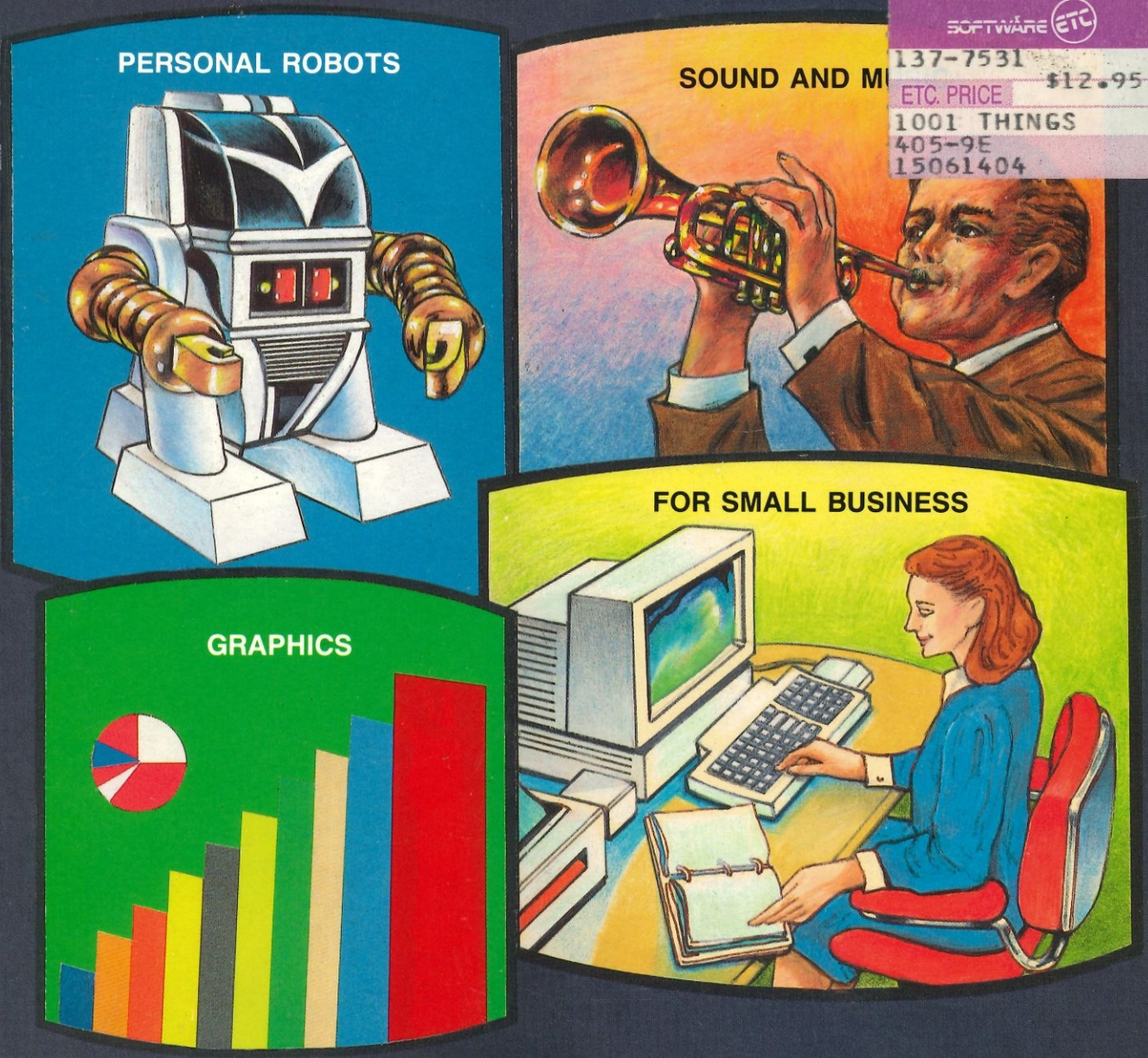
1001 THINGS TO DO WITH YOUR APPLE® IIGS™

MARK R. SAWUSCH AND DAVE PROCHNOW



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Preface

1001 Things To Do With Your Apple IIGS represents an important step in an evolutionary line of computer books. The phenomenal success of this line of books has been demonstrated by its original volume, *1001 Things To Do With Your Personal Computer*, which has sold over 130,000 copies. While *1001 Things To Do With Your Personal Computer* has succeeded in meeting the needs of the novice computer community, the needs of an increasingly computer literate public have necessitated specialized information regarding particular computer types. The result is the production of this book, which is especially designed for Apple IIGS users.

In order to best serve Apple IIGS personal computer users, *1001 Things To Do With Your Apple IIGS* contains new, updated information. The most important facet of this book, however, is that it includes new line illustrations, photographs, and Apple IIGS-specific programs, which have been created exclusively by Dave Prochnow. These new programs take full advantage of the Apple IIGS's remarkable programming capabilities, including sound, graphics, and animation. We hope that this book is a useful step in your continuing evolution as an Apple IIGS user.

Acknowledgments

There are several people who deserve acknowledgment for their participation in this book's preparation. First of all, we would like to thank Mr. Bill Stewart of Heath/Zenith Corporation, for his helpful assistance in arranging the loan of a HEROjr robot for discussion in this book. Second, we would like to express our appreciation of Ms. Loretta Stagnitto of Activision, Inc., for her information regarding the future Apple IIGS software releases from Activision. Receiving our tertiary acknowledgment is Ms. Rachel E. Famighette of Electronic Arts, who directed our attention to the new line of Electronic Arts' Apple IIGS software. Finally, we extend our thanks to our editor, Mr. Brint Rutherford, for giving us the opportunity to participate in this book's creation.

Introduction

If you are holding this book, reading these words, you probably either own, or are planning to purchase, an Apple IIGS personal computer. If you already own an Apple IIGS, you undoubtedly have a few applications in mind for your computer to perform. If, however, you haven't yet purchased the computer, you're probably at the stage where you're intrigued by the hardware but unsure of the computer's possible applications. This is why you should continue holding this book, carry it up to the cash register with a fist full of dollars, and take it home for further study.

Within this book are 1001 fascinating, utilitarian, educational, entertaining, and helpful applications for your Apple IIGS. Suggested possibilities, as well as full-fledged programs, fill this book's pages. Furthermore, these proposed applications are aimed at all types of Apple IIGS users, including personal, professional, domestic, hobby, and business users. There's something in here for everyone.

This book is a unique browser's catalog of potential applications for your Apple IIGS. You can make the best use of this book if you allow it to help you to spawn, identify, and tailor new uses for your Apple system. *1001 Things To Do With Your Apple IIGS* provides the background that you need to become more adept, versatile, and creative in using your Apple's problem solving capabilities. As an idea book, it will stimulate your own creativity, helping you stretch your own limits and those of your Apple system.

This book will appeal to current or potential Apple IIGS owners on three levels. Skeptical buyers may use it in deciding whether the possible applications will justify the cost of the IIGS. Those interested in using the computer, but not in designing their own programs for it, can type in and utilize the complete Applesoft BASIC programs provided within this book. The advanced personal computer user has the opportunity to sharpen her or his programming skills by implementing the book's interesting and challenging program suggestions in self-created programs.

Use your IIGS to do complex calculations that were previously too troublesome to perform manually (for example, the photographer can calculate more precise values for camera settings to achieve a certain effect). Examples of simple formulas are presented within the text and are intended to be part of larger, more complex programs to be written for your own applications.

The Applesoft BASIC program listings that are provided, however, are complete in every regard. These programs are ready for you to type in and enjoy immediately. With your Apple IIGS in its IIGS mode (either from ROM or ProDOS), be sure to type the program lines exactly as they are listed in the text. Unusual looking spaces, character arrangements, and punctuation are all part of the plan to make the program's output look good on the screen and to make the program function correctly. If a listed program fails to run correctly after you have typed it in, be sure to verify each character that you have entered against the listing in the book for possible errors in your entry. If you would like to avoid the exacting task of entering these programs yourself, be sure to examine the program disk offer at the back of this book. Two Apple IIGS disks containing all of these programs are available from TAB BOOKS, Inc. (See the back of the book.)

If you plan to run your Applesoft BASIC programs from the DeskTop, you will need to place a copy of BASIC.SYSTEM in the same directory as your programs. BASIC.SYSTEM is the programming language file that is found on your IIGS' System Disk. This file and all of the Applesoft BASIC program files should be placed inside the same file folder. An alternative method to this technique is to place BASIC.SYSTEM inside a directory that is of a higher-level than the subdirectory that holds your Applesoft BASIC programs.

Once you have entered a program or two into your IIGS, you can go ahead and refer to other portions of the book's text. You are now ready to read and enjoy the applications that you have selected for your Apple IIGS computer.

Chapter 1

Apple IIGS Applications for Everyone

As life on earth becomes increasingly more complex, personal computers continue to demonstrate their indispensable ability to organize and simplify the minutia of everyday life. Within this chapter you will find a broad collection of Apple IIGS computer applications for everyone, each designed to streamline daily life.

PERSONAL REFERENCE SOURCE

Personal reference information often takes the form of paper scraps or dog-eared book pages. Unfortunately, bits of paper are quickly lost and dog-eared books are easily misplaced. Your Apple IIGS (see Fig. 1-1), however, makes an ideal storage place for the information contained on such paper scraps and book pages. When used in conjunction with the appropriate software, your IIGS can organize this information so that it is available for instant retrieval. The possibilities for such data storage are endless, but a few examples of charts, tables, and lists that can be stored in your IIGS include the following:

1. Caloric and nutritional content of selected foods.
2. Appointment itinerary.
3. Important article and book references (stored by author, title, topic, and date).
4. Sports statistics, amateur or professional.
5. Buyer's comparison guide statistics, such as product sources, specifications, and prices from various suppliers.
6. Names, addresses, and telephone numbers.
7. Stock market portfolio data including name, symbol, shares, price, and historical data.
8. Recipes and shopping lists.
9. Postal and shipping rates, requirements, and regulations.
10. Metric conversions and information.
11. Time differences and phone rates between cities.
12. Words commonly misspelled or misused (as a quick reference for writers).
13. Ham radio log of contacts, locations, and times.
14. Collection inventory (e.g., for coins or stamps),

Fig. 1-1. The Apple IIGS differs significantly from all previous Apple II models. A special note concerning this particular IIGS is that it is a "Limited Edition" model autographed on the front panel by Steve Wozniak.

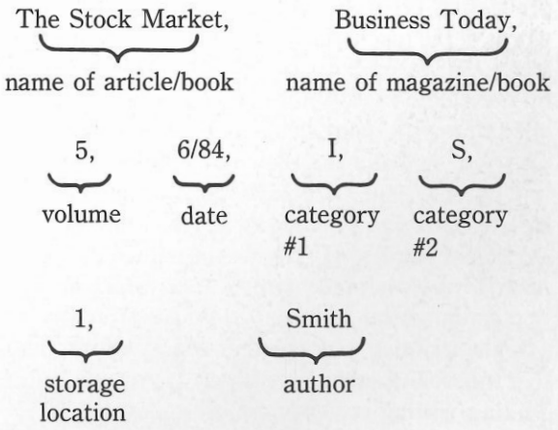
including name of item, age, values, and identifying information.
15. Private pilot flight planning data.
16. Household inventory for insurance and financial purposes.
17. Astronomical data.
18. Planning lists for activities including schedules and deadlines.
19. Fishing log.
20. Quotations by topic and source.
21. References from literature.
22. Dates of birthdays, anniversaries, and other special occasions.
23. Automotive service information.
24. Patient laboratory data over time, differential diagnoses, or drugs for physicians.
25. Credit card list, with telephone numbers to call in the event of loss or theft.
26. Safety deposit box contents.
27. Physical constants, chemical data, formulas.
28. Emergency telephone numbers.
29. Common household poison antidotes.
30. Computer software and hardware comparisons.
31. Cumulative weather data.
32. Abbreviations.
33. Record of valuable household possessions.
34. Horse racing statistics.
35. Log of wine cellar contents, including years and quantities.
36. Insurance policy inventory including coverage, cost, account numbers, and deductibles for house, car, and health.

This list is not exhaustive, and perhaps only a few of these applications will be of use to you. This list does, however, serve to illustrate the variety of possibilities involving the storage of information with the assistance of your Apple IIGS. Sophisticated software is available commercially for data storage and retrieval on the IIGS. Appendix A lists several pieces of commercial software that can be used for these purposes.

AN INDEX TO YOUR LIBRARY

How often do you remember reading an important article or book chapter only to forget the name of the magazine or book? Your Apple IIGS can easily be used to help you organize and cross-reference your books and articles for instant retrieval using only the title, subject, or author to locate the pertinent entries. With the wealth of computer-related books and magazines that are available, an index to relevant subjects will ease the difficulty of finding a special tutorial or program.

One programming method that accomplishes this type of indexing stores information as a number of continuous strings of data. Each string of data is composed of several "fields," and each field is separated by a comma. An example of a string with fields describing a magazine article is as follows:



Data is formatted on a disk in a manner similar to this example. Random access disk commands allow the Apple IIGS to search for all entries with a given field. For example, you could specify a search for all entries having an author named "Smith." The IIGS would then search through the entire disk file examining all the fields containing the author names (the last field in the above example). All fields having "Smith" as the author would then be printed out.

In order to limit the search to more specific entries, the IIGS could examine more than one field. As an example, you could request a list of all arti-

cles published after 1980 concerning the stock market. The Apple IIGS would search both the category and date fields for data meeting both of these requirements. Narrowing the requirements down in this manner results in a more accurate listing at the conclusion of the search.

WORD PROCESSING

Writers have long been subjected to the limitations of using pen and paper as the tools for composition. Paper refuses to accept instant changes at the whim of the writer. Instead, the writer must resort to laboriously deleting, inserting, cutting, and pasting the text into its final form.

Fortunately, we are no longer restricted to using pen and paper to express our thoughts. Word processing programs permit the arrangement of words at the touch of a finger, making erasures obsolete. Similarly, correction fluid has been replaced by the delete key. Word processors give you the ability to write spontaneously. Whereas most people try to mentally edit their words before committing them to paper, the advent of word processing frees you to type as you think, and later modify your document painlessly. The writer enjoys the flexibility of the computer's monitor on which to correct grammatical and typographical errors before actually printing a document. Many writers feel that this ability enhances their creativity while also making writing easier and more enjoyable.

After your manuscripts, letters, or documents are corrected on the monitor, you can set printing parameters within your word processing program to control margins, page lengths, and page numbering. These parameters tell the printer how to reproduce the document exactly to your specifications. Finally, any errors missed during the on-screen editing process that are noted on the printed page can be quickly modified by correcting the word processed file. This means that there is never any need to retype the entire document.

Anyone who writes professionally or composes a letter or two each day should investigate the use of a word processor. Most commercial word processors are very easy to use and they can save tremendous amounts of time, labor, and money (Appendix A lists several word processors for the IIGS). As a matter of fact, word processing is considered one of the most useful applications for Apple IIGS owners.

With most word processors you can do the following:

- Block Move. This feature lets you move pieces of your text—from a word to several paragraphs—around like blocks. You can also delete a block at whatever point you designate, and the rest of the text will fill in the "hole." Or, conversely, you can add new blocks at any point. Think of a word processor as a food processor of writing, capable of slicing, chopping, and dicing the language with ease.
- Word Wrap. As you type on a word processor you can forget hitting the carriage return key at the end of each line, as the computer automatically puts as many words as possible on one line and then starts a new one. This, in computerese, is called *word wrap*.
- Search and Replace. You can instruct the word-processor program to search the entire text or a portion of it for the occurrence of a particular word or phrase. Suppose you would like to correct a misspelled name throughout a six page letter: just type in the name as you misspelled it and again as spelled correctly; the program will automatically correct this error throughout the text. The search command may also be used to rapidly locate a section in a large manuscript.
- Typeover. When you want to substitute one word or phrase for another, you can type your change right over the existing text, and the unwanted letters will vanish as the new ones appear to fill their places.
- Justify. Some programs will automatically adjust the spacing between words or letters so that each line can be printed out at the same length. This process is called *right justification*. Left justification simply means that the lines are aligned at the left margin as usual, although some programs can create special effects by aligning text only at the right margin or by centering all text.

These are the most basic features found on word processing programs. Many other special features come with certain word processing packages. For example, a mouse (see Fig. 1-2) can be used to position the cursor at any point on the screen to facilitate editing. A spelling checker program can automatically verify the spelling of each word you write against its vocabulary and make corrections. Similarly, a thesaurus program can, at your command, display several synonyms for thousands of common English words. Other programs are designed to correct faulty grammar—for those people who don't mind having a computerized English teacher. Still other software packages allow you to design type fonts and integrate graphs and pictures with your text. Several typesetting firms will also accept word processor output directly via a modem or floppy disk for instant, money-saving typesetting jobs.

LETTER WRITING

A word processing program expedites the creation of form letters. For example, if you are writing a business letter for several recipients, the body of the letter could be stored in the IIGS as a form letter. Then, you need to type only the addresses and other personalized information to be integrated within the text to form each complete letter. A mailing list program can be integrated with such a program to automatically produce personalized letters.

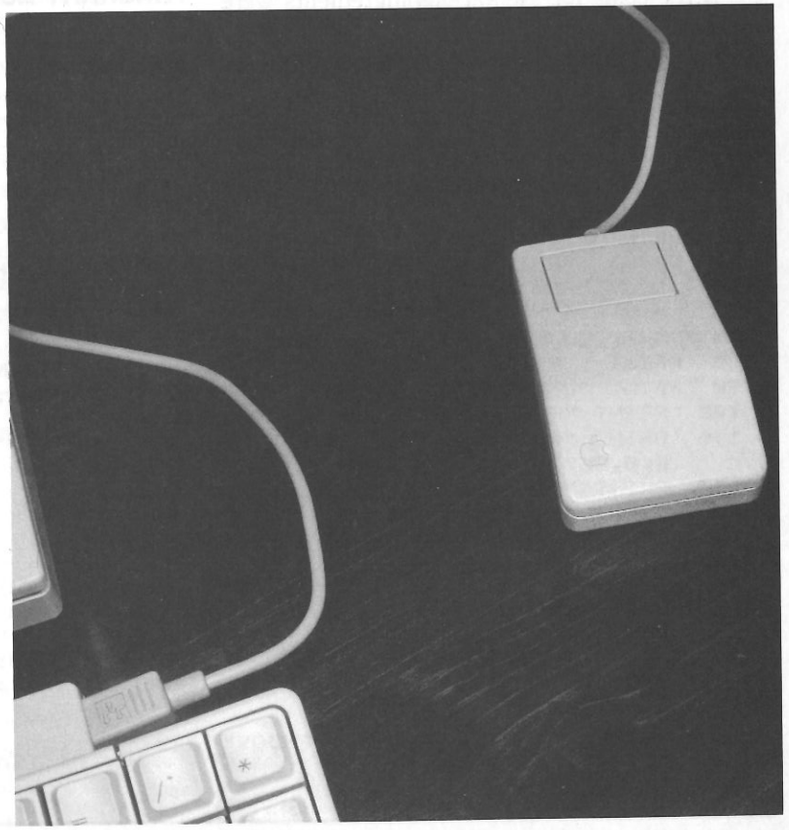


Fig. 1-2. A single-button mouse is used for controlling a desktop pointer within special IIGS application programs.

A RECIPE INDEX AND CALCULATOR

A collection of your favorite recipes can be stored on your Apple IIGS for rapid and selective retrieval. A list of the characteristics of each recipe could be included, such as the time required for preparation, whether the dish is hot or cold, the number of people served, the meal type, the cost, and the number of calories per serving. Using these characteristics, the Apple IIGS could index recipes and print lists of recipes with a selected characteristic for a special occasion.

A recipe calculator could change the amounts of each ingredient so that the proper amount of the recipe will be made for a given number of people. A simple recipe calculator subroutine is presented in Listing 1-1. It can be used alone or it can be incorporated into a recipe database program.

If the costs for the various ingredients were stored in your Apple, the cost of a given recipe could be quickly computed. This calculation could, of course, also include the number of people served as a factor in the final cost calculation. This type of program would be especially useful to those with a sideline or full-time bakery or catering service, because the costs for any recipe for any number of people can be quickly estimated.

A sample field of information for one recipe is shown below:

```
MEATLOAF,  6,     1.5 lb.gr.beef*1cupmilk*.
                  no.  5 cup onion*1egg,
name of item servings. abbreviated ingredients

      350          1. 5hr.,          Bill's favorite
  oven temp.      bake time           comments
```

ITINERARY ASSISTANT

A list of appointments, deadlines, and various tasks can be stored in an Apple IIGS and displayed in a specified format to assist you with your itinerary. Another format can be that of a calendar—each day's block would be filled with things to do. Is there some periodic task that you often forget to perform? Then program the IIGS to automatically remind you.

A program could also print out a customized daily appointment calendar. This program can include beginning and ending times, time intervals, and provisions for recording expenses and comments. It might also be helpful to incorporate a feature that calculates the day of the week that a particular day falls on.

The professional can use a more sophisticated program for the purposes of time billing for clients. The Apple IIGS can also be used as a dedicated reminder, using an audible alarm as a signaling method for those on complex therapeutic regimens.

Listing 1-1: Cook of the House Program

```
10  REM  COOK OF THE HOUSE
20  HOME
30  PRINT  TAB( 12)"IT'S DINNERTIME"
40  PRINT : PRINT : INPUT "HOW MANY GUESTS WILL THERE BE TONIGHT? ";G
50  INPUT "HOW MANY SERVINGS COULD THE ORIGINAL     RECIPE MAKE? ";S
60 I = G / S
70 X = 1: HOME
80  PRINT : PRINT : PRINT : PRINT "WHAT ARE THE INGREDIENTS?"
90  PRINT "USE THE FOLLOWING FORMAT: NAME, AMOUNT, UNITS."
100  PRINT "FOR EXAMPLE, EGGS,1,DOZEN"
110  PRINT "WHEN YOU HAVE ENTERED ALL OF YOUR        INGREDIENTS, TYPE DON
     E,0,OK"
120  PRINT "O.K., I'M READY...ENTER"
130  INPUT A$(X),B(X),C$(X)
140  IF A$(X) = "DONE" THEN  GOTO 160
150 X = X + 1: GOTO 130
160  HOME
170  PRINT : PRINT "PRESS ANY KEY TO CONTINUE"
180  FOR Y = 1 TO (X - 1)
190  PRINT A$(Y),I * B(Y),C$(Y)
200  GET Z$
210  NEXT Y
220  PRINT : PRINT  TAB( 17)"ENJOY"
230  FOR Z = 1 TO 2000: NEXT Z
240  HOME
```

TELEPHONE TIMER

When you are making long distance telephone calls, whether for conversations or telecommunications, keeping track of elapsed time can save you a considerable amount of money (see Listing 1-2). A computerized timer can display the amount of time spent on each call. Also, a record of the number called and the cost for the call could also be kept, for use with income tax deductions or for comparison with your telephone bill.

TELEPHONE FILE, DIALER, AND ANSWERING MACHINE

Listings of emergency and frequently used telephone numbers can be stored on your Apple IIGS, providing that the list is sufficiently long to warrant computer search capabilities.

The data strings used to store this information could be formatted as follows:

```
HOSPITAL,        AMBULANCE,
identifier       additional
                 related identifier
                 (to cross-reference)

643-1998 * 643-1997
tel. numbers
```

For those who enjoy hardware construction, the addition of a pulse or tone dialing circuit for a modem with an automatic dialing capability would allow an Apple IIGS to search and then automatically dial a desired number. If this circuit is used in connection with a burglar/security alarm system, the IIGS can be instructed to dial the police or fire department and deliver a tape-recorded message. You can also construct a computer-controlled, programmable telephone answering machine with

Listing 1-2: Timer Program

```
10  REM  TIMER
20  HOME
30  TEXT
40  PRINT  CHR$ (7)
50  PRINT : PRINT : PRINT  TAB( 17)"TIMER"
60  PRINT : PRINT "AT THE PRESS OF ANY KEY, YOUR IIGS WILL BECOME A VERY
     HEAVY STOP WATCH."
70  PRINT : PRINT : PRINT "WHEN YOU ARE READY...JUST PRESS A KEY."
80  GET Z$: PRINT  CHR$ (7)
90  HOME
100  FOR X = 10 TO 20
110  VTAB 10: PRINT  TAB( 10) CHR$ (95);
120  NEXT X
130  HTAB 10
```

```
140  FOR X = 10 TO 20: VTAB 20: PRINT  CHR$ (95);
150  NEXT X
160  VTAB 11: FOR Y = 10 TO 19
170  HTAB 9: PRINT  CHR$ (124)
180  NEXT Y
190  VTAB 11: FOR Y = 10 TO 19
200  HTAB 21: PRINT  CHR$ (124)
210  NEXT Y
220 Z = 1
230  VTAB 15: HTAB 15: PRINT Z
240  VTAB 12: HTAB 33: PRINT "ACTIVE"
250  VTAB 14: HTAB 33: PRINT "TIMER"
260  VTAB 16: HTAB 30: PRINT "X/60TH SEC"
270 Z = Z + 1
280  VTAB 15: HTAB 15: PRINT Z
290 K =  PEEK ( - 16384)
300  IF K > 127 THEN  GOTO 320
310  POKE  - 16368,0: GOTO 270
320  PRINT  CHR$ (7): PRINT  CHR$ (7)
330  VTAB 24: HTAB 15: PRINT "TIME"
340  POKE  - 16368,0
350  GET Z$
360  PRINT  CHR$ (7)
370  HOME
```

capabilities far exceeding those of commercially available models.

GREETING CARD/INVITATION LIST

A mailing list program could be used to address your holiday greeting cards. If your list is large enough, your Apple IIGS could sort zip codes, allowing you to send your cards under the bulk mail rate. (This would be most practical for businesses with large customer files.) Additionally, the IIGS could print a short "hello" note on the back of each card. The same idea could be applied to producing an invitation list for a party or meeting.

Similarly, a list of dates of birthdays and anniversaries could be stored, and each month the IIGS could remind you of the important dates for the upcoming month.

PERSONAL TIME MANAGEMENT SYSTEM

A personal time management system would assist you in planning the most effective schedule for completing a list of tasks. Input might include the description of each goal, the priority of that goal (using A, B, or C to represent categories of importance), and the deadline date. The program could use *PERT* (Program Evaluation and Review Technique) or *critical path analysis* to plan and output a schedule most evenly distributing the work load. Many people have found that they can accomplish much more if they make schedules and deadlines for themselves. PERT analysis will make that scheduling even more simple.

DECISION MAKER

Complex decision making can be facilitated through the use of the Apple IIGS (see Listing 1-3).

HEALTH

Your Apple IIGS can help you maintain your health. A listing of the caloric or nutrient content of various foods could be stored and subsequently referenced for determining the nutritive value of

Listing 1-3: Decision Maker Program

```
10  REM  DECISION MAKER
20  HOME
30  FOR X = 1 TO 12: PRINT  CHR$ (42);
40  FOR Z = 1 TO 10000: NEXT X
50  PRINT "DECISION"
60  PRINT : PRINT : FOR X = 1 TO 14: PRINT  CHR$ (42);
70  FOR Z = 1 TO 10000: NEXT X
80  PRINT "MAKER"
90  FOR Z = 1 TO 100
100 S =  PEEK ( - 16336):S =  PEEK ( - 16336)
110  NEXT Z
120  FOR Z = 1 TO 2000: NEXT Z
130  HOME
140  PRINT : PRINT : PRINT "ASK ME ANY QUESTION AND I WILL ANSWER"
150  PRINT : PRINT "JUST SPEAK THE QUESTION AND PRESS ANY   KEY..."
160  PRINT : PRINT "AND I'LL DO THE REST."
170  GET Z$
180 X =  INT ( RND (1) * 6 + 1)
190  IF X = 2 OR X = 3 OR X = 6 THEN S =  PEEK ( - 16336): FOR Z = 1 TO 1
     0:S =  PEEK ( - 16336): NEXT Z
200  IF X = 1 OR X = 4 OR X = 5 THEN  PRINT  CHR$ (7)
210  PRINT : PRINT
220  FOR Z = 1 TO 5000: NEXT Z
230  IF X = 1 THEN  PRINT  TAB( 18)"YES"
240  IF X = 2 THEN  PRINT  TAB( 19)"NO"
250  IF X = 3 THEN  PRINT  TAB( 5)"I WOULDN'T IF I WERE YOU"
260  IF X = 4 THEN  PRINT "100% GO!"
270  IF X = 5 THEN  PRINT "REPHRASE THE QUESTION, PLEASE."
280  IF X = 6 THEN  PRINT "I DON'T KNOW."
290  PRINT : PRINT "DO YOU HAVE ANY MORE QUESTIONS (Y/N)?"
300  GET Z$
310  IF Z$ = "Y" THEN  HOME : GOTO 130
320  HOME
```

the food you eat. Additionally, data on the sugar or the salt content of foods could be stored for the diabetic or the person on a salt-free diet. Such a program also lends itself well to diet planning.

