

Fundamentals of Computer Education



Second Edition

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Computer Education



Second Edition

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Introduction Figure 1(a, b): Jak Dempsey (Apple IIe and IIc). Figure 1(c): Apple Computer, Inc. (Apple II GS). Figure 2(a-c): Jak Dempsey (Apple IIe and IIc on/off switches). Figure 6(a, b): Jak Dempsey (Apple IIe and IIc disk drives). Figure 6(c, d): Apple Computer, Inc. (Apple IIe/GS disk drive and disks). Figure 7(a-c): Jak Dempsey (Apple II+, IIe, and IIc keyboards). Figure 7(d): Apple Computer, Inc. (Apple II GS keyboard). **Chapter 1** Figure 2: Sharon Downie Cooper (Robot turtle). **Chapter 4** Figure 5: The Learning Company (Rocky's Boots display). Figure 6: The Learning Company (Rocky's Boots display). **Chapter 5** Figure 1: Sierra On-Line (Homeword display). **Chapter 8** Figure 1(a): Sharon Downie Cooper (Koala Pad). Figure 2: Apple Computer, Inc. (MacPaint display). Figure 3: Jak Dempsey (Apple-Mouse II). Figure 5: Hayes (modem). **Chapter 9** Figure 1: Hartley Courseware, Inc. (Clock display). Figure 2: Microsoft Consumer Products (Olympic Decathlon displays). Figure 3: MECC (MECC Music display). Figure 4: Frontier Software (Plurals and Possessives display). Figure 5: Hartley Courseware, Inc. (Clock display). Figure 6 (a-c): MECC (MECC Elementary Volume 7 displays). **Chapter 10** Figure 2(a-d): EduWare (Perception II displays). Figure 3: EduWare (Perception I displays). Figure 4: EduWare (Perception II displays). Figure 5: SubLogic (Flight Simulator II displays). Figure 8: The Learning Company (Rocky's Boots display). Figure 9: Control Data Corporation (Plato Sentences display). **Chapter 11** Figure 1: MECC (Oregon Trail display). Figure 2: MECC (Pollute display). Figure 3: MECC (Collide display). Figure 4: SubLogic (Flight Simulator II display). **Chapter 12** Figure 1: Control Data Corporation (Plato Sentences displays). Figure 2: Control Data Corporation (Plato Tenses displays). Figure 3: Cambridge Development Laboratory (Mea-

surement displays). Figure 4: Adapted from L.S. Shulman, Psychological controversies in the teaching of science and mathematics, *The Science Teacher* 35: 34-38, 1968 (Task analysis diagram). **Chapter 14** Figure 1: MECC (Lemonade Stand display). Figure 2(a): MECC (Lemonade Stand display). Figure 3: MECC (Odell Lake display). Figure 4: Hartley Courseware, Inc. (Clock display). Figure 5: Muse (Three Mile Island display). Figure 6: MECC (Prefixes display). Figure 7: Sharon Downie Cooper; Developmental Learning Materials (Alligator Mix display). Figure 8: Educational Activities (Compu-solve display). Figure 9: Educational Activities (Dragon Games display). **Appendix A** Figure 1: Jak Dempsey (electric bar). Figure 2(a, b): Jak Dempsey (disks and disk drives for Apple II+, IIe, and IIc). Figure 3(a-c): Jak Dempsey (disk drive doors for Apple II+, IIe, and IIc). Figure 4(a-c): Jak Dempsey (Apple II+, IIe, and IIc keyboards). Figure 4(d): Apple Computer, Inc. (Apple II GS keyboard). **Appendix D** Figure 1: Logo Computer System Inc. (LogoWriter, Apple version, keyboard display). Figure 2: Logo Computer Systems Inc. (IBM PC version). Figure 3: Logo Computer Systems Inc. (IBM PCjr 64 version). **Appendix F** Figure 1(a): Apple Computer, Inc. (Apple II GS desktop system). Figure 1(b, c): Jak Dempsey (Apple Macintosh and IBM PC desktop systems). Figure 2(b): Jak Dempsey (6502 microprocessor). Figure 3(a): Apple Computer, Inc. (Apple II+ motherboard). Figure 3(b): Jak Dempsey (Apple IIe motherboard). Figure 3(c): Janice Flake (Apple II GS motherboard). Figure 4(a, b): Jak Dempsey (Apple II+ expansion slot). Figure 4(c, d): Janice Flake (Apple II GS expansion slots and backview of ports). Figure 5(a-c): Jak Dempsey (Epson MX 100, Okidata, Brother printer). Figure 5(d, e): Apple Computer, Inc. (Apple ImageWriter II and Apple LaserWriter II).

