

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
<i>Chapter 1 How a Computer Works.....</i>	<i>31</i>
1.1 Introduction.....	31
1.2 What is Hardware?	31
1.3 What is Software?.....	32
1.4 How a Computer Executes (Runs) a Program	32
1.5 Compilers and Interpreters	32
1.6 What is Source Code?.....	33
1.7 Review Questions: True/False	33
1.8 Review Questions: Multiple Choice	34
<i>Chapter 2 Visual Basic</i>	<i>37</i>
2.1 What is Visual Basic?	37
2.2 What is the Difference Between a Script and a Program?	37
2.3 Why You Should Learn Visual Basic.....	37
2.4 How Visual Basic Works.....	38
<i>Chapter 3 Software Packages to Install</i>	<i>39</i>
3.1 Visual Studio	39
3.2 How to Set Up Visual Studio Community.....	39
<i>Review Questions in "Introductory Knowledge"</i>	<i>45</i>
Section 2 Getting Started with Visual Basic.....	47
<i>Chapter 4 Introduction to Basic Algorithmic Concepts.....</i>	<i>49</i>
4.1 What is an Algorithm?.....	49
4.2 The Algorithm for Making a Cup of Tea.....	49
4.3 Properties of an Algorithm.....	49
4.4 Okay About Algorithms. But What is a Computer Program Anyway?	50
4.5 The Party of Three!	50
4.6 The Three Main Stages Involved in Creating an Algorithm	50
4.7 Flowcharts	51
Exercise 4.7-1 Finding the Average Value of Three Numbers	53
4.8 What are "Reserved Words"?	53
4.9 What is the Difference Between a Statement and a Command?.....	54

4.10	What is Structured Programming?	54
4.11	The Three Fundamental Control Structures	54
	Exercise 4.11-1 Understanding Control Structures Using Flowcharts	55
4.12	Your First Visual Basic Program.....	56
4.13	What is the Difference Between Syntax Errors and Logic Errors?	56
4.14	Commenting Your Code.....	57
4.15	User-Friendly Programs.....	57
4.16	Review Questions: True/False	58
4.17	Review Questions: Multiple Choice	59
Chapter 5 Variables and Constants.....		61
5.1	What is a Variable?	61
5.2	What is a Constant?	63
5.3	How Many Types of Variables and Constants Exist in Visual Basic?.....	65
5.4	Rules for Naming Variables in Visual Basic	66
5.5	Rules for Naming Constants in Visual Basic.....	66
5.6	What Does the Phrase “Declare a Variable” Mean?.....	67
5.7	How to Declare Variables in Visual Basic	67
5.8	How to Declare Constants in Visual Basic.....	68
5.9	Review Questions: True/False	69
5.10	Review Questions: Multiple Choice	69
5.11	Review Exercises.....	70
Chapter 6 Handling Input and Output		71
6.1	Which Statement Outputs Messages and Results on a User’s Screen?	71
6.2	How to Output Special Characters.....	72
6.3	Which Statement Lets the User Enter Data?	74
6.4	Review Questions: True/False	76
6.5	Review Questions: Multiple Choice	76
Chapter 7 Operators.....		79
7.1	The Value Assignment Operator	79
7.2	Arithmetic Operators	81
7.3	What is the Precedence of Arithmetic Operators?	82
7.4	Compound Assignment Operators	83
	Exercise 7.4-1 Which Visual Basic Statements are Syntactically Correct?	84
	Exercise 7.4-2 Finding Variable Types.....	85
7.5	String Operators	85
	Exercise 7.5-1 Concatenating Names	85
7.6	Review Questions: True/False	86
7.7	Review Questions: Multiple Choice	87
7.8	Review Exercises.....	88
Chapter 8 Trace Tables		91
8.1	What is a Trace Table?	91
	Exercise 8.1-1 Creating a Trace Table.....	92
	Exercise 8.1-2 Swapping Values of Variables.....	92
	Exercise 8.1-3 Swapping Values of Variables – A Second Approach.....	95

Exercise 8.1-4	Creating a Trace Table.....	95
Exercise 8.1-5	Creating a Trace Table.....	96
8.2	Review Questions: True/False	97
8.3	Review Exercises	97
Chapter 9 Using Visual Studio	99	
9.1	Creating a New Visual Basic Project.....	99
9.2	Writing and Executing a Visual Basic Program.....	100
9.3	What "Debugging" Means	103
9.4	Debugging Visual Basic Programs with Visual Studio	103
9.5	Review Exercises	109
Review Questions in "Getting Started with Visual Basic"	111	
Section 3 Sequence Control Structures.....	113	
Chapter 10 Introduction to Sequence Control Structures	115	
10.1	What is the Sequence Control Structure?	115