A low-calorie diet-planning program would compute the number of calories you use per day (on the basis of weight, sex, height, and activities). If you consume more calories than you use up in energy, you build up reserves in the form of fat. Therefore, weight control is primarily based on calorie balance. The amount of weight you could lose by either reducing intake or increasing activities would be mathematically calculated. The following data should be helpful in writing a program to help you lose weight or maintain health through exercise.

A complete nutritional analysis program would allow you to input the types and amounts of food you have eaten during the day, would compute the total intake of proteins, carbohydrates, fats, fiber, vitamins, and minerals, and would determine your average intake of each per day. Similarly, it would compute your average energy expenditure (see Table 1-1) and then subtract this figure from your average daily nutrient intake to determine your calorie balance and to compare your intake with the recommended daily allowances for your age, sex, and weight (see Table 1-2). Therefore, areas for im-

Table 1-1. Energy Consumption Table.

Intensity of Exercise	Heart (Beats Minute)	Respiration (Breaths/Minute)	Energy Consumption (Calories/Hour)
maximum	200	50	1440
very	150	30	1008
heavy	140	25	864
fairly heavy	130	20	720
moderate	120	18	576
light	110	16	432
very light	100	14	288
resting	70	10	100

provement could be easily identified. A diet plan could then be determined to achieve these improvements.

One hobbyist uses a IIGS to determine his pulse rate and lead him through an exercise session, acting as the coach and timer. Along similar lines, another hobbyist computes the aerobic points that he earns in bicycling.

A general purpose data plotting subroutine could graph morning resting pulse versus minutes run on the previous day, or miles run versus subjective feeling at the end of the day to allow you

Mean heights and weights and recommended energy intake

Category	Age (years)	Weight (kg)	Weight (lb)	Height (cm)	Height (in)	Energy needs (with range) (kcall)	Energy needs (with range) (MJ)
Infants	0.0-0.5	6	13	60	24	kg × 115 (95-145)	kg × .48
	0.5-1.0	9	20	71	28	kg × 105 (80-135)	kg × .44
Children	1-3	13	29	90	35	1300 (900-1800)	5.5
	4-6	20	44	112	44	1700 (1300-2300)	7.1
	7-10	28	62	132	52	2400 (1650-3300)	10.1
Males	11-14	45	99	157	62	2700 (2000-3700)	11.3
	15-18	66	145	176	69	2800 (2100-3900)	11.8
	19-22	70	154	177	70	2900 (2500-3300)	12.2
	23-50	70	154	178	70	2700 (2300-3100)	11.3
	51-75	70	70	178	154	2400 (2000-2800)	10.1
	76+	70	154	178	70	2050 (1650-2450)	8.6
Females	11-14	46	101	157	62	2200 (1500-3000)	9.2
	15-18	55	120	163	64	2100 (1200-3000)	8.8
	19-22	55	120	163	64	2100 (1700-2500)	8.8
	23-50	55	120	163	64	2000 (1600-2400)	8.4
	51-75	55	120	163	64	1800 (1400-2200)	7.6
	76+	55	120	163	64	1600 (1200-2000)	6.7
Pregnancy						+ 300	
Lactation						+ 500	

One gram of Carbohydrate = 4 calories
One gram of Fat = 9 calories
One gram of Protein = 4 calories

Table 1-2. Recommended Caloric Intake Table.

to see where you've been and where you are going.

Listing 1-4 is a simple program that will help you calculate your pulse rate. The beginning runner is often unsure of how fast he should run. Pulse taking can be helpful to assure beginners that they're doing the right amount of work—not too much or too little. First, determine your base training pulse using the formula (220 – (your age)) * .65. Anyone who makes sure that his pulse does not rise above this value is in the safety zone where the heart is being strengthened rather than overtaxed.

SHORTHAND TRANSLATOR

You could develop a shorthand system that your Apple IIGS could be programmed to understand and translate. The system could be similar to that used by court reporters, in which a single key represents a word or part of a word. In this manner, you could quickly type your thoughts in shorthand form, and the IIGS could analyze your notes and print the English equivalent. The basic stenographer's character and word assignment list is given in Table 1-3.

KITCHEN INVENTORY

A file of all food items on hand, a pantry inventory, would be useful in determining whether or not a given recipe can be prepared. As each food item is added or subtracted from the pantry, the transaction would be entered into the IIGS. If a desired level of inventory is specified, the computer could automatically print out a shopping list of items that are below desired quantity levels. An inventory program of this type would be best suited for the gour-

Listing 1-4: Pulse-Calc Program

```
10  REM  PULSE-CALC
20  HOME
30  TEXT
40  FOR X = 1 TO 120: PRINT  CHR$ (64);: NEXT X
50  PRINT  TAB( 15)"PULSE RATE"
60  PRINT  TAB( 15)"CALCULATOR"
70  FOR S = 1 TO 100:P =  PEEK ( - 16336): NEXT S
80  FOR X = 1 TO 2
90  FOR S = 1 TO 200:P =  PEEK ( - 16336):P =  PEEK ( - 16336):P =  PEEK
    ( - 16336): NEXT S
100  FOR S = 1 TO 100:P =  PEEK ( - 16336): NEXT S
110  NEXT X
120  FOR S = 1 TO 200:P =  PEEK ( - 16336):P =  PEEK ( - 16336):P =  PEEK
    ( - 16336): NEXT S: HOME
130  FOR X = 1 TO 200: PRINT  CHR$ (64);: NEXT X
140  PRINT "COUNT YOUR NUMBER OF PULSES OVER A   15 SECOND TIME PERIOD."
150  PRINT : PRINT "I WILL TIME YOU.": FOR X = 1 TO 2000: NEXT X
160  PRINT : PRINT "READY...BEGIN COUNTING BY PRESSING ANY   KEY.": GET Z
    $: PRINT : PRINT "GO!"
170  FOR X = 1 TO 29000: NEXT X
180  PRINT : INPUT "STOP, HOW PULSES DID YOU COUNT ";P
190 P = P * 4
200  PRINT : PRINT "YOUR PULSE RATE IS ";P;" BEATS PER MINUTE."
210  FOR X = 1 TO 100: NEXT X
220  PRINT : PRINT "TRY ANOTHER (Y/N)?"
230  GET Z$
240  IF Z$ = "Y" THEN  GOTO 120
250  HOME
```

Character	Word	Suffix	Character	Word	Suffix
A	and	able	V	very	ver
B	been	bility	W	with	ward
C	can	cial	X	experience	
D	down	day	Y	you	
E	even	ent	Z	the	zation
F	from	ful	0	zero	
G	good	ght	1	one	
H	have	hood	2	two	
I	into	ing	3	three	
J	just		4	four	
K	know		5	five	
L	like	less	6	six	
M	more	ment	7	seven	
N	not	ness	8	eight	
O	other	ous	9	nine	
P	people		!	hundred	
Q	quite		@	thousand	
R	right	rent	#	million	
S	said	self	$	dollar	
T	that	tion	%	percent	
U	united	ugh	¢	cent	

Table 1-3. Basic Steno Character Assignment Chart.

met cook who must have a wide variety of seasonings and other ingredients on hand. The inventory of a wine collection or food in the deep freezer could also be maintained.

RATING CALCULATIONS

An equation to determine a rating for a particular stock, car, horse, or home could be computerized if it is referred to often or if it's complex. For example, the horse racing fan could use the following empirically derived equation to determine an objective rating for a particular horse:

$$\text{Rating} = (W + P/3 + S/6) \times 100/R + E/850$$

where W = the number of wins
P = the number of places
S = the number of shows
R = the number of races
E = the amount of earnings in dollars

Rating equations are empirically derived or are determined by finding the statistical correlation between a set of factors and the outcomes that the factors influence.

INVENTORY OF POSSESSIONS

A file of your personal property could be stored with the IIGS for insurance purposes or for determining your net worth. A database program could record the date of purchase, the place of purchase, length of warranty, description of item, price, serial number, and model number. For instance, you could set up a simple database for tracking possessions by using these four fields: date, store, item, and price. This information could be entered from sales receipts or from your checkbook. At the end of the year, the database could be printed and a backup disk stored for safe keeping. This could save you thousands of dollars in the event of a major disaster, because you will have excellent documentation of what you've owned.

The advantage of using a IIGS for inventory keeping is that items are easily added, deleted, or categorized, and a disk copy of the inventory can be stored in a safe-deposit box. If you own a business, use this type of program to inventory your business equipment.

The IIGS may also be useful in comparing various insurance policies to determine which plan offers what you need at the lowest cost. Professionally prepared insurance planning programs are available for the Apple IIGS.

INDEX TO IMPORTANT LITERATURE

Your favorite lines and passages of literature, quotations, scientific and business journal references, anecdotes, and other literary miscellanies could be collected, categorized, cross-referenced, and indexed for rapid retrieval. A specialized database program could be used for this purpose.

DAY OF THE WEEK CALCULATION

Calculation of the day of the week corresponding to a given date is useful to businessmen, vacation planners, and historians. For the sake of curiosity, some people have found amazing congruencies between the days on which U. S. Presidents were born and other significant events in history.

In order to calculate the day of the week for a specific date in the twentieth century, use the following formula:

$$N = D + M + Y[(0.8(2M + 1)] + [Y/4]$$

where D = day of the month
M = Month, where March is considered the first month, April the second, and February the twelfth
Y = Last two digits of the year
[ ] = The integer part of the result

Next, divide the sum N by 7. The remainder from the division gives the day of the week. Count 0 as Sunday, 1 as Monday, and so on.

Programs that calculate the date of Easter for forthcoming years have been written, and this remains an interesting programming challenge (hint—incorporate the above formula).

A simpler program could calculate the day of the year for a given date. Businessmen might find the results of such calculations useful.

FOOD STORE SHOPPING AID

The Apple IIGS can be programmed to add and categorize prices and types of items as they are found in weekly supermarket sale fliers. Provisions could be made for categorizing items into meat, groceries, produce, and taxable subdivisions. Additionally, there may be provisions for multiple entries, unit price calculations and comparisons, error correction, and a warning if a preset cash limit has been exceeded. Outputs could include total cost, tax, item count, and subtotals in each category. This type of program would help you decide where to shop and what specific items to look for.

COUPON FILE

For those who possess the money-saving habit of collecting food coupons, a computerized list of your coupons would be helpful. Enter each coupon by its amount, brand name, product name, and location in your coupon folders or envelopes. Next, enter your shopping list. A IIGS search between your shopping list and the available coupon list should yield a roster of coupons that may be used and where each one is located.

Alternatively, the Apple IIGS could store coupons by type of product, using, for instance, these categories: restaurants, pasta products, drinks, cereals, snacks, meat, poultry, fish, vegetables, condiments, dairy products, baking items, pet food, cosmetics, paper goods, cleaning products, medicine, and miscellaneous. You can call up the list of coupons within a specific category to select the coupons that you are interested in and pick one for a particular brand name product.

HOME PLANNING

A useful program could be written to help a family design a house to fit its needs. The expense of a house certainly justifies an in-depth analysis

of the design before construction is started. You could use a commercially available computer-aided design (CAD) program, to draw and transform basic house plans.

In regards to area planning, square footage could be calculated with the following guidelines in mind: the minimum square footage should equal the number of family members times 200, and the desirable square footage should equal the number of family members times 300. An activity list such as the one below could be included to ensure that the family's activities will not conflict and that there will be provisions for all activities. The program could request the user to enter the activities that are to be done in each room and the times involved. Conflicts could, therefore, be analyzed, and the plans could be altered accordingly. The following activities could be included in the program:

Group Activities

1. Lounging—indoors and outdoors
2. Television watching
3. Listening to stereo, tapes, or radio
4. Playing a musical instrument
5. Meals
6. Children's play areas

Social Activities

1. Holding a meeting in the home
2. Children's/adult's games
3. Viewing movies/slides
4. Visiting with guests

Work Activities

1. Meal preparation and clean-up
2. Household business
3. Laundry
4. Ironing, sewing, or drying clothes
5. Workshop area

Private Areas

1. Study or reading areas
2. Grooming or dressing facilities

Traffic patterns and storage requirements could also be analyzed.

Storage Requirements

Bedrooms: minimum of 4′ by 6′ by 2′ closet space per person
Kitchen: approximately 10 linear feet of base and wall cabinets

PRIVATE INFORMATION STOREHOUSE

Almost everyone has some private informational items—financial information, diaries, or important numbers—that they would like to keep more securely than in a filing cabinet. A program could be written to store this information in coded form so that it could only be retrieved by someone with the proper password. Copies of such data could be stored in a safe-deposit box.

GENERAL PURPOSE CLOCK OR TIMER

Your Apple IIGS, with its internal clock, can be used as an electronic timer or time controller for scientific research, sporting events, or other applications requiring a stopwatch. The capabilities that your IIGS has, but a stopwatch doesn't, are the automatic storage and printout of selected times and the automatic control of instruments or other devices that must be turned on or off at given times.

Your IIGS can even use its timing capabilities to act as a simple timer for applications in which accuracy is not a major factor (see Listing 1-5). When they are not using their Apples for more practical tasks, some hobbyists have transformed their computers into very elegant clocks, with graphic displays of hour and minute hands, digital displays, simulated sundials, or even sand timers (see Fig. 1-3).

CARPENTERS' AND MECHANICS' HELPER

The Apple IIGS can expedite the numerous cal-

Listing 1-5: Tick-Tock Program

```
10  REM  TICK-TOCK
20  HOME
30  TEXT
40  PRINT : PRINT : PRINT "   PRESS ANY KEY TO STOP TICK-TOCK"
50  FOR Z = 1 TO 2000: NEXT Z
60  HGR2
70  HCOLOR= 3
80 R = 50:P = 100
90  FOR X =  - R TO R
100 Y =  SQR ((R ^ 2) - (X ^ 2))
110  HPLOT X + P,Y + P
120 Y = Y * ( - 1)
130  HPLOT X + P,Y + P
140  NEXT X
150  FOR Y =  - R TO R
160 X =  SQR ((R ^ 2) - (Y ^ 2))
170  HPLOT X + P,Y + P
180 X = X * ( - 1)
190  HPLOT X + P,Y + P
200  NEXT Y
210  FOR S = 1 TO 100:P =  PEEK ( - 16336): NEXT S
220  HCOLOR= 3: HPLOT 100,100 TO 100,50
230  FOR S = 1 TO 100:P =  PEEK ( - 16336): NEXT S
240  HCOLOR= 0
250  HPLOT 100,100 TO 100,50
260  HCOLOR= 3
270  HPLOT 100,100 TO 150,100
280  FOR S = 1 TO 100:P =  PEEK ( - 16336): NEXT S
290  HCOLOR= 0
300  HPLOT 100,100 TO 150,100
310  HCOLOR= 3
320  HPLOT 100,100 TO 100,150
330  FOR S = 1 TO 100:P =  PEEK ( - 16336): NEXT S
340  HCOLOR= 0
350  HPLOT 100,100 TO 100,150
360  HCOLOR= 3
370  HPLOT 100,100 TO 50,100
380  FOR S = 1 TO 100:P =  PEEK ( - 16336): NEXT S
390  HCOLOR= 0
400  HPLOT 100,100 TO 50,100
410  HCOLOR= 3:K =  PEEK ( - 16384)
420  IF K <  = 127 THEN  GOTO 220
430  POKE  - 16368,0
440  TEXT
450  HOME
```

culations required by carpenters and mechanics when they perform tasks such as changing the dimensions of a set of plans, converting between anglo and metric measurements, and estimating the amount of building materials needed. Some useful formulas include:

Anglo/metric Conversions

1 meter = 39.37 inches
= 3.281 feet

Table 1-4. Uses for Database Management System.

BUSINESS USES		EDUCATIONAL USES		HOME & HOBBY USES
Customer filing	Workshop data	Student records	Field trips	Personal records
Prospect lists	Assets lists	Grade records	Vehicle records	Check lists
Master files for . . .	Marketing data	Teacher lists	Tenure records	Club rosters
Gen. Ledger	Insurance data	School lists	Parking assignment	Telephone directories
Accts. Receiv.	Pricing schedules	Program design	Violation records	Recipes files
Accts. Payable	Formulas	Tuition data	Meeting schedules	Medical information
Payroll Records	Production data	Enrollment data	Facility schedules	Property records
Personal data	Processes	Property/equipment		Appliance warranties
Telephone logs	Cross referencing	Athletic schedules		Insurance records
Telephone lists	Commission records	Player assignment		Christmas lists/gifts
Hotel/travel data	General filing	Games schedules		Appointments
Reservations		Player statistics		Articles indexes
Property control		Mailing lists		Tax records/data
Library catalogues		Test scores		Expenses
Inventory		Menus		Book ownership
Key Employee data		Diet selections		Utility records
Advertising data		Inventory		Deposit files
Source files		Seating charts		Due dates
Sales leads		Cataloguing		Travel records
Mail lists		Laboratory data		Meal planning
Private records		Inspection data		Mortgage data
Corp. records		Experimental data		Auto records
Directories		Attendance data		Crop yields
Billing information		Course description		Source files
Delivery schedules		Purchase orders		Magazine Article index
Routes		Requisitions		Estimate files
Territories		Vacation records		Investments
Quotations		Budgets		Plus all the Business &
Applintments		Maintenance data		Educational overlaps
Conventions		Locker assignment		

= 1.0936 yards
1 inch = 2.54 cm
1 foot = 30.48 cm
= .3048 m
1 yard = .9144 m
1 mile = 1609 m
= 1.609 km

Wall Paper Estimator

$$N = \frac{8640}{W \times (H + R)} \qquad P = \frac{S}{W \times N}$$

where N = the number of strips in one roll
W = the width of the paper
H = the height of the wall
R = the repeat length of the pattern
P = the number of double rolls needed
S = the width of the wall to be covered

Concrete Block Estimator

$$N = \frac{H \times L \times 1.25}{125}$$

where N = the number of blocks
H = the height of the wall
L = the length of the wall

Concrete Yardage Estimator

$$Y = \frac{L \times W \times T}{324}$$

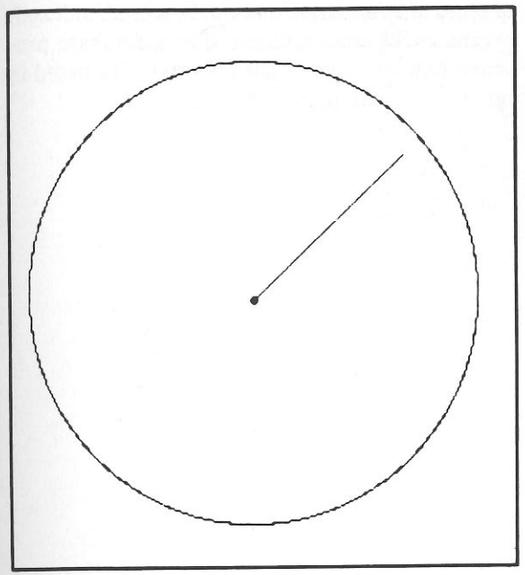


Fig. 1-3. A screen dump of Listing 1-5 in operation.

where Y = the volume of concrete in cubic yards
L = the length(ft.)
W = the width(ft.)
T = the thickness(in.)

CAR MAINTENANCE CALCULATIONS AND RECORD KEEPING

In addition to calculating and recording your car's miles per gallon, your IIGS could keep track of mileage statistics and signal you when a periodic check-up, overhaul, or oil change is necessary. For business people having the privilege of deducting automotive expenses, the IIGS could keep tabs on amounts spent.

RAFFLE TICKET PRODUCER AND DRAWER

If your organization is sponsoring a raffle drawing, your IIGS could print out serialized raffle tickets and then draw the winning ticket based on a random number generator.

DATABASE USE

Many of the program ideas described in this chapter can be implemented with a general purpose database program. This type of program should be able to store information pertaining to many items on a disk and then retrieve selected information.

The usual method of storing data involves the use of one string of information containing several fields of separate data. A field is an item of data. For example, a string containing five fields might look like this:

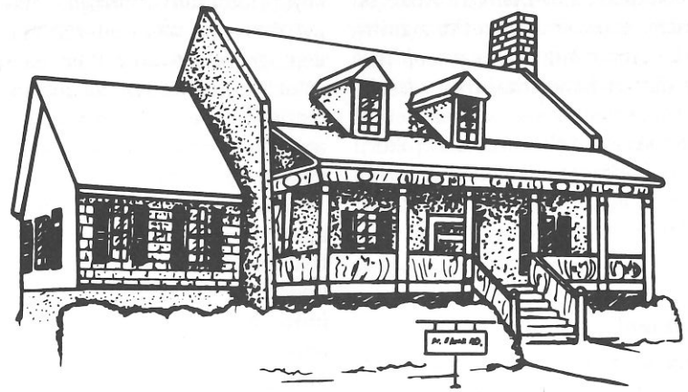
Boolean Algebra*Byte Magazine*25*Schwartz*Feb 1978

The first field signifies the title of the item (in this case, a magazine article). All of the strings to be stored would be formatted in the same way, with the title of the item in the first field. Also, a limit is usually set on the length of any field. If the information in one field does not contain enough characters to fill the allocated space, extra spaces are added. The longer the field, the fewer records the disk can hold. You'll learn to make fields as short as possible when you are dealing with a large database.

The second field in the example above contains the name of the source of the item. The third, fourth, and fifth fields contain the page number, author, and issue date respectively. An adequate database program should be able to search through many such strings and output those that contain items that you want. For example, you can store an index to your library on a database system and subsequently obtain a listing of all of the references pertaining to the stock market and written after a specific date. You would simply instruct the computer to search for all items that contain "stock market" in a certain field and a date later than the date specified in another field. Because the position of each field in all strings is fixed, the computer can search through a string to the beginning of the proper field. Specific information can easily be accessed in this manner.

Database programs are extremely useful Apple IIGS tools because of their wide applications. In what applications could you use a database? The list in Table 1-4 names a number of the thousands of types of information that can be stored, indexed, organized, or cross-referenced by a database program. Many of these applications are discussed in more detail throughout this book.

Chapter 2



Business and Financial Applications

Personal computers have greatly altered the business world by permitting rapid calculation of numerous "What if . . . ?" questions involving both complicated financial formulas and the more traditional accounting functions. Likewise, the home owner will find the Apple IIGS useful in analyzing loans, budgets, and investments. Calculations that were previously time-consuming and open to error can now be accomplished with ease, which permits better decision making.

FINANCES AND INVESTMENTS

A growing number of investors are using their Apple IIGS to help them manage their stock and bond portfolios, analyze trends in the financial markets, investigate individual stocks, and decide when to buy or sell. A IIGS connected to a database can sort out enormous quantities of market and company statistics for an investor; within seconds the results may be projected on the screen as charts, tables, or graphs. This quick access to data enables an investor to evaluate a buying opportunity—or a must-sell situation—quickly and probably more accurately than if the calculations were done by hand. Therefore, the Apple can sometimes make your life as an investor more rewarding and often much easier. Additionally, the cost of investment programs, through proper use, may be counted as a business expense for tax purposes, as can part or all of the cost of your Apple. Be sure to consult your tax guides to determine the exact qualifications.

Stocks, Bonds, and Securities

The IIGS has come to the aid of the individual investor in three areas: portfolio management, technical and fundamental analysis, and database access. Making investment decisions or recommendations requires accurate technical analysis of large amounts of data on a timely basis. Compiling information in standard formats concerning stock performance or company finances, doing statistical computations to update individual stock files, tracking moving averages, and maintaining complete records of one or a number of portfolios are all tasks

ideally suited to the Apple. Professional brokers, as well as individuals, have witnessed the significant impact that the Apple IIGS can have on the analytical functions on which they base their recommendations. With the advent of the bull market of the early 1980s and the rise of the discount broker, professional software packages have become available to help investors at home make the investment decisions that used to be made by their full-service brokerages.

Portfolio Management

Portfolio management programs are really just electronic notebooks. They keep a complete record of the stocks you own and show how well you're doing at the game. They are especially useful at tax time; their compilations of your losses, gains, dividends, and brokerage commissions make it easy to account to the IRS (Internal Revenue Service) for your Wall Street activity.

The limitations on most packages involve the number of stock characteristics maintained or computed for each stock. Most packages will allow for a virtually unlimited number of stock records (letting you track your own portfolio, as well as that of several financial advisors), as long as you are willing to maintain them on a number of separate floppy disks.

The simplest individual portfolio management programs provide a means of recording the basic information on stocks in your own portfolio or on any other stocks that you wish to track for comparison. When you choose to update—on a daily, weekly, or other periodic basis—the program will automatically perform certain calculations, such as the present value of the issues, or long- and short-term gains and losses (as if you sold the stock on that date). It can automatically remind you of a stock that will go long-term within 30 days or maintain other information such as dates and number of shares purchased, total number of shares owned, dividends, growth rate, and percentage appreciation or depreciation. The following analysis factors may be computed for the entire portfolio: sum of cost prices, sum of current value, sum and percentage difference between cost and current price, percentage return on a cost basis, and percentage return on the current value. A report may be automatically prepared for attachment to IRS forms, and the portfolio information may be printed in a variety of formats for ready reference.

More advanced portfolio management packages allow hundreds of open tax lots in a system that matches your transactions against open positions to let you make investment decisions that minimize your tax liability. You can track stocks, options, bonds, treasuries, and mutual funds; the system can accommodate buy, sell, short sell, and buy-to-cover transactions. Return on investment for each stock and the entire portfolio can be computed, as well as the total net earnings. Sophisticated programmers could make use of Sharpe's method (or another method) in determining the proportion of funds that should be allocated to each security in a portfolio to maximize returns.

Technical and Fundamental Analysis

Fundamental analysis assumes that the price fluctuations of stocks are based on the basic financial health of the economy and the performance of the individual company. Therefore, fundamental analysts look at such factors as earnings, sales, assets, and liabilities and use these factors to predict future price movements.

Technical analysts argue that these factors affect stock prices only over a long period. Short-term fluctuations, they maintain, are governed by psychological conditions in the market itself, not external factors. Therefore, they believe that the study of the past market behavior can determine the way to profits in the future. There are many different theories that promote various indicators as being the key to future price movement. Some of the major indicators are the relationship between price and volume, market averages, and new highs versus former lows.

Both fundamental and technical analyses call for extensive number crunching and are well suited

for being handled by computers, although fundamental analysis stretches the memory capacity of the Apple IIGS. In fact, almost all of the analysis programs available on the Apple market do technical analysis. In technical analysis, computers can be especially useful in charting various relationships between individual stock prices and trading volumes. A IIGS can turn a pile of statistics that might take several hours to plot by hand into a chart within seconds. The remainder of this chapter discusses some popular means of technical and fundamental analysis. Interested readers are referred to popular manuals on investment analysis, statistics, and the following publications on computer-assisted stock analysis for further information:

* Milner, W. L., *Personal Money Management with Your Micro*, TAB Books, Inc., Blue Ridge Summit, PA 17214.
* Schmeltz, L. R., *Playing the Stock and Bond Markets with Your Personal Computer*, TAB Books, Inc., Blue Ridge Summit, PA 17214.
* Sparks, L. E., *Investment Analysis with Your Microcomputer*, TAB Books, Inc., Blue Ridge Summit, PA 17214.
* Zonderman, J., *The Personal Computer Investment Handbook*, TAB Books, Inc., Blue Ridge Summit, PA 17214.

With an Apple IIGS at your disposal, you can now develop and test a market theory without countless, error-prone manual calculations. A "paper portfolio," or a collection of stocks to track that are not actually owned, was once too time and effort consuming for the individual investor to experiment with. Now, when you experiment, each "buy and sell" decision can be based on actual market performance and serve as a "lesson learned" in developing your own trading strategies.

