

# Table of Contents

---

<b>Preface</b> .....	<b>21</b>
About the Author .....	23
Acknowledgments.....	24
How This Book is Organized.....	24
Who Should Buy This Book? .....	24
Conventions Used in This Book.....	25
How to Report Errata.....	26
Where to Download Material About this Book.....	26
If you Like this Book.....	26
<b>Part I   Introductory Knowledge</b> .....	<b>27</b>
<b>Chapter 1   How a Computer Works</b> .....	<b>29</b>
1.1   Introduction.....	29
1.2   What is Hardware? .....	29
1.3   What is Software?.....	30
1.4   How a Computer Executes (Runs) a Program .....	30
1.5   Compilers and Interpreters .....	30
1.6   What is Source Code?.....	31
1.7   Review Questions: True/False .....	31
1.8   Review Questions: Multiple Choice .....	32
<b>Chapter 2   PHP and Integrated Development Environments</b> .....	<b>35</b>
2.1   What is PHP?.....	35
2.2   What is the Difference Between a Script and a Program? .....	35
2.3   Why You Should Learn PHP .....	35
2.4   How PHP Works.....	36
2.5   Integrated Development Environments.....	36
2.6   Visual Studio .....	36
<b>Chapter 3   Software Packages to Install</b> .....	<b>37</b>
3.1   What to Install.....	37
<b>Review in “Introductory Knowledge”</b> .....	<b>39</b>
Review Crossword Puzzles.....	39
Review Questions .....	41
<b>Part II   Getting Started with PHP</b> .....	<b>43</b>
<b>Chapter 4   Introduction to Basic Algorithmic Concepts</b> .....	<b>45</b>
4.1   What is an Algorithm? .....	45
4.2   The Algorithm for Making a Cup of Tea.....	45
4.3   Properties of an Algorithm.....	45
4.4   Okay About Algorithms. But What is a Computer Program Anyway? .....	46
4.5   The Three Parties!.....	46
4.6   The Three Main Stages Involved in Creating an Algorithm .....	46
4.7   Flowcharts.....	47
Exercise 4.7-1   Finding the Average Value of Three Numbers .....	49

4.8	What are "Reserved Words"?	49
4.9	What is the Difference Between a Statement and a Command?	50
4.10	What is Structured Programming?	50
4.11	The Three Fundamental Control Structures	50
	Exercise 4.11-1 Understanding Control Structures Using Flowcharts	50
4.12	Your First PHP Script	51
4.13	What is the Difference Between a Syntax Error, a Logic Error, and a Runtime Error?	52
4.14	What "Debugging" Means	52
4.15	Commenting Your Code	53
4.16	User-Friendly Programs and Scripts	54
4.17	Review Questions: True/False	54
4.18	Review Questions: Multiple Choice	55
<b>Chapter 5</b>	<b>Variables and Constants</b>	<b>57</b>
5.1	What is a Variable?	57
5.2	What is a Constant?	58
5.3	How Many Types of Variables and Constants Exist?	60
5.4	Rules and Conventions for Naming Variables and Constants in PHP	61
5.5	What Does the Phrase "Declare a Variable" Mean?	61
5.6	How to Declare Variables in PHP	62
5.7	How to Declare Constants in PHP	62
5.8	Review Questions: True/False	62
5.9	Review Questions: Multiple Choice	63
5.10	Review Exercises	64
<b>Chapter 6</b>	<b>Handling Input and Output</b>	<b>65</b>
6.1	How to Output Messages and Results to a User's Screen?	65
6.2	How to Output Special Characters?	66
6.3	How to Prompt the User to Enter Data?	67
6.4	Review Questions: True/False	70
6.5	Review Questions: Multiple Choice	70
<b>Chapter 7</b>	<b>Operators</b>	<b>71</b>
7.1	The Value Assignment Operator	71
7.2	Arithmetic Operators	72
7.3	What is the Precedence of Arithmetic Operators?	74
7.4	Compound Assignment Operators	75
	Exercise 7.4-1 Which PHP Statements are Syntactically Correct?	75
	Exercise 7.4-2 Finding Variable Types	76
7.5	Incrementing/Decrementing Operators	76
7.6	String Operators	77
	Exercise 7.6-1 Concatenating Names	77
7.7	Review Questions: True/False	78
7.8	Review Questions: Multiple Choice	78
7.9	Review Exercises	80
<b>Chapter 8</b>	<b>Trace Tables</b>	<b>83</b>
8.1	What is a Trace Table?	83

