PROFESSIONAL COPY NOT FOR SALE, PRENTICE-HALL

D.G. Dologite

Using Computers

# Using Computers

D. G. Dologite

Baruch College City University of New York Library of Congress Cataloging-in-Publication Data

DOLOGITE, D. G. (DATE)
Using computers.

Includes bibliographical references and index.

1. Computers.

2. Computer software.

I. Title.

QA76.D64 1987

004 86-21212

ISBN 0-13-939646-2

Editorial/production supervision: Joan E. Foley Interior and cover design: Lee Cohen Manufacturing buyer: Ed O'Dougherty Page layout: Networkgraphics Photo research: Teri Stratford Photo editor: Lorinda Morris Cover photo: Al Satterwhite/The Image Bank

© 1987 by Prentice-Hall, Inc. A division of Simon & Schuster Englewood Cliffs, N.J. 07632

All rights reserved. No part of this book may be reproduced, in any form or by any means, without permission in writing from the publisher.

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

ISBN 0-13-939646-2 D1

Prentice-Hall International (UK) Limited, London
Prentice-Hall of Australia Pty. Limited, Sydney
Prentice-Hall Canada Inc., Toronto
Prentice-Hall Hispanoamericana, S.A., Mexico
Prentice-Hall of India Private Limited, New Delhi
Prentice-Hall of Southeast Asia Pte. Ltd., Singapore
Editora Prentice-Hall do Brasil, Ltda., Rio de Janeiro

#### TO

Kim, Nicky, Chris, Matt, Brad, Kathleen, MaryBeth, Chrissy, JoJo, Barbara, Michael, Joanna, Emily, Andrew—

a new generation of computer users

## Overview

Letter to the Instructor xv Letter to the Student xviii Acknowledgments xix

Index 658

Chapter	1	Introduction to Using Computers 1
Chapier		imodelier to compare to
Module	l:	Understanding Hardware and Software
Chapter	2.	Personal Computer Hardware 32
Chapter	3.	Mainframe and Other Hardware 70
Chapter	4.	Application and System Software 100
Module	II:	Using Personal Productivity Software
Chapter	5.	Spreadsheet and Graphics Packages 132
Chapter	6.	Word Processing, Integrated, and Other Packages 178
Module	III:	Using Database Software
Chapter	7.	Personal Database Software 218
Chapter	8.	Mainframe and Multiuser Database Software 252
Module	IV:	Developing and Using Computer Systems
Chapter	9.	Data Processing, Management Information, and Decision
<b>O</b> I I	••	Support Systems 280
Chapter		Packaged Computer Systems 314
Chapter		Developing Computer Systems 342
Chapter	12.	Programming Computer Systems 374
Module	V:	Advanced Systems
Chapter	13.	Communications 402
Chapter	14.	Robots and Knowledge-Based Systems 444
Module	VI:	Special Topics
Chapter	15.	History and Social Impact of Computing 482
Chapter	16.	Career Opportunities 512
Chapter	17.	Structured BASIC Programming 540
Append	dix:	Number and Code Systems 650

## Letter to the Instructor

Dear Instructor:

This text and supplementary package are designed to give you the support you need for teaching an introduction to computers course.

The presentation of material in this textbook may seem, at first, to be a little different from what you are accustomed to. It speaks from the novice computer user's point of view, since that is who will be reading this text.

It shows people learning to use computers in much the same way your students will be. This helps students to realize that their learning experience is a commonly shared one. It intentionally avoids an approach that threatens the student with a feeling of computer ignorance.

Students like to read about *people* going through experiences with which they can identify. The text is designed to hold reader interest by showing how many different types of people—such as a film writer, a real estate agent, a stock broker, a journalist, a lawyer, an accountant, a farmer, a marketing manager, a teacher, a personnel manager, and a part-time worker for a food catering service—learn to use and actually do use their computers in order to become more productive. The approach provides a basis to cover the learning difficulties experienced by all types of computer users.

Consistently throughout the book, new topics begin from a microcomputer perspective, since most students today can easily relate directly to computers at this level. The text then goes on to fully cover mainframe and other types of computers and computer systems in an integrated discussion of every topic important to students at the introductory level.