Moving Averages

Moving averages provide a measure of the movement of a stock relative to itself (in price, dividend, or volume), a composite summary of a key factor (for example, the average price of a stock group), and a ratio of two or more key factors (for example, price/earnings ratios). The moving average is often most useful in predicting the buy versus sell position of a stock in regard to its past trend. If the current stock price drops below the moving average, a sell position would be taken and vice-versa for a buy position.

Price/Volume Trace

In this analysis technique, the daily stock price and volume data are considered as (x,y) data points. Probability rules may be developed as clues to the immediate future performance of the stock price as it relates to volume.

Rate of Change

The rate of change is a measure that involves price fluctuations of a stock to itself and may be used to compare stocks in terms of price, sales, or earnings. On this basis you can find the stock with the best potential to increase in price in the immediate future, barring any information or indication that the current stock trend will change or reverse. It is computed as follows:

$$\% \text{ Rate of Change} = \frac{\dfrac{\text{Ending-Starting Price}}{\text{Starting Price}}}{\text{No. of trading days}} * 100$$

This value may be determined for daily, weekly, monthly, or yearly periods of time by altering the denominator.

Change Distribution

This analysis technique compares the distributional change of individual stocks within a group to the average change of the group for a given time period. This provides a probabilistic measure of the rate of change in either relative or absolute terms.

The stock distribution, like a normal distribution, is described by the factors of price average

and standard deviation; the standard deviation usually increases as the length of time considered increases and as the market rate of change increases. By knowing the typical stock price distributions for different market index rates of change, the probability of success in short-term trading is increased; the investor is equipped with the probability distribution of the price change.

Price Indexes

Price indexes are indicators of the central drift of a set of stocks or the market as a whole. These indexes include the Dow-Jones, New York Stock Exchange, American Stock Exchange, and Standard & Poor. They can be best applied to determine a consensus of individual stock trends within a given stock category. An indicator that is well suited for computation on your Apple uses the formula:

$$\text{INDEX} = \sum_{\text{all stocks}} \frac{x_n y_n}{y}$$

where x_n = stock price
y_n = number of shares traded at x_n
y = total shares traded

The moving average and indexing concepts may be used as powerful decision-making tools in determining whether the investor should be anticipating a trading decision, trading, or investigating other investments.

Ratio Relationships

The use of ratios is popular in business and finance because they afford a means of comparison of two or more factors that influence investment decisions. A well-known example is the price/earnings (P/E) ratio used in measuring the potential of a stock. Others include the ratio of sales growth, the ratio of consecutive period earnings, the yearly high stock price versus the yearly low price, and the relative strength of a stock versus the market index. The IIGS may be used in automatically calculating many of these popular ratios and in forecasting changes of ratios through the use of statistical regression. For instance, the future price of a stock may be computed given current value per share, projected earnings, and projected percent change in the P/E ratio using this simple formula:

$$V_p = \frac{V_c E_p^{\,2}}{E_c^{\,2}}$$

where V_c = current value per share
E_p = projected earnings
C = projected percent chance of P/E ratio
E_c = current earnings
V_p = projected value per share

Note that all projected values must be for the same length of time.

Trend Line Analysis

Trend line analysis (see Fig. 2-1) is a major statistical computation in financial analysis and is accomplished by using the method of linear least squares fitting of data. Suppose that you obtained a set of data listing the value of one stock over a period of time and that these values were plotted versus the Dow-Jones Index. A trend line analysis would determine the equation of the line that best fits or describes the data, telling you how one variable is related to the other. This equation, in the form of $y = a + bx$, provides a means to estimate the value of a variable (y) given the value of the other variable (x). The other values (a and b) are determined using these regression equations:

$$b = \frac{n\Sigma XY - \Sigma X \Sigma Y}{n\Sigma X^2 - (\Sigma X)^2}$$

$$a = \frac{1}{n}(\Sigma Y - b\Sigma X)$$

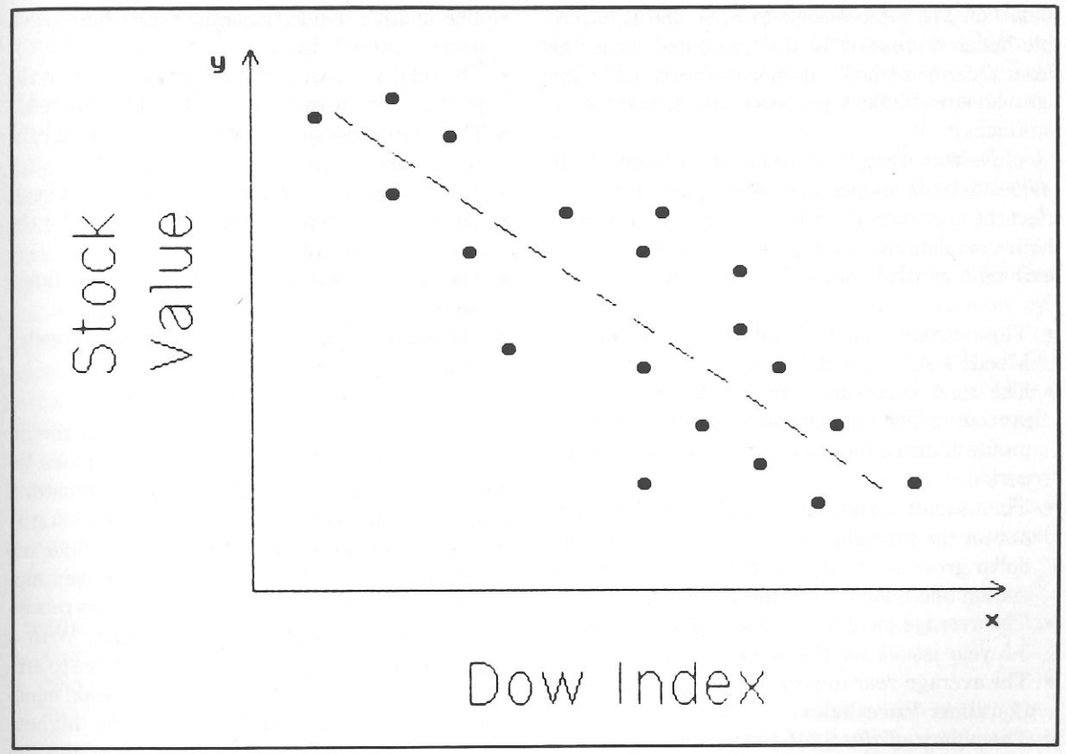


Fig. 2-1. A generic trend line graph.

where n = no. of (x,y) pairs
X = individual x values
Y = individual y values
b = slope of line
a = y axis intercept

As described in Chapter 3, the standard error may be calculated for a regression line to determine how well it describes the data.

The technique of multiple linear regression is used by investors in determining the influence of more than one variable (x . . .) on another variable (y). The total variation in y may often be better explained through the use of multiple x variables (y = . . .), allowing a more precise prediction than is possible through the simple linear regression discussed above. For instance, one investor using Apple techniques has developed a four-variable regression equation describing the stock market average:

$$\log V = a + b \log E + c \log G - d \log R$$

where V = Value of the average
E = Earnings of the average
G = Growth rate of the average's earning
R = Yield of quality long-term bonds

In this example, the variables (E, G, R) are regressed on V. The constants (a, b, c, d) are determined and used in predicting future values of V

based on past relationships to E, G, and R. Multiple linear regression is also computed using the least squares method. For more information on the least squares method, please consult a textbook on statistics.

Investors using multiple linear regression techniques have developed modeling equations that reflect the influence of a wide variety of factors, with high correlations, on stock and security prices, earnings, and P/E ratios. These include:

- The current month's interest yield of the Moody's AAA Bond Index.
- The ratio of pretax corporate profits for the preceding twelve months to pretax corporate profits adjusted for inventory profits for the same period.
- The ratio of current dollar gross national product for the preceding twelve months to current dollar gross national product for twelve months ending one quarter into the future.
- The average yield on taxable U.S. Government 3-5 year issues for the preceding six months.
- The average year-to-year percentage gain of the Consumer Price Index.
- The equity of the S&P 400 one year previous divided by the earnings of the S&P 400 for the latest twelve months.
- The relative consistency of divided growth for ten years, in terms of the ratio of the correlation of the stock's dividend growth with time to that of the S&P Industrial Stock Average's dividend growth.
- The relative consistency of earnings growth for ten years, computed as above.
- The relative profit margin for the latest report twelve months.
- The relative rate of earnings growth for the previous ten years on a per-share basis.
- The relative size measured by net income for the latest twelve months.
- The relative return on equity, as earnings less dividends divided by equity at the beginning of the twelve-month period.
- The relative five-year earnings-per-share least-squares growth rate.
- The relative prospective return on equity in the year for which earnings are being estimated.
- The relative prospective earnings growth for the next quarter.
- The relative reinvestment rate in the latest year.
- The relative prospective earnings growth for the next two quarters.
- The relative dividend payout ratio for the latest twelve months.
- The relative earnings growth for the latest twelve months.

Many other variables could be used at the investors discretion, including DJIA (Dow-Jones Industrial Average), specific industrial indicators, gross national product (GNP), employment statistics, disposable personal income statistics, indexes of industrial production, bank deposits, money supply, interest rates, inventory levels, accounts receivable/payable, and railroad freight usage. With a large selection of apparently useful variables to employ, you can now build a multiple regression equation on your Apple, seeking both the highest possible correlation and confidence level and the least interaction among the variables chosen. The variables may be regressed against individual stock performance, group stock performance, and market indexes or other securities. Those variables that are generally most useful include measures of preceding and following interest rates, inflation, economic activity (e.g., GNP), industrial health, and rates of change.

Database Searching

With the advent of databases that are available to the individual investor at low rates, an Apple computer can be instructed to search for stocks fulfilling any combination of investment criteria. If, for example, you are a conservative investor, you could have a program hunt for companies whose shares have a P/E ratio of 5 or less and annual yields of 10% or more—both of which can signify undervalued companies.

Financial Ratio Analysis

Financial ratio analysis is an ideal, simple method of determining how well a particular company has performed, in relation to other companies in its industry or in relation to its own past performance, and of predicting future performance. Described below are several popular financial ratios that can be determined using figures from corporate annual reports and a simple Applesoft BASIC program that does the necessary calculations or comparisons with figures concerning other corporations. Over the years, security analysts, brokers, and investors have found that financial statements become more meaningful when ratios between various values on the income and balance sheets are computed. These ratios may be divided into four categories:

Liquidity Ratios
- Current ratio
- Quick ratio
- Inventory to working capital

Leverage Ratios
- Debt to total assets
- Times interest earned
- Current liabilities to net worth
- Fixed assets to net worth
- Debt to equity

Activity Ratios
- Cash velocity
- Inventory turnover
- Fixed assets turnover
- Average collection period
- Total assets turnover

Profitability Ratios
- Net operating margin
- Net income margin
- Return on assets
- Return on net worth

Liquidity Ratios are designed to measure a firm's ability to meet its obligations as they mature and relate to the amount of cash in the near future.

Leverage Ratios measure the financing provided by owners as compared with the financing provided by the firm's creditors. Creditors look at the owner-supplied funds to provide them with a margin of safety, but by raising funds through debt, the owners are able to maintain control of the firm with a small investment. The return for the owners is magnified when the firm earns more on the borrowed funds than it pays in interest.

Activity Ratios determine how effectively the firm utilizes the resources that are available.

Profitability Ratios demonstrate the result of the policies and decisions of the firm's management. Both operating margins and new profits are calculated to distinguish between the results of operating policies and the results of financial policies.

The input data needed for computation of these ratios is usually found in the financial statements of a company and includes:

Cash—all cash on hand plus cash in the company's bank accounts. Any cash in certificates of deposit or other short-term deposits should be included.

Marketable securities—investments in obligations that are readily marketable and can be converted into cash on short notice.

Receivables (beginning)—receivables should be net of any reserve for doubtful accounts, and they should also be fully collectible within one year. Beginning receivables are those that were due to the company at the beginning of the operating year.

Receivables (ending)—those receivables due to the company at the end of the operating year.

Inventory (beginning)—inventory that is on hand at the beginning of the operating year.

Inventory (ending)—inventory that is on hand at the end of the operating year.

Current assets—the total cash, marketable securities, receivables, inventories, and other assets of

the company that are expected to be converted into cash in the normal course of business within the current operating year.

Fixed assets—assets such as land, buildings, leasehold improvements, equipment, fixtures, furnishings, vehicles, and other assets with lives longer than one year that are used in the operations of the company.

Total assets—the total of all assets of the company, including current assets, fixed assets, and other assets.

Current liabilities—debts of the company that must be paid within one year, usually consisting of trade accounts payable, payroll taxes withheld, accrued expenses, and that portion of long-term debt coming due within one year.

Total liabilities—the total of all debt of the company, including current, as well as noncurrent, liabilities.

Net worth—(also called owner's equity or stockholder's equity) the difference between total assets and total liabilities.

Sales—the total revenues earned by the company during the year, net of all sales discounts and returns.

Gross operating profit—found by subtracting the cost of sales from the sales. This final value represents the difference between the sales price of all items sold and the cost of the items sold.

Interest charges—the total amount of interest that has been paid by the company on its indebtedness.

Profit before income taxes—the net income of the company for the year after all of the expenses have been considered. This figure is commonly referred to as the "bottom line."

Current Ratio. This ratio is computed by dividing current liabilities into current assets. This ratio is the generally accepted measure of the ability to satisfy short-term obligations. Current ratio also indicates the extent to which claims of short-term creditors can be covered by assets that can be converted to cash in a period corresponding to the time when the obligations become due.

Quick Ratio. This ratio is computed by deducting inventories from current assets and dividing the remainder by current liabilities. This is a measure of the ability to pay short-term obligations without relying on the sale of inventories and is a better guide to short-term liquidity than is the current ratio.

Inventory to Working Capital. This ratio demonstrates the proportion of working capital tied up in inventory and is used to find the possible loss to the company resulting from a decline in inventory values. In this situation, a low ratio is desirable.

Debt to Total Assets. This ratio measures the company's obligations to creditors in relation to all the funds provided to the company; the lower the ratio, the greater the protection from losses being incurred by the creditors in the event of a liquidation. Generally speaking, the maximum debt ratio should be 50 percent.

Times Interest Earned. This ratio is determined by dividing earnings before interest and taxes by interest expense. This measures the extent to which earnings could fall before the company is unable to pay the annual interest costs; the lower the ratio, the more difficulty the company will have in raising additional funds. A manufacturing company should cover interest more than four times and public utilities should cover interest about three times.

Current Liabilities to Net Worth. This ratio indicates the amount of funds supplied by owners compared to funds provided by current debt; if the owners have not put enough funds into the company, long-term creditors will be less likely to provide funds, and the company will have to utilize short-term financing to a greater extent, lengthening the time before current bills are paid. Therefore, lower ratios are favorable.

Fixed Assets to Net Worth. This ratio indicates the extent to which owner's funds are invested in assets with little turnover. Higher ratios will result for industries that are capital intensive versus companies that are labor intensive.

Debt to Equity. This ratio demonstrates the relation between the total debt of the firm and the funds provided by the owners; the lower the ratio, the greater the protection against creditors' losses in the event of liquidation. Owners may desire a high ratio because this will magnify earnings and prevent possible dilution of control of the company if additional equity must be raised.

Cash Velocity Ratio. This ratio is computed by dividing cash and cash equivalents into sales. This ratio indicates the number of times cash has turned over within the year; a high cash velocity indicates that cash is being used effectively.

Inventory Turnover. This ratio is computed by dividing the cost of sales by inventory. This ratio indicates the liquidity of inventory; a high inventory turnover shows that inventories are being held to a minimum, and a low ratio may indicate obsolete or slow-moving stock.

Fixed Assets Turnover. This ratio is computed by dividing sales by fixed assets. This measures the utilization of fixed assets; a low ratio may indicate that the plant isn't being utilized as effectively as possible, unless the company is labor intensive.

Average Collection Period. This ratio is computed by dividing accounts receivable by average daily sales. This represents the average time period after making a sale before the cash is actually received. The result indicates the effectiveness of credit and collection policies; these may need to be strengthened if this ratio is on the increase.

Total Assets Turnover. This ratio is computed by dividing sales by total assets. This shows the effectiveness of the firm in utilizing resources to generate sales; a high ratio may indicate over utilization of assets, and a low ratio may indicate an excessive investment or idle assets.

Gross Operating Margins. This ratio is computed by dividing the gross operating profit by sales. This ratio determines how far unit selling prices may decline before resulting in a loss from the sale of units and how products are priced in relation to their cost.

Net Operating Margin. This ratio is computed by dividing profit before taxes by sales. This shows the amount each sales dollar provides to the continuing operation of the firm before consideration of income taxes.

Net Income Margins. This ratio is determined by dividing net profits after taxes by sales. A lower ratio indicates that selling prices are relatively low and that the total costs are relatively high; therefore, a small percentage drop in sales may result in losses. This ratio indicates the profitability after taking into account all income taxes and expenses and measures the return on sales.

Return on Assets Ratio. This ratio is computed by dividing net profits after taxes by total assets. This measures the rate of return on total resources.

Return on Net Worth Ratio. This ratio is computed by dividing net profit after taxes by net worth. This ratio is indicative of the company's earning on the investment of shareholders. A high or increasing value is favorable, although a very high value may indicate intense competition. Additionally, temporary inventory profits may be the result on increasing commodity prices. A high value could also be caused by general prosperity or a declining position.

Combined Coverage. Combined coverage is computed by dividing annual interest and debt costs plus preferred dividends into the adjusted operating profit after taxes and before interest. A combined coverage of four is considered acceptable for an industrial company; a coverage of three times the combined requirements would make a utility stock high-grade.

Dividend Payout. The dividend payout is the percentage of earnings on common stock that are paid out as dividends. Industrial companies average about 55 percent, utilities average 70 percent, and growth companies reach less than 55 percent.

Book Value Per Share. The book value per share is determined by adding the stated or par value of the common stock to the additional paid-in capital and retained earnings accounts and divid-

ing by the number of common shares. The book value would be lower for companies in which preferred stock is entitled to share in additional paid-in capital. The book value is not as important an indicator as earnings and prospects for industrial companies. The book value of stock for financial institutions and utilities, however, is important in analysis.

Additional Investment Applications

On the following pages you will find ten more ways in which you can use your IIGS as a tool for making profitable financial decisions.

The Intrinsic Value of a Stock. The program in Listing 2-1 calculates this value with this formula:

$$I = \frac{TC \bullet AMT}{CS}$$

Where I = intrinsic value
TC = total corporation capital

Listing 2-1: Intrinsic Stock Val Calc Program

```
10  REM  INTRINSIC STOCK VAL CALC
20  HOME
30  TEXT
40  FOR X = 1 TO 40
50 S =  PEEK ( - 16336)
60  FOR Z = 1 TO 100: NEXT Z
70  NEXT X
80  PRINT : FOR X = 1 TO 32: READ A$: PRINT  TAB( 4)A$;
90 S =  PEEK ( - 16336)
100  FOR Z = 1 TO 100: NEXT Z
110  NEXT X
120  PRINT : PRINT : FOR X = 1 TO 10: READ A$: PRINT  TAB( 14)A$;
130 S =  PEEK ( - 16336)
140  FOR Z = 1 TO 100: NEXT Z
150  NEXT X
160  PRINT : PRINT : FOR X = 1 TO 80: PRINT  CHR$ (46);
170 S =  PEEK ( - 16336)
180  FOR Z = 1 TO 100: NEXT Z
190  NEXT X
200  PRINT : PRINT : PRINT "I WILL CALCULATE THE INTRINSIC VALUE OF A STO
     CK BASED ON FOUR INPUTS."
210  GET Z$
220  HOME
230 I = 0
240  PRINT : INPUT "WHAT IS THE STOCK'S NAME ";N$
250  PRINT : INPUT "WHAT IS THE STOCK'S PRICE PER SHARE ";S
260  PRINT : INPUT "WHAT IS THE CORPORATION'S TOTAL CAPITAL ";C
270  PRINT : INPUT "WHAT IS THE DOLLAR AMOUNT OF CAPITAL     STOCK ";D
280 I = (S * C) / D
290  PRINT : PRINT "THE INTRINSIC VALUE OF ";N$;" IS $";I
300  PRINT : PRINT "CALCULATE ANOTHER (Y/N)?": GET Z$
310  IF Z$ = "Y" THEN  GOTO 220
320  HOME
330  DATA  T,H,I,S," ",I,S," ",A,N," ",I,N,T,R,I,N,S,I,C," ",S,T,O,C,K,"
     ",V,A,L,U,E
340  DATA  C,A,L,C,U,L,A,T,O,R
```


AMT = price per share
CS = amount in dollars of capital stock

A Stock Valuation Program. A program of this type could find current and future values of a stock and the rate of return before and after taxes. Commissions would be considered in all calculations.

Brokerage Commissions. Commissions could be calculated on standard and odd lots, as well as for stocks selling below one dollar per share.

Earnings Per Share Estimation. A historical balance sheet and income data could be used to estimate future earnings for a given stock; future estimations may be made with trend line analysis.

An Options Valuation Program. Using the Black-Scholes or another economic model, an options valuation program could determine the optimum hedge ratio and the spread of any options. When selling partially covered calls or when selling puts and shortening stock, an options writing program could be used to find the maximum profit and upper and lower break-even points.

The purpose of this type of program would be to assist the investor in planning the most profitable stock-option buy and sell strategy. The strategy used by the program would involve the selling of options against stock bought; this is usually considered the least risky strategy and it is often the most profitable one. For example, you could buy 100 shares of stock to use as collateral for each call option sold. A call option, which is sold at a premium, allows the purchaser the rights to buy the stock at a certain price (called the strike point), no matter what the true stock price becomes. The option, however, is valid only for a certain length of time, known as the life of the option.

Such a program would request information pertaining to the stock and would calculate the value of the stock and return on investment (ROI) over a range of 40 to 160 percent of the current value. Using this data, the investor should be able to decide the probability that a certain buy and sell strategy will be profitable. In the final analysis, the program would use a set of financial formulas to recommend a specific buy-sell strategy and then print an itemized listing of all costs, brokerage fees, proceeds, and returns. To make the best use of such a program, you should study references concerning stock-option strategies.

Computation of Short-Term Insolvency. In this "Z-Score" computation based on an American Institute of Certified Public Accountants time-sharing program (see Listing 2-2), the short-term liquidity trend score indicates whether a company is likely to face financial difficulties in the near future.

$$Z = .012*((G-L)/I) + .014*(W/I) + .033*((P+E)/I) + .006*(W/M) + .999*(S/I)$$

where G = current
L = current liabilities
I = total assets
W = net worth
P = profit before income taxes
E = interest changes
M = total liabilities
S = sales
Z = "Z score"

Stock Alpha and Beta. In this approach to analysis, the investor compares the movement of a stock over a period of time with the movement of a market average. This can be best measured by comparing the percent change in a given stock's price with the percent change in the market as a whole over several large recent market fluctuations and deriving a result in the form y = a + bx, where y equals percent change in a stock's price given by x as the percent change in the market level. The constant (a) is called alpha and is a measure of the stock's absolute continuing movement; high positive alphas are always attractive in stocks. The coefficient (b) is called the stock's beta and is a

Listing 2-2: Short-Term Insolvency Calc Program

```
10  REM  SHORT-TERM INSOLVENCY CALC
20  HOME
30  TEXT
40  FOR S = 1 TO 100:P =  PEEK ( - 16336):P =  PEEK ( - 16336):P =  PEEK
    ( - 16336): NEXT S
50  FOR S = 1 TO 50:P =  PEEK ( - 16336): NEXT S
60  FOR S = 1 TO 100:P =  PEEK ( - 16336):P =  PEEK ( - 16336): NEXT S
70  PRINT : PRINT  TAB( 9)"SHORT-TERM INSOLVENCY"
80  PRINT : PRINT  TAB( 14)"CALCULATOR"
90  PRINT : PRINT "I WILL CALCULATE SHORT-TERM INSOLVENCY  BY COMPUTING A
    COMPANY'S Z-SCORE."
100  GET Z$
110  HOME
120  PRINT : INPUT "WHAT IS THE COMPANY'S NAME ";N$
130  PRINT : INPUT "WHAT ARE THE COMPANY'S CURRENT ASSETS ";G
140  PRINT : INPUT "WHAT ARE ITS CURRENT LIABILITIES ";L
150  PRINT : INPUT "WHAT ARE ITS TOTAL ASSETS ";I
160  PRINT : INPUT "WHAT IS ITS NET WORTH ";W
170  PRINT : INPUT "WHAT IS ITS PROFIT BEFORE INCOME TAXES ";P
180  PRINT : INPUT "WHAT ARE ITS INTEREST CHANGES ";E
190  PRINT : INPUT "WHAT ARE ITS TOTAL LIABILITIES ";M
200  PRINT : INPUT "WHAT ARE ITS SALES ";S
210 Z = .012 * ((G - L) / I) + .014 * (W / I) + .033 * ((P + E) / I) + .0
    06 * (W / M) + .999 * (S / I)
220  PRINT : PRINT "THE Z-SCORE FOR ";N$;" IS ";Z
230  PRINT : PRINT "WANT TO FIGURE ANOTHER (Y/N)?": GET Z$
240  IF Z$ = "Y" THEN  GOTO 110
250  HOME
```

measure of the riskiness of a given stock. High betas should produce good relative performance in a bull market, but relatively poor performance in a declining market. Betas may be calculated separately as a function of such factors as size of the company involved, its capital structure (for example, its debt/equity ratio), return on equity, and earnings consistency. You may experiment with multiple linear regression in determining the relationship between betas and these or other variables. In general, the greater the beta, the cheaper the stock should be and the greater the appreciation potential. A risk versus benefit analysis may be conducted, with, for example, betas charted versus potential appreciation based on present discounted value of the price of the stock.

Equations used to independently determine stock betas are as follows and are well suited for incorporation into a portfolio analysis program:

Stock Beta

$$\text{Beta} = \frac{\begin{pmatrix}\text{Covariance of market and}\\ \text{stock risk premiums}\end{pmatrix}}{\begin{matrix}\text{Variance of market risk}\\ \text{premium}\end{matrix}}$$

$$\text{Variance} = \sum_{\text{time}} \begin{pmatrix}\text{(market risk premium-ave.}\\ \text{market risk premium)}^2\end{pmatrix}$$

$$\text{Covariance} = \sum_{\text{time}} \begin{pmatrix}\text{(SRP-ave. SRP)*}\\ \text{(MRP-ave. MRP)}\end{pmatrix}$$

SRP = stock risk premium
MRP = market risk premium
risk premium = (rate of return) – (risk free rate of return)

$$\text{risk free rate of return} = \frac{1}{\begin{matrix}12 \bullet (\text{annual rate of}\\ \text{a 3 month T-bill})\end{matrix}}$$

$$\text{rate of return} = \frac{\begin{matrix}(\text{price at month end} + \text{dividend}) -\\ (\text{price at month start})\end{matrix}}{\text{price at month start}}$$

Portfolio Beta

$$\text{Beta} = \sum_{\text{portfolio}} \begin{pmatrix}\text{(stock beta)} \bullet\\ \text{(\% of market value)}\end{pmatrix}$$

$$\text{\% market value} = \frac{\text{market value of a stock}}{\text{total market value}}$$

market value of a stock = current price × no. of-shares

Inflation Rate Effect. An oversimplified, but often useful, method of forecasting the effect of a given inflation rate on the stock market obeys the following structure. First, assume that the cost of money is constant at three percent. Add to this value a one percent constant that will be assumed to be the risk factor for owning stocks instead of bonds. To this sum, add the current inflation rate. Divide this final sum into 100; the result is the average stock market multiple of earnings. Now, multiply this result by the sum of the estimated yearly earnings of the thirty Dow-Jones Industrial stocks. If the sum of the estimated earnings is not known, a simple Apple program could determine earnings for the industrial stocks from the newspaper listings of price and price/earnings ratios (earnings = price ÷ P/E ratio); a method of determining future earnings growth would have to be employed. The final product calculated is a projected Dow-Jones industrial stock average.

