise 23.4-4 Finding the Values of y 327
Exercise 23.4-5 Progressive Rates and Electricity Consumption 330
Exercise 23.4-6 Progressive Rates, Electricity Consumption, Taxes, Data Validation and Code Optimization, All in One! 331
Exercise 23.4-7 Progressive Rates and Text Messaging Services 333
23.5 Exercises of a General Nature with Decision Control Structures 334
Exercise 23.5-1 Finding a Leap Year 334
Exercise 23.5-2 Displaying the Days of the Month 335
Exercise 23.5-3 Is the Number a Palindrome? 337
Exercise 23.5-4 Checking for Proper Capitalization and Punctuation 338
23.6 Review Exercises 339

Review Questions in "Decision Control Structures" *345*

Section 5 Loop Control Structures **347**

Chapter 24 Introduction to Loop Control Structures *349*
24.1 What is a Loop Control Structure? 350
24.2 From Sequence Control to Loop Control Structures 350
24.3 Review Questions: True/False 352

Chapter 25 The Pre-Test Loop Structure *353*
25.1 The Pre-Test Loop Structure 354
Exercise 25.1-1 Designing the Flowchart and Counting the Total Number of Iterations 355
Exercise 25.1-2 Counting the Total Number of Iterations 356
Exercise 25.1-3 Designing the Flowchart and Counting the Total Number of Iterations 357
Exercise 25.1-4 Counting the Total Number of Iterations 358
Exercise 25.1-5 Finding the Sum of 10 Numbers 358
Exercise 25.1-6 Finding the Product of 20 Numbers 359
Exercise 25.1-7 Finding the Product of N Numbers 360
Exercise 25.1-8 Finding the Sum of Odd Numbers 361
Exercise 25.1-9 Finding the Sum of an Unknown Quantity of Numbers 362
25.2 Review Questions: True/False 363
25.3 Review Questions: Multiple Choice 364
25.4 Review Exercises 366

Chapter 26 The Post-Test Loop Structure *369*
26.1 The Post-Test Loop Structure 370
Exercise 26.1-1 Designing the Flowchart and Counting the Total Number of Iterations 371
Exercise 26.1-2 Counting the Total Number of Iterations 372
Exercise 26.1-3 Designing the Flowchart and Counting the Total Number of Iterations 372
Exercise 26.1-4 Counting the Total Number of Iterations 374

Exercise 26.1-5 Finding the Product of N Numbers 374
Exercise 26.1-6 Finding the Product of an Unknown Quantity of Numbers 375
26.2 Review Questions: True/False 376
26.3 Review Questions: Multiple Choice 377
26.4 Review Exercises 378

Chapter 27 Counted Loop Structures 383
27.1 Counted Loop Structures 384
Exercise 27.1-1 Designing the Flowchart and Creating the Trace Table 387
Exercise 27.1-2 Creating the Trace Table 388
Exercise 27.1-3 Counting the Total Number of Iterations 389
Exercise 27.1-4 Finding the Sum of 10 Numbers 390
Exercise 27.1-5 Finding the Square Roots from 0 to N 391
27.2 Rules that Apply to Counted Loop Structures 391
Exercise 27.2-1 Counting the Total Number of Iterations 392
Exercise 27.2-2 Counting the Total Number of Iterations 392
Exercise 27.2-3 Counting the Total Number of Iterations 393
Exercise 27.2-4 Counting the Total Number of Iterations 394
Exercise 27.2-5 Finding the Average Value of N Numbers 394
27.3 Review Questions: True/False 395
27.4 Review Questions: Multiple Choice 396
27.5 Review Exercises 399

Chapter 28 Nested Loop Control Structures 403
28.1 What is a Nested Loop? 404
Exercise 28.1-1 Say "Hello Zeus". Designing the Flowchart and Creating the Trace Table 405
Exercise 28.1-2 Creating the Trace Table 406
28.2 Rules that Apply to Nested Loops 407
Exercise 28.2-1 Breaking the First Rule 408
Exercise 28.2-2 Counting the Total Number of Iterations 408
28.3 Review Questions: True/False 409
28.4 Review Questions: Multiple Choice 410
28.5 Review Exercises 412