Where full topic coverage requires it, microcomputer and mainframe discussions are given separate chapters, as in Chapter 2 on "Personal Computer Hardware" and in Chapter 3 on "Mainframe and Other Hardware." At different times, for example in the Chapter 4 coverage of operating systems, the microcomputer and mainframe discussions are integrated within a single chapter. In all cases, problems are analyzed, and solutions recommended, whatever the size of computer. Throughout, an effort is made to avoid detail superfluous to introductory course objectives.

The book concentrates on the application of computers to user tasks. It explores five main application areas:

 Using personal productivity software (like spreadsheet, word processing, and graphic packages) (Chapters 5-6)

- Using database software (Chapters 7-8)
- Using data processing, management information, and decision support systems (Chapters 9-12)
- · Using communications systems, including local area networks (Chapter 13)
- Using advanced (artificial intelligence-based) systems, including robot and expert systems (Chapter 14)

The overriding theme, as the title of the book suggests, is to show people actually using these applications on their computers, or on terminals connected to a central computer. It provides students with a simulated "hands-on" experience. They are left with a feeling of having used software in all the major application categories. A similar approach is used in my earlier book, Using Small Business Computers, which has been adopted by over 150 schools.

The book is written to be independent of a particular brand of software. This approach allows an instructor to choose among alternative microcomputer lab software offerings.

Woven throughout the text are two major, and numerous minor, case studies. One major case study concerns a mainframe-oriented organization, while the other concerns a microcomputer-oriented organization. All case studies are designed to integrate the material in a natural way. They are drawn from real-life examples, including those recast into hypothetical companies or situations.

At the end of chapters, separate case studies are presented as chapter "highlights." They add an entirely new dimension to chapter material, or show a familiar topic from a new perspective. They include questions designed to encourage discussion of case and chapter material. These questions are in addition to the more detailed review questions, which conclude every chapter along with a chapter summary and a list of key terms.

For courses that include BASIC programming, a chapter is included that can be used as a tutorial. It is organized into three parts of increasing difficulty. Only Part 1 is necessary to learn how to execute simple BASIC programs. Parts 2 and 3 challenge students who have advanced beyond the fundamentals.

Many instructors have a preferred way to teach the introduction to computer courses. This text has been organized so that you can mold it to fit your personal preferences. After the first chapter, you can progress into hardware (Chapter 2), or you may want to prepare students for microcomputer lab work on a spreadsheet (Chapter 5) or a word processing package (Chapter 6), or you may want your students to explore BASIC (Chapter 17). If you prefer, the book's modular structure enables you to even skip Chapter 1 to begin with a review of the history and social impact of computing (Chapter 15).

Finally, a complete set of supplementary materials has been assembled to support the text. They include:

- Instructor's Guide (which includes recommended and alternate outlines for various course emphases)
- · Student Study Guide and Workbook

- · Microcomputer lab software with tutorial guides
- · Transparency masters and color transparencies
- · Computerized test bank
- Floppy disk of programs in the BASIC chapter (which is offered as a convenience to instructors to explore the programs in the chapter without having to key them in)

If you would like to offer your comments on the text, supplementary package, or the introductory computer course they support, please write to me at:

Box 513 Baruch College—CUNY 17 Lexington Avenue New York, NY 10010

I would like to hear from you.

Best regards, D. G. Dologite

## Letter to the Student

Dear Student:

This book was written for you. It is designed to help you learn about computers.

As the title suggests, you are especially encouraged to use computers. That is the best way to know them well. They are sturdy machines that will let you experiment as long as you like. (If your school has a computer lab, you will probably have restrictions about how long you can use a computer at any one sitting.)

There are so many ways that a computer can help you accomplish current and future tasks. Examples include producing written assignments, like term papers (using word processing), to preparing a company's annual budget (using an electronic spreadsheet).

Be open-minded about exploring the rich storehouse of programs available. Programs are also called "software" or "applications." They make the computer perform useful tasks, such as word processing. There is an endless variety of software available to support school, work, home, and even entertainment purposes.

Hopefully you will be motivated to pursue a study of computers beyond this book. Chapter 1 offers some ideas about how to do this.