Preface



Computers are now common in school settings; consequently, teacher education programs are requiring students to take courses in computer education. In addition, in-service teachers are returning to college for computer education courses.

We each teach courses in computer education and felt a need for a textbook such as *Fundamentals of Computer Education*. For the first edition, verification of proposed topics and suggestions for additional topics came from a survey conducted by Wadsworth Publishing Company of 366 professional educators, including computer educators, computer scientists, psychologists, and curriculum and instruction faculty. The text was then carefully field tested, and students gave considerable input. The result was a comprehensive computer education textbook that gave educators—preservice or in-service—a solid foundation for any future study in the area.

To prepare for the second edition, we surveyed many more people concerning the field of computer education, which is rapidly growing and changing. Because of this survey we have made the following modifications for the second edition.

- ▶ Increased the emphasis on tool uses of the computer
- ▶ Increased the amount of software reviewed
- ▶ Included sample activities to be incorporated directly into school classrooms
- ▶ Added LogoWriter and Logo Plus

Because of space limitations, we then eliminated our section on BASIC.

Features of This Book

Fundamentals of Computer Education is unique in the following ways:

- ▶ Provides *comprehensive coverage* of computer education
- ▶ Emphasizes *problem solving*
- ▶ Draws connections between *learning theory* and *educational applications* of the computer
- ▶ Provides *applications* and *uses* of multiple versions of Logo, including LogoWriter
- ▶ Emphasizes *graphics* and the importance of *imagery* development through both programming experiences and software evaluation
- ▶ Discusses in detail educational computer *applications*, including in-depth analyses and evaluations of various types of educational software

- ▶ Gives concrete examples, emphasizing AppleWorks, of the computer's use as a *tool* through word processing, databases, and spreadsheets
- ▶ Includes *numerous* computer programs, exercises, and applications in a variety of subject areas
- ▶ Builds connections between the *past* and the *future* by analyzing *societal changes* brought on by *technology*
- ▶ Utilizes an *applications disk of sample programs* illustrating specific educational ideas, which is keyed to the text by a disk symbol in the text margin
- ▶ Provides *activities* and *worksheets* that can be directly applied to classroom use.



Problem Solving and Logo

Problem solving is a major focus of the book. We feel that teaching problem-solving processes is a fundamental responsibility of schools. Most educators consider problem solving to be the one stable educational goal in a rapidly changing society. Some facts and skills necessary in the past are obsolete today; problem-solving ability, in contrast, does not become obsolete.

Original programming is problem solving, requiring problem-solving processes. Effective use of process-type software and the important uses of computer tool programs involve problem solving. For example, decision-making can be facilitated by electronic spreadsheets; organizing and analyzing information to solve problems is inherent in the use of databases. In addition, commercial programs that enhance problem solving are being developed and are examined.

We consider Logo to be a fundamental computer language for use in the teaching of problem-solving processes. To help students visualize concepts, Logo uses graphics and other methods; it was developed through applications of a constructivist theory, including Piagetian theory. The logic, exploration, and problem solving inherent in the use of Logo make it an excellent tool for helping teachers to achieve fundamental educational goals. The principles of organizing, reasoning, planning, and decision-making learned through Logo transcend specific academic subjects taught in school and provide an overall framework for all school subjects. This second edition includes LogoWriter and Logo Plus. Such an active approach to learning provides motivation for the learning of all academic subjects.

Educational Theory

We consider the underlying principles of education, particularly those expounded by Gestalt, Bruner, Piaget, Polya, and Papert, to be fundamental to computer education. Chapter 12 discusses how teaching/learning theories, including those developed from the observation of *expert teachers* by K. B. Henderson and B. O. Smith, can be developed into *expert systems*, using the capabilities of the computer. This chapter also covers the designing of lessons to include the dynamic and visual aspects, as well as abstractions, of conceptual learning. The text goes on to discuss a combination of moves that builds from the *concrete* to the *iconic* (including visualization and imagery development) and finally to the *abstract*.