Exercise 10.1-1	Calculating the Area of a Parallelogram.....	115
Exercise 10.1-2	Calculating the Area of a Circle.....	116
Exercise 10.1-3	Calculating Fuel Economy.....	117
Exercise 10.1-4	Where is the Car? Calculating Distance Traveled.....	117
Exercise 10.1-5	Kelvin to Fahrenheit.....	118
Exercise 10.1-6	Calculating Sales Tax	119
Exercise 10.1-7	Calculating a Sales Discount	120
Exercise 10.1-8	Calculating the Sales Tax Rate and Discount	120
10.2	Review Exercises	121
Chapter 11 Manipulating Numbers.....	123	
11.1	Introduction.....	123
11.2	Useful Mathematical Procedures.....	124
Exercise 11.2-1	Calculating the Distance Between Two Points	127
Exercise 11.2-2	How Far Did the Car Travel?	128
11.3	Review Questions: True/False	129
11.4	Review Questions: Multiple Choice	129
11.5	Review Exercises	130
Chapter 12 Complex Mathematical Expressions	133	
12.1	Writing Complex Mathematical Expressions	133
Exercise 12.1-1	Representing Mathematical Expressions in Visual Basic.....	133
Exercise 12.1-2	Writing a Mathematical Expression in Visual Basic.....	134
Exercise 12.1-3	Writing a Complex Mathematical Expression in Visual Basic	134
12.2	Review Exercises	136
Chapter 13 Exercises With a Quotient and a Remainder	139	
13.1	Introduction.....	139
Exercise 13.1-1	Calculating the Quotient and Remainder of Integer Division.....	139
Exercise 13.1-2	Finding the Sum of Digits	140
Exercise 13.1-3	Displaying an Elapsed Time	145
Exercise 13.1-4	Reversing a Number	146
13.2	Review Exercises	147

Chapter 14 Manipulating Strings	149
14.1 Introduction.....	149
14.2 The Position of a Character in a String	149
14.3 Retrieving an Individual Character From a String	150
Exercise 14.3-1 Displaying a String Backwards.....	151
14.4 Useful String Procedures	151
Exercise 14.4-1 Switching the Order of Names.....	155
Exercise 14.4-2 Creating a Login ID	157
Exercise 14.4-3 Creating a Random Word.....	157
14.5 Review Questions: True/False	158
14.6 Review Questions: Multiple Choice.....	159
14.7 Review Exercises.....	161
Review Questions in "Sequence Control Structures"	163
Section 4 Decision Control Structures	165
Chapter 15 Introduction to Decision Control Structures	167
15.1 What is a Decision Control Structure?	167
15.2 What is a Boolean Expression?	167
15.3 How to Write Boolean Expressions	167
Exercise 15.3-1 Filling in the Table	168
15.4 Logical Operators and Complex Boolean Expressions	169
15.5 What is the Order of Precedence of Logical Operators?	170
15.6 What is the Order of Precedence of Arithmetic, Comparison, and Logical Operators?	170
Exercise 15.6-1 Filling in the Truth Table.....	171
Exercise 15.6-2 Calculating the Results of Complex Boolean Expressions.....	172
Exercise 15.6-3 Converting English Sentences to Boolean Expressions.....	173
15.7 How to Negate Boolean Expressions	174
Exercise 15.7-1 Negating Boolean Expressions	175
15.8 Review Questions: True/False	176
15.9 Review Questions: Multiple Choice.....	177
15.10 Review Exercises.....	178
Chapter 16 The Single-Alternative Decision Structure.....	181
16.1 The Single-Alternative Decision Structure	181
Exercise 16.1-1 Trace Tables and Single-Alternative Decision Structures.....	181
Exercise 16.1-2 The Absolute Value of a Number.....	183
16.2 Review Questions: True/False	184
16.3 Review Questions: Multiple Choice.....	185
16.4 Review Exercises.....	186
Chapter 17 The Dual-Alternative Decision Structure.....	189
17.1 The Dual-Alternative Decision Structure	189
Exercise 17.1-1 Finding the Output Message	189
Exercise 17.1-2 Trace Tables and Dual-Alternative Decision Structures	190
Exercise 17.1-3 Who is the Greatest?.....	191
Exercise 17.1-4 Finding Odd and Even Numbers.....	193

Exercise 17.1-5 Weekly Wages	194
17.2 Review Questions: True/False	195
17.3 Review Questions: Multiple Choice	195
17.4 Review Exercises	196
Chapter 18 The Multiple-Alternative Decision Structure.....	199
18.1 The Multiple-Alternative Decision Structure.....	199
Exercise 18.1-1 Trace Tables and Multiple-Alternative Decision Structures.....	200