Exercise 8.1-1	Creating a Trace Table .....	83
Exercise 8.1-2	Creating a Trace Table .....	84
Exercise 8.1-3	Swapping Values of Variables.....	85
Exercise 8.1-4	Swapping Values of Variables – An Alternative Approach.....	86
8.2	Review Questions: True/False .....	87
8.3	Review Exercises .....	87
<b>Chapter 9</b>	<b>Using Visual Studio Code .....</b>	<b>89</b>
9.1	Write, Execute and Debug PHP Scripts.....	89
	<b>Review in “Getting Started with PHP” .....</b>	<b>91</b>
	Review Crossword Puzzles.....	91
	Review Questions .....	93
<b>Part III</b>	<b>Sequence Control Structures.....</b>	<b>95</b>
<b>Chapter 10</b>	<b>Introduction to Sequence Control Structures .....</b>	<b>97</b>
10.1	What is the Sequence Control Structure? .....	97
Exercise 10.1-1	Calculating the Area of a Rectangle .....	97
Exercise 10.1-2	Calculating the Area of a Circle .....	98
Exercise 10.1-3	Where is the Car? Calculating Distance Traveled .....	99
Exercise 10.1-4	Kelvin to Fahrenheit.....	99
Exercise 10.1-5	Calculating Sales Tax.....	100
Exercise 10.1-6	Calculating a Sales Discount.....	100
Exercise 10.1-7	Calculating a Sales Discount and Tax.....	101
10.2	Review Exercises .....	101
<b>Chapter 11</b>	<b>Manipulating Numbers.....</b>	<b>105</b>
11.1	Introduction.....	105
11.2	Useful Mathematical Functions (Subprograms), and More.....	106
Exercise 11.2-1	Calculating the Distance Between Two Points.....	109
Exercise 11.2-2	How Far Did the Car Travel?.....	110
11.3	Review Questions: True/False .....	110
11.4	Review Questions: Multiple Choice .....	111
11.5	Review Exercises .....	112
<b>Chapter 12</b>	<b>Complex Mathematical Expressions .....</b>	<b>113</b>
12.1	Writing Complex Mathematical Expressions .....	113
Exercise 12.1-1	Representing Mathematical Expressions in PHP .....	113
Exercise 12.1-2	Writing a Mathematical Expression in PHP.....	114
Exercise 12.1-3	Writing a Complex Mathematical Expression in PHP.....	114
12.2	Review Exercises .....	115
<b>Chapter 13</b>	<b>Exercises With a Quotient and a Remainder.....</b>	<b>117</b>
13.1	Introduction.....	117
Exercise 13.1-1	Calculating the Quotient and Remainder of Integer Division .....	117
Exercise 13.1-2	Finding the Sum of Digits.....	118
Exercise 13.1-3	Displaying an Elapsed Time .....	121
Exercise 13.1-4	Reversing a Number.....	123
13.2	Review Exercises .....	123
<b>Chapter 14</b>	<b>Manipulating Strings.....</b>	<b>125</b>
14.1	Introduction.....	125
14.2	The Position of a Character in a String .....	125

14.3	Useful String Functions (Subprograms), and More.....	125
	Exercise 14.3-1    Displaying a String Backwards.....	130
	Exercise 14.3-2    Switching the Order of Names.....	130
	Exercise 14.3-3    Creating a Login ID.....	131
	Exercise 14.3-4    Creating a Random Word.....	131
	Exercise 14.3-5    Finding the Sum of Digits.....	132
14.4	Review Questions: True/False.....	133
14.5	Review Questions: Multiple Choice.....	134
14.6	Review Exercises.....	135
	<b>Review in “Sequence Control Structures”.....</b>	<b>137</b>
	Review Crossword Puzzle.....	137
	Review Questions.....	137
<b>Part IV</b>	<b>Decision Control Structures.....</b>	<b>139</b>
	<b>Chapter 15 Making Questions.....</b>	<b>141</b>
15.1	Introduction.....	141
15.2	What is a Boolean Expression?.....	141
15.3	How to Write Simple Boolean Expressions.....	141
	Exercise 15.3-1    Filling in the Table.....	142
15.4	Logical Operators and Complex Boolean Expressions.....	142
	Exercise 15.4-1    Calculating the Results of Complex Boolean Expressions.....	144
15.5	Assigning the Result of a Boolean Expression to a Variable.....	144
15.6	What is the Order of Precedence of Logical Operators?.....	145
	Exercise 15.6-1    Filling in the Truth Table.....	145
	Exercise 15.6-2    Converting English Sentences to Boolean Expressions.....	146
15.7	What is the Order of Precedence of Arithmetic, Comparison, and Logical Operators?.....	148
15.8	How to Negate Boolean Expressions.....	148
	Exercise 15.8-1    Negating Boolean Expressions.....	149
15.9	Review Questions: True/False.....	150
15.10	Review Questions: Multiple Choice.....	151
15.11	Review Exercises.....	152
	<b>Chapter 16 The Single-Alternative Decision Structure.....</b>	<b>155</b>
16.1	The Single-Alternative Decision Structure.....	155
	Exercise 16.1-1    Trace Tables and Single-Alternative Decision Structures.....	157
	Exercise 16.1-2    The Absolute Value of a Number.....	158
16.2	Review Questions: True/False.....	159
16.3	Review Questions: Multiple Choice.....	159
16.4	Review Exercises.....	160
	<b>Chapter 17 The Dual-Alternative Decision Structure.....</b>	<b>163</b>
17.1	The Dual-Alternative Decision Structure.....	163
	Exercise 17.1-1    Finding the Output Message.....	164
	Exercise 17.1-2    Trace Tables and Dual-Alternative Decision Structures.....	164
	Exercise 17.1-3    Who is the Greatest?.....	165
	Exercise 17.1-4    Finding Odd and Even Numbers.....	167
	Exercise 17.1-5    Weekly Wages.....	168
17.2	Review Questions: True/False.....	169
17.3	Review Questions: Multiple Choice.....	169