Here is an example of the use of these calculations, assuming an inflation rate of five percent and estimated Dow-Jones Industrial stock earnings of $110:

$$\frac{100}{(3\% + 1\% + 5\%} \bullet 110. = 1222.$$

Investment Analysis Using Interest Rate Formulas. The set of interest rate formulas outlined below may be used to assess and compare the values of investments with respect to time and money, considering that money today is inherently worth more than the same money tomorrow. In an investment, money passes from and to the investor in the form of borrowed money, loaned money, dividends received, and installment loan payments made; these are called cash flows. The resulting profit or loss can be measured as an interest rate, the rate being absolute throughout the whole period of investment or applying only to a specific time interval. A $30 profit on a $100 investment four years ago is a 30 percent profit in absolute terms, but when it is measured at an annual rate (using the equations in Table 2-1), the profit comes to 6.8 percent.

The interest equations in the table may be divided into two sets: equations 1, 4, 7, and 9 are used to measure investments in which transactions occur only twice—once at the beginning and once at the end of the investment period. The other eight equations apply to problems in which constant dollar transactions occur at regular intervals. An installment loan is a good example of this kind of problem. If you borrow $4000 to buy a car and pay off the loan over 36 months at 12 percent interest, equation 11 may be used to compute the amount for each payment ($132.86).

It is important to note that there is no formula for solving for interest rates directly in the second set of equations, because the interest rate per period (i) cannot be isolated on one side of the equation.

This table shows the appropriate formulae to use given three input parameters and a required output parameter.

GIVEN		REQUIRED											
no. of uniform periods	(n)	x	x	x	x	x	x	n				1	2 3
interest rate per period	(i)	x	x	x			x	i			4	5	6
present value	(P)	x			x	x	x	P		7	8		
future value	(F)		x		x	x	x	F	9		10		
uniform payments	(R)			x	x	x	x	R	11	12			

1. $n = \frac{\log \frac{F}{P}}{\log (1 + i)}$	5. $i = \frac{R}{P}(1 - i)^{-n})$	9. $F = P(1 + i)^n$
2. $n = \frac{\log \frac{1}{1 - iP:R}}{\log (1 + i)}$	6. $i = \frac{R}{F}([1 + i)^n - 1)$	10. $F = R\frac{(1 + i)^n - 1}{i}$
3. $n = \frac{\log 1 + \frac{iF}{R}}{\log (1 + i)}$	7. $P = \frac{F}{(1 + i)^n}$	11. $R = P\frac{i}{1 - (1 + i)^{-n}}$
4. $i = \frac{F}{P} - 1$	8. $P = R\frac{1 + (1 + i)^{-n}}{i}$	12. $R = F\frac{i}{(1 + i)^n - 1}$

Table 2-1. Look-up Table of Financial Formulae.

The only method to solve for interest rates in this situation is to use a "brute force" approach in which the Apple tries values for i and solves for F or P until the right answer is found. The value for i would be successively approximated.

The formulas in Table 2-1 will be used throughout this chapter in discussing loans, mortgages, annuities, and real estate evaluation. Their uses are as varied as the diversity of investments. The IIGS becomes useful in answering "what if . . . ?" questions involving changes in interest rates, time periods, and other variables with these equations; it can also be useful in solving equations 5 and 6 in Table 2-1, which require an iterative approach.

Financial Databases. The easiest way to enter information into stock market programs is over the telephone. Various database services supply detailed financial information—both current and historical—which can be retrieved by any Apple through a modem. On-line services offer most, if not all, of the securities you are likely to be interested in. For instance, one of the popular networks (CompuServe) offers the following financial information for instant retrieval:

- Figures on more than 9,000 securities, updated throughout each trading day—no need to wait for day-old stock values in the newspaper.

- Detailed descriptive and financial information on thousands of major publicly-held companies.
- Current and historical information on more than 40,000 stocks, bonds, and options.
- Continually updated information on prices and basic news stories incorporating market commentary and statistics.
- Specialized reports on commodities, today's economy, and implications for the future.
- Financial commentary from the nation's leading news publications.

Other databases specializing in business information can supply the text of leading industry newsletters, with extensive search and indexing capabilities. The NewsNet Network, for instance, provides the full text of over 125 business newsletters in the following areas:

advertising and marketing
aerospace
automobile industry
behavioral sciences and social services
coporate communications
education
electronics and computers
energy
entertainment and leisure
environment
farming and food
finance, accounting, and taxes
general business management
government regulations and law
international affairs
investments
labor
metals and mining
office automation
politics
publishing and broadcasting
real estate
politics
telecommunications
transportation

Interest Calculations. The Apple IIGS can be used to calculate simple, compound, and true interest. A program could be written to calculate the exact number of days between two dates, and the number of months, days, and years in the interest period; leap years would be accounted for. The following formula would be the basis:

$$i = \frac{cpd}{100\ 360}$$

where i = interest on the capital
c = capital, invested or borrowed
p = rate of interest
d = number of days

Compound interest can also be calculated. Given three of the four variables (F, P, i, and n), the fourth may be solved for using equations 1, 4, 7, or 9 in Table 2-1.

The true interest is calculated as follows:

$$R = \frac{24F_c}{m\ I_m\ (m + 1)}$$

where R = the true interest rate
F_c = finance charge
m = number of months
I_m = monthly installment

Minimum Investment for Withdrawals. This formula may be used to determine the minimum investment required to allow regular withdrawals of a given amount over a given time period, assuming compounded interest with each withdrawal and an ending balance of $0. A retiree might use this formula to compute the amount to invest in a savings account at 6 percent interest to provide monthly withdrawals of $100 for 10 years.

$$P = \frac{R \bullet N}{i}\left(1 - \frac{1}{(1 + i/N)^{NY}}\right)$$

where P = initial investment
R = amount of regular withdrawal
i = nominal interest rate
N = number of withdrawals per year
Y = number of years

Mortgages

The IIGS can be very useful to the home buyer in simplifying the many financial options that are available. You can use your Apple to determine mortgage payments based on the interest rates available, the length of the life of the mortgage, and the amount. With recent swings in interest rates, knowing what you will be paying at any given interest can be very important; a difference of a half or one percent can be substantial. This information is also important in budget planning—in determining how much of the family income must be allocated to mortgage or loan payments. You can do a "What if . . . ?" analysis; that is, if interest rates are predicted to decline by 3 percent next year, is it best to buy or wait? With your IIGS and the financial formulas outlined in Table 2-1, the financial ramifications of home buying or other investments can be easily determined.

It may be worth your while to analyze a mortgage agreement on your Apple IIGS before signing any contracts. A yearly amortization program could calculate a schedule of payments, the annual debt service, the mortgage constant, the remaining balance, the payment to principal, the payment to interest, the accumulated principal, and the accumulated interest for each year. A general amortization program could solve for the following additional factors: the number of payments to reach a certain balance, the payment amount, the annual percentage rate, and the principal amount.

Special programs could calculate the above values for wrap-around mortgages and determine the price and yield of discounted mortgages.

Loan with Points. Points are a percentage of the value of a loan that is paid at the start of the loan period. Theoretically, the seller pays the points, but in practice it does not matter who pays—the price of the house increases with the addition of points.

One point represents one percent of the mortgage value. It must be paid at the beginning of the loan. The important question to consider is how does the addition of points affect the annual percentage rate actually being paid for the loan? A IIGS program could calculate this value given the number of points, amount of the loan, years, and annual percentage rate of the loan. It would then output the value for monthly payments and the true annual percentage rate.

Direct Reduction Loan. The payment, present value, or number of time periods for a reduction loan may be calculated by using the equations 2, 8, and 11 in Table 2-1.

Additional Loan Formulas. Here are some more formulas that you will find useful when you are dealing with loans.

- Principal on a loan

$$P = \frac{R \bullet N}{i} \bullet \left(1 - \frac{1}{(1 + i/N)^{N \bullet Y}}\right)$$

where P = principal
R = regular payment
i = annual interest rate
N = number of payments per year
Y = number of years

- Regular payment on a loan

$$R = \frac{i \bullet P/N}{1 - \left(\frac{i}{N} + 1\right)^{-N \bullet Y}}$$

where R = regular payment
i = annual interest rate
P = principal
N = number of payments per year
Y = number of years

- Term of a loan

$$Y = -\frac{\log\left(1 - \frac{P \bullet i}{N \bullet R}\right)}{\log\left(1 + \frac{i}{N}\right)} \bullet \frac{1}{N}$$

where Y = term of payment in years
P = principal
i = annual interest rate
N = number of payments per year
R = amount of payments

Depreciation Calculations

Standard, composite, and excess depreciations may be calculated with the following methods:

1) Straight line depreciation

$$D = PV/n$$
$$B_k = PV - kD$$

2) Sum-of-the-years-digits depreciation

$$B_k = \frac{S + (n-k)\,D_k}{2} \qquad D_k = \frac{2\,(n-k+1)\,PV}{n\,(n+1)}$$

3) Variable rate declining balance depreciation

$$D_k = PV\,\frac{R}{n}\,(1 - R/n)^{k-1}$$

$$B_k = PV\,(1 - R/n)^k$$

In each of the above depreciation formulas,

PV = original value of asset (less salvage value)
n = lifetime number of periods of asset
B_k = book value at time period K
D = each year's depreciation
k = the number of the time period (that is, 1, 2, 3, . . . n)
S = salvage value
R = depreciation rate
D_k = depreciation at time period k

The actual depreciation rate for an investment is computed with the formula (see Listing 2-3):

$$\text{depreciation rate} = 1 - \left(\frac{\text{resale price}}{\text{original price}}\right)^{1/age}$$

This depreciation rate formula may be used to answer queries such as "If a car was bought for $9000 and sold three years later for $5100, what is the depreciation rate?"

The *salvage value* of an item at the end of a given year may be calculated with the formula:

$$S = P(1 - i)^Y$$

where S = salvage value
P = original price
i = depreciation rate
Y = age in years

Annuities

Given the values of the required variables as input data, an annuity program could calculate the remaining variable in any of the following situations:

- Sinking funds—a sinking fund is an annuity in which a future value is accumulated by making equal payments at equal intervals at a certain interest rate. The value can be computed using equation 10 in Table 2-1.
- Annuity due—the future or present value can be calculated using equations 8 and 10 in Table 2-1.
- Ordinary annuity—This value may or may not include a balloon payment. Again, use equations 2, 8, and 11 in Table 2-1.

Listing 2-3: Depreciation Rate Calc Program

```
10  REM  DEPRECIATION RATE CALC
20  HOME
30  TEXT
40  PRINT : PRINT  TAB( 11)"DEPRECIATION RATE"
50  PRINT : PRINT  TAB( 15)"CALCULATOR"
60  PRINT : PRINT "I WILL CALCULATE THE DEPRECIATION RATE  ON ANY ITEM FO
    R YOU."
70  GET Z$
80  HOME
90  PRINT : INPUT "WHAT IS THE ITEM'S NAME-";N$
100  PRINT : INPUT "WHAT IS THE ITEM'S ORIGINAL PRICE-";O
110  PRINT : INPUT "WHAT IS THE ITEM'S RESALE PRICE-";R
120  PRINT : INPUT "WHAT WILL THE ITEM'S AGE BE, IN YEARS,  WHEN IT IS SO
    LD-";A
130 D = 1 - (R / O) ^ (1 / A)
140  PRINT : PRINT "THE DEPRECIATION RATE FOR ";N$;" IS ";D
150  PRINT : PRINT "DO ANOTHER (Y/N)": GET Z$
160  IF Z$ = "Y" THEN  GOTO 80
170  HOME
180  PRINT  CHR$ (7)
190  END
```

Bonds and Warrants

A simple, useful program could be written to determine the value of both short- and long-term warrants. Given present value, coupon interest, yield to maturity, and maturity value for the number of periods (three values out of the four), an Apple program can compute the remaining term. Taxes, commissions, and current yield could also be determined. The formula used to calculate the present value (cost) of a bond with annual coupons is as follows:

$$\text{Price} = \left[\left(\frac{1 - (1 + i/c)^{-n}}{i/c}\right)^{(1000\ Cr/2)}\right] + [(1+i/c)^{-n}\ (1000)]$$

where

- i = discount rate as %
- n = number of years to maturity multiplied by 2
- Cr = coupon rate of bond
- c = number of compounding periods per year

The formula used to calculate the bond yield of an annual coupon is as follows:

$$j = \frac{\dfrac{Fg - (B.V.)_1 - (B.V.)_n}{n}}{\dfrac{(B.V.)_1 + (B.V.)_n}{2}}$$

where

- j = nominal yield rate
- $(B.V.)_1$ = original bond value
- $(B.V.)_n$ = bond at n years
- F = face value
- g = nominal dividend rate
- n = number of years

PERSONAL ACCOUNTING

There are a number of ways in which your IIGS can help you manage your personal finances more effectively. The Apple can help you deal with everything from credit card payments to income tax calculations.

Personal Accounts Receivable/Payable

A personal accounts receivable/payable (AR/AP) program similar to a business AR/AP program could manage a large portion of your financial affairs. The program could include these features:

1. A checking and savings account management program to enable you to maintain the current balance of your checking and savings accounts. Interest credits could be calculated and added. A file of each check (with its number, purpose, notes, amount, and payee) could be stored for later income tax preparation. Specialized reports could be generated from this check file, including a check register for a specified time period, the distribution of expenditures, and statements of selected accounts. The ideal program would request all information concerning each check written, store this information, and print the check itself.
2. A budgeting program to keep you up to date on expenditures in various areas so that income can be allocated appropriately. A plan for family spending could take the following format:

Set-asides

- Emergencies and future goals _____
- Seasonal expenses _____
- Debt payments _____
- Regular monthly expenses _____
  - Rent or mortgage payment _____
  - Utilities _____
- Installment payments _____
  - Other _____
  - Total _____

Day to day expenses

- Food and beverages _____
- Household maintenance _____
- Furnishings, equipment _____
- Clothing _____
- Personal _____
- Transportation _____
- Medical care _____
- Recreation, education _____
- Gifts, contributions _____
  - Total _____

Total of all expenses _____

Alternatively, you could take realistic estimates for the upcoming year and enter these figures. A program could then use this information in computing the percentage of gross income that each item requires. As a rule of thumb, housing should cost no more than one fourth of your gross income. This is an example of one of the budgeting principles discussed in most references concerning family budget preparation. The IIGS removes the drudgery of manual calculations for those determined to stick to a well-planned budget.

On command, a budget program could print month-to-date figures and an end-of-month comparison of budget versus actual expenses. It can also show the amount of cash needed to meet budgeted expenses for the rest of the month. It could also maintain tax records, keep a running balance of cash on hand, keep an inventory of your possessions, and even help in planning weekly menus.

Table 2-2 shows a portion of a personal budget report that indicates where the money has been and where it will be spent in a spreadsheet fashion. Such spreadsheets, besides being a personal planning benefit, are often useful when securing a personal loan.

3. A financial behavior determination program to help you analyze your expenditures and summarize your spending in various areas (the same categories from the above budget) that would be useful in preparing a budget plan.

According to the experts at the United States Department of Labor, a family of four should typically allocate its spending as follows:

Housing	24%

Table 2-2. A Portion of a Personal Budget Sheet in Spreadsheet Form.

EXPENSE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG
	ACTUAL FOR JOE SMITH OCT. 8, 1982							
RENT	650	0	0	0	0	0	0	0
FOOD	323	361	357	371	290	251	410	356
CLOTHES	154	0	54	0	0	0	0	68
UTILITIES	57	56	50	59	62	51	53	59
CREDIT CARD INTEREST	0	0	0	0	0	0	0	0
ENTERTAINMENT	143	100	58	13	24	45	125	54
GASOLINE	100	110	90	100	100	100	95	90
MORTGAGE INTEREST	0	0	0	0	0	0	0	0
MISCELLANEOUS EXPENSE	28	0	44	0	98	0	0	48
CAR EXPENSES	990	0	0	0	0	0	0	0
TOTAL EXPENSE	2445	627	653	543	574	447	683	675
NET INCOME	105	1623	1597	2091	1676	1803	1863	1825

Food	24%
Transportation	15%
Clothing, personal care	13%
Taxes	13%
Medical	7%
All other	4%

Families differ, but how do your own expenses correspond to these percentages?

4. A file of unfulfilled contracts, mail orders, and so on for which you have sent checks and have not received a reply. As replies are received, the appropriate accounts are removed from the file.

Daily Interest Passbook Savings Account

You can create an Applesoft BASIC program to maintain a savings account. The program should have provisions for interest, withdrawals, and deposits.

Income Tax

Preparation of income tax forms is a task that lends itself very well to the Apple IIGS because computers are great organizers and calculators (see Fig. 2-2), and they can save you both time and money. Tax preparation programs range from the simple arithmetic calculators to the complete personal accounting programs. In the most popular approach, the computer requests answers to such questions as, "What are your federal withholding taxes?" You proceed to answer all of the possible questions necessary to prepare a 1040 tax form (approximately 50), but unfortunately, you must first do considerable accounting and calculating to answer some of the questions. The program would complete the simple arithmetic that is necessary for filling in the 1040 form and then print the proper values in the appropriate boxes on the form.

A more complex approach would involve the periodic storage of all of your financial data on a floppy disk. For example, each week you could store the names, addresses, purposes, numbers, and amounts of all checks written or cashed. At year's end, the Apple would search and group all relevant data and do all of the necessary calculations. In this latter approach, a complete summary of all deductions and income could be printed categorically. References to the filed location of the original

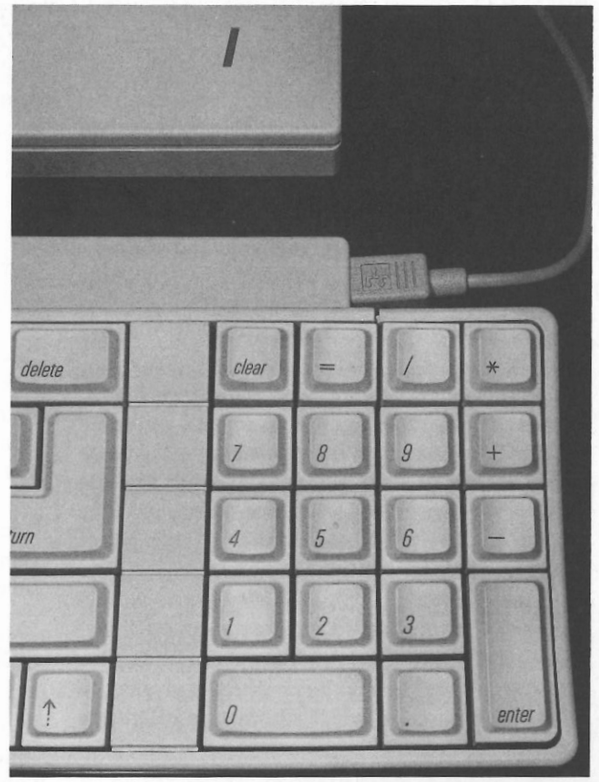


Fig. 2-2. Financial and statistical programming is enhanced with this 18-key keypad that is located to the right of the main IIGS keyboard.

checks, bills, and receipts could be included for proof of the transactions. A warning could also be issued in the event that your deductions exceed ten percent of your income (a tax audit would be likely). Provisions could be made to compare the taxes that you would pay if you filed jointly with your spouse to what you would pay if you filed as an individual.

A tax planning program can help cut your tax liability in the years to come. Investment decisions, personal financial decisions, and business decisions with tax consequences can all be analyzed in planning a tax strategy. In a divorce, for example, the arrangement of a settlement can result in substantially less tax depending upon how the money is allocated between property settlement, alimony, and child support. A tax planning program can be used to quickly answer "What if . . . ?" questions during the negotiation of a settlement. The ease of changing inputs and having the program recalculate the entire return can be a tremendous time-saver.

Additionally, complex calculations such as income averaging on Form G can be done automatically, perhaps yielding a bigger refund for those who previously would not have attempted the calculations manually. A tax planning program in the form of a spreadsheet allows the simultaneous consideration of multiple cases covering different facts and years. The spreadsheet can include graphics showing the impact of adding or subtracting income, deductions, or credits, and varying tax computations over a period of several years—including

regular tax, alternative minimum tax, add-on minimum tax, income averaging, and the consideration of limitations on the use of credits. For instance, you could consider the possibility of a second income versus staying at home by having your Apple IIGS program figure the after-tax results of that extra income, which is often discouraging. As another example, assume that you own a business and want to know if you should pay your spouse a salary. Depending upon your income level, this may or may not be advantageous; a tax planning program could determine the best option for your income bracket.

A recurring question among investors is "What are the sources of tax-free income whose yields are equal to or greater than the yields provided by taxable investments?" Should you invest in tax-free bonds and other tax-free securities, or place your money in a fully taxable bond, savings account, or treasury bill? Remember that you may wish to consider other factors, such as liquidity of assets. The two formulas necessary to compute taxable and tax-free yields are given below. A simple Applesoft BASIC program could compute these for a given situation and determine which alternative offers the better investment.

taxable yield = tax-free yield/(1 – federal tax bracket)

tax-free yield = taxable yield*(1 – federal tax bracket)

For instance, if you are in the 35 percent federal income bracket, have invested in a money-market account at 8 percent, and are offered the opportunity to invest in a tax-free fund yielding 6.2 percent, which is the better investment? Using the second equation above, you find that the tax-free fund would be a better investment at 6.2 percent versus the 5.2 percent after taxes for the money-market account. A more sophisticated program could print a table of yields given the known tax-free or taxable yield starting value and the increment and the starting value of the tax bracket and the increment. Investors in some states are allowed tax exemptions for qualifying tax-free investments. In this situation, simply add the exempted state tax rate to the federal tax rate when entering your tax bracket value.

Home Banking

You may soon be able to do your banking from home with an Apple IIGS. Many banks are conducting pilot home-banking studies and are beginning to sell such services to depositors. With most of these services, a customer dials the bank's central computer or uses one of the timesharing networks, such as CompuServe, through a modem. After providing a secret password, the customer can, for instance, ask for a list of recent deposits and pay bills directly by transferring money from the customer's account to the accounts of the creditors. Banks charge from $5 to $15 per month for this service.

MONEY-MAKING APPLICATIONS

There are many ways to use your Apple IIGS to make money; you might consider starting a part-time or full-time business based on one of the following ideas.

Stock Market

One Apple IIGS user is deriving his income from his stock prediction newsletter that is composed of market predictions determined by using "twelve confidential indicators" on his Apple. In a similar fashion, you could experiment with mathematical analysis of the stock market using the statistical methods outlined earlier in this chapter. An Apple IIGS could also serve to maintain stock portfolios and organize or correlate market predictions and stock recommendations to ease decision making. With the proliferation of financial databases available through the use of a modem, information on stock prices, market performance, and so on could be entered automatically to a stock analysis program designed to scan the entire market, stocks of a given industry group, or solitary stocks. Financial databases may also be scanned to provide historical data or the latest news reports on selected corporations.

The Apple is certainly useful in mathematical analysis and data storage for other forms of financial investment, including stock options and commodities. Again, the use of financial databases accessible via modems permits the automatic input of data to your analysis program. The commodities trader will probably find the Apple IIGS to be a real boon in organizing and obtaining information in the fast-moving and volatile commodities market and in allowing trading from the home for the first time.

Services

The Apple owner is in the position to offer the following services.

Mailing Lists. A mailing list of people in your area could be used by local firms with direct mail campaigns. The mailing list could be compiled from area phone books and association directories, entered into your IIGS, and stored permanently on floppy disks. The list can then be printed on adhesive labels and sold to local businesses. The advantage of being a local business serves to eliminate competition from large mailing list brokers in other cities.

Resumes. People in all areas can use a resume preparation service to write, type, and mail resumes to potential employers. A word processing system could automate this business entirely.

Typesetting, Indexing, and Editing. All businesses and organizations can use a printing preparation enterprise for typesetting and editing promotional material. An Apple IIGS interfaced to a letter-quality printer (e.g., Diablo, Qume, Epson, NEC), laser printer (e.g., Apple LaserWriter, Hewlett-Packard LaserJet), or conventional typesetting equipment can produce excellent justified and camera-ready artwork for printing. The cost savings of using an Apple will allow the entrepreneur to offer lower prices for such services and ensure greater accuracy. Furthermore, an indexing service using a IIGS program to create book and magazine indexes could provide a valuable service to small publishing firms.

Home Swap and Rental Locator Services. The practice of swapping one's home with other people during vacation time is quite popular. A service that used an Apple to categorize homes available and homes wanted could profit by publishing a newsletter of listings.

A rental locator service categorizes homes and apartments for rent from classified newspaper ads or other sources. In metropolitan areas, where finding an ideal home to rent is a difficult task, a service to match people with the right living conditions at the right price would be useful. In a similar manner, a service company could match people with cars for sale by the owners.

One entrepreneur has developed a computerized bartering service for matching the needs to the services of those in high income tax brackets for the purpose of mutual tax write-offs. He charges a small fee for successful bartering arrangements.

Finder Fees. A finder's fee is a sum of money paid to someone who finds something wanted by another person who is willing to offer an award for it, be it business opportunities, products, or rare items. Usually, finder's fees are expressed as a percentage of the amount of money involved in purchasing the item when it is found. A few organizations publish newsletters listing finder's fee opportunities. A person could computerize hundreds of listings for future reference and could correlate the need of buyers with the offerings of sellers.

Telephone Answering Message Service and Newspaper Clippings Service. Telephone answering services of sufficient size can use an Apple to increase efficiency and lower costs. A newspaper clipping service, which clips articles of interest to paying clients, could use a IIGS to keep track of the varied categories to search for.

Computer Dating Service. Popular a few years ago, computer dating services could make a

return appearance, especially in metropolitan areas.

Sports Predictions and Gambling. An enterprising hobbyist uses his Apple to predict college football scores. The information produced is sold as "CLYDE the computer" sports forecasts to television stations for use on local news broadcasts. Other entrepreneurs have used Apple predictions of sporting events to publish flyers that are sold at legal dog and horse races.

Employment Agency. The IIGS could be useful to an employment agency in matching the right people with the right jobs. The use of the Apple may also serve to increase business in itself.

Small Business Systems and Software. Many hobbyists have turned Apples into a profitable sideline business by selling packaged computer systems with accounting, word processing, and spreadsheet software to small businesses and offering technical support and training. You could also create personalized programs including databases and mailing lists on a freelance basis for firms with Apples.

Collection Service. A word processing system could automatically output personalized collection letters, which theoretically generate a greater response. Therefore, a low-cost collection service charging a flat rate or a percentage of the money collected would be an excellent sideline business for the IIGS hobbyist.

Word Processing. A word processing service can be employed by businesses to prepare typewritten personalized sales letters. Such a business would be almost totally automated by an Apple IIGS.

Bowling League Bookkeeping. A few hobbyists have sideline businesses that calculate bowling league scores and handicaps for ten to thirty cents per player per week. This cost is usually less than the costs of hiring a person to do the bookkeeping.

Supermarket Comparison Service. A hobbyist-turned-businessman uses his Apple to collect and compare price data for popular foods at local supermarkets and sells a listing of the most economical stores to shoppers.

Personalized Books. Children's books containing a child's name, address, and other personal information can be printed by a IIGS and printer economically. Studies show that children prefer reading personalized books over any other type of book and that there is a considerable demand for them. An enterprising hobbyist could develop a large-scale business along these lines. Perhaps a humorous personalized book could be sold for adults as well.

Educational Programs. You could form a distributorship to bring educational Apple materials to schools, bookstores, and other institutions. The market for educational computer programs is also growing. You could develop popular tutorials concerning electronics, higher mathematics, business and investments, and computers.

Real Estate

Possible applications for Apples in real estate include the following:

Residential Purchase Analysis. A useful program could calculate the total monthly payment, income tax deductions, and equity build-up resulting from the purchase of a home. An own versus rent analysis could also be useful.

General Real Estate Investment Analysis. Mortgages, cash flow in percent growth return, taxable income (tax shelter), and financial feasibility can be calculated by considering such factors as inflation and interest rates. Income property reports and closing statements may also be generated.

Rental Property Management. A program designed for management of rental properties could store the following types of information for each property or client: receipts, disbursements, gross income, calculated profit and loss, calculated return on investment, and calculated net income.

Appraisal Tabulator Program. A program designed for an appraiser could organize and tabulate variables and could determine an appraisal.