Exercise 18.1-2 Counting the Digits.....	202
18.2 Review Questions: True/False	202
18.3 Review Exercises	203
Chapter 19 The Case Decision Structure.....	207
19.1 The Case Decision Structure.....	207
Exercise 19.1-1 The Days of the Week.....	210
19.2 Review Questions: True/False	212
19.3 Review Exercises	212
Chapter 20 Nested Decision Control Structures	217
20.1 What are Nested Decision Control Structures?.....	217
Exercise 20.1-1 Trace Tables and Nested Decision Control Structures	218
Exercise 20.1-2 Positive, Negative or Zero?.....	220
20.2 A Mistake That You Will Probably Make!	221
20.3 Review Questions: True/False	224
20.4 Review Exercises	224
Chapter 21 Tips and Tricks with Decision Control Structures.....	227
21.1 Introduction.....	227
21.2 Choosing a Decision Control Structure	227
21.3 Streamlining the Decision Control Structure.....	228
Exercise 21.3-1 “Shrinking” the Algorithm	229
Exercise 21.3-2 “Shrinking” the Visual Basic Program.....	229
Exercise 21.3-3 “Shrinking” the Algorithm	230
21.4 Logical Operators – to Use, or not to Use: That is the Question!.....	233
Exercise 21.4-1 Rewriting the Code.....	234
Exercise 21.4-2 Rewriting the Code.....	235
21.5 Merging Two or More Single-Alternative Decision Structures	236
Exercise 21.5-1 Merging the Decision Control Structures.....	237
Exercise 21.5-2 Merging the Decision Control Structures.....	238
21.6 Replacing Two Single-Alternative Decision Structures with a Dual-Alternative One	239
Exercise 21.6-1 “Merging” the Decision Control Structures	240
21.7 Put the Boolean Expressions Most Likely to be True First	241
Exercise 21.7-1 Rearranging the Boolean Expressions.....	242
21.8 Converting a Case Decision Structure to a Multiple-Alternative Decision Structure, and Vice Versa.....	243
Exercise 21.8-1 Converting the Visual Basic Program.....	244
Exercise 21.8-2 Converting the Visual Basic Program.....	245
Exercise 21.8-3 Converting the Visual Basic Program.....	246

21.9	Converting a Multiple-Alternative Decision Structure to Nested Decision Control Structures, and Vice Versa.....	246
	Exercise 21.9-1 Converting the Visual Basic Program.....	247
	Exercise 21.9-2 Converting the Visual Basic Program.....	249
21.10	Converting a Case Decision Structure to Nested Decision Control Structures, and Vice Versa	249
	Exercise 21.10-1 Converting the Visual Basic Program.....	250
	Exercise 21.10-2 Converting the Visual Basic Program.....	251
21.11	What is Code Indentation and Why is it so Important?	252
21.12	Using the “From Inner to Outer” Method in Decision Control Structures	253
21.13	Review Questions: True/False	254
21.14	Review Questions: Multiple Choice	255
21.15	Review Exercises.....	258
Chapter 22 Flowcharts with Decision Control Structures		267
22.1	Introduction.....	267
22.2	Converting Visual Basic Programs to Flowcharts.....	267
	Exercise 22.2-1 Designing the Flowchart.....	268
	Exercise 22.2-2 Designing the Flowchart.....	269
	Exercise 22.2-3 Designing the Flowchart.....	270
	Exercise 22.2-4 Designing the Flowchart.....	271
22.3	Converting Flowcharts to Visual Basic Programs.....	272
	Exercise 22.3-1 Writing the Visual Basic Program	273
	Exercise 22.3-2 Writing the Visual Basic Program	274
	Exercise 22.3-3 Writing the Visual Basic Program	275
	Exercise 22.3-4 Writing the Visual Basic Program	277
	Exercise 22.3-5 Writing the Visual Basic Program	279
22.4	Review Exercises.....	280
Chapter 23 More Exercises with Decision Control Structures		287
23.1	Simple Exercises with Decision Control Structures.....	287
	Exercise 23.1-1 Both Odds or Both Evens?.....	287
	Exercise 23.1-2 Validating Data Input and Finding if a Number is Exactly Divisible by both 5 and 8.....	287
	Exercise 23.1-3 Is it an Integer?.....	290
	Exercise 23.1-4 Converting Gallons to Liters, and Vice Versa.....	291
	Exercise 23.1-5 Converting Gallons to Liters, and Vice Versa (with Data Validation)	292
	Exercise 23.1-6 Where is the Tollkeeper?.....	293
	Exercise 23.1-7 The Most Scientific Calculator Ever!.....	294