17.4	Review Exercises .....	170
<b>Chapter 18</b>	<b>The Multiple-Alternative Decision Structure .....</b>	<b>173</b>
18.1	The Multiple-Alternative Decision Structure .....	173
	Exercise 18.1-1 Trace Tables and Multiple-Alternative Decision Structures .....	174
	Exercise 18.1-2 Counting the Digits .....	176
18.2	Review Questions: True/False .....	177
18.3	Review Exercises .....	178
<b>Chapter 19</b>	<b>The Case Decision Structure .....</b>	<b>181</b>
19.1	The Case Decision Structure .....	181
	Exercise 19.1-1 The Days of the Week .....	182
19.2	Review Questions: True/False .....	183
19.3	Review Exercises .....	184
<b>Chapter 20</b>	<b>Nested Decision Control Structures .....</b>	<b>187</b>
20.1	What are Nested Decision Control Structures? .....	187
	Exercise 20.1-1 Trace Tables and Nested Decision Control Structures .....	188
	Exercise 20.1-2 Positive, Negative or Zero? .....	189
20.2	Review Questions: True/False .....	191
20.3	Review Exercises .....	191
<b>Chapter 21</b>	<b>More about Flowcharts with Decision Control Structures .....</b>	<b>195</b>
21.1	Introduction .....	195
21.2	Converting PHP scripts to Flowcharts .....	195
	Exercise 21.2-1 Designing the Flowchart .....	196
	Exercise 21.2-2 Designing the Flowchart .....	197
	Exercise 21.2-3 Designing the Flowchart .....	198
21.3	A Mistake That You Will Probably Make! .....	199
21.4	Converting Flowcharts to PHP scripts .....	203
	Exercise 21.4-1 Writing the PHP Script .....	203
	Exercise 21.4-2 Writing the PHP Script .....	204
	Exercise 21.4-3 Writing the PHP Script .....	205
21.5	Review Exercises .....	207
<b>Chapter 22</b>	<b>Tips and Tricks with Decision Control Structures .....</b>	<b>213</b>
22.1	Introduction .....	213
22.2	Choosing a Decision Control Structure .....	213
22.3	Streamlining the Decision Control Structure .....	213
	Exercise 22.3-1 "Shrinking" the Algorithm .....	214
	Exercise 22.3-2 "Shrinking" the PHP script .....	215
	Exercise 22.3-3 "Shrinking" the Algorithm .....	216
22.4	Logical Operators – to Use, or not to Use: That is the Question! .....	218
	Exercise 22.4-1 Rewriting the Code .....	219
	Exercise 22.4-2 Rewriting the Code .....	220
22.5	Merging Two or More Single-Alternative Decision Structures .....	221
	Exercise 22.5-1 Merging the Decision Control Structures .....	221
	Exercise 22.5-2 Merging the Decision Control Structures .....	222
22.6	Replacing Two Single-Alternative Decision Structures with a Dual-Alternative One .....	223
	Exercise 22.6-1 "Merging" the Decision Control Structures .....	224
22.7	Put the Boolean Expressions Most Likely to be True First .....	225
	Exercise 22.7-1 Rearranging the Boolean Expressions .....	225