Chapter 29 Tips and Tricks with Loop Control Structures 415
29.1 Introduction 416
29.2 Choosing a Loop Control Structure 416
29.3 The "Ultimate" Rule 416
29.4 Breaking Out of a Loop 420
29.5 Cleaning Out Your Loops 422
Exercise 29.5-1 Cleaning Out the Loop 423
Exercise 29.5-2 Cleaning Out the Loop 424
29.6 Endless Loops and How to Avoid Them 425
29.7 Converting from a Counted Loop Structure to a Pre-Test Loop Structure 426
Exercise 29.7-1 Converting the PHP Script 426
Exercise 29.7-2 Converting the PHP Script 427
29.8 Converting from a Pre-Test Loop Structure to a Counted Loop Structure 428
Exercise 29.8-1 Converting the PHP Script 429

Exercise 29.8-2 Converting the PHP Script 431
Exercise 29.8-3 Converting the PHP Script 432
Exercise 29.8-4 Converting the PHP Script 433
Exercise 29.8-5 Converting the PHP Script 434
29.9 Converting from a Post-Test Loop Structure to a Pre-Test Loop Structure 436
Exercise 29.9-1 Converting the PHP Script 436
Exercise 29.9-2 Converting the PHP Script 438
Exercise 29.9-3 Converting the PHP Script 438
29.10 Converting from a Pre-Test Loop Structure to a Post-Test Loop Structure 439
Exercise 29.10-1 Converting the PHP Script 440
Exercise 29.10-2 Converting the PHP Script 441
Exercise 29.10-3 Converting the PHP Script 441
29.11 Converting from a Counted Loop Structure to a Post-Test Loop Structure 442
Exercise 29.11-1 Converting the PHP Script 443
Exercise 29.11-2 Converting the PHP Script 444
29.12 Converting from a Post-Test Loop Structure to a Counted Loop Structure 446
Exercise 29.12-1 Converting the PHP Script 447
Exercise 29.12-2 Converting the PHP Script 448
29.13 Using the "From Inner to Outer" Method in Loop Control Structures 449
29.14 Review Questions: True/False 451
29.15 Review Questions: Multiple Choice 453
29.16 Review Exercises 455

Chapter 30 Flowcharts with Loop Control Structures 461
30.1 Introduction 462
30.2 Converting PHP Scripts to Flowcharts 462
Exercise 30.2-1 Designing the Flowchart 463
Exercise 30.2-2 Designing the Flowchart 464
Exercise 30.2-3 Designing the Flowchart 465
Exercise 30.2-4 Designing the Flowchart 466
Exercise 30.2-5 Designing the Flowchart 467
Exercise 30.2-6 Designing the Flowchart 469
Exercise 30.2-7 Designing the Flowchart 470
30.3 Converting Flowcharts to PHP Scripts 471
Exercise 30.3-1 Writing the PHP Script 471
Exercise 30.3-2 Writing the PHP Script 472
Exercise 30.3-3 Writing the PHP Script 473
Exercise 30.3-4 Writing the PHP Script 475
30.4 Review Exercises 478

Chapter 31 More Exercises with Loop Control Structures 485
31.1 Simple Exercises with Loop Control Structures 486
Exercise 31.1-1 Finding the Sum of $1 + 2 + 3 + \ldots + 100$ 486
Exercise 31.1-2 Finding the Product of $2 \times 4 \times 6 \times 8 \times 10$ 487
Exercise 31.1-3 Finding the Sum of $2^2 + 4^2 + 6^2 + \ldots (2N)^2$ 488
Exercise 31.1-4 Finding the Sum of $3^3 + 6^6 + 9^9 + \ldots (3N)^{3N}$ 489
Exercise 31.1-5 Finding the Average Value of Positive Numbers 489
Exercise 31.1-6 Counting the Numbers According to Which is Greater 490
Exercise 31.1-7 Counting the Numbers According to Their Digits 491