We consider *learning styles* to be essential in the improvement of educational practices. Tools such as computers now can enhance learning styles. Computers not only help educators to develop instructional materials that are consistent with students' learning styles but also help them to strengthen individual students' weaknesses. For example, with well-designed computer experiences, *visual* learners can develop their *verbal* learning skills, and vice versa; *impulsive* learners can become more *reflective* in learning style.

Orientation to This Book

This is a machine-specific book for the Apple® II series. We have designed it this way to aid easy entry to computers. Our data suggests that the Apple II series is the most commonly used computer in education today. Our Logo sections include M.I.T. versions (Terrapin, Krell, and Logo Plus) and LCSl versions (Apple Logo and LogoWriter) because we find that these versions are used heavily. LogoWriter is also a multiple-machine version for the Apple IIe/c and Apple IIGS, IBM PC, IBM PC_{JR}, and Commodore.

The book has three parts. Part One focuses on control of the computer and emphasizes programming. Its goal, to build an understanding of the computer and its power and versatility, can best be met through the readers' actual programming of the computer. We believe that people *learn best by doing* and have included many activities, experiences, and exercises to help guide that learning. The book will be most effective if computer time is carefully allocated.

We also stress the importance of developing problem-solving strategies. In Chapter 1, first programming experiences are with Logo, which is proving to be a very good language for beginners. Logo has many of the features of a well-designed programming language, as well as easy entry. Also using Logo, Chapter 2 develops programming concepts along with problem-solving strategies. Computer uses that are more *generalizable*, such as word processing concepts, are presented through the Logo editor in Chapter 3. *Structured programming* is examined in the writing of Logo programs and also is applied to music. The concept of *microworlds* is explored in Chapter 3. In addition to those aspects of Logo, LogoWriter includes an easy-to-use shapemaker, which allows for multiple-shaped turtles and multiple turtles (up to four); it also includes built-in music and easy-to-use systems for editing and manipulating files.

Parts Two and Three examine educational applications of the computer. Part Two, Chapters 5–8, focuses on instructional uses of word processors, databases, spreadsheets, and graphics packages; AppleWorks is emphasized. In Part Three, educational software is discussed in chapters on drill and practice (9), visualization and imagery development (10), simulations (11), tutorials (12), and computer-managed instruction (13). Chapter 14 examines software evaluation.

The final chapter of the book examines *trends* and *issues* of computer education; particular emphasis is given to the past and future societal changes generated by technology. Other issues include *computer literacy*, schools' uses of the computer, legal aspects of computer use, intelligent computers, and artificial intelligence.

We were unable to come up with a consensus on where the chapter "What Is a Computer?" should be placed. Some people prefer starting with this chapter. We prefer having students first have some successful experiences with the computer before making the computer the object of study. Because we were unable to get any consensus about placement, we moved it to an appendix (Appendix F) so that you can study it whenever it is appropriate for you.

So that the flow of the book will be smooth, the more mechanical instructions on use of the computer are built into the appendixes. These appendixes cover operating the computer, using operating systems, editing features within the Logo language, and a discussion of utility programs on the DOS 3.3, ProDOS, and GS OS MASTER DISK for the Apple II computer series. In this second edition, appendixes also describe special features of LogoWriter, Logo Plus, AppleWorks, and Apple IIGS, and Logo commands.

Also in the appendixes are two more lists that we hope will be helpful. One list is a set of computer programs used in the text and the distributors from whom they can be purchased. The second is a cross-listing of subject areas and computer programs discussed in the text.

A Note to Instructors

The materials discussed in *Fundamentals of Computer Education* can be sequenced in various ways. The chapters are organized so that students can gain confidence in controlling the machine before they examine the applications. Programming and applications also could be taught simultaneously. Adequate time must be given for students to develop appropriate problem-solving abilities; we see this as the most important objective and the one most in need of time to develop.

A Note to Students

Fundamentals of Computer Education is designed to be used actively with the computer. If you wish to develop machine skills, you need to plan time to work at a computer. Throughout the book, explorations, activities, and discussions are designed to help you gain the most from your computer experiences.