22.8	Why is Code Indentation so Important? .....	226
22.9	Review Questions: True/False .....	227
22.10	Review Questions: Multiple Choice .....	228
22.11	Review Exercises .....	229
<b>Chapter 23</b>	<b>More with Decision Control Structures .....</b>	<b>233</b>
23.1	Simple Exercises with Decision Control Structures .....	233
Exercise 23.1-1	Is it an Integer? .....	233
Exercise 23.1-2	Validating Data Input and Finding Odd and Even Numbers .....	233
Exercise 23.1-3	Where is the Tollkeeper? .....	235
Exercise 23.1-4	The Most Scientific Calculator Ever! .....	236
Exercise 23.1-5	Converting Gallons to Liters, and Vice Versa .....	237
Exercise 23.1-6	Converting Gallons to Liters, and Vice Versa (with Data Validation) .....	238
23.2	Finding Minimum and Maximum Values with Decision Control Structures .....	239
Exercise 23.2-1	Finding the Name of the Heaviest Person .....	240
23.3	Decision Control Structures in Solving Mathematical Problems .....	241
Exercise 23.3-1	Finding the Value of $y$ .....	241
Exercise 23.3-2	Finding the Values of $y$ .....	242
Exercise 23.3-3	Solving the Linear Equation $ax + b = 0$ .....	243
Exercise 23.3-4	Solving the Quadratic Equation $ax^2 + bx + c = 0$ .....	244
23.4	Exercises with Series of Consecutive Ranges of Values .....	247
Exercise 23.4-1	Calculating the Discount .....	248
Exercise 23.4-2	Validating Data Input and Calculating the Discount .....	249
Exercise 23.4-3	Sending a Parcel .....	250
Exercise 23.4-4	Finding the Values of $y$ .....	253
Exercise 23.4-5	Progressive Rates and Electricity Consumption .....	255
Exercise 23.4-6	Progressive Rates and Text Messaging Services .....	256
23.5	Exercises of a General Nature with Decision Control Structures .....	257
Exercise 23.5-1	Finding a Leap Year .....	257
Exercise 23.5-2	Displaying the Days of the Month .....	258
Exercise 23.5-3	Checking for Proper Capitalization and Punctuation .....	260
Exercise 23.5-4	Is the Number a Palindrome? .....	260
23.6	Boolean Expressions Reference and Handy Tips .....	263
23.7	Review Exercises .....	264
	<b>Review in "Decision Control Structures" .....</b>	<b>269</b>
	Review Crossword Puzzle .....	269
	Review Questions .....	269
<b>Part V</b>	<b>Loop Control Structures .....</b>	<b>271</b>
<b>Chapter 24</b>	<b>Introduction to Loop Control Structures .....</b>	<b>273</b>
24.1	What is a Loop Control Structure? .....	273
24.2	From Sequence Control to Loop Control Structures .....	273
24.3	Review Questions: True/False .....	274
<b>Chapter 25</b>	<b>Pre-Test, Mid-Test and Post-Test Loop Structures .....</b>	<b>277</b>
25.1	The Pre-Test Loop Structure .....	277
Exercise 25.1-1	Designing the Flowchart and Counting the Total Number of Iterations .....	278
Exercise 25.1-2	Counting the Total Number of Iterations .....	279
Exercise 25.1-3	Counting the Total Number of Iterations .....	279
Exercise 25.1-4	Counting the Total Number of Iterations .....	280
Exercise 25.1-5	Finding the Sum of Four Numbers .....	280

Exercise 25.1-6	Finding the Sum of Odd Numbers .....	281
Exercise 25.1-7	Finding the Sum of N Numbers.....	282
Exercise 25.1-8	Finding the Sum of an Unknown Quantity of Numbers .....	282
Exercise 25.1-9	Finding the Product of 20 Numbers .....	284
25.2	The Post-Test Loop Structure.....	284
Exercise 25.2-1	Designing the Flowchart and Counting the Total Number of Iterations .....	286
Exercise 25.2-2	Counting the Total Number of Iterations.....	286
Exercise 25.2-3	Designing the Flowchart and Counting the Total Number of Iterations .....	287
Exercise 25.2-4	Counting the Total Number of Iterations.....	287
Exercise 25.2-5	Finding the Product of N Numbers .....	288
25.3	The Mid-Test Loop Structure .....	289
Exercise 25.3-1	Designing the Flowchart and Counting the Total Number of Iterations .....	290
25.4	Review Questions: True/False .....	291
25.5	Review Questions: Multiple Choice .....	292
25.6	Review Exercises .....	295
<b>Chapter 26</b>	<b>Definite Loops.....</b>	<b>299</b>
26.1	The for statement .....	299
Exercise 26.1-1	Creating the Trace Table.....	301
Exercise 26.1-2	Creating the Trace Table.....	303
Exercise 26.1-3	Counting the Total Number of Iterations.....	303
Exercise 26.1-4	Finding the Sum of Four Numbers .....	304
Exercise 26.1-5	Finding the Square Roots from 0 to N .....	305
Exercise 26.1-6	Finding the Sum of $1 + 2 + 3 + \dots + 100$ .....	305
Exercise 26.1-7	Finding the Product of $2 \times 4 \times 6 \times 8 \times 10$ .....	306
Exercise 26.1-8	Finding the Sum of $2^2 + 4^2 + 6^2 + \dots (2N)^2$ .....	307
Exercise 26.1-9	Finding the Sum of $3^3 + 6^6 + 9^9 + \dots (3N)^{3N}$ .....	307
Exercise 26.1-10	Finding the Average Value of Positive Numbers .....	307
Exercise 26.1-11	Counting the Vowels .....	308
26.2	Rules that Apply to For-Loops .....	309
Exercise 26.2-1	Counting the Total Number of Iterations.....	309
Exercise 26.2-2	Counting the Total Number of Iterations.....	310
Exercise 26.2-3	Counting the Total Number of Iterations.....	310
Exercise 26.2-4	Counting the Total Number of Iterations.....	311
Exercise 26.2-5	Finding the Sum of N Numbers .....	312
26.3	Review Questions: True/False .....	312
26.4	Review Questions: Multiple Choice .....	313
26.5	Review Exercises .....	315
<b>Chapter 27</b>	<b>Nested Loop Control Structures.....</b>	<b>319</b>
27.1	What is a Nested Loop?.....	319
Exercise 27.1-1	Say "Hello Zeus". Counting the Total Number of Iterations.....	320
Exercise 27.1-2	Creating the Trace Table.....	320
27.2	Rules that Apply to Nested Loops .....	321
Exercise 27.2-1	Violating the First Rule .....	321
Exercise 27.2-2	Violating the Second Rule .....	322
27.3	Review Questions: True/False .....	323
27.4	Review Questions: Multiple Choice .....	324
27.5	Review Exercises .....	325
<b>Chapter 28</b>	<b>More about Flowcharts with Loop Control Structures .....</b>	<b>329</b>