Exercise 31.1-8 How Many Numbers Fit in a Sum 491
Exercise 31.1-9 Finding the Sum of Integers 492
Exercise 31.1-10 Iterating as Many Times as the User Wishes 493
Exercise 31.1-11 Finding the Sum of the Digits 494
Exercise 31.1-12 Counting the Digits 496
31.2 Exercises with Nested Loop Control Structures 497
Exercise 31.2-1 Displaying all Three-Digit Integers that Contain a Given Digit 497
Exercise 31.2-2 Displaying all Instances of a Specified Condition 498
31.3 Data Validation with Loop Control Structures 500
Exercise 31.3-1 Finding the Square Root - Validation Without Error Messages 501
Exercise 31.3-2 Finding the Square Root - Validation with One Error Message 502
Exercise 31.3-3 Finding the Square Root - Validation with Individual Error Messages 503
Exercise 31.3-4 Finding the Sum of 10 Numbers 503
31.4 Using Loop Control Structures to Solve Mathematical Problems 505
Exercise 31.4-1 Calculating the Area of as Many Triangles as the User Wishes 505
Exercise 31.4-2 Finding x and y 506
Exercise 31.4-3 From Russia with Love 507
Exercise 31.4-4 Finding the Number of Divisors 509
Exercise 31.4-5 Is the Number a Prime? 510
Exercise 31.4-6 Finding all Prime Numbers from 1 to N 512
Exercise 31.4-7 Heron's Square Root 513
Exercise 31.4-8 Calculating π 515
Exercise 31.4-9 Approximating a Real with a Fraction 516
31.5 Finding Minimum and Maximum Values with Loop Control Structures 517
Exercise 31.5-1 Validating and Finding the Minimum and the Maximum Value 520
Exercise 31.5-2 Validating and Finding the Maximum Temperature 521
Exercise 31.5-3 "Making the Grade" 523
31.6 Exercises of a General Nature with Loop Control Structures 524
Exercise 31.6-1 Fahrenheit to Kelvin, from 0 to 100 524
Exercise 31.6-2 Wheat on a Chessboard 525
Exercise 31.6-3 Just a Poll 526
Exercise 31.6-4 Is the Message a Palindrome? 527
31.7 Review Questions: True/False 530
31.8 Review Exercises 531

Review Questions in "Loop Control Structures" ***537***

Section 6 Arrays **539**

Chapter 32 Introduction to Arrays ***541***
32.1 Introduction 542
32.2 What is an Array? 543
Exercise 32.2-1 Designing an Array 545
Exercise 32.2-2 Designing Arrays 546
Exercise 32.2-3 Designing Arrays 547
32.3 Review Questions: True/False 547
32.4 Review Exercises 548

Chapter 33 One-Dimensional Arrays ***549***
33.1 Creating One-Dimensional Arrays in PHP 550

33.2 How to Get Values from One-Dimensional Arrays 551
Exercise 33.2-1 Creating the Trace Table 551
Exercise 33.2-2 Using a Non-Existing Index 552
33.3 How to Add Values Entered by the User to a One-Dimensional Array 552
33.4 How to Iterate Through a One-Dimensional Array 553
Exercise 33.4-1 Displaying Words in Reverse Order 554
Exercise 33.4-2 Displaying Positive Numbers in Reverse Order 555
Exercise 33.4-3 Displaying Even Numbers in Odd–Numbered Index Positions 555
Exercise 33.4-4 Finding the Sum 556
33.5 Review Questions: True/False 557
33.6 Review Questions: Multiple Choice 559
33.7 Review Exercises 561

Chapter 34 Two-Dimensional Arrays 565

34.1 Creating Two-Dimensional Arrays in PHP 566
34.2 How to Get Values from Two-Dimensional Arrays 569
Exercise 34.2-1 Creating the Trace Table 569
34.3 How to Add Values Entered by the User to a Two-Dimensional Array 571
34.4 How to Iterate Through a Two-Dimensional Array 571
Exercise 34.4-1 Displaying Reals Only 574
Exercise 34.4-2 Displaying Odd Columns Only 575
34.5 What's the Story on Variables `$i` and `$j`? 576
34.6 Square Arrays 576
Exercise 34.6-1 Finding the Sum of the Elements of the Main Diagonal 576
Exercise 34.6-2 Finding the Sum of the Elements of the Antidiagonal 578
Exercise 34.6-3 Filling in the Array 580
34.7 Review Questions: True/False 581
34.8 Review Questions: Multiple Choice 583
34.9 Review Exercises 586

Chapter 35 Tips and Tricks with Arrays 591

35.1 Introduction 592
35.2 Processing Each Row Individually 592
Exercise 35.2-1 Finding the Average Value 593
35.3 Processing Each Column Individually 596
Exercise 35.3-1 Finding the Average Value 597
35.4 How to Use One-Dimensional Along with Two-Dimensional Arrays 600
Exercise 35.4-1 Finding the Average Value 600
35.5 Creating a One-Dimensional Array from a Two-Dimensional Array 603
35.6 Creating a Two-Dimensional Array from a One-Dimensional Array 604
35.7 Review Questions: True/False 605
35.8 Review Questions: Multiple Choice 606
35.9 Review Exercises 607