Real Estate Evaluation. A program could be designed for use by a potential investor in evaluating a piece of real estate, such as an apartment building. The program would estimate the total monthly income, annual rate of return, and tax deductions based on such input data as cost, down payment on mortgage, estimated overhead costs, and income.

Here's a sample run that will show you what information this kind of program might request and what kind of results it might produce:

```
Enter the purchase price of the real estate? 75000
Enter the mortgage interest (%)? 9.75
Enter the mortgage down payment as a % of purchase cost? 10
Enter the number of years in the loan term? 25
Enter the closing cost (% of purchase price)? 2
Enter miscellaneous initial expenses as one sum? 100
Enter the estimated income per month from the property? 1125
Enter the real estate tax for one year? 1300
Enter the estimated overhead costs (maint., utilities, insur., etc.)? 525
For tax deduction purposes, enter the est. property value? 15000
Enter your tax bracket as a % of your income? 40
Is the building on the property new or used ("N" or "U")? N

Tax and Cash Flow Analysis

Monthly expenses $525.00
Monthly taxes $108.33
Monthly mortgage $601.52
Monthly income $1125.00
Monthly cash flow $109.85

Tax hedge:

Expenses (yr. #1) $7650.00
Depreciation (yr. #1) $6000.00
Deductible interest $6581.25
Real estate tax (yearly) $1300.00

Total: (yr. #) $21531.30
Total income (yr. #1) $13500.00
Net deduction (yr. #1) $8031.25
Tax advantage (yr. #1) $3212.50

Return on investment 18%
```

Curve Fit. A program to fit such data as land prices or construction cost per square foot to a curve may be used to make more accurate forecasts, bids, and estimates.

Internal Rate of Return and Cash Flows. One purpose of an internal rate of return and cash flow program would be to calculate the net present value of a series of cash flows. In general, an investment, V_o, is made in some enterprise that is expected to bring periodic cash flows C_1, C_2, . . . C_n. Given a discount rate (i), the program would compute the net present value at period k, NPV_k for each cash flow. A negative value for NPV_k indicates that the NPV_k enterprise has not been profitable. A positive value for NPV_k indicates that the enterprise has been profitable to the extent that a rate of return (i) on the original investment has been exceeded.

$$NPV_k = -V_o + \sum_{j=1}^{k} \frac{C_j}{(1+i)^j}$$

BUSINESS DECISION MAKING

The following Apple applications can help you make the decisions that will optimize the way that you run your business.

Spreadsheets

Most people have seen or worked with the traditional accounting ledger spreadsheet or work-

sheet. Typically, there are descriptions along the left edge, month designations across the top of each column, and room for a totals column on the right. For budget preparation, each line could represent a budget category and have budgeted monthly amounts across the page. Each line and each month's column are totaled. A change to a single number involves replacing a figure with a new one, and readjusting the affected column and row. This is a tedious procedure and one that is prone to error. Therefore, you can appreciate the tremendous benefits of a totally electronic spreadsheet.

A spreadsheet program is a super calculator that provides you with a giant electronic grid that functions analogously to the traditional spreadsheet, as described above. When you change the values of numbers in the grid, the program automatically calculates what effect, if any, there is on all of the other numbers. The spreadsheet can provide answers within seconds to all sorts of financial "What if . . . ?" questions. For example, to qualify for the mortgage that you want, how much income must you have? Or, how would your portfolio value change with a half-point advance in a stock?

A typical electronic spreadsheet may be 2,048 rows long by 256 columns high, depending on the program, floppy disk space (see Fig. 2-3), and available Apple memory. Formulas, equations, and algorithms may be input to provide comparisons, ratios, and totals.

Who uses spreadsheet programs? Anyone who works with numbers might find a use for such a program. Obviously, accounting is a primary area of application, but scientists, engineers, managers, and executives use spreadsheets. How useful a spreadsheet is in a particular situation depends on the degree to which it increases productivity. Frequently, a spreadsheet user will get important answers that previously were not cost effective to obtain. Anyone who needs more accurate and faster calculations is a potential spreadsheet user.

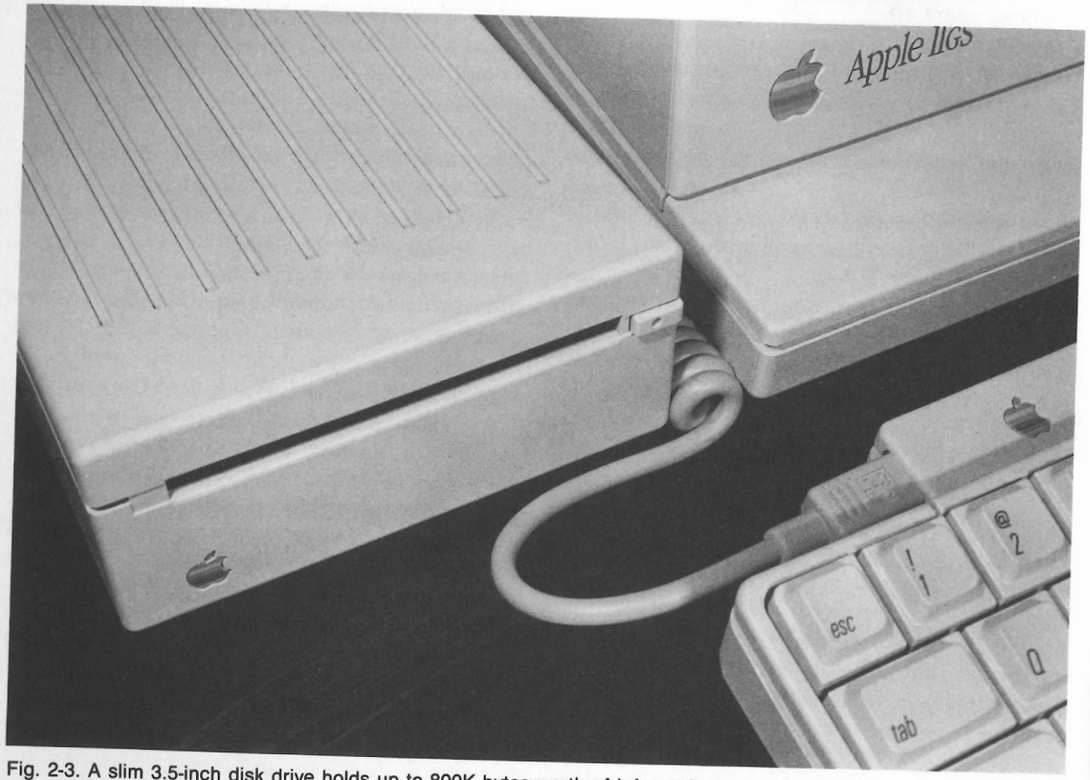


Fig. 2-3. A slim 3.5-inch disk drive holds up to 800K bytes worth of information.

Spreadsheet programs are being used in an endless variety of applications. Some are used for solving simple or complex equations, others for normal calculator functions, and still others as a complete decision-support tool. Specific uses include financial modeling, budgeting, doing cash flow analysis, planning, making projections, making business plans, creating sales reports, doing "What if . . . ?" analysis, pricing, making cost estimates, tax planning, improving time management, performing chemical formulation, doing regression analysis, and analyzing structural design. Anything that can be done using a calculator can be done more easily and more extensively through the use of a spreadsheet program.

Other Decision-Making Computer Applications

In addition to making the electronic spreadsheet available as a decision-making tool, the Apple IIGS enables you to use programs to guide you in making decisions in the following areas:

Long- and Short-Term Financing Requirements. A commercially available long-term financing requirement calculation program could compute the cost of capital for various forms of funding (e.g., common stocks, preferred stocks, and bonds), select the cheapest form, and determine the amount needed to support operating plans. A short-term financing requirement calculation program could compute the amount and timing of short-term financing based on sales forecasts, inventory purchases, and collection and payment policies.

Breakeven Analysis. Programs can be used to compute the breakeven points for projects or products based on fixed and variable costs and selling prices; learning curves may also be applied (see Listing 2-4).

The following must be true, in order to break even:

$$P \bullet K = FC + (VC \bullet Q)$$

where

- P = sales price of each unit
- K = quantity of units sold
- FC = fixed costs over the period in question
- VC = variable costs per unit produced
- Q = no. of units produced

Inventory Control. The generalized inventory model known as the economic order quantity (EOQ) is an important part of the management of inventory. The formulas below may be used to compute the EOQ, the minimum inventory costs for a specified time period, and the number of times to order replacement stock during a given time period.

$$EOQ = \frac{\sqrt{2KL}}{M} + S$$

$$C_{min} = \sqrt{2KLM}$$

$$N = \frac{L}{EOQ}$$

where

- EOQ = the economic order quantity in units.
- C_{min} = the minimum inventory costs for the time period
- N = the number of times replacement stock should be ordered during the period
- K = The cost of placing and receiving each order
- L = the total number of units used during the period

Listing 2-4: Breakeven Calc Program

```
10  REM  BREAKEVEN CALC
20  HOME
30  TEXT
40  PRINT : PRINT  TAB( 15)"BREAKEVEN"
50  PRINT : PRINT  TAB( 15)"CALCULATOR"
60  PRINT : PRINT "I WILL CALCULATE THE BREAKEVEN POINT OF A PRODUCT FOR
     YOU."
70  GET Z$
80  HOME
90  PRINT : INPUT "WHAT IS THE ITEM'S NAME-";N$
100  PRINT : INPUT "WHAT IS THE ITEM'S SELLING PRICE-";P
110  PRINT : INPUT "HOW MANY HAVE BEEN SOLD-";K
120  PRINT : INPUT "WHAT ARE THE FIXED COSTS-";F
130  PRINT : INPUT "WHAT ARE THE VARIABLE COSTS-";V
140  PRINT : INPUT "HOW MANY ITEMS HAVE BEEN PRODUCED-";Q
150  IF P * K = F + (V * Q) THEN  PRINT : PRINT N$;" IS A BREAKEVEN PRODU
     CT.": GOTO 170
160  PRINT : PRINT N$;" IS NOT A BREAKEVEN PRODUCT."
170  PRINT : PRINT "DO ANOTHER (Y/N)": GET Z$
180  IF Z$ = "Y" THEN  GOTO 80
190  HOME
200  PRINT  CHR$ (7)
```

M = the cost of carrying one unit in inventory for the time period

S = the "safety" quantity of stock to be held in inventory, to minimize the risks or losses involved in running out of a crucial part or item.

Reorder Timing. Programs can be used to compute the reorder point based on inventory carrying costs, stockout costs, and demand variation.

Facility Scheduling. Programs can be used to compute job shop performance (average turnaround time and percent late) based on a variety of scheduling rules (e.g., first-in-first-out or most overdue items first) and on job processing times.

Demand Forecasting. Programs can be used to compute a forecast of future demand by exponentially smoothing past demand.

Market and Media Research. Programs can perform many aspects of this kind of research, including questionnaire analysis.

Purchasing. Programs can analyze vendors (e.g., order-filling speed and previous complaints record) to select the best overall vendors.

Bid Preparation and Job Pricing. The salesman or contractor would find a bid preparation program useful in calculating variable sales prices, keeping running totals, and figuring markups or markdowns. Preparation on the Apple typically requires one fifth to one tenth the time required by manual methods and frees up more time that can be spent on profit-making.

GENERAL BUSINESS CALCULATIONS AND BUSINESS ACCOUNTING SYSTEMS

The Apple IIGS can be used to keep track of accounts receivable, to prepare aged trial balances, monthly statements, follow-up sales letters and collection letters, and to provide on-line account status inquiry handling.

Writing a Small Business Accounting System

The following is an outline of a small business accounting system designed for use on an Apple IIGS, an Epson dot-matrix printer, and an optional second floppy disk drive. The program is intended for use by an individual proprietorship or a small partnership. For such a business, tax returns are prepared (either Form 1040 Schedule C or Form 1065), bookkeeping is done, and balance sheets are produced by the system described, for management and banking purposes. Advantages of computerizing this information include savings in time and improved error detection.

The most desirable bookkeeping system is called the double entry system; each transaction is entered into two different accounts, and therefore, the system is self-checking. With the double entry system, each transaction is first recorded as money coming from some account and then recorded as money going to some account. Debits, abbreviated as DR for Apple use, represent an addition to your account or to an expense; credits, abbreviated CR, represent a subtraction from an account or from an expense. In order to determine whether or not the bookkeeping has been done correctly, find out whether or not the debits always equal the credits. For example, if you paid a bill for $50 and received a check for $100 for services performed, the bookkeeping entries would be as follows:

a. Debit (subtract from what you owe) accounts payable for $50.
b. Credit (subtract from what you have) cash on hand for $50.
c. Debit (add to what you have) cash on hand for $100.
d. Credit (add to revenue) income or revenue for $100.

The continual upkeep of the status of each account for a business is the purpose of the bookkeeping program. An example of the account files along with a suggested Apple abbreviation for each is listed below:

EXPENSES (debit to add, credit to subtract)

Return and allowances	RTN	(goods returned for refund)
Depreciation	DEP	(for equipment owned)
Business taxes	TAX	
Rent	RNT	
Repairs	RPR-	
Bad debts	BDB	(for the charge-off accounting method)
Professional fees	PRF	
Amortization	AMT	(charge partial costs of organization expense, research/development, etc.)
Fuel	FUL	
Telephone	PON	
Electricity	PWR	
Salaries and wages	SAL	(does not include wages included in costs of goods sold)
Interest	INT	(interest paid, only)
Labor/production costs	LAB	
Purchases	PUR	
Insurance	INS	
Pension/profit sharing	PEN	
Depletion	DPL	(used for such assets as mines/oil fields)
Materials/supplies	MAT	
Cost of goods sold	CGS	(includes: purchases, materials/supplies, labor/production costs, other costs)

ASSETS (debit to add, credit to subtract)

Cash	CSH	(usually checking acct. balances)
Receivable	RBL	(amounts owed by customers on accounts)
Inventory	INV	
Prepaid expenses	PPD	
Supplies	SUP	
Equipment	EQT	
Investments	IVS	
Miscellaneous	ETC	

LIABILITIES AND EQUITY

Payables	PBL	(amounts owed on an account)
Notes	NOT	(borrowed money)
Long term payables	LTP	
Proprietor	PRP	(amount invested in business and net income)
Drawing	DRW	(amount from which owner may use money for personal expenses)

REVENUES (credit to add, debit to subtract)

Gross receipts	RCP
Other revenue	REV

The IRS requires reports in the following areas: depreciation, business taxes, repairs, and amortization.

The various reports that may be generated by the system include the balance sheet; a sample balance sheet is listed below:

ASSETS		LIABILITIES	
Equipment	5000.	Notes	2000.
Receivables	500.	Payables	3500.
Cash	3000.	Total	5500.
Total	8500.		

EQUITY

Proprietor 3000

Total (Liabilities + Equity) = 8500.

Assets represent what the businessman has, liabilities represent the amounts owed, and equities are amounts contributed or earned by the owners.

Another report that is a necessary part of a small business accounting system is termed the income statement. It displays the income and expense of the business during a certain period of time; it may be used to fill out tax forms 1040C or 1065. In order to generate this report, total income is computed and total expenses are subtracted from this figure. Income for accounts may be stated on an accrual basis, which is to say that future expenses or revenues are included if the exact amount is known and certain (e.g., the amounts customers owe may be stated on an accrual basis). Business owners may prefer to prepare a tax return report on a cash basis, in which the only revenue considered is to be cash in and the only expenses considered are cash out. To prepare such a report, you must eliminate payables, receivables, prepaid expenses, and supplies that are not yet part of the cost of the goods sold; the revenue and expense accounts should be adjusted to reflect this change.

Another necessary report is the ledger, which may be of two types: summary and detailed. The detailed ledger is a complete listing of each account transaction (name and amount) that has been input within a certain period of time (usually done on a weekly or monthly basis). The balances up to the time of the beginning of the report have been stored from prior ledgers and are read into the Apple. A report listing each transaction and the remaining balance in each account is generated. The summary ledger report only lists the remaining balances after adding and subtracting all transactions for a given period of time.

The balance sheet is the final report necessary on a small accounting system. The sum of the liabilities is subtracted from the sum of the assets to determine the balance or net profit for the business owner. This balance is credited to the proprietor (PRP) account, and therefore, the assets plus the net income will balance (remain equal) with the liabilities.

Additional functions of the accounting system could include forecasting income using trend line analysis of previous balance sheets, forecasting other accounts using previous records, preparing amortization schedules, determining depreciation amounts, and budgeting cash based on forecasting cash on hand and cash payable.

Additional Applications for the Small Business Person or the Professional

The small businessperson or professional could use his or her Apple for the following additional purposes.

Order Processing. The Apple IIGS could be used for order editing, freight cost computation, credit card checks, stock availability checks, and order status checks. A billing/invoicing calculation program could provide the following information: net total, total tax, total tax plus freight, total profit, percent of net profit, total value of back-ordered items, total discount amount, total gross amount, and total cost amount.

Sales. The Apple could prepare a breakdown of sales volume and profitability by product, customer, or salesman. Sales order processing software could print packing slips, deduct sold merchandise from inventory, verify orders, process returned goods, accumulate back orders, enter cash receipts, print invoices, print sales and credit journals, and maintain a customer master file.

General Accounting. General accounting functions include cost record keeping, budgeting, daily exception record keeping, and the issuing of profit and loss statements.

Mailing List. One of the prime assets of a small business is its mailing list, representing customers who are likely to be repeat purchasers. The Apple IIGS simplifies mailing list maintenance and is capable of sorting names according to a variety of characteristics, depending upon how much information is stored by the program in addition to names and addresses. Consider the following promotional or money-saving activities that can easily be accomplished through the use of a full-featured mailing list program:

- Sort list by zip for bulk mail savings.
- Sort list alphabetically and printout as a customer reference.
- Mail pieces to residents of a certain town or zip for a special local promotion.
- Mailings to customers having an upcoming birthday.
- Mailings to all women for announcing a special sale on dresses.
- Mailings to only the most active customers for a special "favored customer promotion."

The ability of a mailing list program to sort customers by these and other criteria requires that special codes be input along with the names and addresses. The coding used and its extent are at the user's discretion.

Customer File Management. By functioning like a mailing list program, a customer file management program could keep track of customers in a way that is useful to the business. The data stored could include customer name, address, telephone number, occupation, credit limit, current balance, brand preference, total purchases, sales representative, and date of last order. The business manager could then obtain lists of customers according to:

- Outstanding balance of 30+ days, for collection purposes.

- Brand preference, for research and promotional purposes.
- Sales representatives.
- Those who have not ordered within the last year, for consideration of removal from the active list or for a followup campaign.

A mailing list program could be combined with a customer maintenance program to provide a powerful tool—an accurate profile of your customer base, useful reports for the sales staff, and a means for select mail promotion.

Payroll. A complete payroll calculation program would include the following features: time card hours computation, check writing, and provisions for commissions, bonuses, piecework salaries, and incentives. Additionally, W-2 forms and payroll summaries could also be generated.

Inventory. A complete inventory management program should be able to output the following reports: detailed inventory, inventory status, on-order, order exception, analysis by cost, list for use in physical inventory, period to date, year to date, minimum quantity search, and inventory projections. The following file update functions should also be provided: place an order, cancel an order, add a new inventory item, and initialize a new period or year. The inventory program could also print purchase orders or reminders.

Contract Preparation. A word processing system could print personalized contract forms. Cost estimation functions could also be integrated into the contract preparation program.

General Business Calculations. Consider the use of your Apple in performing the following general business computations, which may previously have been too awkward or time consuming when done by manual methods: cash flow, breakeven point, government withholding calculations, selling price from cost and gross profit prorating, unit price comparisons, order quantity for optimum price break, moving average, seasonal average, cyclical analysis, histogram generation, worse-case analysis, universal rate of return, summation of ledger columns, optimum markup or markdown, net present value, choice between debt and equity, lease versus buy determinations, funds statement preparation, perpetual sales quantity, and gross sales revenue.

Professional Practice Management

Professionals with large practices should consider using an Apple IIGS system to do the following:

- Maintaining appointments
- Billing and collection
- Generating appointment reminders
- Accessing reference libraries and data resources for journal articles, diagnoses, case laws, standards, rules and regulations, codes, and drug information.
- Correspondence and document preparation
- Telecommunication with laboratories for diagnostic tests.
- Insurance form preparation or transmission.

Business Letters

Professionally prepared files of business letters are available for Apple computers to save you time from having to create your own letters. There are typically over 1000 letters for review, modification, and output through the use of a word processing program.

Sales Device

The Apple IIGS can be used as a sales device in several ways. Now that telephone dialing interfaces are available, you can use the Apple to call every possible telephone number in an exchange or from a customer file and deliver a taped retail sales message to anyone who answers. At expositions or retail sales outlets, an Apple with a video display can continually list sales information. Crude question-and-answer capabilities could also be provided.

Use of the Apple as a customer advisor can increase sales traffic, as well. For example, a garden supply shop could provide customers with access to an Apple IIGS programmed to answer gardening questions about specific plants (e.g., questions about growing seasons and nutrient requirements), amount and type of fertilizer for a certain size lawn and type of grass, and possibly output a complete garden plan. A wine shop Apple could recommend a type of wine to accompany a given meal, the glass and temperature to use, and the comparative prices of wines. The cosmetics department of a store could use the Apple IIGS to suggest brand name cosmetics to use in achieving a certain complexion. A swimming pool maintenance company advertises that it offers a free computer analysis of anyone's swimming pool water. From water samples, the computer determines the type and amount of chemicals necessary to maintain a specific pool; these chemicals are then sold to the pool owner.

Time Calculations

Calculation of the difference in hours or days between two given times is an important business application. The results can be used in determining hours worked for payroll purposes or in figuring accumulated interest.

Time differences between major cities or time zones could be calculated by a program. A world map could also be displayed on a video screen with the appropriate times in major cities continuously updated. This application may be useful to those making long distance calls or flying into other time zones.

The Calculation of Reference Tables

Any mathematical function may be expressed as a table of values corresponding to the factors in the equation. Businesses that need to calculate the value of a particular function could produce a table listing values at specified intervals for easy reference. For example, a portion of a chart used in converting British pounds to American dollars is reproduced here. Note that the dollar equivalents are found in the interior of the chart.

		pence									
		.00	.10	.20	.30	.40	.50	.60	.70	.80	.90
pounds	1	1.90	2.09	2.28	2.47	2.66	2.85	3.04	3.23	3.42	3.61
	2	3.80	3.99	4.18	4.37	4.56	4.75	4.94	5.13	5.32	5.51
	3	5.70	5.89	6.08	6.27	6.46	6.65	6.84	7.03	7.22	7.41
	4	7.60	7.79	7.98	8.17	8.36	8.55	8.74	8.99	9.12	9.31

The conversion rate for this chart is 1.90 dollars per British pound. As an example of its use, the number of dollars that are equivalent to 4.90 pounds is given by the chart as 9.31.

Your Apple IIGS can be a time saver by computing and outputting tables concerning areas such as:

- Stock commissions.
- Values of an investment or savings account over periods of time.
- Unit prices after certain quantity purchases.
- Break-even values for various prices and sales of a product.
- UPS/USPS rates to various cities for various weights.

THE COMPUTER AND THE PROFESSIONS

In this section a variety of ways in which the IIGS can be used in the professions and in many blue collar occupations are listed. This short listing is far from complete; uses of Apples are so diverse that these descriptions can only be suggestive of a few of the many applications.

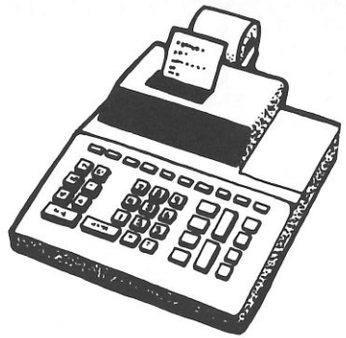
Accountants and tax specialists:	All aspects of work
Advertising:	Client fees
	Composition and printing costs
	Production (film and TV) costs

	Space and time buying
	Statistics in market research
Agriculture:	Yields per acre
	Livestock growth and feeding
	Livestock food supplements
	Crop mix and rotation
	Fertilizer ratios
Appraisers:	Comparative values
	Quantities
	Summations
Architects:	Strength of materials
	Loads, stresses, and strains
	Geometrical configurations
Artists and designers:	Supplies and materials
	Scale reductions and expansions
Attorneys:	Client fees by hours worked
	Terms of contracts
	Tax calculations
	Bankruptcy dispositions
Auto salesmen:	Optional equipment costs
	Discounts and prices
	Used car allowances
Auto service and repair:	Towing and road service costs
	Costs of materials and labor
	Estimates
Banking:	Interest, assets, annuities, insurance
	Foreign exchange
	Collateral
	Trust and pensions
Broadcasting:	Program scheduling
	Advertising rates
	Station logs
Building contractor:	Measuring land sites
	Amounts and costs of roofing, flooring, siding, etc.
	Electrical loads and needs
	Figuring gutters, windows, screen sizes
	Water pressures, plumbing
	Work schedules and transportation
Building maintenance:	Supplies and power
	Waste disposal
Buyer:	Comparative costs among suppliers
	Shipping charges
	Foreign size conversions
	Cost relative to markup at retail
	Profit potential
Chemists and lab technicians:	Quantitative measurements
	Composition of solutions and compounds
	Rates of reactions
	Volumetric and gravimetric analysis.
Construction trades:	Calculations of materials, labor time, charges, and so on by bricklayers, masons, carpenters, plasterers, plumbers, etc.
Dieticians:	Food quantities and costs
	Nutritional and caloric values
Educators—teachers:	Grading homework and examination papers
	Classroom games and instructions in arithmetic, English, etc.

Employment counselors:	Working conditions, wages, and salaries
	Fringe Benefits
	Labor supply and openings
Engineers:	All phases of construction, including plant location studies, tax rates, labor and transportation charges, loads, amounts and costs of raw materials, excavation needs, fill, wood, wire and cement forms, steel reinforcement, strength of materials, electrical loads, chemical reactions, etc.
Geologists:	Land measurements
	Chemical analysis and assays
	Mineral depletion rates
Hotel and inn keepers:	Supplies and labor
	Occupancy rates
	Concession profits and activity
	Group discounts and catering
Independent businesses:	Balance sheet, profit and loss statements
	Purchases, returns, and allowances
	Cost of materials, labor, services, loans
	Figuring profit on investment and costs of expansion
	Itemizing for tax deductions
	Depreciation schedules
Insurance salesman:	Premiums, dividends on policies
	Annuities
	Alternative insurance packages
	Proper levels of coverage
Interior decorating:	Amounts and costs of fabrics, rugs, carpeting, drapes, wallpaper, etc.
	Discounts for quantity
	Shipping times and charges
Jewelers:	Pricing and costs
	Composition of precious metals
	Gem weights and sizes
Landscape architects and contractors:	Land areas, planting and fertilization schedules
	Land fill
Manufacturer's representative:	Cost of items less discounts
	Shipping and insurance costs
	Invoices prepared for suppliers and clients
Market research:	Statistics of opinion and field testing
	Extent and nature of competition
Medical, dental, and other health services:	Prescribing or utilizing medications, anesthetics, prosthetic devices, etc.
	Operational costs of services
	Supplies inventories and costs
Pattern makers:	Geometric configurations
	Measurements and conversions
	Alternative designs
Personnel administration:	Absenteeism rates, efficiency
	Vacations, illness rates
	Wage rate compliances

	and comparisons
	Employee benefits
	Hirings and severances
Pharmacists:	Pharmaceutical measurements
	Supplies inventory and costs
	Pricing
Photographers:	Composition of solutions
	Supplies comparisons
	Pricing
	Exposure times and shutter speeds
Pilots:	Passenger and freight loads
	Fuel consumption and capacities
	Navigation
Printers:	Paper stocks
	Scheduling printing runs
Psychologists:	Psychological testing
	Statistics of experiments
Publishing:	Composition and printing costs
	Postage and shipping costs
	Inventory control
	Distribution costs
	Discounts
Real estate:	Market and appraised value
	Development costs
	Taxes, insurance, water, and heating costs,
	Closing fees
Restaurants:	Commissions
	Food and liquor costs and prices
	Tips
Renting and leasing:	Interest charges and cash flow
	Inventory and usage rates
Sales, door to door:	Travel and other expenses
	Statements to suppliers
	Commissions
Sales, retail:	Taxes and commissions
	Inventory and turnover
	Pricing—markups and markdowns
Secretaries:	Petty cash, travel expenses
	Postage costs
	Budget, production, sales reports
	Employer's personal finances
	Correspondence and memo verification
Security analysts:	Profits, expenses, P/E ratios working capital, depreciation, growth rates, dividends, etc.
	Technical and fundamental analyses
Securities salesmen:	Margin costs and availability
	Dividend and interest yields
	Commissions earned
	Growth rates, price changes, balanced portfolios
Social services:	Welfare availability versus family needs
	Family budgeting
Surveyors:	Land measurements
Travel agents:	Discounts on fares, tours, hotels
	Commissions earned
	Distances and costs per distance
	Converting foreign currencies, kilometer distances, etc.
	Billing airlines, steamship lines, bus companies, tours, hotels, etc.
Trucking and shipping:	Load capacities by weight and volume
	Distances, time schedules, costs
	Equipment inventory and maintenance
	License fees and taxes
Typographers:	Printers' measurements
	Plates and etchings
Waiters and waitresses:	Tips
	Totaling checks
Wholesalers and manufacturers:	Labor and overhead
	Loss on discounting customers' interest-bearing notes
	Interest on account balances
	Recording payments, promissory notes, partial payments
	Consignments and returns
	Shipping costs and taxes

Chapter 3



Apple IIGS Number Crunching: Mathematical and Statistical Applications

One of the biggest assets of the Apple IIGS is its ability to perform complicated and tedious mathematical calculations with unerring diligence. Your IIGS can be programmed to emulate a simple adding machine or a complex scientific business calculator. It can perform statistical computations of use to those involved with businesses, investments, questionnaire analysis, and the sciences.