23.2	Decision Control Structures in Solving Mathematical Problems	295
	Exercise 23.2-1 Finding the Value of y.....	295
	Exercise 23.2-2 Finding the Values of y	296
	Exercise 23.2-3 Validating Data Input and Finding the Values of y.....	297
	Exercise 23.2-4 Solving the Linear Equation $ax + b = 0$	299
	Exercise 23.2-5 Solving the Quadratic Equation $ax^2 + bx + c = 0$	300
23.3	Finding Minimum and Maximum Values with Decision Control Structures	303
	Exercise 23.3-1 Finding the Name of the Heaviest Person	304
23.4	Exercises with Series of Consecutive Ranges of Values	306
	Exercise 23.4-1 Calculating the Discount	306

Exercise 23.4-2	Validating Data Input and Calculating the Discount	308
Exercise 23.4-3	Sending a Parcel.....	309
Exercise 23.4-4	Finding the Values of y	311
Exercise 23.4-5	Progressive Rates and Electricity Consumption.....	314
Exercise 23.4-6	Progressive Rates, Electricity Consumption, Taxes, Data Validation and Code Optimization, All in One!.....	315
Exercise 23.4-7	Progressive Rates and Text Messaging Services.....	317
23.5	Exercises of a General Nature with Decision Control Structures	318
Exercise 23.5-1	Finding a Leap Year	318
Exercise 23.5-2	Displaying the Days of the Month	319
Exercise 23.5-3	Is the Number a Palindrome?.....	320
Exercise 23.5-4	Checking for Proper Capitalization and Punctuation	322
23.6	Review Exercises	323
<i>Review Questions in "Decision Control Structures"</i>.....		329
Section 5 Loop Control Structures		331
<i>Chapter 24 Introduction to Loop Control Structures</i>		333
24.1	What is a Loop Control Structure?.....	333
24.2	From Sequence Control to Loop Control Structures.....	333
24.3	Review Questions: True/False	335
<i>Chapter 25 The Pre-Test Loop Structure</i>		337
25.1	The Pre-Test Loop Structure	337
Exercise 25.1-1	Designing the Flowchart and Counting the Total Number of Iterations.....	338
Exercise 25.1-2	Counting the Total Number of Iterations.....	339
Exercise 25.1-3	Designing the Flowchart and Counting the Total Number of Iterations.....	340
Exercise 25.1-4	Counting the Total Number of Iterations.....	341
Exercise 25.1-5	Finding the Sum of 10 Numbers.....	341
Exercise 25.1-6	Finding the Product of 20 Numbers.....	342
Exercise 25.1-7	Finding the Product of N Numbers.....	343
Exercise 25.1-8	Finding the Sum of Odd Numbers.....	344
Exercise 25.1-9	Finding the Sum of an Unknown Quantity of Numbers.....	345
25.2	Review Questions: True/False	347
25.3	Review Questions: Multiple Choice	348
25.4	Review Exercises	349
<i>Chapter 26 The Post-Test Loop Structure</i>		353
26.1	The Post-Test Loop Structure	353
Exercise 26.1-1	Designing the Flowchart and Counting the Total Number of Iterations.....	354
Exercise 26.1-2	Counting the Total Number of Iterations.....	355
Exercise 26.1-3	Designing the Flowchart and Counting the Total Number of Iterations.....	356
Exercise 26.1-4	Counting the Total Number of Iterations.....	357
Exercise 26.1-5	Finding the Product of N Numbers.....	358
Exercise 26.1-6	Finding the Product of an Unknown Quantity of Numbers	359
26.2	Review Questions: True/False	360

26.3	Review Questions: Multiple Choice	361
26.4	Review Exercises	362
Chapter 27 Counted Loop Structures.....		367
27.1	Counted Loop Structures	367
	Exercise 27.1-1 Designing the Flowchart and Creating the Trace Table	369
	Exercise 27.1-2 Creating the Trace Table	371
	Exercise 27.1-3 Counting the Total Number of Iterations	372
	Exercise 27.1-4 Finding the Sum of 10 Numbers	373
	Exercise 27.1-5 Finding the Square Roots from 0 to N	374
27.2	Rules that Apply to Counted Loop Structures	375
	Exercise 27.2-1 Counting the Total Number of Iterations	375
	Exercise 27.2-2 Counting the Total Number of Iterations	376
	Exercise 27.2-3 Counting the Total Number of Iterations	376
	Exercise 27.2-4 Counting the Total Number of Iterations	377
	Exercise 27.2-5 Finding the Average Value of N Numbers	378
27.3	Review Questions: True/False	379
27.4	Review Questions: Multiple Choice	380
27.5	Review Exercises	382