Chapter 36 Flowcharts with Arrays 611

36.1 Introduction 612
36.2 Converting PHP Scripts to Flowcharts 612
Exercise 36.2-1 Designing the Flowchart 612

Exercise 36.2-2 Designing the Flowchart 613
Exercise 36.2-3 Designing the Flowchart 614
36.3 Converting Flowcharts to PHP Scripts 616
Exercise 36.3-1 Writing the PHP Script 616
Exercise 36.3-2 Writing the PHP Script 617
Exercise 36.3-3 Writing the PHP Script 618
36.4 Review Exercises 619

Chapter 37 More Exercises with Arrays 625
37.1 Simple Exercises with Arrays 626
Exercise 37.1-1 Creating an Array that Contains the Average Values of its Neighboring Elements 626
Exercise 37.1-2 Creating an Array with the Greatest Values 628
Exercise 37.1-3 Merging One-Dimensional Arrays 630
Exercise 37.1-4 Merging Two-Dimensional Arrays 631
Exercise 37.1-5 Creating Two Arrays – Separating Positive from Negative Values 633
Exercise 37.1-6 Creating an Array with Those who Contain Digit 5 636
37.2 Data Validation with Arrays 637
Exercise 37.2-1 Displaying Odds in Reverse Order – Validation Without Error Messages 639
Exercise 37.2-2 Displaying Odds in Reverse Order – Validation with One Error Message 640
Exercise 37.2-3 Displaying Odds in Reverse Order – Validation with Individual Error Messages 640
37.3 Finding Minimum and Maximum Values in Arrays 641
Exercise 37.3-1 Which Depth is the Greatest? 641
Exercise 37.3-2 Which Lake is the Deepest? 643
Exercise 37.3-3 Which Lake, in Which Country, Having Which Average Area, is the Deepest? 643
Exercise 37.3-4 Which Students are the Tallest? 646
Exercise 37.3-5 Finding the Minimum Value of a Two-Dimensional Array 647
Exercise 37.3-6 Finding the City with the Coldest Day 648
Exercise 37.3-7 Finding the Minimum and the Maximum Value of Each Row 650
Exercise 37.3-8 Finding the Minimum and the Maximum Value of Each Column 653
37.4 Sorting Arrays 656
Exercise 37.4-1 The Bubble Sort Algorithm – Sorting One-Dimensional Arrays with Numeric Values 656
Exercise 37.4-2 Sorting One-Dimensional Arrays with Alphanumeric Values 661
Exercise 37.4-3 Sorting One-Dimensional Arrays While Preserving the Relationship with a Second Array 662
Exercise 37.4-4 Sorting Last and First Names 663
Exercise 37.4-5 Sorting a Two-Dimensional Array 666
Exercise 37.4-6 The Modified Bubble Sort Algorithm – Sorting One-Dimensional Arrays 667
Exercise 37.4-7 The Five Best Scorers 669
Exercise 37.4-8 The Selection Sort Algorithm – Sorting One-Dimensional Arrays 672
Exercise 37.4-9 Sorting One-Dimensional Arrays While Preserving the Relationship with a Second Array 674
Exercise 37.4-10 The Insertion Sort Algorithm – Sorting One-Dimensional Arrays 675
Exercise 37.4-11 The Three Worst Elapsed Times 678