Each chapter contains *chapter objectives*, *important terms*, and *exercises* to help you organize your knowledge. Also included are sample activities for your students. Each of these should be examined carefully while you work through the chapter. We hope you will enjoy learning about computers, developing problem-solving abilities, and understanding computer education!

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Brief Contents

Introduction 1

Part One Controlling the Machine 11

Chapter 1 Introduction to Logo 12
Chapter 2 Writing Turtlegraphics Programs 33
Chapter 3 Beyond Turtlegraphics 66
Chapter 4 Problem Solving: Looking Back 97

Part Two Tool Uses of the Computer 121

Chapter 5 Word Processing 122
Chapter 6 Database Management 135
Chapter 7 Electronic Spreadsheets 153
Chapter 8 Other Tool Uses of the Computer 173

Part Three Educational Uses of the Computer 193

Chapter 9 Drill and Practice 194
Chapter 10 Visualization and Imagery Development 207
Chapter 11 Simulation 233
Chapter 12 Tutorial Programs 251
Chapter 13 The Computer as a Manager 268
Chapter 14 Evaluating Software 275
Chapter 15 Trends and Issues in Computer Education 294

Appendix A Operating the Computer Equipment 317
Appendix B The Logo Editor for Terrapin, Logo Plus, and Apple Logo 320
Appendix C Using the Logo System in Terrapin, Logo Plus, and Apple Logo 321
Appendix D Special Features of Logo Writer 324
Appendix E Logo Plus 330
Appendix F What Is a Computer? 333
Appendix G Using the DOS 3.3 Apple Operating System 352
Appendix H Utility Programs on the DOS 3.3, ProDOS, and GS/OS Master Disk 356
Appendix I Special Features of AppleWorks 361
Appendix J Computer Programs and Software Reviews Mentioned in Text 362
Appendix K Subject Areas and Computer Programs Mentioned in Text 368

Glossary/Index 373

Detailed Contents

- ▶ Preface xiii
 - Introduction 1
 - Getting Started 2
 - Developing Thinking Processes through the Activities 5
 - Important Terms 10
- ▶ Chapter 1 Introduction to Logo 12
 - Exploring with Turtlegraphics—Direct Mode 13
 - ▶ Box 1 Typing Hints 15
 - Exploring with Turtlegraphics—Indirect Mode 17
 - Exploring Shapes and Patterns 20
 - Exploring Colors 21
 - Building with Procedures 22
 - Exploring with Inputs 24
 - Logo Philosophy 25
 - Strategies for Teaching Logo 27
 - Summary 29 Important Terms 29
 - Exercises 29 References 32
- ▶ Chapter 2 Writing Turtlegraphics Programs 33
 - Extending Logo 33
 - Calling Procedures within a Procedure 34
 - Input Variables 34
 - Using Simple Recursion 36
 - Using More Complex Recursion 38
 - ▶ Box 1 Controlling What You See on the Screen 38
 - Teaching Logo—More Strategies 41
 - Rectangular Coordinate Systems 47
 - Comments from Research 49
 - Summary 51 Important Terms 51
 - Exercises 52 References 57
 - Activity: Polygons to Circles 59
 - Activity: General Bear 59
 - ❖❖ Exploration: Patterns in Pictures, Worksheet I 62

Part One
Controlling the Machine
11

- ✧ Exploration: Patterns in Pictures, Worksheet II 63
- ✧ Exploration: Problems Using Procedures, Worksheet I 64
- ✧ Exploration: Problems Using Procedures, Worksheet II 65

► Chapter 3 Beyond Turtlegraphics 66

- Introduction to Interaction 67
- Using Words and Lists for Interactive Programs 70
- Developing Interactive Programs 74
- The Edit Mode as a Word Processor 76
- Microworlds 79
 - Box 1 Checklist for Microworlds 83
- Music in Logo 83
- Lego-Logo 87
- Summary 88 Important Terms 89 Exercises 89 References 92
- Activity: Stars or Polygons 93
- Activity: Word-Forming Game 94
- Activity: Extending *Sent* 95
- ✧ Exploration: Stars or Polygons Worksheet 96