28.1	Introduction.....	329
28.2	Converting PHP scripts to Flowcharts.....	329
	Exercise 28.2-1    Designing the Flowchart Fragment.....	330
	Exercise 28.2-2    Designing the Flowchart Fragment.....	330
	Exercise 28.2-3    Designing the Flowchart.....	331
	Exercise 28.2-4    Designing the Flowchart Fragment.....	332
	Exercise 28.2-5    Designing the Flowchart.....	333
28.3	Converting Flowcharts to PHP scripts.....	334
	Exercise 28.3-1    Writing the PHP Script.....	335
	Exercise 28.3-2    Writing the PHP Script.....	335
	Exercise 28.3-3    Writing the PHP Script.....	336
	Exercise 28.3-4    Writing the PHP Script.....	338
28.4	Review Exercises.....	340
<b>Chapter 29  Tips and Tricks with Loop Control Structures .....</b>		<b>345</b>
29.1	Introduction.....	345
29.2	Choosing a Loop Control Structure.....	345
29.3	The “Ultimate” Rule.....	345
29.4	Breaking Out of a Loop .....	349
29.5	Cleaning Out Your Loops.....	350
	Exercise 29.5-1    Cleaning Out the Loop.....	351
	Exercise 29.5-2    Cleaning Out the Loop.....	351
29.6	Endless Loops and How to Stop Them.....	352
29.7	The “From Inner to Outer” Method.....	353
29.8	Review Questions: True/False .....	354
29.9	Review Questions: Multiple Choice.....	355
29.10	Review Exercises.....	356
<b>Chapter 30  More with Loop Control Structures .....</b>		<b>359</b>
30.1	Simple Exercises with Loop Control Structures.....	359
	Exercise 30.1-1    Counting the Numbers According to Which is Greater.....	359
	Exercise 30.1-2    Counting the Numbers According to Their Digits .....	360
	Exercise 30.1-3    How Many Numbers Fit in a Sum.....	360
	Exercise 30.1-4    Finding the Total Number of Positive Integers.....	361
	Exercise 30.1-5    Iterating as Many Times as the User Wishes .....	361
	Exercise 30.1-6    Finding the Sum of the Digits .....	362
30.2	Exercises with Nested Loop Control Structures.....	365
	Exercise 30.2-1    Displaying all Three-Digit Integers that Contain a Given Digit.....	365
	Exercise 30.2-2    Displaying all Instances of a Specified Condition .....	366
30.3	Data Validation with Loop Control Structures.....	367
	Exercise 30.3-1    Finding Odd and Even Numbers - Validation Without Error Messages .....	369
	Exercise 30.3-2    Finding the Sum of Four Numbers.....	370
30.4	Finding Minimum and Maximum Values with Loop Control Structures.....	371
	Exercise 30.4-1    Validating and Finding the Minimum and the Maximum Value .....	373
	Exercise 30.4-2    Validating and Finding the Hottest Planet.....	373
	Exercise 30.4-3    “Making the Grade”.....	375
30.5	Using Loop Control Structures to Solve Mathematical Problems.....	376
	Exercise 30.5-1    Calculating the Area of as Many Triangles as the User Wishes.....	376
	Exercise 30.5-2    Finding x and y .....	377
	Exercise 30.5-3    The Russian Multiplication Algorithm .....	378

