Mathematical Techniques

1

Problem Solving: Techniques and Notation 4

- 1.1 Problem Solving 6
- 1.2 Algorithms and Pseudocode 15
- 1.3 Flowcharting and the Sequence Structure 21
- 1.4 Decision Structure 29
- 1.5 Repetition Structure 42
- 1.6 Problem Solving and the Scientific Method 51

Concepts Introduced in This Chapter 52 Review Exercises 53

2

Sets 56

- 2.1 Definitions 58
- 2.2 Set Operations 63
- 2.3 Laws of Sets 70
 - 2.3.1 Commutative Laws 70
 - 2.3.2 Associative Laws 71
 - 2.3.3 Distributive Laws 72
 - 2.3.4 Identity Laws 74

2.4 Relational Data Bases: An Application 76
 Concepts Introduced in This Chapter 82
 Review Exercises 82

3

Arithmetic Operators in Elementary Algebra 84

- 3.1 Real Numbers in Algebra 86
- 3.2 The Negative and Absolute Value of a Real Number 86
- 3.3 Addition 87
- 3.4 Subtraction 90
- 3.5 Multiplication 94
- 3.6 Division 96
- 3.7 Laws Involving Addition and Multiplication 99
 - 3.7.1 Associative Laws 99
 - 3.7.2 Commutative Laws 99
 - 3.7.3 Identity Laws 100
 - 3.7.4 Distributive Law of Multiplication over Addition 100
- 3.8 Exponents 103
 Concepts Introduced in This Chapter 109
 Review Exercises 109

4

Computations with Algebraic Expressions 112

- 4.1 Like Terms and Simplifying Algebraic Expressions 114
- 4.2 Evaluation of Algebraic Expressions 117
- 4.3 Evaluation of Expressions in Programming 121
- 4.4 Solving Simple Equations in One Variable 128
- 4.5 Solving Quadratic Equations 137

CONTENTS xiii

Concepts Introduced in This Chapter 144
Review Exercises 144

5

Principles of Counting 146

- 5.1 Fundamental Principle of Counting 148
- 5.2 Permutations 151
- 5.3 Combinations 156
- 5.4 Programming Considerations (Optional) 158
- 5.5 Addition Counting Principles 162
- 5.6 Trees 165

Concepts Introduced in This Chapter 169 Review Exercises 169

PART TWO

Logic

6

Symbolic Logic in Programming 174

- 6.1 Variables and the Ambiguous Equal Sign 176
- 6.2 Logical Expressions 177
 - 6.2.1 Relational Operators and Expressions 177
 - 6.2.2 AND, OR, and NOT 181
- 6.3 Truth Tables for Compound Expressions 185
- 6.4 Equivalence of Logical Expressions 191
- 6.5 Laws Governing Logical Expressions 194
- 6.6 Decision Logic (Optional) 198

XIV CONTENTS

Concepts Introduced in This Chapter 209 Review Exercises 209

7

Boolean Algebra 212

7.1 A Boolean Algebra	214
-----------------------	-----

- 7.2 Bit Strings as a Boolean Algebra 216
 - 7.2.1 Bit String Manipulation 216
 - 7.2.2 Masking 220
- 7.3 Logic Circuits as a Boolean Algebra 225
 - 7.3.1 AND, OR, NOT Gates 225
 - 7.3.2 Logic Circuits 229
 - 7.3.3 Outputs as Boolean Expressions 233
 - 7.3.4 Simplifying Circuits 238
 - 7.3.5 Expressions from Truth Tables 242

Concepts Introduced in This Chapter 247

Review Exercises 247

PART THREE

Computer Mathematics

8

Computer Number Systems 254

- 8.1 A Look at Decimal 256
- 8.2 Binary Number System 257
 - 8.2.1 Binary Addition 257
 - 8.2.2 Binary-to-Decimal Conversion 260
 - 8.2.3 Decimal-to-Binary Conversion 262