Chapter 28 Nested Loop Control Structures.....		387
28.1	What is a Nested Loop?	387
	Exercise 28.1-1 Say "Hello Zeus". Designing the Flowchart and Creating the Trace Table	388
	Exercise 28.1-2 Creating the Trace Table	389
28.2	Rules that Apply to Nested Loops	391
	Exercise 28.2-1 Breaking the First Rule.....	391
	Exercise 28.2-2 Counting the Total Number of Iterations	392
28.3	Review Questions: True/False	393
28.4	Review Questions: Multiple Choice	393
28.5	Review Exercises	395
Chapter 29 Tips and Tricks with Loop Control Structures		399
29.1	Introduction.....	399
29.2	Choosing a Loop Control Structure	399
29.3	The "Ultimate" Rule	399
29.4	Breaking Out of a Loop	403
29.5	Cleaning Out Your Loops	406
	Exercise 29.5-1 Cleaning Out the Loop.....	406
	Exercise 29.5-2 Cleaning Out the Loop.....	407
29.6	Endless Loops and How to Avoid Them.....	408
29.7	Converting from a Counted Loop Structure to a Pre-Test Loop Structure	409
	Exercise 29.7-1 Converting the Visual Basic Program.....	410
	Exercise 29.7-2 Converting the Visual Basic Program.....	411
29.8	Converting from a Pre-Test Loop Structure to a Counted Loop Structure	412
	Exercise 29.8-1 Converting the Visual Basic Program.....	413
	Exercise 29.8-2 Converting the Visual Basic Program.....	415
	Exercise 29.8-3 Converting the Visual Basic Program.....	416
	Exercise 29.8-4 Converting the Visual Basic Program.....	418

Exercise 29.8-5	Converting the Visual Basic Program.....	419
29.9	Converting from a Post-Test Loop Structure to a Pre-Test Loop Structure	421
Exercise 29.9-1	Converting the Visual Basic Program.....	421
Exercise 29.9-2	Converting the Visual Basic Program.....	423
Exercise 29.9-3	Converting the Visual Basic Program.....	424
29.10	Converting from a Pre-Test Loop Structure to a Post-Test Loop Structure	425
Exercise 29.10-1	Converting the Visual Basic Program.....	426
Exercise 29.10-2	Converting the Visual Basic Program.....	427
Exercise 29.10-3	Converting the Visual Basic Program.....	427
29.11	Converting from a Counted Loop Structure to a Post-Test Loop Structure	429
Exercise 29.11-1	Converting the Visual Basic Program.....	430
Exercise 29.11-2	Converting the Visual Basic Program.....	431
29.12	Converting from a Post-Test Loop Structure to a Counted Loop Structure	433
Exercise 29.12-1	Converting the Visual Basic Program.....	434
Exercise 29.12-2	Converting the Visual Basic Program.....	435
29.13	Using the “From Inner to Outer” Method in Loop Control Structures	437
29.14	Review Questions: True/False	438
29.15	Review Questions: Multiple Choice	440
29.16	Review Exercises	442
Chapter 30 Flowcharts with Loop Control Structures		447
30.1	Introduction.....	447
30.2	Converting Visual Basic Programs to Flowcharts	447
Exercise 30.2-1	Designing the Flowchart.....	448
Exercise 30.2-2	Designing the Flowchart.....	449
Exercise 30.2-3	Designing the Flowchart.....	450
Exercise 30.2-4	Designing the Flowchart.....	451
Exercise 30.2-5	Designing the Flowchart.....	452
Exercise 30.2-6	Designing the Flowchart.....	453
Exercise 30.2-7	Designing the Flowchart.....	454
30.3	Converting Flowcharts to Visual Basic Programs	455
Exercise 30.3-1	Writing the Visual Basic Program.....	456
Exercise 30.3-2	Writing the Visual Basic Program.....	457
Exercise 30.3-3	Writing the Visual Basic Program.....	458
Exercise 30.3-4	Writing the Visual Basic Program.....	460
30.4	Review Exercises	463
Chapter 31 More Exercises with Loop Control Structures.....		471
31.1	Simple Exercises with Loop Control Structures	471
Exercise 31.1-1	Finding the Sum of $1 + 2 + 3 + \dots + 100$	471
Exercise 31.1-2	Finding the Product of $2 \times 4 \times 6 \times 8 \times 10$	472
Exercise 31.1-3	Finding the Sum of $2^2 + 4^2 + 6^2 + \dots + (2N)^2$	473
Exercise 31.1-4	Finding the Sum of $3^3 + 6^6 + 9^9 + \dots + (3N)^{3N}$	474
Exercise 31.1-5	Finding the Average Value of Positive Numbers	474
Exercise 31.1-6	Counting the Numbers According to Which is Greater.....	475
Exercise 31.1-7	Counting the Numbers According to Their Digits.....	476