Exercise 30.5-4	Finding the Number of Divisors .....	379
Exercise 30.5-5	Is the Number a Prime? .....	380
Exercise 30.5-6	Finding all Prime Numbers from 1 to N.....	381
Exercise 30.5-7	Heron's Square Root .....	382
Exercise 30.5-8	Calculating $\pi$ .....	384
Exercise 30.5-9	Approximating a Real with a Fraction.....	385
30.6	Exercises of a General Nature with Loop Control Structures .....	386
Exercise 30.6-1	Fahrenheit to Kelvin, from 0 to 100 .....	386
Exercise 30.6-2	Rice on a Chessboard.....	386
Exercise 30.6-3	Just a Poll .....	387
Exercise 30.6-4	Is the Message a Palindrome?.....	388
30.7	Review Questions: True/False .....	391
30.8	Review Exercises .....	391
	<b>Review in "Loop Control Structures" .....</b>	<b>399</b>
	Review Crossword Puzzle.....	399
	Review Questions .....	399
<b>Part VI</b>	<b>Arrays in PHP.....</b>	<b>401</b>
	<b>Chapter 31 One-Dimensional Arrays .....</b>	<b>403</b>
31.1	Introduction.....	403
31.2	What is an Array? .....	403
Exercise 31.2-1	Designing an Array .....	405
Exercise 31.2-2	Designing Arrays.....	406
Exercise 31.2-3	Designing Arrays.....	406
31.3	Creating One-Dimensional Arrays in PHP .....	407
31.4	How to Get Values from a One-Dimensional Array .....	409
Exercise 31.4-1	Creating the Trace Table.....	409
Exercise 31.4-2	Using a Non-Existing Index.....	409
31.5	How to Alter the Value of an Array Element .....	410
31.6	How to Iterate Through a One-Dimensional Array .....	410
Exercise 31.6-1	Finding the Sum .....	412
31.7	How to Add User-Entered Values to a One-Dimensional Array .....	413
Exercise 31.7-1	Displaying Words in Reverse Order .....	413
Exercise 31.7-2	Displaying Positive Numbers in Reverse Order .....	414
Exercise 31.7-3	Finding the Average Value .....	414
Exercise 31.7-4	Displaying Reals Only.....	415
Exercise 31.7-5	Displaying Elements with Odd-Numbered Indexes.....	416
Exercise 31.7-6	Displaying Even Numbers in Odd-Numbered Index Positions.....	416
31.8	What is an Map? .....	417
31.9	Creating Associative Arrays in PHP.....	417
31.10	How to Get a Value from an Associative Array.....	418
Exercise 31.10-1	Roman Numerals to Numbers.....	418
Exercise 31.10-2	Using a Non-Existing Key in Dictionaries .....	419
31.11	How to Alter the Value of an Element of an Associative Array .....	419
31.12	How to Iterate Through an Associative Array .....	420
31.13	Review Questions: True/False .....	420
31.14	Review Questions: Multiple Choice .....	422
31.15	Review Exercises .....	425

<b>Chapter 32 Two-Dimensional Arrays</b> .....	<b>429</b>
32.1 Creating Two-Dimensional Arrays in PHP.....	429
32.2 How to Get Values from Two-Dimensional Arrays .....	431
Exercise 32.2-1 Creating the Trace Table.....	432
32.3 How to Iterate Through a Two-Dimensional Array.....	433
32.4 How to Add User-Entered Values to a Two-Dimensional Array .....	437
Exercise 32.4-1 Displaying Reals Only.....	438
Exercise 32.4-2 Displaying Odd Columns Only.....	438
32.5 What's the Story on Variables \$i and \$j?.....	439
32.6 Square Matrices .....	439
Exercise 32.6-1 Finding the Sum of the Elements on the Main Diagonal.....	439
Exercise 32.6-2 Finding the Sum of the Elements on the Antidiagonal.....	441
Exercise 32.6-3 Filling in the Array.....	442
32.7 Review Questions: True/False .....	443
32.8 Review Questions: Multiple Choice.....	445
32.9 Review Exercises.....	447
<b>Chapter 33 Tips and Tricks with Arrays</b> .....	<b>451</b>
33.1 Introduction.....	451
33.2 Processing Each Row Individually.....	451
Exercise 33.2-1 Finding the Average Value.....	452
33.3 Processing Each Column Individually.....	454
Exercise 33.3-1 Finding the Average Value.....	455
33.4 How to Use More Than One Arrays in a Script.....	457
Exercise 33.4-1 Using Three One-Dimensional Arrays.....	457
Exercise 33.4-2 Using a One-Dimensional Array Along with a Two-Dimensional Array.....	458
Exercise 33.4-3 Using an Indexed Array Along with an Associative Array.....	461
33.5 Creating a One-Dimensional Array from a Two-Dimensional Array .....	462
33.6 Creating a Two-Dimensional Array from a One-Dimensional Array .....	463
33.7 Useful Array Functions (Subprograms).....	464
33.8 Review Questions: True/False .....	466
33.9 Review Questions: Multiple Choice.....	467
33.10 Review Exercises.....	469
<b>Chapter 34 More with Arrays</b> .....	<b>473</b>
34.1 Simple Exercises with Arrays .....	473
Exercise 34.1-1 Creating an Array that Contains the Average Values of its Neighboring Elements.....	473
Exercise 34.1-2 Creating an Array with the Greatest Values .....	474
Exercise 34.1-3 Merging One-Dimensional Arrays.....	474
Exercise 34.1-4 Creating Two Arrays – Separating Positive from Negative Values .....	476
Exercise 34.1-5 Creating an Array with Those who Contain Digit 5 .....	479
34.2 Data Validation with Arrays .....	480
Exercise 34.2-1 Displaying Odds in Reverse Order .....	481
34.3 Finding Minimum and Maximum Values in Arrays.....	483
Exercise 34.3-1 Which Depth is the Greatest? .....	483
Exercise 34.3-2 Which Lake is the Deepest?.....	484
Exercise 34.3-3 Which Lake, in Which Country, Having Which Average Area, is the Deepest?.....	485
Exercise 34.3-4 Which Students Have got the Greatest Grade? .....	486
Exercise 34.3-5 Finding the Minimum Value of a Two-Dimensional Array .....	488
Exercise 34.3-6 Finding the City with the Coldest Day.....	489