CONTENTS XV

8.3	Неха	ıdecimal	Number System 265
	8.3.1	Hexad	ecimal-to-Decimal rsion 266
	8.3.2	Hexad	ecimal and Binary
	022	Conve	rsions 267
	8.3.3	Conve	al-to-Hexadecimal rsion 269
	8.3.4	Hexade	ecimal Addition 272
	8.3.5	Hexade	ecimal Subtraction 276
8.4		Number	System 280
	8.4.1	Octal-to	o-Decimal Conversion 281
	8.4.2 8.4.3		al-to-Octal Conversion 281 and Binary
	0.4.5	Conver	sions 282
	Conc	epts Intro	duced in This
	Chap	oter 285	
	Revie	w Exercis	es 285
		9	
Internal Da	ıta Por	aroconta	tion of Characters
an	d Coc	ded Dec	imals 288
9.1		acter Date	
	9.1.1		
	9.1.2	EBCDIC	292
	9.1.3	Parity 2	
	9.1.4	Charact	er Codes Represented as cimal 293
9.2	Code	d Decimo	SINGI 293
, . <u> </u>	9.2.1		Decimal 297
	9.2.2		Decimal 299
		9.2.2.1	Hexadecimal
			Representation of
		0222	Packed Decimal 302
		9.2.2.2	Rounding Packed Decimal Numbers via
			Half-Adjust 304
	9.2.3	Binary C	Coded Decimal
9.3	Intorna	(Optiono	31) 307
7.3	(Optio	reiing me nal) 310	mory Contents
		•	duced in This Chapter 317
	Reviev	v Exercise	98 317

10

Internal Data Representation of Integers 320

10.1	Nonnegative Integers 322	
10.2	Negative Integers 325	
10.3	Addition of Integers 329	
10.4	Subtraction of Integers 334	
10.5	Multiplication and Division (Optional) 336	
	Concepts Introduced in This Chapter	341
	Review Exercises 342	

11

Internal Data Representation of Real Numbers 344

Review Exercises 381

		· · · · · · · · · · · · · · · · · · ·	
11.1	Significant Digits and Precision 346		
11.2 Exponential Notation 351			
	11.2.1	Scientific Notation 351	
	11.2.2	E-notation 355	
	11.2.3	Normalized Form 357	
11.3	Repre	senting Fractions 359	
	11.3.1	Converting Decimal Fractions to Binary Fractions 359	
	11.3.2	Converting Binary Fractions to Decimal Fractions 363	
	11.3.3	Comparison of Fractions in Binary Form to Those in Packed Decimal 367	
		ng-Point Representation for Real ers 369	
	11.4.1	Binary Form 369	
	11.4.2	Hexadecimal Normalization (Optional) 374	
	11.4.3	Single and Double Precision 375	
	11.4.4	Word Sizes and Ranges 377	
11.5		cations of Different Forms of al Representation 377	
		epts Introduced in This er 380	

PART FOUR

Advanced Computer Concepts

12

Sequences and Series 386

- 12.1 Sequences 388
- 12.2 Programming Considerations for Sequences (Optional) 394
- 12.3 Series 401
- 12.4 Programming Considerations for Series (Optional) 407
 Concepts Introduced in This Chapter 411
 Review Exercises 411

13

Matrices 414

- 13.1 Introduction 416
- 13.2 Matrix Definition and Initialization in Programming (Optional) 421
- 13.3 Storage Mapping Functions 426
- 13.4 Matrix Addition, Subtraction, and Scalar Multiplication 429
- 13.5 Matrix Multiplication 434
- 13.6 Some Other Properties of Matrices 440
- 13.7 Application: Using Matrices to Solve Systems of Linear Equations 445
 Concepts Introduced in This Chapter 455
 Review Exercises 455

14

Computer Error 458

- 14.1 Syntax Error 460
- 14.2 Program Verification 460

XVIII CONTENTS

14.3	Debugging 461
14.4	Error from Inappropriate Selection of Data Types 461
14.5	Unrepresentable Numbers, Underflow, and Overflow 465
14.6	Roundoff Error 469
14.7	Absolute and Relative Error 473
14.8	Selecting an Algorithm to Minimize Error 476
14.9	Compatability of Machines 480
	Concepts Introduced in This Chapter 481
	Review Exercises 481

Answers A-1

Index I-1