Exercise 31.1-8	How Many Numbers Fit in a Sum.....	477
Exercise 31.1-9	Finding the Sum of Integers.....	478
Exercise 31.1-10	Iterating as Many Times as the User Wishes.....	478

Exercise 31.1-11	Finding the Sum of the Digits	480
Exercise 31.1-12	Counting the Digits.....	482
31.2	Exercises with Nested Loop Control Structures.....	482
	Exercise 31.2-1 Displaying all Three-Digit Integers that Contain a Given Digit.....	482
	Exercise 31.2-2 Displaying all Instances of a Specified Condition	484
31.3	Data Validation with Loop Control Structures	486
	Exercise 31.3-1 Finding the Square Root - Validation Without Error Messages.....	487
	Exercise 31.3-2 Finding the Square Root - Validation with One Error Message	488
	Exercise 31.3-3 Finding the Square Root - Validation with Individual Error Messages ..	489
	Exercise 31.3-4 Finding the Sum of 10 Numbers	489
31.4	Using Loop Control Structures to Solve Mathematical Problems.....	491
	Exercise 31.4-1 Calculating the Area of as Many Triangles as the User Wishes.....	491
	Exercise 31.4-2 Finding x and y	492
	Exercise 31.4-3 From Russia with Love.....	493
	Exercise 31.4-4 Finding the Number of Divisors.....	495
	Exercise 31.4-5 Is the Number a Prime?.....	497
	Exercise 31.4-6 Finding all Prime Numbers from 1 to N	498
	Exercise 31.4-7 Heron's Square Root.....	500
	Exercise 31.4-8 Calculating π	501
	Exercise 31.4-9 Approximating a Real with a Fraction	503
31.5	Finding Minimum and Maximum Values with Loop Control Structures	504
	Exercise 31.5-1 Validating and Finding the Minimum and the Maximum Value	506
	Exercise 31.5-2 Validating and Finding the Maximum Temperature.....	507
	Exercise 31.5-3 "Making the Grade"	509
31.6	Exercises of a General Nature with Loop Control Structures	511
	Exercise 31.6-1 Fahrenheit to Kelvin, from 0 to 100.....	511
	Exercise 31.6-2 Wheat on a Chessboard.....	511
	Exercise 31.6-3 Just a Poll.....	513
	Exercise 31.6-4 Is the Message a Palindrome?	514
31.7	Review Questions: True/False	517
31.8	Review Exercises.....	518
<i>Review Questions in "Loop Control Structures"</i>		525
Section 6	Arrays	527
<i>Chapter 32 Introduction to Arrays</i>		529
32.1	Introduction.....	529
32.2	What is an Array?	530
	Exercise 32.2-1 Designing an Array	533
	Exercise 32.2-2 Designing Arrays	533
	Exercise 32.2-3 Designing Arrays	534
32.3	Review Questions: True/False	535
32.4	Review Exercises.....	535
<i>Chapter 33 One-Dimensional Arrays</i>		537
33.1	Creating One-Dimensional Arrays in Visual Basic.....	537
33.2	How to Get Values from One-Dimensional Arrays	538
	Exercise 33.2-1 Creating the Trace Table	538
	Exercise 33.2-2 Using a Non-Existing Index	539

33.3	How to Add Values Entered by the User to a One-Dimensional Array	539
33.4	How to Iterate Through a One-Dimensional Array	539
	Exercise 33.4-1 Displaying Words in Reverse Order	540
	Exercise 33.4-2 Displaying Positive Numbers in Reverse Order	542
	Exercise 33.4-3 Displaying Even Numbers in Odd-Numbered Index Positions	542
	Exercise 33.4-4 Finding the Sum.....	543
33.5	Review Questions: True/False	545
33.6	Review Questions: Multiple Choice	546
33.7	Review Exercises	548
Chapter 34 Two-Dimensional Arrays.....		551
34.1	Creating Two-Dimensional Arrays in Visual Basic	551
34.2	How to Get Values from Two-Dimensional Arrays	552
	Exercise 34.2-1 Creating the Trace Table	553
34.3	How to Add Values Entered by the User to a Two-Dimensional Array	554
34.4	How to Iterate Through a Two-Dimensional Array	554
	Exercise 34.4-1 Displaying Reals Only	557
	Exercise 34.4-2 Displaying Odd Columns Only	558
34.5	What's the Story on Variables <i>i</i> and <i>j</i> ?	559
34.6	Square Arrays.....	559
	Exercise 34.6-1 Finding the Sum of the Elements of the Main Diagonal.....	560
	Exercise 34.6-2 Finding the Sum of the Elements of the Antidiagonal.....	562
	Exercise 34.6-3 Filling in the Array.....	563
34.7	Review Questions: True/False	564
34.8	Review Questions: Multiple Choice	567
34.9	Review Exercises	569
Chapter 35 Tips and Tricks with Arrays		573