► Chapter 4 Problem Solving: Looking Back 97

- Characterizing Problem Solving 97
 - Box 1 Heuristics 99
- Approaching Problem-Solving Experiences 100
 - Box 2 Questions Guiding Problem-Solving Thought 101
- Teaching and Learning Strategies 102
- Programming versus Problem Solving 103
- Computer Uses in Problem Solving 104
- Comparing Top-Down and Bottom-Up Programming 106
- Applications to the Use of Software 110
- Summary 111 Important Terms 111
- Exercises 112 References 119

► Chapter 5 Word Processing 122

- Features of a Word Processor 122
 - Box 1 Using One Word Processor: *Bank Street Writer* 125
 - Box 2 Working with AppleWorks: A Hands-On Word Processing Activity 126
- Using Word Processors in the Classroom 127
- Summary 129 Important Terms 129
- Exercises 129 References 130
- Activity: Finding the Big Picture 131
- Activity: A Book Report on Plot 132
- Activity: Poetry: Cinquain 133
- ✧ Exploration: A Book Report on Plot Worksheet 134

► Chapter 6 Database Management 135

- Features of Database Management 135
- Creating Your Own Database 137

- ▶ Box 1 Using Existing Databases: A Hands-On Activity with AppleWorks 138
- ▶ Box 2 Creating and Using an Instructional Database: A Hands-On Activity Using AppleWorks 140
- ▶ Box 3 Working with AppleWorks: Creating Your Own Database Template 143
- Using Databases in the Classroom 144
- Summary 144 Important Terms 145
- Exercises 145 References 145
- Activity: Pets We Have at Home 146
- Activity: What's in a Name 147
- Activity: Letters . . . Words . . . Sentences 148
- Activity: Animals and Their Young 149
- Activity: TV Viewing 150
- Activity: Food, Calorie, Group, and Nutrition 151
- ❖ Exploration: Pets We Have at Home Worksheet 152

▶ Chapter 7 Electronic Spreadsheets 153

- Features of a Spreadsheet 153
- Using a Spreadsheet—The Effects of Smoke 154
- Administrative Uses of a Spreadsheet 156
- ▶ Box 1 Working with AppleWorks: Creating Your Spreadsheet Template 160
- Summary 165 Important Terms 165
- Exercises 165 References 166
- Activity: Organizing Data for a Spreadsheet 168
- ❖ Exploration: Organizing Data for a Spreadsheet Worksheet 169
- ❖ Exploration: Problem Solving with Spreadsheets, Worksheet I 170
- ❖ Exploration: Problem Solving with Spreadsheets, Worksheet II 171
- Activity: Suggestion for the Cyclist Problem 172

▶ Chapter 8 Other Tool Uses of the Computer 173

- Graphics Utilities 173
- Telecommunication 176
- Networks 179
- Integrated Packages 182
- Auditory Communication 184
- Using The Computer for Instrumentation 185
- Interactive Video Disks 185
- Summary 186 Important Terms 186 References 187
- Activity: Koala Pad Activities 188
- Activity: Code Contest 190
- Activity: Electronic Scavenger Hunt 191
- Activity: Electronic Brain Bowl 191
- Activity: Electronic Bulletin Boards 192