37.5 Searching Elements in Arrays 680
Exercise 37.5-1 The Linear Search Algorithm – Searching in a One-Dimensional Array that may Contain the Same Value Multiple Times 680
Exercise 37.5-2 Display the Last Names of All Those People Who Have the Same First Name 681
Exercise 37.5-3 Searching in a One-Dimensional Array that Contains Unique Values 682
Exercise 37.5-4 Searching for a Given Social Security Number 684
Exercise 37.5-5 Searching in a Two-Dimensional Array that may Contain the Same Value Multiple Times 685
Exercise 37.5-6 Searching in a Two-Dimensional Array that Contains Unique Values 686
Exercise 37.5-7 Checking if a Value Exists in all Columns 688
Exercise 37.5-8 The Binary Search Algorithm – Searching in a Sorted One-Dimensional Array 691
Exercise 37.5-9 Display all the Historical Events for a Country 693
Exercise 37.5-10 Searching in Each Column of a Two-Dimensional Array 695
37.6 Exercises of a General Nature with Arrays 699
Exercise 37.6-1 On Which Days was There a Possibility of Snow? 699
Exercise 37.6-2 Was There Any Possibility of Snow? 699
Exercise 37.6-3 In Which Cities was There a Possibility of Snow? 701
Exercise 37.6-4 Display from Highest to Lowest Grades by Student, and in Alphabetical Order 705
Exercise 37.6-5 Archery at the Summer Olympics 707
37.7 Review Questions: True/False 708
37.8 Review Exercises 710

Review Questions in "Arrays" ***715***

Section 7 Subprograms **717**

Chapter 38 Introduction to Subprograms ***719***
38.1 What is Procedural Programming? 720
38.2 What is Modular Programming? 720
38.3 What Exactly is a Subprogram? 721
38.4 Review Questions: True/False 722

Chapter 39 User-Defined Functions ***723***
39.1 Writing your Own Functions in PHP 724
39.2 How Do You Call a Function? 724
39.3 Formal and Actual Function Arguments 726
39.4 How Does a Function Execute? 727
Exercise 39.4-1 Back to Basics – Calculating the Sum of Two Numbers 729
Exercise 39.4-2 Calculating the Sum of Two Numbers Using Fewer Lines of Code! 730
39.5 Review Questions: True/False 730
39.6 Review Exercises 732

Chapter 40 User-Defined Procedures ***735***
40.1 Writing your Own Procedures in PHP 736
40.2 How Do You Call a Procedure? 736
40.3 Formal and Actual Procedure Arguments 738
40.4 How Does a Procedure Execute? 738

Exercise 40.4-1 Back to Basics – Displaying the Absolute Value of a Number 740
Exercise 40.4-2 A Simple Currency Converter 741
40.5 Review Questions: True/False 742
40.6 Review Exercises 743

Chapter 41 Tips and Tricks with Subprograms 747
41.1 Can Two Subprograms use Variables of the Same Name? 748
41.2 Can a Subprogram Call Another Subprogram? 749
Exercise 41.2-1 A Currency Converter – Using Functions with Procedures 750
41.3 Passing Arguments by Value and by Reference 752
Exercise 41.3-1 Finding the Logic Error 754
Exercise 41.3-2 Finding the Absolute Value of a Number 755
Exercise 41.3-3 Converting a Function to a Procedure 757
41.4 Passing and/or Returning an Array 758
41.5 Default Argument Values (Optional Arguments) 760
41.6 The Scope of a Variable 761
41.7 Converting Parts of Code into Subprograms 763
41.8 Recursion 768
Exercise 41.8-1 Calculating the Fibonacci Sequence Recursively 770
41.9 Review Questions: True/False 772
41.10 Review Exercises 773

Chapter 42 Flowcharts with Subprograms 781
42.1 Designing and Calling Sub-Algorithms in Flowcharts 782
42.2 Converting PHP Scripts to Flowcharts 784
Exercise 42.2-1 Designing the Flowchart 784
Exercise 42.2-2 Designing the Flowchart 785
Exercise 42.2-3 Designing the Flowchart 785
42.3 Converting Flowcharts to PHP Scripts 787
Exercise 42.3-1 Writing the PHP Script 787
Exercise 42.3-2 Writing the PHP Script 788
42.4 Review Exercises 789

Chapter 43 More Exercises with Subprograms 797
43.1 Simple Exercises with Subprograms 798
Exercise 43.1-1 Finding the Average Values of Positive Integers 798
Exercise 43.1-2 Finding the Sum of Odd Positive Integers 799
Exercise 43.1-3 Finding the Values of y 800
Exercise 43.1-4 Roll, Roll, Roll the… Dice! 801
Exercise 43.1-5 How Many Times Does Each Number of the Dice Appear? 802
43.2 Exercises of a General Nature with Subprograms 804
Exercise 43.2-1 Validating Data Input 804
Exercise 43.2-2 Sorting an Array 806
Exercise 43.2-3 Progressive Rates and Electricity Consumption 808
43.3 Review Exercises 809

Review Questions in "Subprograms" 815

Index 817