35.1	Introduction.....	573
35.2	Processing Each Row Individually.....	573
	Exercise 35.2-1 Finding the Average Value.....	575
35.3	Processing Each Column Individually	577
	Exercise 35.3-1 Finding the Average Value.....	578
35.4	How to Use One-Dimensional Along with Two-Dimensional Arrays	581
	Exercise 35.4-1 Finding the Average Value.....	581
35.5	Creating a One-Dimensional Array from a Two-Dimensional Array.....	584
35.6	Creating a Two-Dimensional Array from a One-Dimensional Array.....	585
35.7	Review Questions: True/False	586
35.8	Review Questions: Multiple Choice	587
35.9	Review Exercises	588
Chapter 36 Flowcharts with Arrays		593
36.1	Introduction.....	593
36.2	Converting Visual Basic Programs to Flowcharts	593
	Exercise 36.2-1 Designing the Flowchart.....	593
	Exercise 36.2-2 Designing the Flowchart.....	594
	Exercise 36.2-3 Designing the Flowchart.....	595
36.3	Converting Flowcharts to Visual Basic Programs.....	597

Exercise 36.3-1	Writing the Visual Basic Program	597
Exercise 36.3-2	Writing the Visual Basic Program	598
Exercise 36.3-3	Writing the Visual Basic Program	599
36.4	Review Exercises.....	600
Chapter 37 More Exercises with Arrays.....		607
37.1	Simple Exercises with Arrays	607
Exercise 37.1-1	Creating an Array that Contains the Average Values of its Neighboring Elements	607
Exercise 37.1-2	Creating an Array with the Greatest Values	609
Exercise 37.1-3	Merging One-Dimensional Arrays.....	611
Exercise 37.1-4	Merging Two-Dimensional Arrays.....	612
Exercise 37.1-5	Creating Two Arrays – Separating Positive from Negative Values	614
Exercise 37.1-6	Creating an Array with Those who Contain Digit 5	616
37.2	Data Validation with Arrays	618
Exercise 37.2-1	Displaying Odds in Reverse Order – Validation Without Error Messages	620
Exercise 37.2-2	Displaying Odds in Reverse Order – Validation with One Error Message.....	620
Exercise 37.2-3	Displaying Odds in Reverse Order – Validation with Individual Error Messages	621
37.3	Finding Minimum and Maximum Values in Arrays	622
Exercise 37.3-1	Which Depth is the Greatest?	622
Exercise 37.3-2	Which Lake is the Deepest?.....	624
Exercise 37.3-3	Which Lake, in Which Country, Having Which Average Area, is the Deepest?	624
Exercise 37.3-4	Which Students are the Tallest?.....	627
Exercise 37.3-5	Finding the Minimum Value of a Two-Dimensional Array	628
Exercise 37.3-6	Finding the City with the Coldest Day.....	630
Exercise 37.3-7	Finding the Minimum and the Maximum Value of Each Row.....	631
Exercise 37.3-8	Finding the Minimum and the Maximum Value of Each Column.....	634
37.4	Sorting Arrays.....	636
Exercise 37.4-1	The Bubble Sort Algorithm – Sorting One-Dimensional Arrays with Numeric Values	637
Exercise 37.4-2	Sorting One-Dimensional Arrays with Alphanumeric Values	642
Exercise 37.4-3	Sorting One-Dimensional Arrays While Preserving the Relationship with a Second Array	643
Exercise 37.4-4	Sorting Last and First Names	644
Exercise 37.4-5	Sorting a Two-Dimensional Array	647
Exercise 37.4-6	The Modified Bubble Sort Algorithm – Sorting One-Dimensional Arrays	648
Exercise 37.4-7	The Five Best Scorers.....	650
Exercise 37.4-8	The Selection Sort Algorithm – Sorting One-Dimensional Arrays	653
Exercise 37.4-9	Sorting One-Dimensional Arrays While Preserving the Relationship with a Second Array.....	655
Exercise 37.4-10	The Insertion Sort Algorithm – Sorting One-Dimensional Arrays	656
Exercise 37.4-11	The Three Worst Elapsed Times	658
37.5	Searching Elements in Arrays.....	660
Exercise 37.5-1	The Linear Search Algorithm – Searching in a One-Dimensional Array that may Contain the Same Value Multiple Times	661

Exercise 37.5-2	Display the Last Names of All Those People Who Have the Same First Name	661
Exercise 37.5-3	Searching in a One-Dimensional Array that Contains Unique Values	662
Exercise 37.5-4	Searching for a Given Social Security Number	664
Exercise 37.5-5	Searching in a Two-Dimensional Array that may Contain the Same Value Multiple Times	665