Part Three
Educational Uses of the
Computer
193

- ▶ Chapter 9 Drill and Practice 194
 - Characterizing Drill and Practice Programs 194
 - Strategies for Teaching and Learning Skills 196
 - ▶ Box 1 Teacher-Initiated Moves in Drill and Practice 197
 - ▶ Box 2 Moves That a Learner Uses in Drill and Practice 198
 - Features of Drill and Practice Programs 199
 - Uses of Drill and Practice Programs 200
 - Preparing One's Own Materials 203
 - Applications in Available Software 203
 - ▶ Box 3 Principles for Skill Development 204
 - Comments from Research 204
 - Summary 205 Important Terms 205
 - Exercises 205 References 206
- ▶ Chapter 10 Visualization and Imagery Development 207
 - Concept Formulation 209
 - Using Spatial Experiences to Develop Problem-Solving Abilities 213
 - Visualization and Prepared Computer Materials 214
 - Evaluating and Using Computer Materials for Concept and Visualization Development 215
 - ▶ Box 1 Principles for the Selection and Use of Computer Materials for Visualization and Concept Development 216
 - Graphics Applications 219
 - Applications to Available Software 221
 - Comments on Research 225
 - Summary 226 Important Terms 226
 - Exercises 226 References 227
 - Activity: Transforming Shapes 229
 - Activity: Shape Construction Set Activities 230
 - ✧ Exploration: Shape Construction Set Worksheet 232
- ▶ Chapter 11 Simulation 233
 - Characterizing Simulation 234
 - ▶ Box 1 Components of a Simulation 236
 - Using Simulations in the Classroom 236
 - Analyzing a Simulation 236
 - ▶ Box 2 Instructional Applications of Simulations 237
 - ▶ Box 3 Factors in Analyzing or Designing a Simulation 237
 - ▶ Box 4 Analysis of *Oregon Trail* 238
 - Using Simulations for Problem Solving 240
 - Making Your Own Simulation 240
 - ▶ Box 5 Analysis of *Flight Simulator II* 241
 - Simulation Software for Classroom Use 243
 - Summary 247 Important Terms 247
 - Exercises 247 References 248
 - Analysis of a Simulation Form 249
- ▶ Chapter 12 Tutorial Programs 251
 - Characterizing a Tutorial 251
 - Examining Teaching/Learning Theory Relevant to Tutorials 255
 - Learning/Teaching Theory in Instructional Design 256

- Knowledge and Process in Tutorials 258
 - Box 1 Moves Used in Teaching Concepts 259
 - Box 2 Moves Used in Teaching Principles 260
 - Essential Features of Tutorial Software 261
 - Tutorials' Role in Well-Rounded Learning 262
 - Applications to Available Software 263
 - General Comment 265
 - Summary 265 Important Terms 266
 - Exercises 266 References 267
- Chapter 13 The Computer as a Manager 268
 - Computer-Managed Instruction 268
 - Box 1 Implementing a CMI System 271
 - Applications in Available Software 272
 - Summary 273 Important Terms 273
 - Exercises 273 References 274
- Chapter 14 Evaluating Software 275
 - Why Do We Need to Review Software? 275
 - How Do We Recognize Quality Software? 276
 - Description before Evaluation 276
 - Evaluation Criteria 277
 - Review Procedure 285
 - Box 1 A Software Evaluation Walkthrough 286
 - Courseware Review Form 290
 - Summary 292 Important Terms 292
 - Exercises 292 References 293
- Chapter 15 Trends and Issues in Computer Education 294
 - Influences of the Computer 294
 - Computer Literacy 297
 - Integration of the Computer into the Schools 301
 - Evaluations of the Effectiveness of Computers in Education 305
 - Equity Issues 307
 - Developing Software—Who Should Do It? 308
 - Legal Issues: Privacy and Copyrights 308
 - Recreational Uses of the Computer 309
 - Intelligent Machines 309
 - Summary 313 Important Terms 314
 - Exercises 314 References 314
- Appendix A Operating the Computer Equipment 317
 - Care and Use of Floppy Disks 317
 - Turning the Computer On and Off 317
 - Suggestions for the Best Use of Your Equipment 318
- Appendix B The Logo Editor for Terrapin, Logo Plus, and Apple Logo 320
- Appendix C Using the Logo System in Terrapin, Logo Plus, and Apple Logo 321
 - Reading/Loading and Saving Procedures 321
 - Screen Commands 322
 - Printing Out Programs and Pictures 323