If there is any topic concerning this book that you would like to express an opinion about, you are invited to write to me. I would like to hear from you. You can write to me at:

Box 513 Baruch College—CUNY 17 Lexington Avenue New York, NY 10010

> Best regards, D. G. Dologite

## **Acknowledgments**

#### Appreciation is gratefully extended to:

- The following companies for furnishing software and other materials for research: Ashton-Tate, Borland International, IBM Corporation, Lifetree Software, Lotus Development Corporation, MicroData Base Systems, Inc., MicroPro International Corporation, MicroRIM, Inc., Open Systems, Inc.
- Contributors of material for the end-of-chapter case studies: Business Week,
  Cahners Publishing Company, Consumer Software Inc., CW Communications, Inc., Hayden Publishing Company, Inc., International Computer Programs, Inc., M&T Publishing, Inc., Macdonald/Futura, London, New American Library, The New York Times, Texas Instruments, Inc., Warner Books,
  Yourdon Press.
- Manuscript reviewers: Rosann Webb Collins, University of North Carolina; John W. Fendrich, Bradley University; Madison K. Finley, Dutchess Community College; Elaine Haight, Santa Monica Community College; Cynthia J. Kachik, Santa Fe Community College; Richard Lee Kerns, East Carolina University; Kenneth E. Martin, University of North Florida; as well as colleagues and students at Baruch College—City University of New York for reviewing and criticising the text, including B. Loerinc Helft, Samuel Ryan, David Stephan, William Ferns.
- Research and student assistants for helping to construct the manuscript:
   S. L. Chia, Dean Hannotte, Ted Jaye, Maxwell Lown, Mary Ann Vasaturo, May-Mei Wong.
- A special acknowledgment is made of the contribution and support of Robert
  J. Mockler, Professor of Management, St. John's University, to the development and production of *Using Computers*.

## Contents

Letter to the Instructor xv Letter to the Student xviii Acknowledgments xix



## **Introduction to Using Computers 1**

Computer Distinctions 2 Importance of Software 3 Computer Uses and Users 6 Improving Personal Productivity 6 Writer 6 Creating Database Applications 10 Campaigner 8 Manager 10 Marketing 12 Tenant Billing 12 Large Organizations 13 **Automating** Farming 14 a Business 13 Distribution 13 Retailina 14 Banking 15 Health Care 15 Communications 16 Personal Using a Computer 19 Newer Uses 18 Use 17 Networking 17 What Is a System? 21 Under the Hood 23 Input, Processing, and Output 23 Storage 25 Bits and Bytes 25 Becoming Informed 25 Books 25 Periodicals 26 User Groups 27 Shows, Exhibitions, and Other Sources 27 Case Study: The Smart Way to Conferences 27 Learn Computing 28 Chapter Summary 30 Key Terms 31 Review Questions 31

#### **Understanding Hardware and Software** Module I:



## Personal Computer Hardware 32

**Business Standard 34** System Board 37 Memory 39 Expansion Slots 41 Keyboard Input 41 Keyboard Alternatives 43 Display Output 46 Monochrome 46 Resolution 47 Color 47 RGB Monitor 48 Flat-Panel Displays 49 Printed Output 49 Letter-Quality Dual-Mode Dot-Matrix Printers 53 Printers 51 Dot-Matrix Printers 51 Jet Printers 54 Laser Printers 54 Storage 56 Floppy Disks 56 Hard Optical Disks 59 Compatibles 59 Disks 57 Backup 58 Portables 60 Tests 61 PC of the Future 61 RISC Evaluation 63 Case Study: Buying a Personal Microprocessor 61 Computer 65 Chapter Summary 66 Key Terms 67 Review Questions 68

## 33

#### Mainframe and Other Hardware 70

Mainframe Computer Environment 72 Terminal 72 Special-Purpose Automated Teller Machines 73 Point-of-Sale Terminals 74 Terminals 72 Data Collection Terminals 75 Batch versus Transaction Processing 75 Off-Line Data Collection 76 Keypunch Machines 76 MICR Reader 77 Smart Cards 79 Computer Center 80 Facsimile Equipment 79 Processing 84 Mainframe Computer 81 Processor 81 Memory 84 Supercomputers 86 Upward Capability 85 Plua Compatibles 85 Parallel Processing 87 Fault-Tolerant Computers 88 Storing Information 89 Disk Storage 89 Mass Storage 89 Magnetic Laser Printer 91 Line Printers 91 Tape 90 Printing Information 90 Minicomputers 91 Super-Minicomputers 93 Multiuser Microcomputers 94 Case Study: Making a Supercomputer 96 Chapter Summary 97 Key Terms 98 Review Questions 99