Exercise 37.5-6	Searching in a Two-Dimensional Array that Contains Unique Values	667
Exercise 37.5-7	Checking if a Value Exists in all Columns	669
Exercise 37.5-8	The Binary Search Algorithm – Searching in a Sorted One-Dimensional Array	671
Exercise 37.5-9	Display all the Historical Events for a Country.....	674
Exercise 37.5-10	Searching in Each Column of a Two-Dimensional Array	675
37.6	Exercises of a General Nature with Arrays	678
Exercise 37.6-1	On Which Days was There a Possibility of Snow?.....	678
Exercise 37.6-2	Was There Any Possibility of Snow?	679
Exercise 37.6-3	In Which Cities was There a Possibility of Snow?.....	681
Exercise 37.6-4	Display from Highest to Lowest Grades by Student, and in Alphabetical Order	684
Exercise 37.6-5	Archery at the Summer Olympics	686
37.7	Review Questions: True/False	688
37.8	Review Exercises	689
<i>Review Questions in "Arrays"</i>	.....	695
Section 7 Subprograms	.....	697
<i>Chapter 38 Introduction to Subprograms (Procedures)</i>	.....	699
38.1	What is Procedural Programming?	699
38.2	What is Modular Programming?.....	700
38.3	What Exactly is a Subprogram?.....	700
38.4	Review Questions: True/False	701
<i>Chapter 39 User-Defined Functions</i>	.....	703
39.1	Writing your Own Functions in Visual Basic.....	703
39.2	How Do You Call a Function?	704
39.3	Formal and Actual Arguments.....	706
39.4	How Does a Function Execute?	707
Exercise 39.4-1	Back to Basics – Calculating the Sum of Two Numbers.....	708
Exercise 39.4-2	Calculating the Sum of Two Numbers Using Fewer Lines of Code!.....	709
39.5	Review Questions: True/False	710
39.6	Review Exercises	711
<i>Chapter 40 User-Defined Subprocedures</i>	.....	715
40.1	Writing your Own Subprocedures in Visual Basic.....	715
40.2	How Do You Call a Subprocedure?	715
40.3	Formal and Actual Arguments.....	717
40.4	How Does a Subprocedure Execute?	717
Exercise 40.4-1	Back to Basics – Displaying the Absolute Value of a Number	719
Exercise 40.4-2	A Simple Currency Converter	720
40.5	Review Questions: True/False	721

40.6	Review Exercises.....	722
Chapter 41 Tips and Tricks with Subprograms		725
41.1	Can Two Subprograms use Variables of the Same Name?	725
41.2	Can a Subprogram Call Another Subprogram?	727
	Exercise 41.2-1 A Currency Converter – Using Functions with Subprocedures	727
41.3	Passing Arguments by Value and by Reference.....	729
	Exercise 41.3-1 Finding the Logic Error	732
41.4	Passing and/or Returning an Array.....	733
41.5	Default Argument Values (Optional Arguments).....	735
41.6	The Scope of a Variable	736
41.7	Converting Parts of Code into Subprograms	737
41.8	Recursion.....	743
	Exercise 41.8-1 Calculating the Fibonacci Sequence Recursively	745
41.9	Overloading Functions.....	747
41.10	Review Questions: True/False.....	750
41.11	Review Exercises.....	751
Chapter 42 Flowcharts with Subprograms		759
42.1	Designing and Calling Sub-Algorithms in Flowcharts	759
42.2	Converting Visual Basic programs to Flowcharts.....	761
	Exercise 42.2-1 Designing the Flowchart.....	761
	Exercise 42.2-2 Designing the Flowchart.....	762
	Exercise 42.2-3 Designing the Flowchart.....	763
42.3	Converting Flowcharts to Visual Basic Programs.....	764
	Exercise 42.3-1 Writing the Visual Basic Program.....	764
	Exercise 42.3-2 Writing the Visual Basic Program.....	766
42.4	Review Exercises.....	767
Chapter 43 More Exercises with Subprograms		775
43.1	Simple Exercises with Subprograms	775
	Exercise 43.1-1 Finding the Average Values of Positive Integers	775
	Exercise 43.1-2 Finding the Sum of Odd Positive Integers.....	776
	Exercise 43.1-3 Finding the Values of y	777
	Exercise 43.1-4 Roll, Roll, Roll the... Dice!	778
	Exercise 43.1-5 How Many Times Does Each Number of the Dice Appear?	779
43.2	Exercises of a General Nature with Subprograms.....	782
	Exercise 43.2-1 Validating Data Input	782
	Exercise 43.2-2 Sorting an Array.....	783
	Exercise 43.2-3 Progressive Rates and Electricity Consumption.....	785
43.3	Review Exercises.....	786
Review Questions in "Subprograms"		791
Index.....		793