- ▶ Appendix D Special Features of LogoWriter 324
 - The Basics 324
 - Unique Features of LogoWriter 325
- ▶ Appendix E LogoPlus 330
 - Shapes 330
 - Text and Graphics 331
 - The Screen 331
 - Disk and Files 332
- ▶ Appendix F What Is a Computer? 333
 - Background: 1642–1988 333
 - ▶ Box 1 Getting a Perspective on Computer History 334
 - Terminology of Parts of a Computer System 336
 - Disk Operating Systems 340
 - Input Devices 341
 - Output Devices 343
 - Apple II GS 347
 - References 350
- ▶ Appendix G Using the DOS 3.3 Apple Operating System 352
 - Initializing a Disk 352
 - Saving Programs on the Disk 353
 - Loading Programs from the Disk 353
 - Copying, Renaming, and Removing Programs 354
 - Printing Program Listings 355
- ▶ Appendix H Utility Programs on the DOS 3.3, ProDOS, and GS/OS Master Disk 356
 - Slots and Drives 357
 - ProDOS 358
- ▶ Appendix I Special Features of AppleWorks 361
- ▶ Appendix J Computer Programs and Software Reviews Mentioned in Text 362
 - Addresses of Distributors 364
 - Software Reviews 367
- ▶ Appendix K Subject Areas and Computer Programs Mentioned in Text 368
 - Art 368 Business Education 368 Computer Science 368
 - Foreign Language 368 Language Education 369 Logic 369
 - Mathematics 369 Music 370 Physical Education 370 Problem Solving 370
 - Science 370 Social Studies 371 Teacher Utility 371
- Glossary/Index 373

Introduction



When confronted with a new gadget, a new dance step, a new idea . . . first, relate what is new and to be learned to something you already know. Second, take what is new and make it your own. Make something new with it, play with it, build with it. [Papert, 1980, p. 120]

Welcome to computer education! Computers are becoming a major part of school settings. These new “gadgets” offer much potential for education. By using prepared computer materials and developing their own computer programs, students can learn content. They can also learn about computers and the influences of technology on our society. They can learn to use the computer as an effective tool. Using Papert’s words, students can learn to experiment, make something new, play with it, and build with it.

As high technology rapidly changes our society, new skills will be needed for successful adaptation. One of these skills, programming the computer, can help shape thinking. Through learning to program, students can learn to control machines, and in the process learn to develop problem-solving, logical-thinking, and visualization abilities.

This is a book about computers; it is also a book about learning. We believe that the best way to learn is through experience and exploration of various ideas, such as through *writing* programs or *using* available software. One of the features of computers is their interactive nature, with immediate feedback. Throughout this book, we encourage you to use the immediate feedback: try out various ideas as you read.

We stress use of computer graphics and development of problem-solving processes. We use computer graphics to make ideas concrete and to develop your ability to make mental images. You control and manipulate the graphics displays. In some cases, you construct the graphics through programming the computer; in others, you manipulate already prepared software.

To develop content and principles, such as effective ways of using simulation or visualization materials, we provide activities and then analyze these learning experiences. We encourage you to participate in the activities. Experiment, conjecture, build knowledge. To make the best use of the book, plan to spend adequate time at the computer.

The book has three parts. Part One helps you gain control of the computer through programming and problem solving. Part One teaches you to do these tasks:

1. Program the computer through Logo
2. Identify a variety of programming concepts
3. Illustrate approaches to teaching programming concepts
4. Describe a philosophy for a learning environment
5. Describe the problem-solving process, identify a variety of problem-solving strategies, and develop your own problem-solving abilities
6. Develop some simple microworlds

Part Two explores educational tool uses of the computer, including the following:

1. Word processor
2. Database
3. Spreadsheet
4. Telecommunications
5. Graphics packages
6. Desktop publishing
7. Integrated software