THE APPLE IIGS AS A SOPHISTICATED CALCULATOR

A program could be written to emulate the functions of an ordinary calculator (see Listing 3-1) or an RPN calculator. The computer could be used as a simple business or scientific calculator for a variety of purposes (see Fig. 3-1). Additionally, functions not provided on an ordinary calculator

Listing 3-1: Desktop Calculator Program

```
10  REM  DESKTOP CALCULATOR
20  HOME
30  TEXT
40 X = 10:Y = 0:C$ = "":D$ = "":E$ = "": DIM A(35)
50  VTAB 1: HTAB 9: FOR X = 1 TO 9
60  PRINT  CHR$ (95);: NEXT X
70  VTAB 3: HTAB 9: FOR X = 1 TO 9
80  PRINT  CHR$ (95);: NEXT X
90  VTAB 15: HTAB 9: FOR X = 1 TO 9
100  PRINT  CHR$ (95);: NEXT X
110  FOR Y = 2 TO 15: VTAB Y
120  HTAB 8: PRINT  CHR$ (124);: NEXT Y
130  FOR Y = 2 TO 15: VTAB Y
140  HTAB 18: PRINT  CHR$ (124);: NEXT Y
```

```
150  VTAB 5: HTAB 10: PRINT "7 8 9 +"
160  VTAB 7: HTAB 10: PRINT "4 5 6 -"
170  VTAB 9: HTAB 10: PRINT "1 2 3 ="
180  VTAB 11: HTAB 10: PRINT "   0"
190  VTAB 13: HTAB 10: PRINT "  END"
200  VTAB 20: HTAB 7: PRINT "PRESS E TO END"
210  GET N$
220  FOR S = 1 TO 10:P =  PEEK ( - 16336): NEXT S
230 X = X + 1
240  IF X > 16 THEN X = 9: VTAB 2: HTAB X: PRINT "          ":Y = 0
250  VTAB 2: HTAB X + 1: PRINT N$
260  IF N$ =  CHR$ (43) THEN Z = Y: FOR W = 0 TO Y:C$ = C$ +  STR$ (A(W))
     : NEXT W:M = 0
270  IF N$ =  CHR$ (45) THEN Z = Y: FOR W = 0 TO Y:C$ = C$ +  STR$ (A(W))
     : NEXT W:M = 1
280  IF N$ =  CHR$ (69) THEN  GOTO 430
290 A(Y) =  VAL (N$)
300  IF N$ =  CHR$ (61) THEN  GOTO 320
310 Y = Y + 1: GOTO 210
320  FOR W = Z + 1 TO Y:D$ = D$ +  STR$ (A(W)): NEXT W
330 C =  VAL (C$):D =  VAL (D$)
340  IF M = 1 THEN E = C - D
350  IF M = 0 THEN E = C + D
360 E$ =  STR$ (E): IF E$ = "0" THEN E$ = "0-"
370 L =  LEN (E$)
380 E$ =  LEFT$ (E$,L - 1)
390  IF E$ = " " THEN E$ = "0"
400  VTAB 2: HTAB 9: PRINT "          ": VTAB 2: HTAB 10: PRINT E$
410 Y = 0:Z = 0:X = 8:E = 0:C = 0:D = 0:M = 0:C$ = "":D$ = "":E$ = ""
420  GOTO 210
430  HOME
```

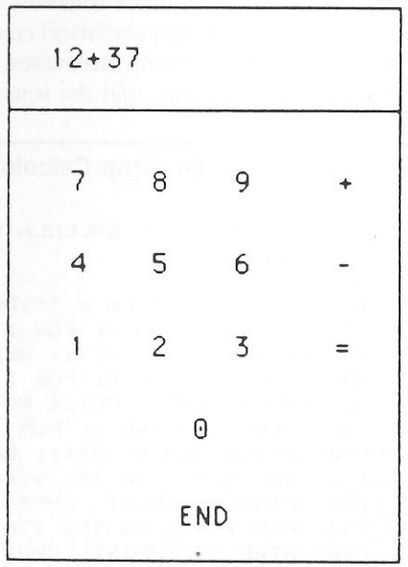


Fig. 3-1. Listing 3-1 generates a functional desktop calculator. In this example, the addition of 12 and 37 awaits the pressing of the equals key (=). All calculations in this program are entered in conventional fashion. In other words, you would press the following keys in this demonstration: 1, 2, +, 3, 7, and =.

could easily be included (e.g., the ability to solve quadratic equations).

RPN Calculator

RPN, which stands for Reverse Polish Notation, is a system of representing mathematical equations. Some of the advanced scientific calculators use the RPN system because fewer keystrokes are required to do complex calculations with an RPN system than with the regular system. The RPN system is often easier to use after you have become familiar with it. You could program the IIGS to emulate an RPN calculator, providing many mathematical functions.

In the RPN system there are no parentheses and no = (equals) key. Only two numbers are worked with at one time. A sample calculation would proceed as follows:

Step	Input	Display	Comments
①	2.5	2.5	Enter first number
		0	
		0	These are the four registers
		0	
②	4	4	Enter second number as new numbers are input, preceding inputs are shifted through the registers.
		2.5	
		0	
		0	
③	*	10	*stands for multiplication. The answer to 2.5 × 4 was calculated and put in the first position in the display.
		4	
		2.5	
		0	
④	10	10	enter third number
		10	
		4	
		2.5	
⑤	5	5	enter fourth number
		10	
		10	
		4	
⑥	/	2	/stands for division. The following calculation was performed, and the answer was stored in the first display position: 10/5 = 2
		5	
		10	
		10	
⑦	+	12	The + sign instructed that the two preceding results were to be added: 10 + 2 = 12; the answer was stored in the first position. The two preceding results were added because no new numbers were input for the computation.
		2	
		5	
		10	

The functions that should be available in such an RPN program are described below:

Function	Description
*	multiplication
+	addition
/	division
–	subtraction
↑	powers(e.g.,x↑y stands for x^y and x↑.5
$\sqrt{\ }$	stands for $\sqrt{x}$)
INV	inverse(e.g., 1/x)
C	clear display/registers
SIN	compute the sine of x
ASIN	compute the arcsine of x
COS	compute the cosine of x

Function	Description
ACOS	compute the arccosine of x
TAN	compute the tangent of x
ATAN	compute the arctangent of x
SEC	compute the secant of x
ASEC	compute the arcsecant of x
COT	compute the cotangent of x
ACOT	compute the arccotangent of x
CSC	compute the cosecant of x
ACSC	compute the arccosecant of x
PI	place the value of π in the register
E	compute the exponential of x (i.e., e^x)
LOG	compute the logarithm of x
MEM+	add a number to the memory register
MEM–	delete a number from the memory register
%	change x to a percentage value
N!	compute the factorial of x
SD	compute the standard deviation for a set of scores
HYP	compute the value for the hypotenuse of a triangle given the two sides
SIDE	compute the value for a side of a triangle given the hypotenuse and another side
DEG	change x from radians to degrees
RAD	change x from degrees to radians
POLR	compute polar coordinates given rectangular coordinates
RECT	compute rectangular coordinates given polar coordinates
MET	compute metric conversions-a subprogram
HSIN	compute the hyperbolic sine of x
HCOS	compute the hyperbolic cosine of x
HTAN	compute the hyperbolic tangent of x
HSEC	compute the hyperbolic secant of x
HCSC	compute the hyperbolic cosecant of x
HCOT	compute the hyperbolic cotangent of x
#SIN	inverse hyperbolic sine of x
#COS	inverse hyperbolic cosine of x
#TAN	inverse hyperbolic tangent of x
#SEC	inverse hyperbolic cosecant of x
#CSC	inverse hyperbolic cotangent of x
#COT	inverse hyperbolic secant of x
SZ	switch the z registers
RZ	rotate the z registers
QUAD	compute solutions to quadratic equations with the quadratic equation
?	put computer in monitor mode so that ordinary calculations may be made in the form PRINT 5*1.6 Type CONT in some BASICs to continue with the program

STATISTICS

The Apple IIGS is well suited for dealing with statistics. Basic statistics for one or two variables (e.g., mean, variance, and standard deviation) can be found for a set of observations on one variable. For paired variable sets, the above statistics could be determined for each, and the covariance and correlation coefficient calculated.

$$\text{Mean } \overline{x} = \frac{\Sigma x}{n}$$

$$\text{Variance } \sigma_x^2 = \frac{\Sigma(\text{deviation from true mean})^2}{n}$$

$$= \frac{\Sigma(x-\mu)^2}{n}$$

$$\text{Standard deviation } \sigma_x \sqrt{\text{variance}}$$

$$r = \frac{\Sigma XY - n\overline{XY}}{\sqrt{(\Sigma X^2 - n\overline{X}^2)(\Sigma Y^2 - n\overline{Y}^2)}}$$

Means and Moments. For grouped or ungrouped data, the arithmetic, geometric, and harmonic means can be determined. The second, third, and fourth moments about the mean and the coefficients of skewness and kurtosis can also be calculated.

One and Two Way Analysis of Variance. The mean and variance for two treatment groups and for the entire sample can be calculated, and an F statistic can be applied to the differences between populations.

Contingency Table Analysis. The chi-square statistic may be used to test independence between row and column classifications of a contingency table.

Linear Regression. A set of observations can be fit to a straight line by linear regression. The coefficient of determination, the standard error of y on x, and the standard error for the coefficients can also be computed. Multiple linear regression fits and polynomial regression could also be performed.

For the linear equation $y = a + bx$.

$$b = \frac{\Sigma XY - n\overline{X}\,\overline{Y}}{\Sigma X^2 - n\overline{X}^2}$$

$$a = \overline{Y} - b\overline{X}$$

where $\overline{X} = (\Sigma X)/n$, $\overline{Y} = (\Sigma Y)/n$

Survey Analysis. The following statistical parameters could be calculated by a complete survey analysis program: multivariate analysis, regression analysis, time-series analysis, variance determination, factor analysis, descriptions, and tabulations.

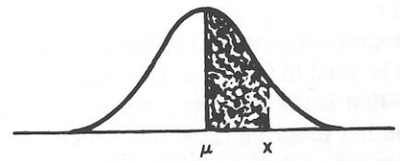
Generation of Frequency Tables. For a large sample, a sorting program could output a standard or relative frequency table.

Hypothesis Testing. A useful program could determine confidence intervals for a given sample, which can then be used in testing hypotheses. Statistical hypothesis testing is used to answer such questions as, "A businessman claimed that 20 percent of the public prefers his product. If 100 people were asked their opinion, what percentage would have to respond negatively for this claim to be refutable?"

Statistical Distribution. The approximations for normal and student's t-distributions given below are designed for easy translation into Applesoft BASIC program statements and have wide applications in statistical analysis.

Similar approximations, available in statistical handbooks and the U. S. Bureau of Standards manuals of computer approximations, can be used to compute chi-square and F distributions.

- Normal Distribution



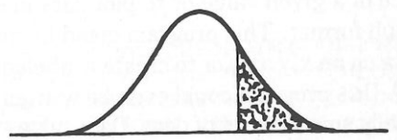
Standard Normal Distribution

$$u = \frac{(x-\mu)}{\sigma x}$$

probability of x falling in the shaded area above = $1 - r(a_1t + a_2t^2 + a_3t^3) + \epsilon(x)$

where: $a_1 = 0.4361836$
$a_2 = -0.1201676$
$a_3 = 0.9372980$
$r = (e^{-x/2})(2\pi)^{-1/2}$
$t = (1 + 0.3326x)^{-1}$
$|\epsilon(X)| < 10^{-5}$

- Student's t-distribution



Student's t-distribution

area of right-tail = $1/4(1 + a_1x + a_2x^2 + a_3x^3 + a_4x^4)^{-4} + \epsilon(x)$

where: a_1 = 0.196854
a_2 = 0.115194
a_3 = 0.000344
a_4 = 0.019527
t = t-value
d = no. degrees of freedom

$x = (t^{2/3}(1 - 2/9d) - 7/9)(2/9 + t^{2/3} \bullet 2/9d)^{-1/2}$

$| \epsilon(x) | < 2.5 \bullet 10^{-4}$

Statistical Analysis

Statistical analysis programs have a wide range of applications in business, stock analysis, and the sciences.

A program dealing with statistics with one variable can be used to find basic descriptions for a set of data—that is the mean and the standard deviation. Another program could determine the linear regression for a set of (x,y) pairs. For example, the relationship between the price of a stock (x) to the Dow-Jones Industrial Average (y) could be determined by inputting corresponding pairs of values. A program could be created that computes the area under a normal curve between two points. A normal curve is used to describe many phenomena; it is pictured and mathematically described above. The area under the curve is equal to one. The average of a set of data (x) is the point at which the curve peaks. If two values on the x axis are picked, the area under the curve between these two points is equal to the probability of a value being between those points.

You could program your Apple IIGS to compute the cumulative binomial probability for the occurrence of a given value or to plot data in simple bar-graph format. This program could be made to plot data on an x,y axis or to create a labeled histogram. A IIGS program could even be written to exponentially smooth a set of data. Data values would be entered, and an exponential function used to predict future values. This smoothing constant should be adjusted so that the output error is minimized.

MATHEMATICS

Your Apple IIGS can be called upon to perform all of the following:

- Solution of quadratic and cubic equations: given the coefficients of either a quadratic or cubic equation, a program could solve for both real and complex roots; equations of degrees could also be solved for.
- Roots of f(x): a program could find the roots of a user-defined function using the bisection method or Newton's method.
- Vector operations: given two vectors in two dimensions, a program could calculate their magnitudes, the angle between them, and their dot and cross products.
- Triangle solution: for a triangle with three known "variables, the lengths of the sides, the angles between sides, and the area could be computed.
- Curve solution: the arc length, central angle, radius, chord length, and tangent length for a curve could be calculated given two known parts; the area enclosed by these parts could also be calculated.
- Arithmetic, geometric, and harmonic progressions: a table of elements for the above three progressions could be generated. The element and the sum of the first n elements could also be determined.
- Factors of integers, GCD, LCM: the prime factors of an integer, the greatest common divisor (GCD), and the least common multiple (LCM) of two integers could be determined.
- Function value table: a useful program could print the values for a user-defined function over a specified interval.
- Prime number table: a table of prime numbers or a test for primes in a specified interval could be generated.
- Partial sums and products: the partial sum or product of a user-defined function could be computed.

- Interpolation between known values: Lagrange polynomial interpolation, or the Newton divided difference method may be performed to interpolate values of a function.
- Guassian integration: the integral of a user-defined function can be determined by Gaussian quadrature.
- Solutions of differential equations: first-order differential equations may be solved by a program using the Runge Kutta method; a step size may be determined to yield results within a specific error tolerance.
- Polynomial arithmetic: addition, subtraction, multiplication, and division of polynomials may be accomplished.
- Polynomial evaluation: a polynomial $(P_x) = a_0 + a_1x + a_2x^2 + \ldots + a_nx^n$ may be evaluated at a point x with complex coefficients.
- Polynomial root finding: Barstow's method is well suited for computer evaluation of quadric factors for polynomials of degree n.
- Complex arithmetic: addition, subtraction, multiplication, division, squares, inverses, and so on may be performed using complex numbers.
- Complex trigonometric functions: common trigonometric functions may be evaluated using complex numbers.
- Base conversions: a useful program could transform numbers of any real base to another base.
- Graphing calculations: the intervals to use for proportional axes given the minimum/maximum values and number of major divisions could be calculated and used for plotting data manually or with a plotter/printer. Additionally, conversion routines between radians, quadrants, revolutions, and degrees could be provided.
- Coordinate conversion between rectangular and polar equivalents may be computed with these formulae:

$r = \sqrt{x^2 + y^2}$
A = arctangent (y/x)
x = r • cosine(A)
y = r • sine(A)

where: x = abscissa, y = ordinate } Cartesian coordinates
r = magnitude of ray, A = angle(in degrees) } Polar coordinates

See Listings 3-2 and 3-3, and Fig. 3-2.

Listing 3-2: Trig Calculator Program

```
10  REM  TRIG CALCULATOR
20  HOME
30  TEXT
40 X = 10:Y = 0:C$ = "":D$ = "":E$ = "": DIM A(35)
50  VTAB 1: HTAB 9: FOR X = 1 TO 9
60  PRINT  CHR$ (95);: NEXT X
70  VTAB 3: HTAB 9: FOR X = 1 TO 9
80  PRINT  CHR$ (95);: NEXT X
90  VTAB 15: HTAB 9: FOR X = 1 TO 9
100  PRINT  CHR$ (95);: NEXT X
110  FOR Y = 2 TO 15: VTAB Y
120  HTAB 8: PRINT  CHR$ (124);: NEXT Y
130  FOR Y = 2 TO 15: VTAB Y
140  HTAB 18: PRINT  CHR$ (124);: NEXT Y
150  VTAB 5: HTAB 10: PRINT "7 8 9 A": VTAB 5: HTAB 20: PRINT "A=ATN"
160  VTAB 7: HTAB 10: PRINT "4 5 6 C": VTAB 7: HTAB 20: PRINT "C=COS"
170  VTAB 9: HTAB 10: PRINT "1 2 3 L": VTAB 9: HTAB 20: PRINT "L=LOG"
180  VTAB 11: HTAB 10: PRINT "S  0  Q": VTAB 11: HTAB 20: PRINT "S=SIN
     Q=SQR"
190  VTAB 13: HTAB 10: PRINT " E  ="
```

```
200  VTAB 19: HTAB 7: PRINT "PRESS E TO END": VTAB 21: HTAB 1: PRINT "ENT
     ER FUNCTION, THEN VALUE": VTAB 23: HTAB 3: PRINT "ENTER ANGLES IN RA
     DIANS"
210  GET N$
220  FOR S = 1 TO 10:P =  PEEK ( - 16336): NEXT S
230 X = X + 1
240  IF X > 16 THEN X = 9: VTAB 2: HTAB X: PRINT "          ":Y = 0
250  VTAB 2: HTAB X + 1: PRINT N$
260  IF N$ =  CHR$ (65) THEN Z = Y:M = 0
270  IF N$ =  CHR$ (67) THEN Z = Y:M = 1
280  IF N$ =  CHR$ (76) THEN Z = Y:M = 2
290  IF N$ =  CHR$ (83) THEN Z = Y:M = 3
300  IF N$ =  CHR$ (81) THEN Z = Y:M = 4
310  IF N$ =  CHR$ (69) THEN  GOTO 480
320 A(Y) =  VAL (N$)
330  IF N$ =  CHR$ (61) THEN  GOTO 350
340 Y = Y + 1: GOTO 210
350  FOR W = Z + 1 TO Y - 1:D$ = D$ +  STR$ (A(W)): NEXT W
360 D =  VAL (D$)
370  IF M = 0 THEN E =  ATN (D)
380  IF M = 1 THEN E =  COS (D)
390  IF M = 2 THEN E =  LOG (D)
400  IF M = 3 THEN E =  SIN (D)
410  IF M = 4 THEN E =  SQR (D)
420 E$ =  STR$ (E)
430 E$ =  LEFT$ (E$,8)
440  IF E$ = " " THEN E$ = "0"
450  VTAB 2: HTAB 9: PRINT "          ": VTAB 2: HTAB 10: PRINT E$
460 Y = 0:Z = 0:X = 8:E = 0:C = 0:D = 0:M = 0:C$ = "":D$ = "":E$ = ""
470  GOTO 210
480  HOME
```

Listing 3-3: Trig Plotter Program

```
10  REM  TRIG PLOTTER
20  HOME
30  TEXT
40  PRINT : PRINT "I AM A TRIGONOMETRIC PLOTTER": PRINT : PRINT "TO USE M
    E, FOLLOW THE MENU INSTRUCTIONS"
50  PRINT : PRINT "PRESS ANY KEY TO GO TO THE MENU": GET Z$: HOME
60  PRINT : PRINT  TAB( 12)"TRIG PLOTTER MENU"
70  PRINT : INPUT "CHOOSE ONE: S)SIN  C)COS  ";C$
80  PRINT : INPUT "ENTER AN AMPLITUDE: (1-80)  ";A
90  PRINT : INPUT "ENTER A PERIOD: (.1-4.5)  ";P
100  PRINT : PRINT "YOU WILL SOON SEE THE FOLLOWING PLOT-"
110  IF C$ = "S" THEN  PRINT : PRINT "A SIN PLOT OF X FROM 0 TO 280 WITH
    A    PERIOD OF ";P;" AND AN AMPLITUDE OF ";A
120  IF C$ = "C" THEN  PRINT : PRINT "A COS PLOT OF X FROM 0 TO 280 WITH
    A    PERIOD OF ";P;" AND AN AMPLITUDE OF ";A
130  PRINT : PRINT "PRESS ANY KEY TO SEE THIS PLOT": GET Z$
140  HGR2
150  HCOLOR= 3
160  IF C$ = "S" THEN 180
170  IF C$ = "C" THEN 230
```



```
180  FOR X = 0 TO 279 STEP P
190 Y = ( SIN (X)) * A
200  HPLOT X,Y + 90
210  NEXT X
220  GOTO 270
230  FOR X = 0 TO 279 STEP P
240 Y = ( COS (X)) * A
250  HPLOT X,Y + 90
260  NEXT X
270  GET Z$
280  HOME
290  TEXT
300  PRINT : PRINT "DO ANOTHER (Y/N)?": GET Z$
310  IF Z$ = "Y" THEN  HOME : GOTO 60
320  HOME
```

The Solution of Simultaneous Equations

The IIGS can be used to find the solution to a set of simultaneous equations. This mathematical operation has applications in many areas, including business and science. An example of two equations to be solved simultaneously follows:

$$5X = 4Y + 24$$

$$2.5Y = 6X - 4$$

If the equations are solved simultaneously, a value will be found for X and Y such that both equations will be correct.

Integral Evaluation

Among the many methods used for computer

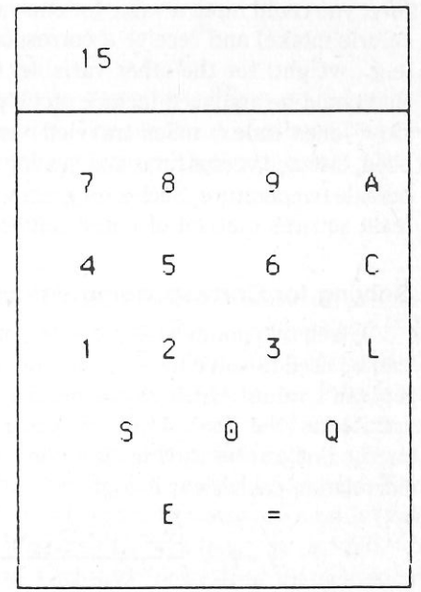


Fig. 3-2. This trigonometric calculator is from Listing 3-2. The displayed result, 15, was obtained by finding the square root of 225. These keys were pressed to find this answer: Q, 2, 2, 5, and =. When using this program, always enter the function followed by the value.

evaluation of integrals is Simpson's Rule:

$$\int_a^b f(x)dx \cong h/3[f(a)+4f(a+h)+2f(a+2h)+4f(a+3h)+\ldots+2f(a+(n-2)h)+4f(a+(n-1)h)+f(b)]$$

where $h = \frac{b-a}{n}$ and n = number of iterations

(as n increases, accuracy increases)

The trapezoidal approximation is another algorithm used with computers.

Determining the Equation of a Line

One useful Apple IIGS program would accept (x,y) data points and use linear regression to determine the equation of the line that best fits, or describes, the data. Applications are numerous. For instance, if you were on a weight-loss plan and input values for your weight versus your amount of exercise or calorie intake, the program could find the equation of a line that best fits this data. Therefore, you could input a value for one variable (e.g., calorie intake) and receive a corresponding value (e.g., weight) for the other variable. Other areas that could be analyzed include stock price versus Dow-Jones Index, miles traveled versus gallons used, distance versus time, and heating costs versus outside temperature. Such a program would use the least squares method of linear regression.

Solving for Corresponding Values

Given two points of a line, linear interpolation can be used to solve for y values corresponding to a given x value. Although this method is not as accurate as the least squares linear regression method, it can be used in situations in which the correlation coefficient is high.

$$y = y_1 + \frac{(y_2-y_1)\bullet(x-x_1)}{(x_2-x_1)}$$

where: x_1,y_1 = coordinates of first point on the line
x_2,y_2 = coordinates of second point on the line
x = abscissa of point to be interpolated
y = ordinate of the point on the line with x

Computer Calculus

Long perceived as merely number crunchers, computers are now moving into the realm of elegant mathematics. Computer algebra programs are now available for the Apple IIGS. These programs can manipulate abstract symbolic mathematical expressions and have the ability to do virtually everything taught in the first two years of university mathematics. They can factor polynomials, simplify expressions, differentiate functions, solve equations, expand functions into a Taylor series, invert matrices, and even integrate functions. Before you invest in your next college level calculus course, you might want to try one of the commercial calculus teaching programs for the IIGS.

MATHEMATICAL RECREATIONS AND PROGRAMMING CHALLENGES

Interesting mathematical problems and ideas to implement on your computer include the following.

Using Probability to Forecast the Outcome of a Sporting Event. For example, an equation expressing the probability that a stronger team will win in a seven game series is:

$$p^4+4p^4q+10p^3q^2x+10p^2q^2(1-x)p$$

where

p = proabability that stronger team will win ($\geq .5$)
q = proabability that weaker team will win ($=1-p$)
x = conditional probability particular to a sport for example, for basketball this value has been calculated to be $=.408$)

For further information, see *Mathematics Magazine* (Sept.-Oct. 1975, pp. 187-192).

Solving Mathematical Puzzles. Puzzles such as the following can probably be solved only with the use of brute force, trial and error computer techniques—that is, if they can be solved at all:

- Find three distinct right triangles with the following properties:

  A. Are pythagorean (all three sides are integers)
  B. The perimeters of the three triangles are equivalent
  C. The areas of the triangles are in arithmetic progression

- Find the smallest solution in positive integers x and y of $x^2 - n \bullet y^2 = 1$ where $n = 61$
- Find how many ways the integer 10,000 can be expressed as a sum of distinct positive integers (ignoring permutations).
- Find the minimum value of the gamma function, gamma (n) = (n-1)! for an integer n in the range $1 < n < 2$.