Exercise 34.3-7	Finding the Minimum and the Maximum Value of Each Row.....	490
34.4	Sorting Arrays.....	493
Exercise 34.4-1	The Bubble Sort Algorithm – Sorting One-Dimensional Arrays with Numeric Values.....	493
Exercise 34.4-2	Sorting One-Dimensional Arrays with Alphanumeric Values.....	497
Exercise 34.4-3	Sorting One-Dimensional Arrays While Preserving the Relationship with a Second Array.....	498
Exercise 34.4-4	Sorting Last and First Names.....	499
Exercise 34.4-5	Sorting a Two-Dimensional Array.....	501
Exercise 34.4-6	The Modified Bubble Sort Algorithm – Sorting One-Dimensional Arrays.....	502
Exercise 34.4-7	The Selection Sort Algorithm – Sorting One-Dimensional Arrays.....	503
Exercise 34.4-8	Sorting One-Dimensional Arrays While Preserving the Relationship with a Second Array.....	505
Exercise 34.4-9	The Insertion Sort Algorithm – Sorting One-Dimensional Arrays.....	506
Exercise 34.4-10	The Three Worst Elapsed Times.....	508
34.5	Searching Elements in Arrays.....	510
Exercise 34.5-1	The Linear Search Algorithm – Searching in a One-Dimensional Array that may Contain the Same Value Multiple Times.....	510
Exercise 34.5-2	Display the Last Names of All Those People Who Have the Same First Name.....	511
Exercise 34.5-3	The Linear Search Algorithm – Searching in a Two-Dimensional Array that May Contain the Same Value Multiple Times.....	512
Exercise 34.5-4	The Linear Search Algorithm – Searching in a One-Dimensional Array that Contains Unique Values.....	512
Exercise 34.5-5	Searching for a Social Security Number.....	514
Exercise 34.5-6	The Linear Search Algorithm – Searching in a Two-Dimensional Array that Contains Unique Values.....	515
Exercise 34.5-7	Checking if a Value Exists in all Columns.....	516
Exercise 34.5-8	The Binary Search Algorithm – Searching in a Sorted One-Dimensional Array.....	518
Exercise 34.5-9	Display all the Historical Events for a Country.....	520
Exercise 34.5-10	Searching in Each Column of a Two-Dimensional Array.....	522
34.6	Exercises of a General Nature with Arrays.....	524
Exercise 34.6-1	On Which Days was There a Possibility of Snow?.....	524
Exercise 34.6-2	Was There Any Possibility of Snow?.....	525
Exercise 34.6-3	In Which Cities was There a Possibility of Snow?.....	526
Exercise 34.6-4	Display from Highest to Lowest Grades by Student, and in Alphabetical Order.....	529
Exercise 34.6-5	Archery at the Summer Olympics.....	531
Exercise 34.6-6	The Five Best Scorers.....	532
Exercise 34.6-7	Counting the Frequency of Vowels.....	534
34.7	Review Questions: True/False.....	535
34.8	Review Exercises.....	536
	<b>Review in “Arrays in PHP”.....</b>	<b>543</b>
	Review Crossword Puzzle.....	543
	Review Questions.....	543
	<b>Part VII Subprograms.....</b>	<b>545</b>
	<b>Chapter 35 Introduction to Subprograms.....</b>	<b>547</b>
	35.1 What Exactly is a Subprogram?.....	547
	35.2 What is Procedural Programming?.....	547
	35.3 What is Modular Programming?.....	548
	35.4 Review Questions: True/False.....	548
	<b>Chapter 36 User-Defined Subprograms.....</b>	<b>551</b>
	36.1 Subprograms that Return a Value.....	551
	36.2 How to Make a Call to a Function.....	552