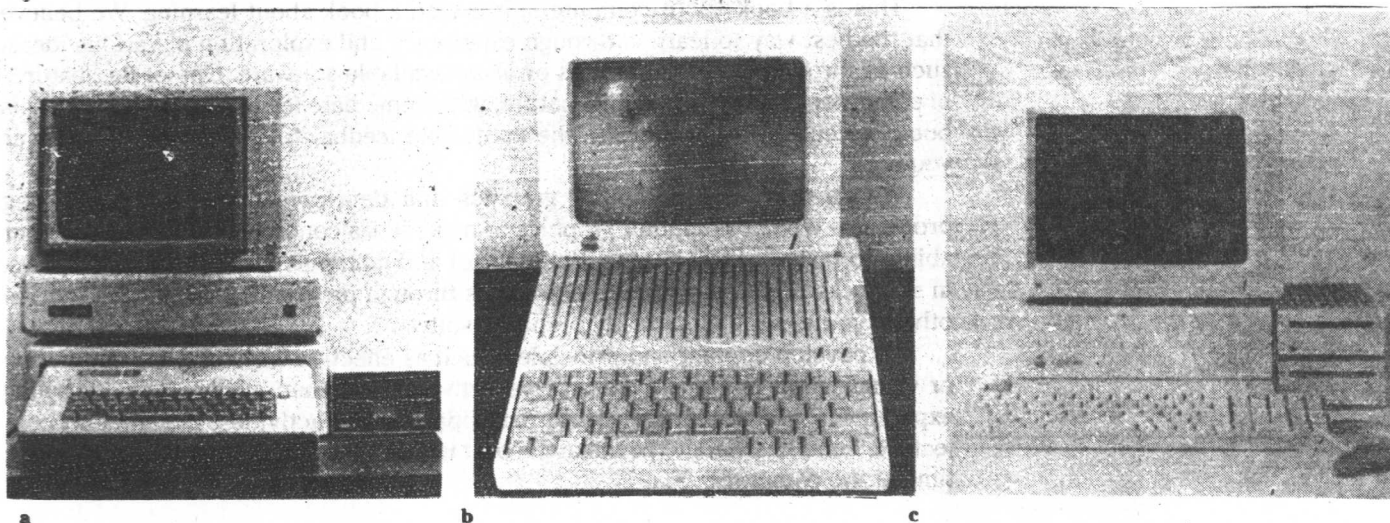
Part Three is designed to explore educational software applications of the computer. Part Three teaches you to do this:

1. Identify types of instructional programs and effective ways of using them
2. Identify ways of using the computer for management
3. Evaluate software
4. Describe the influence of technology on society, and other trends and issues in computer education

Getting Started

This is a book about computers, so we will first examine a computer and its parts. If you have available *Know Your Apple* by Muse Software, place it into the disk drive, as shown in Figures 1 and 6. (This program is available in two versions,

Figure 1 Sample computer systems: (a) Apple IIe, (b) Apple IIc, and (c) Apple IIGS.



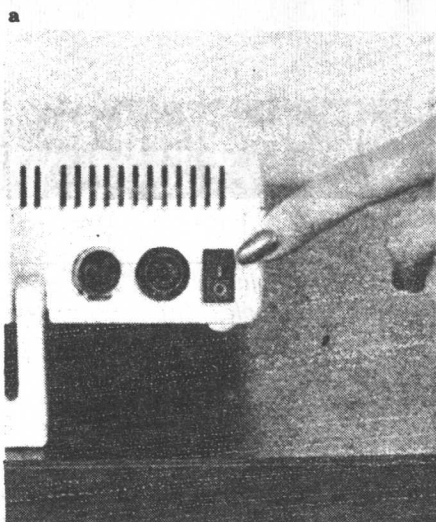
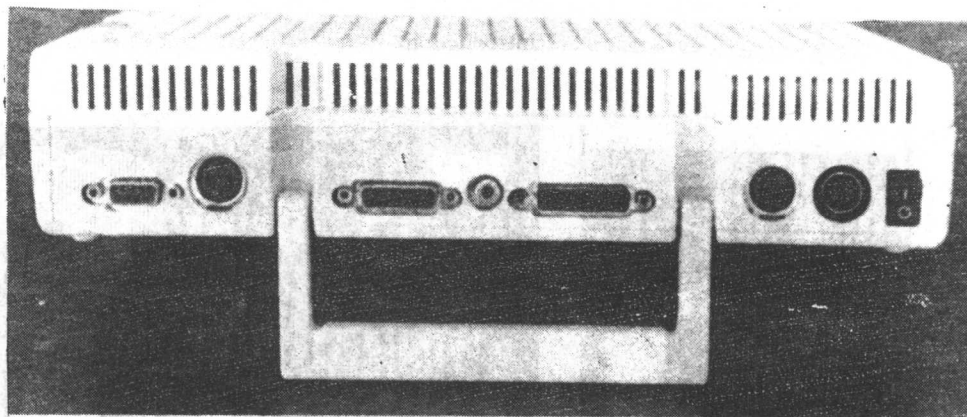


Figure 2 On/off switches with (a) back of Apple IIc, (b) pointing to on/off switch for Apple IIc, and (c) back of Apple II+ and IIe with on/off switch.

Figure 3 Main menu of Know Your Apple IIe shows the Apple system.

Figure 4 The monitor is displayed by the Know Your Apple program.