## Application and System Software 100

Application Software and Categories 102 Personal Productivity 104 Computer System Software to Automate a Business 104 Database Management 106 Communication 108 Advanced Systems 108 Other 110 Software Acquisition Choices 110 Buy a Package 110 Modify a Package 111 Use a Database Package 111 Program from Scratch 111 Evaluating Applications 112 General Considerations 112 Testing Services 114 Hands-On Test 114 System Software 115 Operating System Functions 116 Input and Output Management 117 Program Execution Management 117 Management 117 Operating System Environments 118 Single Taskina 118 Multitaskina 118 Multiuser Operating Environments 120 System Generation 121 Time Sharing 121 Virtual Memory 121 Performance Monitoring 122 Utility Variations 124 Programs 124 Format 124 Diskcopy 126 **Copy** 127 Directory 127 Erase 127 Other Capabilities 127 Case Study: This Program Has a Defect 128 Chapter Summary 129 Key Terms 130 Review Questions 131

#### Module II: Using Personal Productivity Software



## Spreadsheet and Graphics Packages 132

Spreadsheet Characteristics 134 Creating a Spreadsheet 134 "What If" Questions 137 **Productivity Features 138** Built-In Functions 139 Special Features 141 Protection 141 Linking and Integration 142 Naming 142 Macros 143 Templates 143 Hybrid Packages 147 Documentation 146 Spreadsheet

Other Criteria 151 Graphics 151 Evaluation 149 Style 150 Presentation Graphics 153 Creatina **Analytic Graphics 152** Slide Entering Data 157 Graphics Hardware 160 Graphs 156 Shows 160 Evaluating Presentation Graphics 162 Imagina Systems 166 Computer-Aided Painting 163 Case Study: Three Dimensions 171 Benefits 173 Design 167 Avoiding Spreadsheet Disaster 173 Chapter Summary 175 Review Questions 176 Key Terms 176



## Word Processing, Integrated, and Other Packages 178

Word Processing Characteristics 180 **Document Creation 181** Editina 183 Function Keys 183 Alternate Approaches 184 Formattina 188 Printing a Mouse 187 Search and Replace 188 Speller and Grammar Document 190 Utilities 191 Checkers 192 Personalized Form Letters 193 Word Processina Evaluation 193 Computer-Aided Writing 197 Outline Processors 198 Text-Based Data Manager 199 Desktop Publishing 201 Integrated Packages 201 Styles 203 Family of Products 205 Other Packages 208 Desk-Windows, 205 top Organizer 208 Limitations 210 Project Features 210 Management 210 Case Study: Per-Scheduling 211 Uses 214 sonal Computing Without a Personal Computer 214 Chapter Summary 216 Key Terms 217 Review Questions 217

## Module III: Using Database Software



#### Personal Database Software 218

File Managers 220 Step 1: Draw Layout 221 Step 2: Use Report to Set Up Files 221 Create the File 223 Search Files 224 Sort the File 227 Creating a Report 228 Interface with Other Applications 230 Database Management System 230 Relate Files 231 Multiple File Design 234 DBMS Program Language 236 Program Example 238 Package Variations 238 Graphics 238 Data Features 240 Hybrid Natural Language 243 Packages 241 Internal Dictionary 243 Microcomputer Versions of Mainframe DBMSs 246 **Evaluation 247** Fulfilling Requirements 247 Checklist 247 Case Study: A Database Response to Tourist Inquiries 249 Chapter Summary 250 Terms 251 Review Questions 251



## Mainframe and Multiuser Database Software 252

Mainframe Database Software 254 Database Administration 254
Create the Database 254 Database Inquiry 256 Generate

Advanced Inquiries 259 Data-Oriented Decision Reports 258 Data Dictionary 261 Services Provided 263 Support Tool 261 Older DBMS Data Models 264 Hierarchical/ Data Security 263 Network 266 Types of Databases 267 Distributed Databases 269 Links to Microcomputers 270 Directories 270 Installation 271 Database Machines 271 On-Line Multiple Processors 272 Databases 272 Categories 273 Benefits 275 Problems 276 Case Study: Tracking Your Competition 277 Costs 277 Chapter Summary 278 Key Terms 279 Review Questions 279

#### Module IV: Developing and Using Computer Systems



## Data Processing, Management Information, and Decision Support Systems 280

Computer System Hierarchy 283 Industry-Specific Example 285 Sales Order Processing 286 Line Items 288 Order Header 287 Operational Benefits 288 Management Information Benefits 290 Exception Reports 291 Mainframe Example 292 Stage 1: Production Focus 292 Stage 2: Information Focus 294 Stage 3: Distributed Focus 295 Information Services Department 296 Computer Center User Services 296 Operations 296 Systems Development 298 Visual Information Systems 299 Critical Success Factors 299 Libraries 301 User Demands 302 Decision Support Systems 302 Modeling 302 Decision Support Center 304 Goal Seeking 304 Case Study: Information Power 311 Package Versions 307 Chapter Summary 312 Key Terms 313 Review Questions 313