Puzzles that are simpler to solve include such popular logic games as

- Instant Insanity™ blocks: five blocks with different colors on each side must be arranged so that all five blocks in a row have the same colors on each side. The computer could determine all possible solutions. (7,962,624 possible combinations exist and there are 192 solutions.)
- The High I.Q. Game, which consists of a board in the shape of a cross with markers in every hole except the center hole. The player jumps markers with adjacent markers as in checkers and then removes the one jumped over. Markers may not be moved unless a jump is possible. The object of the game is to jump all the markers on the board, leaving only one final marker; this is difficult to accomplish. The computer could determine the strategy for winning the game and the number of different ways possible to win. (Is there only one method?) A mathematical analysis of this game appeared in *The Journal of Recreational Mathematics*, Vol. 5, No. 2, 1972 pp. 133-. The triangular version was discussed in *The Mathematics Teacher*, January 1979, pp. 53-.

Computing for Pi, e, Solutions for High-Degree Equations, and Mathematical Oddities. Many mathematicians take delight in computing values for irrational expressions, determining equations for special mathematical circumstances, and discovering unusual properties of specific numbers. The Apple IIGS is useful in such computations.

Pi can be calculated using this successive approximation:

$$\pi = 4 - 4/3 + 4/5 - 4/7 + 4/9 - 4/11 + \ldots$$

Similarly, the value of the natural log e can be calculated using this successive approximation:

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \ldots$$

Programs to compute a Fibonacci Sequence are also popular. The sequence is created by adding each previous term to the term before that:

1, 1, 2, 3, 5, 8, 13 . . .

Sunflower and daisy florets, pinecones, pineapples, the shells of some mollusks, and even patterns of paving stones and the mating habits of bees and rabbits exhibit properties given by the Fibonacci Sequence. For example, the seeds of sunflowers and daisies form a pattern of two sets of spirals, one clockwise and the other counterclockwise. The numbers of spirals in the two sets are usually consecutive Fibonacci numbers (e.g., 34 and 55).

Playing Games. Interesting mathematical

games for your IIGS include the following:

- The four color map problem: a recreation that has interested mathematicians for many years is to prove that only four colors are needed to copy any map in such a manner that no bordering countries are of the same color. The proof was accomplished by a large-scale, brute-force computer program.

A game based on this fact could involve two players who attempt to force each other to color two bordering countries the same color. In each turn, a player would choose any color to apply to any country on a map with random boundaries. Proper logic will ensure that one player will lose. The computer could serve as one of the opponents.

- Magic squares game: the magic squares game pits the computer against a human in an attempt to complete a magic square while blocking an opponent. A magic square is composed of smaller squares, each with a separate number inside. The numbers in the smaller squares in horizontal, vertical, and diagonal rows sum to the same amount. Opposing players could attempt to complete a magic square in opposing directions.
- Maze games: maze games involve a randomly generated maze and a computer controlled mouse that learns to find its way through the maze.
- Exacto: this game for young people involves two five-digit numbers that have been randomly selected by the computer. Players are instructed to transform the first number into the second through multiplication, division, addition, or subtraction of any other number within a specified range. The computer would keep track of all computations at each stage. The players are scored according to speed or number of operations required to finish.
- Euclid: in this game (p,q) represents a pair of positive numbers such that p is greater than q; A and B signify the two players. Players alternate turns. Each turn consists of replacing the larger of the two numbers given to a player by any positive number obtained by subtracting a positive multiple of the smaller number from the larger number. (All numbers are integers). The first player to obtain zero for the (new) smaller number is declared the winner.

A sample game is shown below; (51,30) is the starting pair of numbers.

A:(30,21) B:(21,9) A:(9,3) B:(3,0) B wins

or the game could have been

A:(30,21) B:(21,9) A:(12,9) B:(9,3) A:(3,9) A wins

- The Two Move Game: in the first half of this game, the two players secretly enter four nonnegative numbers totaling the same number into the cells of a 2 by 2 matrix:

x1	x2
x3	x4

y1	y2
y3	y4

The entries are then exposed and a third 2 by 2 matrix is developed in which the entries are x_1 y_1. This final matrix is then analyzed by the first player who chooses a column and tries to maximize. The second player then chooses a row and tries to maximize. The player with the greatest variation wins. A mathematical strategy exists to win this game; can you find it?

- Sim: the game of Sim involves a gameboard like this:

```
      x     x
   x           x
      x     x
```

The players take alternate turns drawing lines between two points. The first player to draw an equilateral triangle or square loses. A mathematical strategy exists to win this game.

See Listing 3-4 and Fig. 3-3.

Listing 3-4: The Sim Game Program

```
10  REM  THE SIM GAME
20  HOME
30  TEXT
40  PRINT : PRINT "HERE IS A SIMPLE GAME THAT HUMANS LOVE  TO PLAY"
50  PRINT : PRINT  TAB( 9)"THE GAME IS CALLED SIM."
60  PRINT : PRINT "HERE ARE THE INSTRUCTIONS FOR SIM"
70  PRINT : PRINT "EACH PLAYER TAKES A TURN DRAWING A LINE BETWEEN TWO DI
    FFERENT POINTS."
80  PRINT : PRINT "THE FIRST PLAYER THAT COMPLETES AN EQUI-LATERAL TRIANG
    LE OR A SQUARE--LOSES."
90  PRINT : PRINT "SOUNDS SIMPLE DOESN'T IT?"
100  PRINT : PRINT "LET ME DRAW THE GAME BOARD--THEN WE'LL  BEGIN."
110  PRINT : PRINT "PRESS ANY KEY TO BEGIN": GET Z$: PRINT : PRINT : PRINT

120  HGR
130  HCOLOR= 3: RESTORE
140  FOR Z = 1 TO 67: FOR S = 1 TO 25:P =  PEEK ( - 16336): NEXT S: READ
     X,Y: HPLOT X,Y: NEXT Z
150  PRINT : PRINT : PRINT : INPUT "OK, PLAYER 1, MOVE FROM ";A$
160  INPUT "AND MOVE TO ";B$
170  GOSUB 330
180  HPLOT A,B TO C,D
190  PRINT : PRINT : PRINT : INPUT "OK, PLAYER 2, MOVE FROM ";A$
200  INPUT "AND MOVE TO ";B$
210  GOSUB 330
220  HPLOT A,B TO C,D
230  PRINT : PRINT : PRINT : PRINT "DID ANYONE LOSE YET (Y/N)": GET Z$
240  IF Z$ = "N" THEN  PRINT : PRINT : GOTO 150
250  HOME
260  TEXT
270  PRINT : PRINT "CONGRATULATIONS"
280  FOR S = 1 TO 75:P =  PEEK ( - 16336):P =  PEEK ( - 16336): NEXT S
290  PRINT : PRINT "PLAY ANOTHER (Y/N) ?": GET Z$
300  IF Z$ = "Y" THEN  GOTO 120
310  HOME
320  END
330  IF A$ = "1" THEN A = 140:B = 74
340  IF A$ = "2" THEN A = 153:B = 75
350  IF A$ = "3" THEN A = 134:B = 81
360  IF A$ = "4" THEN A = 159:B = 82
370  IF A$ = "5" THEN A = 141:B = 87
380  IF A$ = "6" THEN A = 154:B = 87
390  IF B$ = "1" THEN C = 140:D = 74
400  IF B$ = "2" THEN C = 153:D = 75
410  IF B$ = "3" THEN C = 134:D = 81
420  IF B$ = "4" THEN C = 159:D = 82
430  IF B$ = "5" THEN C = 141:D = 87
440  IF B$ = "6" THEN C = 154:D = 87
450  RETURN
500  DATA  140,70,140,71,140,72,140,73,140,74,132,79,133,79,134,79,135,79
     ,134,80,133,81,134,81,135,82,135,83,134,84
510  DATA  133,84,132,84,138,87,139,87,140,87,141,87,138,88,138,89,139,89
```

```
      ,140,89,141,90,141,91,140,92,139,92,138,92
520   DATA  153,71,154,70,155,70,156,71,156,72,155,73,154,74,153,74,153,75
      ,154,75,155,75,156,75,162,79
530   DATA  161,80,162,80,160,81,162,81,159,82,160,82,161,82,162,82,163,82
      ,162,83,162,84,156,88
540   DATA  155,87,154,87,153,88,153,88,153,89,153,90,153,91,154,90,155,90
      ,156,91,154,92,155,92
```

Computing Probabilities. You could use your Apple IIGS to calculate the following probabilities:

- Life: this popular computer recreation was devised by John Conway, a mathematician at Cambridge University. It simulates an ecological system and illustrates the rise, fall, and changes of a society of living organisms as they interact with their environment and each other. The game begins with a small population of organisms; as time progresses (measured in terms of generations), the population experiences one of three fates: it dies out due to over or underpopulation, it becomes stable, or it oscillates in a repeating pattern. Each member of the population has one of three fates during each generation. It can die from "starvation,' give birth to another organism, or survive in a stable form.

The game board is a grid of arbitrary size, often larger than 20 × 20. Each square on the grid may be occupied by one organism or empty. Thus, each organism always has eight surrounding squares. It will die if it touches fewer than two or more than three occupied squares. If three occupied squares touch an empty square, a new occupant is born to fill that square. Births and deaths are evaluated simultaneously.

- Poker Probabilities: you could compute the probability that m * n cards held by a defender in a bridge hand will be split m and n, or the probabilities for obtaining a certain hand in poker after certain cards have been played.
- Birthdays: in a classroom of 24 students, how many would you estimate have the same birthday? The chances are slightly better than even that 2 or more students will have birthdays on the same date, counter to our intuition! For a given number of people, x, the percent chance that 2 or more will have the same birthday is given by

$$\% \text{ chance} = 100 - 100 \bullet \left(\frac{365 - x}{365}\right)$$

Write a BASIC program to calculate the percent chance of coincident birthdays for any input of x, the number of people in the group considered.

- An Apocalyptic Possibililty: an equation expressing the probability of an accidental nuclear missile launch by the United States or the Soviet Union falsely triggering World War III is as follows:

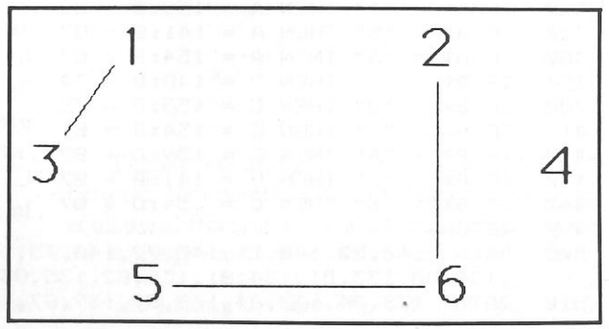


Fig. 3-3. Is this a winning or losing strategy for Sim? The Sim game is found in Listing 3-4. The object is to make the other player form an equilateral triangle or a square. In order to achieve this goal, each player takes turns connecting lines between two different points.

$$PA = 1 - (1 - P)^{(N(U+S))}$$

where PA = Probability of the Apocalypse (for percent chance, multiply PA • 100)
U = Total number of strategic missiles in the U.S. arsenal (2000 est.)
S = Total number of strategic missiles in the Soviet arsenal (2300 est.)
P = Probability of accidental launching of a nuclear missile by either side during a 24-hr. period (1^{-8} estimated)
N = Number of days under consideration (20 years = 7,300 days)

Write a BASIC program to consider different values for U, S, P, and N.

Calculating Useful Information. You can use your IIGS to figure out practical information such as the following:

- Easter: a program to calculate the date of Easter for any year would make use of the fact that Easter falls on the first Sunday following the arbitrary Paschal Full Moon, which does not necessarily coincide with a real or astronomical moon. The Paschal Full Moon is calculated by adding 1 to the remainder obtained by dividing the year by 19 and applying the information given in Table 3-1.

Table 3-1. The Paschal Full Moon Date.

1-Apr 14	6-Apr 18	11-Mar 25	16-Mar 30
2-Apr 3	7-Apr 8	12-Apr 13	17-Apr 17
3-Mar 23	8-Mar 28	13-Apr 2	18-Apr 7
4-Apr 11	9-Apr 16	14-Mar 22	19-Mar 27
5-Mar 31	10-Apr 5	15-Apr 10	

Thus, for the year 2000, the key is 6, or April 18. A program to calculate the day of the week (see the Business and Financial Applications chapter) could then indicate that April 18, 2000 is a Tuesday. Note: If the Paschal Full Moon falls on a Sunday, Easter is the following Sunday. The earliest Easter can fall is March 23rd and the latest is April 25th.

- Horizons: the distance to the horizon in miles is approximately $\sqrt{1.5h}$, where h = elevation above sea level in feet. Write a BASIC program to draw a mountain and print the miles to the horizon for viewers located at 100 foot intervals.

Creating Artistic Patterns. You can use your Apple IIGS to generate interesting, artistic patterns such as Pascal's art. As described in the December 1966 issue of *Scientific American*, Pascal's triangle can be used to generate artistic geometric patterns. A sample Pascal triangle is shown below. Each number in the successive rows is generated by adding the two numbers above and to the immediate left and right of the number in question.

```
          1
        1   1
      1   2   1
    1   3   3   1
  1   4   6   4   1
1   5   10  10  5   1
```

In order to write an Applesoft BASIC program to generate patterns using the triangle, you could, for example, represent all odd numbers by an X and all even numbers by a space. Then, print the results on a dot matrix printer. A variety of interesting geometrical patterns involving triangles will be formed.

Chapter 4

Technical and Scientific Applications

Personal computers, rather than their large-scale mainframe counterparts, are being increasingly used by technicians and scientists for problem solving. They offer the advantages of ease of use, low cost, and greater portability. Although many large-scale scientific problems are best left to supercomputers, the Apple has become an asset in its own right in all types of laboratories.

In this chapter, we will examine the ways Apples have been put to scientific and technical use. The IIGS can help to rid the professional or amateur scientist of the mathematical drudgery that is so much a part of the discovery process. It can rapidly and accurately solve problems, many of which would not have previously been undertaken because of their sheer magnitude.

Many of these applications are specialized. The purpose of this chapter is to touch upon just a few of the most commonly used scientific applications, provide sources for further information, and demonstrate some solutions in Applesoft BASIC. Due to space restrictions, formulas and in-depth coverage of each application are impossible, but this information should be readily available in standard reference volumes.

WEATHER FORECASTING

Forecasting the weather is usually thought to be a task that is limited to large computers. Local weather forecasting, however, can be accomplished with surprising accuracy by just taking note of wind direction and barometric changes. A chart in use by local weather bureaus has been based upon these two parameters and could easily be computerized. This data could be input automatically by the use of electronic barometers and wind direction instruments.

Wind change		Barometric condition	Forecast code
From	*To*		
S	SW	7	L
S	SE	3	E
		4	F
		9	M

Wind change		Barometric condition	Forecast code
From	*To*		
NE	SE	3	G
		4	H
		5	J
		6	K
		9	M
N	E	3	I
		4	A
		9	N
to the	West	8	O
NW	SW	1	C
		2	B
		3	D
		7	L

If a forecast is not listed for the proper barometric condition, enumerated below, other factors must be used to provide the forecast.

Barometric Conditions
(IN INCHES Hg)

1. 30.1 or more and steady
2. 30.1-30.2 rising rapidly
3. 30.1 or more falling slowly
4. 30.1 or more falling rapidly
5. 30.0 or less falling slowly
6. 30.0 or less falling rapidly
7. 30.0 or less rising slowly
8. 29.8 or less rising rapidly
9. 29.8 or less falling rapidly

A rapid change is considered to be over 0.06 inches per hour. Thirty inches of mercury equals 760 mm mercury.

Forecasts

A. Summer: rain probable within 12-24 hours. Winter: rain or snow, increasing wind; bad weather often sets when barometer begins to fall and winds set in from the northeast.
B. Fair, followed within two days by rain.
C. Continued fair, no decided temperature change.
D. Fair for two days with slowly rising temperatures.
E. Rain within 24 hours.
F. Wind increasing, rain within 24 hours.
G. Rain within 12-18 hours.
H. Wind increasing, rain within 12 hours.
I. Summer: light winds, rain may not fall for several days. Winter: rain within 24 hours.
J. Rain will continue for 1 to 2 days.
K. Rain, with high wind, followed within 36 hours by clearing, and in winter by colder temperatures.
L. Clearing within a few hours, fair for several days.
M. Severe storm imminent, followed within 24 hours by clearing, and in winter by colder temperatures.
N. Severe northeast gale and heavy precipitation; in winter, heavy snow followed by a cold wave.
O. Clearing and colder.

A cloud chart with forecasts included is also useful. The forecast data for the various types of clouds could be stored and a comparison made between this forecast and a forecast from the above chart.

Other suggestions for applying an Apple IIGS to weather calculations include the following:

1. Pressure/height conversions to allow an anaeroid barometer to serve as an altimeter.
2. Dew point temperature and relative humidity from wet and dry bulb readings.
3. Normal maximum, mean, and minimum temperature degree days for a given date and location.
4. Estimates of cloud base heights from dew point and surface temperature observation.
5. Almanac data for a given time and date (e.g., declination of the sun, distance of the sun from the earth, phase of the moon, and positions of the planets) stored for ready access.
6. Analysis and display of hourly weather data derived from a phone line connected with a weather data channel.
7. Temperature humidity index and relative humidity calculations.
8. Wind chill factor calculations. To calculate the wind chill factor, use the following formula:

$$H = (.14 + .47 * V) * (36.5 - T)$$

where

H = chill in calories lost per square centimeter of skin per second
V = wind velocity (m/sec)
T = temperature (Centigrade)

Create a program that converts dry bulb temperature in °F and wind speed in miles per hour into the apparent wind chill temperature. The only problem with using such a program is that now you will really know how cold you feel.

ENERGY EFFICIENCY COMPUTATION

You can use your IIGS to make the following studies:

- A computerized statistical comparison between the water temperature in a solar energy system and the outside temperature, the angle of the sun, and so on could serve to evaluate the efficiency of a home solar energy system. Analog to digital converters could be used to gather the information automatically.
- Those of you considering the installation of a solar system might want to do another statistical analysis of the heating requirements for your home based on Btu/hr times the number of hours that your furnace operates during the heating season. The size of a solar system necessary to heat your house can then be calculated using this data and the manufacturer's efficiency data.

In the central United States on June 21, the maximum solar energy striking the earth is 290 Btu/square foot (approximately 15 hours in the day). Conversely, on December 21, the solar energy is a maximum of 220 Btu/square foot (approximately 9 hours in the day). Therefore, you can compute the average values for the variables in the formula below:

$$\text{Solar collector Btu output} = \frac{B*h*s*m}{2}$$

where B = Btu/sq ft
h = hrs/day
s = sq. ft of collector
m = max. efficiency

Keep in mind that it takes 500 Btus to heat water at ground temperature (40° F) to 100° F, and that the desired water temperature for home use is 120° F.

- The answer to "How much fuel can be saved by turning the thermostat down from 70 °F to 60 °F at night?" may be determined using this equation:

$$A = \frac{.0625\ (n-1)W}{Z}$$

where
A = amount of heat (Btu)
W = the normal heat loss/hr. (Btu)
n = the number of hours of discontinued heating
z = the number of hours from the beginning of reheating until the house is at an acceptable temperature

- To find the heat loss of your home, use the formula

$$H = \frac{kA(t-t^1)T}{d}$$

where

H = heat transmission (Btu)
K = coefficient of thermal conduction (Values for the type of construction used in your home may be found in builder's manuals)
A = exposed area
$(t - t^1)$ = temperature difference between inside and outside (°F)
T = duration of exposure (hours)
d = thickness of walls (inches)

- To calculate fuel requirements use the formula

$$C = \frac{H(ta - tb)N \times S \times q}{100{,}000 \times (ti - to)}$$

where C = fuel cost
H = heat loss/hr.
t_o = outside temperature
t_i = inside temperature
t_a = average inside temperature
t_b = average outside temperature
N = number of hours of heating required
S = number of units of fuel
q = cost per unit of fuel

TECHNICAL AND SCIENTIFIC CALCULATIONS

The IIGS can be used to perform calculations needed by those involved in many fields, from navigation to chemistry.

Aviation

The private or business pilot will find the following calculations useful. Additional information on aviation calculations may be found in: *The Pilot's Complete Computer Book* by John L. Nelson, TAB Books, Inc., Blue Ridge Summit, PA 17214.

1. Flight plan with wind allowances: calculation of the heading, speed, fuel, and ETA for a trip of multiple legs could be done.
2. Long-range flight plan: calculations could be done for great circle routes and could include distance, time, fuel, and source.
3. Atmosphere, speed, temperature, and altitude: from pressure altitude, a program could calculate the speed of sound, temperature, pressure, and density relative to standard sea level.
4. Prediction of freezing level and lowest usable flight level.
5. Wind components and average vector: crosswind and tail or head wind components of a single wind vector could be calculated.
6. Dead reckoning of position.
7. Great circle flying navigation.
8. Course correction to fly correct path.
9. Rhumb line navigation.
10. Unit conversions: length, volume, weight, U. S. equivalents and metric temperature conversions:

°F = (9/5) * (°C + 32°)
°C = (5/9) * (°F − 32°)

Marine Navigation

Some of the following applications are designed for use on board a small vessel.

1. Time-speed-distance with current sailing: a useful program could solve time-speed-distance equations and could consider the current in determining the proper course to steer and the speed through the water that is necessary to reach a given destination in a specified amount of time.
2. Distance short of, beyond, or to a horizon: a program could calculate the distance to the apparent horizon, as well as the distance to and visibility of an object of known height.
3. Velocity, VMG, and current vectors: given two of the following, 1) drift and set of the current, 2) speed and course through the water, and 3) speed and course made good, a program could calculate the unknown value.
4. Running fix from two objects: a program could calculate a fix of a vessel from bearings of two objects.
5. Planet location. A program could estimate the altitude and azimuth of the four navigational planets. The GMT (Greenwich mean time) of twilight could also be calculated or manually input.
6. Rhumb line and great circle navigation calculation.
7. Sight reduction calculation.
8. Length conversions. For example, nautical miles converted to statute miles.
9. Vector addition.
10. Estimated time of arrival.
11. Conversion of compass points to degrees.
12. Area navigation by VOR (very-high-frequency omnirange).
13. Rhumb line navigation.
14. Dead reckoning of position.
15. Great circle computations.
16. Distance from VOR/OMNI.
17. Course correction.
18. Distance by two bearings.
19. Conversions between knots, miles, statute miles, and kilometers.
20. Speed computation given distance covered and time.

Medical Calculations

Doctors, nurses, technicians, and other medical personnel might find the following calculations useful:

1. Conversions of weight, length, and volume to other units, or conversion of U. S. measurements to their metric equivalents.
2. Lung diffusion calculations.
3. Blood acid-base status determination.
4. Beer's law calculation.
5. Protein electrophoresis: given integration counts of a number of protein fractions, the percentage of each may be found.
6. Body surface area estimation.
7. Oxygen saturation and content. Oxygen content and saturation in the blood may be found given: pO_2, pCO_2, pH, and body temperature.

Publications containing computer programs and applications of use to the health professional include:

Computers in Biology and Medicine
Computers in Medicine
Medical Computer Journal
Physicians Microcomputer Report

Surveying Calculations

Those involved in surveying could utilize the following calculations:

1. Azimuth/bearing traverse: given reference coordinates, leg length, azimuth or bearing, and quadrant, the endpoint coordinates, departure, latitude, and total distance may be computed.
2. Slope reduction determinations.
3. Point of intersection calculation.

Chemistry

Chemists and chemistry students might find the following calculations useful:

1. Calculation of the requirements to produce a given solution.
2. Calculations of the following parameters, given adequate inputs: pH, molality, total atomic weights, gas density and pressure, electron energies, gravimetric factors, liquid pressure, degree of saturation, gram equivalent weight, normality, percent composition, mole fraction, mole percent, and ionic strength dilution factor.
3. Plotting/simulation of reaction rates and electron distribution.

Physics

Those involved with physics will also find the Apple's capacity for performing calculations useful. Potential uses include:

1. The plotting of potential energy functions and lab data.
2. Conversions of units.
3. Solutions to elementary equations: velocity, acceleration, momentum, work, and power.
4. Statistical analysis and data compilation.

An article discussing the use of personal computers by physicists appeared in *Physics Today* (December 1983, pp. 25-28). The author states, ". . . it is very likely that most calculations in physics will be performed by the home computer in the future," because of the benefit of independence from large computer organizations, bureaucracies, and economic constraints.

General Purpose Experimental Applications

Scientists in many fields can use their Apples to perform the following types of calculations:

1. Statistical analysis of data: useful statistical applications include curve fitting and plotting, chi-square tests, analysis of variance and standard deviation, solutions to equations, and correlation coefficients.
2. Calculation of tables for a specific application: functions that are commonly referred to, yet do not have reference tables, could be calculated for a number of different values and the results displayed in a table form for easy reference.

In addition to using Apples for calculations, scientists can interface these same microcomputers to lab instrumentation and develop automatic data log and acquisition systems. They can also develop voice input interfaces that could accept data called out by a lab technician who is too busy to manually record the data.

ENGINEERING APPLICATIONS

Professionals and hobbyists will have several uses for IIGS programs in the following engineering fields.

Electrical Engineering

Apples can help those who deal with electricity by performing calculations and analyses and by facilitating design work.

Active High- and Low-Pass Filter Design. High- and low-pass filters can be designed for a given center frequency, gain, and Q values for the resistors and capacitors in the infinite-gain multiple-feedback circuit. An Apple IIGS program can be created for use in designing simple filters through the use of schematics and formulas.

Active Bandpass Filter Design. Second-order active bandpass filters can be designed using a multiple-feedback network. Both high-Q and low-Q circuits could be designed. Standard values may be selected for easy implementation.

Chebyshev and Butterworth Filter Design. Chebyshev and Butterworth low-pass filters can be designed for specified filter order, termination resistance, and corner frequency.

Resonant Circuits. The impedance and resonant frequency could be calculated by a program for a series or parallel resonant circuits whose component values are specified.

Attenuators. Component values for T and Pi impedance matching circuits can be found for specified input/output impedances and desired loss. Minimum-loss pad matching may be performed for given impedances.

T to Pi Transformations. T(Pi) networks can be transformed to Pi(T) networks having the same characteristics.

Ladder Network Analysis. The input impedance for a ladder network could be calculated; the network may be composed of any combination of resistors, capacitors, and inductors.

Coil Properties. The inductance or number of turns for a single or multilayer coil can be found

when given the wire diameter and the dimensions of the coil. The inductance of two parallel, round wires, one forming a return circuit is given by:

$$L = .0041\ [2.303\ \log_{10}\ (2 * D / d - D / c)]$$

where,

L = inductance (μH)
D = distance in cm between the centers of wires
d = diameter of wire (cm)
c = conductor length (cm)

Power Transformer Design. Core weight can be calculated for a specified power requirement. For a specified core, area flux density and frequency, the number of primary and secondary turns is found. A program for designing power transformers can be found in *Electronic Design News* (October 27, 1983, p. 346).

Rectifier Circuits. Full-wave or half-wave rectifier circuits can be evaluated for a given component value, input voltage, and frequency. The dc (direct current) output voltage and peak-to-peak ripple can also be calculated.

S and Y Parameter Transformations. A set of S(Y) parameters expressed as magnitudes and angles can be transformed to a set of Y(S) parameters.

Phase-Locked Loops. Natural frequency, damping factor, and loop noise bandwidth can be found for either passive or active phase-locked loops. Loop gain and component values for the circuits are required for input.

Transistor Amplifier Design. Collector current and sensitivity factors can be computed for transistor circuits for specified current gain, supply voltage, and resistor values.

Fourier Series. Fourier coefficients can be computed for discrete values for a periodic function. Sine and cosine coefficients may be found and could be used to calculate new values of the function.

Reactive L-Network Impedance Matching. Networks that will match any two complex impedances may be determined.

Bilateral Design, Stability Factor, Maximum Gain, and Optimum Matching. A program could compute the maximum gain available and the load and source reflection coefficients that yield the maximum gain.