36.3	Subprograms that Return no Values.....	554
36.4	How to Make a Call to a void Function.....	554
36.5	Formal and Actual Arguments.....	555
36.6	How Does a Function Execute? .....	556
	Exercise 36.6-1 Back to Basics – Calculating the Sum of Two Numbers .....	557
	Exercise 36.6-2 Calculating the Sum of Two Numbers Using Fewer Lines of Code! .....	558
36.7	How Does a void Function Execute? .....	559
	Exercise 36.7-1 Back to Basics – Displaying the Absolute Value of a Number.....	560
36.8	Review Questions: True/False .....	561
36.9	Review Exercises .....	563
<b>Chapter 37 Tips and Tricks with Subprograms .....</b>		<b>569</b>
37.1	Can Two Subprograms use Variables of the Same Name? .....	569
37.2	Can a Subprogram Call Another Subprogram? .....	570
37.3	Passing Arguments by Value and by Reference.....	570
37.4	Passing and/or Returning an Array .....	572
37.5	Default Argument Values (Optional Arguments) and Named Arguments.....	575
37.6	The Scope of a Variable.....	576
37.7	Converting Parts of Code into Subprograms.....	577
37.8	Recursion .....	581
37.9	Review Questions: True/False .....	583
37.10	Review Exercises .....	584
<b>Chapter 38 More with Subprograms .....</b>		<b>591</b>
38.1	Simple Exercises with Subprograms .....	591
	Exercise 38.1-1 A Simple Currency Converter.....	591
	Exercise 38.1-2 Finding the Average Values of Positive Integers.....	592
	Exercise 38.1-3 Finding the Sum of Odd Positive Integers .....	593
	Exercise 38.1-4 Finding the Values of y .....	594
38.2	Exercises of a General Nature with Subprograms .....	595
	Exercise 38.2-1 Validating Data Input Using a Subprogram .....	595
	Exercise 38.2-2 Sorting an Array Using a Subprogram .....	596
	Exercise 38.2-3 Progressive Rates and Electricity Consumption .....	597
	Exercise 38.2-4 Roll, Roll, Roll the... Dice!.....	599
	Exercise 38.2-5 How Many Times Does Each Number of the Dice Appear?.....	599
38.3	Review Exercises .....	601
<b>Review in “Subprograms”.....</b>		<b>607</b>
	Review Crossword Puzzle .....	607
	Review Questions.....	607
<b>Part VIII Object-Oriented Programming.....</b>		<b>609</b>
<b>Chapter 39 Introduction to Object-Oriented Programming.....</b>		<b>611</b>
39.1	What is Object-Oriented Programming?.....	611
39.2	Classes and Objects in PHP .....	612
39.3	The Constructor and the Keyword \$this .....	614
39.4	Passing Initial Values to the Constructor.....	615
	Exercise 39.4-1 Historical Events.....	616
39.5	Getter and Setter Methods .....	617
	Exercise 39.5-1 The Roman Numerals.....	620

39.6 Can a Method Call Another Method of the Same Class? .....	622
Exercise 39.6-1 Doing Math.....	622
39.7 Class Inheritance .....	623
39.8 Review Questions: True/False .....	626
39.9 Review Exercises .....	627
<b>Review in “Object-Oriented Programming” .....</b>	<b>633</b>
Review Crossword Puzzle.....	633
Review Questions .....	633
<b>Part IX Files .....</b>	<b>635</b>
<b>Chapter 40 Introduction to Files.....</b>	<b>637</b>
40.1 Introduction.....	637
40.2 Opening a File.....	637
40.3 Closing a File .....	638
40.4 Writing in (or Appending to) a File .....	638
40.5 The File Pointer .....	640
40.6 Reading from a File.....	641
40.7 Iterating Through the Contents of a File .....	642
40.8 Review Questions: True/False .....	642
40.9 Review Exercises .....	644
<b>Chapter 41 More with Files.....</b>	<b>647</b>
41.1 Exercises of a General Nature with Files.....	647
Exercise 41.1-1 Calculating the Sum of 10 Numbers .....	647
Exercise 41.1-2 Calculating the Average Value of an Unknown Quantity of Numbers.....	648
Exercise 41.1-3 Finding Minimum and Maximum Values .....	649
Exercise 41.1-4 Concatenating Files .....	649
Exercise 41.1-5 Searching in a File .....	651
Exercise 41.1-6 Combining Files with Subprograms .....	652
41.2 Review Exercises .....	653
<b>Review in “Files” .....</b>	<b>657</b>
Review Crossword Puzzle.....	657
Review Questions .....	657
<b>Some Final Words from the Author .....</b>	<b>659</b>
<b>Index.....</b>	<b>660</b>
<b>Some of my Books .....</b>	<b>667</b>