## $\widehat{1} \widehat{\bigcirc}$ Packaged Computer Systems 314

Systematic Approach 316 Professional Support 316 Specify Requirements 317 Budget Guidelines 319 Cost Justification 320 Locate Software 321 Software Evaluation 323 Hands-On Test 324 Data Entry 327 Displays and Reports 327 Other Tests 328 Vendor Evaluation 329 Program Changes 329 Disaster Insurance 329 User Questions 330 Selection 330 Hardware Planning 330 Workstations 331 Disk Storage 332 Printer 333 Installation 335 Conversion 335 Training 336 Convert Data 336 Parallel Testina 336 Security and Performance Monitoring 337 Case Study: Pursuing a Package 338 Chapter Summary 339 Key Terms 340 Review Questions 340

## **Developing Computer Systems 342**

System Development Life Cycle 344 Requirements Analysis 345 Interviews and Observations 346 Examine Documents 346 Specification 347 Data Flow Diagrams 348 System Report 347 Design 351 Output 353 Database 353 Data Flowcharting 350 Other Data Storage 354 Input 357 Structured Dictionary 354 Walkthrough 357 Hardware Specification 358 Programs 359 Installation 359 System Documentation 360 Convert Data 360 Modifications 361 User-Developed Systems 362 Information and Decision Support Centers 363 Prototyping 363 Application Development Software 363 Advanced Methods 365 Application Generator 366 Staffina 367 Advantages 368 Case Study: Do-It-Yourself Systems 370 Chapter Summary 371 Key Terms 372 Review Questions 372

## Programming Computer Systems 374

Program Design 376 Hierarchy Charts 377 Process Logic Definition 379 Decision Tree 379 Decision Table 379 Pseudocode 380 Structured Programs 380 Other Methods 382 Structured Walkthrough 383 Program Coding 383 Programming Languages 384 Assembly Language 384 Machine Language 385 BASIC 387 Language Processors 385 COBOL 390 Higher-Level Top-Down Testing 396 Languages 392 Debugging 395 Implementation 397 Program Maintenance 397 Program Documentation 398 Case Study: Invading COBOL Territory 398 Chapter Summary 399 Key Terms 400 Review Questions 401

## Module V: Advanced Systems



#### Communications 402

Personal Computer Communications 404 Modem 404 Linking Computers 406 Asynchronous Communication 408 Echo 408 On and Public Services 410 Electronic Mail 411 Uploading and Downloading 413 Private Service 413 Voice Mail 413 **Bulletin Board** Services 414 Computer Conferencing 415 Communication Software Evaluation 415 Local-Area Networks 416 **Automated** Office 417 Choices 421 Connections 422 LAN Evaluation 423 Wide-Area Networks 423 Distributed Data Processing 423 Host and Front End 424 Multiplexers and Encryption 427 Communication Lines 428 Microwave and Satellite 431 Cellular Radio Networks 432 Communication Carriers 432 Packet-Switched Service 434

Transmission Rules 437 Synchronous Communication 437 Full- or Half-Duplex 439 Standards 439 Case Study: Modern Communicators 440 Chapter Summary 441 Key Terms 442 Review Questions 443

## Robots and Knowledge-Based Systems 444

Robot Systems 446 Robot Images and Reality 446 Programming Considerations 446 Sensory Subsystem 447 Vision 448 Touch 449 Telepresence 449 Sonar Sensor 450 Factory of the Future 450 Teaching 451 Axes 451 Cost Justification 452 Social Impact 454 Economic 454 Personal 455 Psychological 455 Knowledge-Based Systems 456 Knowledge Base 457 Using a Knowledge-Based System 458 Knowledge Engineering 460 Inference Engine 460 Testing 460 Explanation System Development 462 Microcomputer Shells 463 Facility 462 Telephone Services Application 464 Package Limitations and Personal Advisory Software 468 Benefits 465 Sales Consultant 468 Strategy Report 470 Improve Management Skills 471 **Decision Assistant** Software 474 Product Pricing Application 474 Evaluating Results 477 Limitations and Uses 477 Case Study: Campbell's Keeps Kettles Boiling with Personal Consultant 479 Chapter Summary 479 Key Terms 480 Review Questions 481

### Module VI: Special Topics

## 15 History and Social Impact of Computing 482

Computing Milestones 484 1940s—The Beginnings 484 1950s-**Business Computers 486** Program Languages 487 1960s-Minicomputers 488 1970s-Microcomputers 489 1980s and Beyond 490 Computers in Society 492 Health Care 492 Handicapped 493 Home 493 Community 494 Education 495 Research 497 Entertainment and Sports 501 Music, Art, and Information Age Changes 504 Dance 501 Work Environment 504 Electronic Watchdoas 505 Privacy 506 Computer Crime 506 Hackers 506 Laws and Ethics 508 Future 508 Case Study: Examining Megatrends 508 Chapter Summary 510 Key Terms 511 Review Questions 511

## $\widehat{\mathbb{1}}$ Career Opportunities 512

User Areas 514 Job Requirement 520 Job Displacement 520 Careers in Information Services Departments 521 Programmers 522

Information Center Specialists 528 Technical System Analyst 528 Education and Entry-Level Training 530 Managers 529 Operations 529 Software 533 Hardware 531 Computer Industry Careers 531 Continuing Education 535 Services, Supplies, and Education 534 Case Study: The Computer Entrepreneurs 536 Chapter Summary 537 Key Terms 538 Review Questions 538

## 17/

## Structured BASIC Programming 540

#### Part I: An Introduction to BASIC Programming 542

A Simple First Program 542 Input 549 Variables 550 Variable Names 551 LET 552 PRINT 554 Debugging 557 Commands 557 Review Questions (Part 1A) 559 Backup 559 Programming Exercises (Part 1A) 560 Loops 562 Program Logic 562 Structured WHILE/WEND 565 FOR/NEXT 565 Programs 564 Loop Control 565 Program Design 569 Review Questions (Part 1B) 570 Programming Exercises (Part 1B) 571 Decisions 572 Initialization 574 IF/ THEN 574 GOSUB 575 Accumulators 575 Remarks 578 Review Questions (Part 1C) 579 Programming Exercises (Part 1C) 580

#### Part 2: Additional Programming Concepts 582

Structured Design 582 Hierarchy Chart 583 Programming Steps 586 Consistent Style 587 Input Alternatives 587 READ/DATA 588 Mainline Module 588 Password Module 588 Review Questions (Part 2A) 589 Programming Exercises (Part 2A) 590 DIM 591 Initialization 594 Search a Table 596 Reusable Variables 597 Dimensional Table 597 Review Questions (Part 2B) 597 Exercises (Part 2B) 599 Creating a Report 599 Report Design 602 Coding Features 609 PRINT USING 607 Report Programs 607 Review Questions (Part 2C) 610 Programming Exercises (Part 2C) 610 Creating a Menu 612 LOCATE 616 Menu Design 616 Selection 618 Error Trapping 619 AND/OR 619 LPRINT 620 Review Questions (Part 2D) 620 Programming Exercises (Part 2D) 620

#### Part 3: Programming Disk Data Files 622

File Fundamentals 623 Program Versus Data Files 623 **Processing** Concepts 623 Seauential Files 623 Create a Sequential File 624 Display a Sequential File 625 Review Questions (Part 3A) 626 Random File 627 Programming Exercises (Part 3A) 626 Create a Random File 627 Buffer 628 Display a Random File 630 Review Questions (Part 3B) 631 Programming Exercises (Part 3B) 631 Maintenance 631 Key Field 631 Program Stubs 634 Mainline 635 Display Menu and Get Selection 639 Initialize 637 Add a Customer Record 639 Change a Customer Record 640 Delete a Customer Record 641 A New BASIC 642 Review Questions (Part 3C) 644

Programming Exercises (Part 3C) 644 BASIC Summary 644 BASIC Instructions 644 BASIC Instructions for Disk Data Files 646 Operators 646 BASIC Commands 647 Special Key Combinations 647 Error Messages 648 Key Terms 649

### Appendix: Number and Code Systems 650

Binary Number System 650 Binary Addition 652 Decimal Conversion to Binary 653 Hexadecimal Number Systems 653 Hexadecimal Arithmetic 654 Contrast to Code Systems 656 Review Questions 657

#### Index 658