Frequency Conversion Program. An Applesoft BASIC program to interconvert velocity, period, wavelength, and frequency values could make use of these commonly used formulas:

$$T = 1/f$$
$$\omega = 2\pi f$$
$$\lambda = v/f$$
$$f = 1/T$$
$$f = \omega/2\pi$$
$$f = v/\lambda$$

where T = period
f = frequency
ω = radian frequency
λ = wavelength
V = propagation velocity

Similarly, frequency and reactance conversions may be accomplished with these formulas:

$$X_c = \frac{1}{2\pi fC} = \frac{1}{\omega C}$$

$$X_L = 2\pi fL = \omega L$$

$$C = \frac{1}{2\pi fX_C} = \frac{1}{\omega X_C}$$

$$L = \frac{X_L}{2\pi f} = \frac{X_L}{\omega}$$

$$f = \frac{1}{2\pi C X_C}$$

$$f = \frac{X_L}{2\pi L}$$

555 Timer Circuit Design. Given the frequency duty cycle and either the timing capacitor or resistor, a program could calculate the other timing component, charge time, discharge time, and period of the commonly used 555 stable multivibrator circuit.

Resonance Calculations. Resonant frequency of inductance-capacitance circuit is given by:

$$fr = \frac{L - R_L{}^2C}{2\pi\sqrt{LC}\,(L - Rc^2C)}$$

where $L = 1/(4\pi^2f^2C)$
$C = 1/(4\pi^2f^2L)$
R_L = series resistance of inductor
R_C = effective series resistance of capacitor
f_r = resonant frequency

Antenna Design. A given frequency could be input to a program that would calculate the antenna dimensions for a dipole, Yagi, or cubical quad antenna. A special program can be created to calculate the dimensions for a Yagi antenna to receive television, radio, or amateur radio broadcasts. When an antenna is designed for a specific frequency, it can often receive signals from distances not previously approached. If the mathematical specifications of the antenna design are unclear, refer to an electronic manual for a picture. Construction of the antenna is not difficult and should cost no more than twenty dollars.

Decibel Conversion and Voltage to dBm Conversion. Voltage ratio in decibels is given by:

$$N_{dB} = 20 \log_{10} (E_{OUT}/E_{IN})$$

where E_{OUT} = output voltage
E_{IN} = input voltage

Such computations would be helpful to the serious audiophile. Also of interest to the audiophile would be a formula used to compute the inductance of a straight wound speaker wire:

$$L = .021 * [2.303 * \log_{10}(41/d) - .75]$$

where,

L = inductance (μH)
d = diameter of wire (cm)

Evaluation Routine for a Program of Boolean Functions. AND, OR, NOT, and other logical statements could be evaluated in a program; the circuit status at each step would be output.

Ohm's Law Calculation. A IIGS can be used to determine the unknown value, as shown in Listing 4-1 and Fig. 4-1.

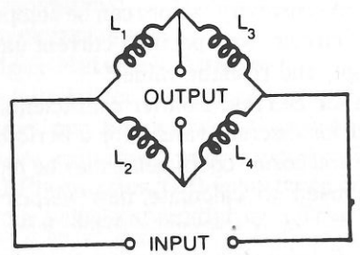
$$E = I * R$$

where

R = resistance (ohms)
E = voltage
I = current

Resistor Color Codes. An ideal program for the novice in electronics is one that outputs the value for a resistor when given the color from the component (see Listing 4-2 and Fig. 4-2).

Inductance Bridge Calculation. Given this design:



Listing 4-1: Ohm's Law Calc Program

```
10  REM  OHM'S LAW CALC
20  HOME
30  TEXT
40  PRINT : PRINT  TAB( 10)"OHM'S LAW CALCULATOR"
50  PRINT : PRINT  TAB( 13)"FOR DC CIRCUITS"
60  GET Z$
70  HOME
80  PRINT : PRINT "WHICH VALUE DO YOU WISH TO SOLVE FOR:"
90  PRINT : INPUT "1)VOLTAGE 2)CURRENT 3)POWER 4)RESISTANCE 5)HELP  ";A$
100  HOME
110  IF A$ = "1" THEN  GOTO 210
120  IF A$ = "2" THEN  GOTO 290
130  IF A$ = "3" THEN  GOTO 370
140  IF A$ = "4" THEN  GOTO 450
150  IF A$ = "5" THEN  GOTO 530
160  HOME
170  PRINT : PRINT "DO ANOTHER (Y/N) ?": GET Z$
180  IF Z$ = "Y" THEN  GOTO 70
190  HOME
200  END
210  REM  VOLTAGE
220  HOME
230  PRINT : INPUT "WHICH EQUATION DO YOU WISH TO USE:       1)E=IR 2)E=P/
     I 3)E=SQR(PR)";A$
240  IF A$ = "1" THEN  PRINT : INPUT "HOW MANY AMPS ";I: PRINT : INPUT "H
     OW MANY OHMS ";R:E = I * R
250  IF A$ = "2" THEN  PRINT : INPUT "HOW MANY WATTS ";P: PRINT : INPUT "
     HOW MANY AMPS ";I:E = P / I
260  IF A$ = "3" THEN  PRINT : INPUT "HOW MANY WATTS ";P: PRINT : INPUT "
     HOW MANY OHMS ";R:E =  SQR (P * R)
270  PRINT : PRINT "THE VOLTAGE EQUALS ";E;" VOLTS": PRINT : PRINT "PRESS
      ANY KEY": GET Z$
280  GOTO 160
290  REM  CURRENT
300  HOME
310  PRINT : INPUT "WHICH EQUATION DO YOU WISH TO USE:       1)I=E/R 2)I=P
     /E 3)I=SQR(P/R)";A$
320  IF A$ = "1" THEN  PRINT : INPUT "HOW MANY VOLTS ";E: PRINT : INPUT "
     HOW MANY OHMS ";R:I = E / R
330  IF A$ = "2" THEN  PRINT : INPUT "HOW MANY WATTS ";P: PRINT : INPUT "
     HOW MANY VOLTS ";E:I = P / E
340  IF A$ = "3" THEN  PRINT : INPUT "HOW MANY WATTS ";P: PRINT : INPUT "
     HOW MANY OHMS ";R:I =  SQR (P / R)
350  PRINT : PRINT "THE CURRENT EQUALS ";I;" AMPS": PRINT : PRINT "PRESS
     ANY KEY": GET Z$
360  GOTO 160
370  REM  POWER
380  HOME
390  PRINT : INPUT "WHICH EQUATION DO YOU WISH TO USE:       1)P=EI 2)P=E^
     2/R 3)P=I^2R";A$
400  IF A$ = "1" THEN  PRINT : INPUT "HOW MANY VOLTS ";E: PRINT : INPUT "
     HOW MANY AMPS ";I:P = E * I
```

```
410  IF A$ = "2" THEN  PRINT : INPUT "HOW MANY VOLTS ";E: PRINT : INPUT "
     HOW MANY OHMS ";R:P = (E ^ 2) / R
420  IF A$ = "3" THEN  PRINT : INPUT "HOW MANY AMPS ";I: PRINT : INPUT "H
     OW MANY OHMS ";I: PRINT : INPUT "HOW MANY OHMS ";R:P = (I ^ 2) * R
430  PRINT : PRINT "THE POWER EQUALS ";P;" WATTS": PRINT : PRINT "PRESS A
     NY KEY": GET Z$
440  GOTO 160
450  REM  RESISTANCE
460  HOME
470  PRINT : INPUT "WHICH EQUATION DO YOU WISH TO USE:       1)R=E/I 2)R=E
     ^2/P 3)R=P/I^2";A$
480  IF A$ = "1" THEN  PRINT : INPUT "HOW MANY VOLTS ";E: PRINT : INPUT "
     HOW MANY AMPS ";I:R = E / I
490  IF A$ = "2" THEN  PRINT : INPUT "HOW MANY VOLTS ";E: PRINT : INPUT "
     HOW MANY WATTS ";P:R = (E ^ 2) / P
500  IF A$ = "3" THEN  PRINT : INPUT "HOW MANY WATTS ";P: PRINT : INPUT "
     HOW MANY AMPS ";I:R = P / (I ^ 2)
510  PRINT : PRINT "THE RESISTANCE EQUALS ";R;" OHMS": PRINT : PRINT "PRE
     SS ANY KEY": GET Z$
520  GOTO 160
530  REM  HELP
540  HOME
550  PRINT : PRINT "IN EACH MENU CATEGORY, YOU WILL BE PRE- SENTED WITH A
      CHOICE OF DIFFERENT EQUA- TIONS."
560  PRINT : PRINT "SELECT THE EQUATION THAT CONTAINS THE   VARIABLES FOR
      WHICH YOU HAVE VALUES."
570  PRINT : PRINT "IN THIS PROGRAM, VOLTAGE IS IN VOLTS,   CURRENT IS IN
      AMPS, POWER IS IN WATTS,  AND RESISTANCE IS IN OHMS."
580  PRINT : PRINT "PRESS ANY KEY TO BEGIN.": GET Z$
590  GOTO 70
```

if any of the three values are known, the fourth can be calculated:

$$L_1 = L_2L_3/L_2$$
$$L_2 = L_1L_4/L_3$$
$$L_3 = L_1L_4/L_2$$
$$L_4 = L_2L_3/L_1$$

Logic Circuit Analysis. It is possible to simulate the operation of a simple logic circuit with a IIGS program. The circuitry (gates and connecting lines or nodes) is described to the Apple along with the input states to the circuit (on and off are represented as 1 and 0, respectively). Next, the program could determine what the resultant states of the nodes will be throughout the circuit following all of the logic "decisions." Essentially, this program would allow you to design and test a logic circuit without all of the problems associated with breadboarding.

Additional Applications for Electrical Engineers. The following list includes a number of other areas in which the Apple IIGS can make an EE's life much easier.

- Transistor configuration conversion
- Resistive attenuator design
- Smith chart conversions
- Phase shift oscillator design
- Dc bias analysis
- Waveform limits determination
- Plotting of waveforms
- Plate resistance/transconductance calculations
- Gauss calculations
- Reactance chart calculations
- Design of controlled rectifier circuits

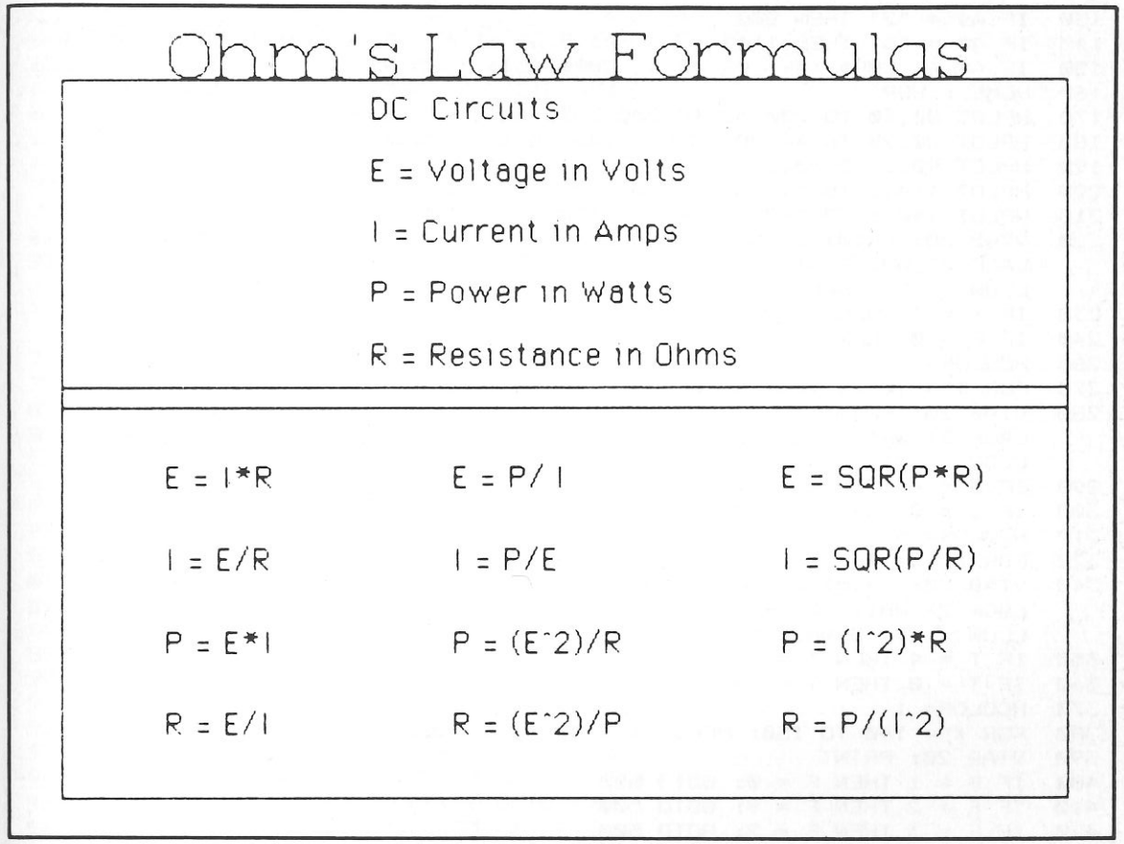


Fig. 4-1. These are the formulas used in the Ohm's Law calculator from Listing 4-2.

Listing 4-2: Resistor Color Coder Program

```
10  REM  RESISTOR COLOR CODER
20  HCOLOR= 6
30  HOME
40  TEXT
50  PRINT : PRINT  TAB( 11)"THE HANDY RESISTOR"
60  PRINT : PRINT  TAB( 15)"COLOR CODER"
70  PRINT : PRINT "I WILL HELP YOU DETERMINE THE COLOR     CODES FOR ANY
     RESISTOR."
80  PRINT : PRINT "PRESS ANY KEY TO BEGIN.": GET Z$
90  HCOLOR= 6
100  TEXT : HOME
110  PRINT : INPUT "WHICH DO YOU WISH TO SOLVE FOR: 1) COLOR  2) VALUE  3
     )HELP ";A$
120  IF A$ = "1" THEN 160
```

```
130  IF A$ = "2" THEN 800
140  IF A$ = "3" THEN 1640
150  IF A$ <  CHR$ (49) OR A$ >  CHR$ (51) THEN 90
160  HOME : HGR
170  HPLOT 80,40 TO 200,40 TO 200,1 TO 80,1 TO 80,40
180  HPLOT 80,20 TO 40,20: HPLOT 200,20 TO 250,20
190  HPLOT 90,1 TO 90,39: HPLOT 100,1 TO 100,39
200  HPLOT 114,1 TO 114,39: HPLOT 124,1 TO 124,39
210  HPLOT 140,1 TO 140,39: HPLOT 150,1 TO 150,39
220  VTAB 20: PRINT : INPUT "CHOOSE THE COLOR OF THE FIRST BAND:      1) B
     LACK 2) WHITE 3) RED 4) GRAY          5) VIOLET 6) GREEN 7) BLUE 8) YE
     LLOW    9) ORANGE 0) BROWN ";F
230  IF F = 4 THEN F = 13
240  IF F = 0 THEN F = 10
260  HCOLOR= 3
270  FOR X = 90 TO 100: HPLOT X,2 TO X,39: NEXT X
280  VTAB 20: PRINT : INPUT "CHOOSE THE COLOR OF THE SECOND BAND:     1) B
     LACK 2) WHITE 3) RED 4) GRAY          5) VIOLET 6) GREEN 7) BLUE 8) YE
     LLOW    9) ORANGE 0) BROWN ";S
290  IF S = 4 THEN S = 13
300  IF S = 0 THEN S = 10
310  HCOLOR= 5
320  FOR X = 114 TO 124: HPLOT X,2 TO X,39: NEXT X
340  VTAB 20: PRINT : INPUT "CHOOSE THE COLOR OF THE THIRD BAND:      1) B
     LACK 2) WHITE 3) RED 4) GRAY          5) VIOLET 6) GREEN 7) BLUE 8) YE
     LLOW    9) ORANGE 0) BROWN ";T
350  IF T = 4 THEN T = 13
360  IF T = 0 THEN T = 10
370  HCOLOR= 1
380  FOR X = 140 TO 150: HPLOT X,2 TO X,39: NEXT X
390  VTAB 20: PRINT
400  IF F = 1 THEN F = 0: GOTO 500
410  IF F = 2 THEN F = 9: GOTO 500
420  IF F = 3 THEN F = 2: GOTO 500
430  IF F = 13 THEN F = 8: GOTO 500
440  IF F = 5 THEN F = 7: GOTO 500
450  IF F = 6 THEN F = 5: GOTO 500
460  IF F = 7 THEN F = 6: GOTO 500
470  IF F = 8 THEN F = 4: GOTO 500
480  IF F = 9 THEN F = 3: GOTO 500
490  IF F = 10 THEN F = 1: GOTO 500
500  IF S = 1 THEN S = 0: GOTO 600
510  IF S = 2 THEN S = 9: GOTO 600
520  IF S = 3 THEN S = 2: GOTO 600
530  IF S = 13 THEN S = 8: GOTO 600
540  IF S = 5 THEN S = 7: GOTO 600
550  IF S = 6 THEN S = 5: GOTO 600
560  IF S = 7 THEN S = 6: GOTO 600
570  IF S = 8 THEN S = 4: GOTO 600
580  IF S = 9 THEN S = 3: GOTO 600
590  IF S = 10 THEN S = 1: GOTO 600
600  IF T = 1 THEN T = 1: GOTO 690
610  IF T = 2 THEN T = 1000000000: GOTO 690
620  IF T = 3 THEN T = 100: GOTO 690
630  IF T = 13 THEN T = 100000000: GOTO 690
```



```
640  IF T = 5 THEN T = 10000000: GOTO 690
650  IF T = 6 THEN T = 100000: GOTO 690
660  IF T = 7 THEN T = 1000000: GOTO 690
670  IF T = 8 THEN T = 10000: GOTO 690
680  IF T = 9 THEN T = 1000
690 V = ((F * 10) + S) * T
700 V$ =  STR$ (V)
710 L =  LEN (V$)
720  IF  RIGHT$ (V$,6) = "000000" THEN V$ =  LEFT$ (V$,L - 6) + " M"
730  IF  RIGHT$ (V$,3) = "000" THEN V$ =  LEFT$ (V$,L - 3) + " K"
740  TEXT : HOME
750  PRINT : PRINT "YOUR RESISTOR HAS A VALUE OF:"
760  PRINT V$;" OHMS"
770  PRINT : PRINT "DO ANOTHER (Y/N) ?": GET Z$
780  IF Z$ = "Y" THEN  GOTO 90
790  GOTO 2000
800  HCOLOR= 6: HOME : HGR
810  HPLOT 80,40 TO 200,40 TO 200,1 TO 80,1 TO 80,40
820  HPLOT 80,20 TO 40,20: HPLOT 200,20 TO 250,20
830  HPLOT 90,1 TO 90,39: HPLOT 100,1 TO 100,39
840  HPLOT 114,1 TO 114,39: HPLOT 124,1 TO 124,39
850  HPLOT 140,1 TO 140,39: HPLOT 150,1 TO 150,39
860  VTAB 20: PRINT : INPUT "WHAT IS THE FIRST DIGIT ";F
870  IF F = 0 THEN F$ = "BLACK": GOTO 970
880  IF F = 1 THEN F$ = "BROWN": GOTO 970
890  IF F = 2 THEN F$ = "RED": GOTO 970
900  IF F = 3 THEN F$ = "ORANGE": GOTO 970
910  IF F = 4 THEN F$ = "YELLOW": GOTO 970
920  IF F = 5 THEN F$ = "GREEN": GOTO 970
930  IF F = 6 THEN F$ = "BLUE": GOTO 970
940  IF F = 7 THEN F$ = "VIOLET": GOTO 970
950  IF F = 8 THEN F$ = "GRAY": GOTO 970
960  IF F = 9 THEN F$ = "WHITE"
970  HCOLOR= 3
980  FOR X = 90 TO 100: HPLOT X,2 TO X,39: NEXT X
990  PRINT : PRINT : PRINT : PRINT
1000  PRINT : INPUT "WHAT IS THE SECOND DIGIT ";S
1010  IF S = 0 THEN S$ = "BLACK": GOTO 1110
1020  IF S = 1 THEN S$ = "BROWN": GOTO 1110
1030  IF S = 2 THEN S$ = "RED": GOTO 1110
1040  IF S = 3 THEN S$ = "ORANGE": GOTO 1110
1050  IF S = 4 THEN S$ = "YELLOW": GOTO 1110
1060  IF S = 5 THEN S$ = "GREEN": GOTO 1110
1070  IF S = 6 THEN S$ = "BLUE": GOTO 1110
1080  IF S = 7 THEN S$ = "VIOLET": GOTO 1110
1090  IF S = 8 THEN S$ = "GRAY": GOTO 1110
1100  IF S = 9 THEN S$ = "WHITE"
1110  HCOLOR= 5
1120  FOR X = 114 TO 124: HPLOT X,2 TO X,39: NEXT X
1130  PRINT : PRINT : PRINT : PRINT
1140  PRINT : INPUT "HOW MANY ZEROS ARE THERE ";T
1150  IF T = 0 THEN T$ = "BLACK": GOTO 1250
1160  IF T = 1 THEN T$ = "BROWN": GOTO 1250
```

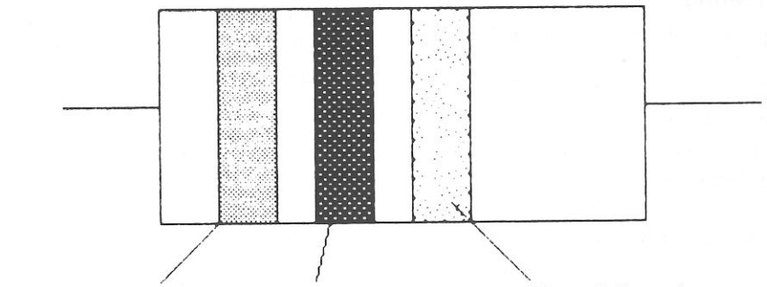
```
1170  IF T = 2 THEN T$ = "RED": GOTO 1250
1180  IF T = 3 THEN T$ = "ORANGE": GOTO 1250
1190  IF T = 4 THEN T$ = "YELLOW": GOTO 1250
1200  IF T = 5 THEN T$ = "GREEN": GOTO 1250
1210  IF T = 6 THEN T$ = "BLUE": GOTO 1250
1220  IF T = 7 THEN T$ = "VIOLET": GOTO 1250
1230  IF T = 8 THEN T$ = "GRAY": GOTO 1250
1240  IF T = 9 THEN T$ = "WHITE"
1250  HCOLOR= 1
1260  FOR X = 140 TO 150: HPLOT X,2 TO X,39: NEXT X
1270  TEXT : HOME
1280  PRINT : PRINT "YOUR RESISTOR HAS THE FOLLOWING COLOR   CODE:"
1290  PRINT F$;" - ";S$;" - ";T$
1300  PRINT : PRINT "DO ANOTHER (Y/N) ?": GET Z$
1310  IF Z$ = "Y" THEN  GOTO 90
1320  GOTO 2000
1640  HCOLOR= 6: HOME : HGR
1650  HPLOT 80,40 TO 200,40 TO 200,1 TO 80,1 TO 80,40
1660  HPLOT 80,20 TO 40,20: HPLOT 200,20 TO 250,20
1670  HPLOT 90,1 TO 90,39: HPLOT 100,1 TO 100,39
1680  HPLOT 114,1 TO 114,39: HPLOT 124,1 TO 124,39
1690  HPLOT 140,1 TO 140,39: HPLOT 150,1 TO 150,39
1700  VTAB 21: PRINT "IN THIS RESISTOR COLOR CODER, YOU WILL  BE GIVEN A
     CHOICE BETWEEN TWO METHODS:  1) COLOR  2)VALUE": GET Z$
1710  PRINT : PRINT "USING THE COLOR METHOD YOU WILL BE ASKED THE COLOR O
     F THE THREE BANDS": GET Z$
1720  PRINT "BAND 1": HCOLOR= 3: FOR X = 90 TO 100: HPLOT X,2 TO X,39:
      NEXT X: PRINT  CHR$ (7);: PRINT "BAND 2": HCOLOR= 5: FOR X = 114 TO
      124: HPLOT X,2 TO X,39: NEXT X: PRINT  CHR$ (7);
1730  PRINT "BAND 3": HCOLOR= 1: FOR X = 140 TO 150: HPLOT X,2 TO X,39:
      NEXT X: PRINT  CHR$ (7);: GET Z$
1740  PRINT : PRINT : PRINT "AFTER YOU HAVE ENTERED THE THREE COLORS, YOU
      WILL RECEIVE THE FINAL VALUE.": GET Z$
1750  PRINT : PRINT : PRINT : PRINT "IN THE VALUE METHOD, YOU WILL ENTER
     THE VALUE FOR EACH DIGIT.": GET Z$
1760  PRINT : PRINT : PRINT : PRINT "ON THE THIRD DIGIT, YOU WILL ENTER T
     HE  NUMBER OF ZEROS.": GET Z$
1770  PRINT "REMEMBER, K=000 AND M=000000"
1780  GET Z$
1790  GOTO 90
2000  HOME
2010  TEXT
```

- Integrated circuit current-source design
- Solution of resistive networks
- Rf amplifier analysis
- Bipolar junction transistor analysis
- Complex matrix calculations as used in electrical engineering
- Wheatstone bridge design

Civil Engineering

Civil engineers will find Apples useful for performing the following functions:

- Moment of inertia calculation
- Vector statics
- Section properties



Colors & Values

	First Band	Second Band	Third Band
Black	0	0	1
Brown	1	1	10
Red	2	2	100
Orange	3	3	1000
Yellow	4	4	10000
Green	5	5	100000
Blue	6	6	1000000
Violet	7	7	10000000
Gray	8	8	100000000
White	9	9	NA

Fig. 4-2. Listing 4-3 is a resistor color coder. This program will enable you to correctly identify any resistor based on either its color or its value. The speed and execution of this program make it educational, as well as enjoyable—even if you don't like resistors.

- Stress on an element or beam
- Static equilibrium about a point

Chemical Engineering

Chemical engineers can use Apples for the following:

- Ideal gas equation of state
- Conservation of energy calculations
- Heat exchanger analysis
- Curve fitting
- Hydrocarbon combustion calculations

Machine Design

Machine designers can use Apples to do the following:

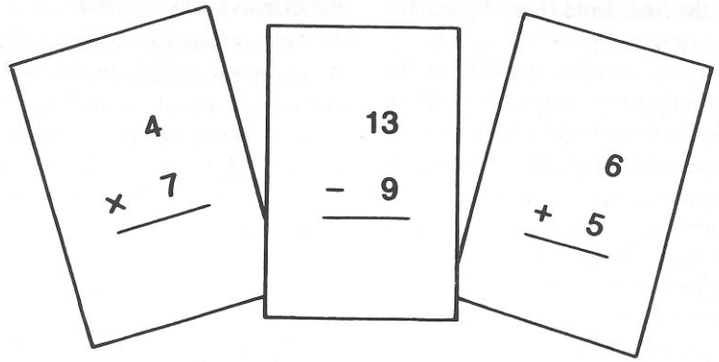
- Constant acceleration calculations, relation to time and velocity.
- Kinetic energy determination
- Critical shaft speed calculation
- Cam design functions
- Gear and spring calculations/design
- RPM/torque/power computation
- Tachometer/dwell meter calculation: your oscilloscope can be converted into a tachometer and dwell meter in conjunction with your computer. The following information must be input to the computer to determine engine RPM and dwell angle:

  a. Number of cylinders in the engine
  b. Interval in milliseconds for open ignition points
  c. Interval in milliseconds for closed ignition points

Factors a and b are determined using the oscilloscope. (RPM may also be calculated using the factors of tire diameter, gear ratio, and vehicle speed.)

$$\text{ignition pulse frequency} = \frac{\text{RPM} \times \text{No. Cylinders}}{120}$$

Chapter 5



Apple IIGS Goes to School: Educational Applications

One of the most important uses for an Apple IIGS is education. The acronym CAI, which stands for computer-assisted instruction, is often used to represent the application of computers in the field of education. Not only can the Apple serve as a drill and practice machine for teaching a wide variety of different subjects, but it can also teach the fundamentals of computer programming and prepare the learner for a career in the computerized future. Likewise, the IIGS can be used as a tool, much like a pencil and a piece of paper can be, by the student.

We all have memories of learning addition and subtraction, repeating spelling words, and memorizing the dates of important events. Most of us considered this to be one of the boring essentials of elementary education, and our attention span was accordingly short.

The addition of the Apple IIGS to education reduces the tendency towards this mind-wandering habit. Although the subject matter has not changed, the method of "drill-till-you-drop" practice has become much more entertaining with the insertion of the IIGS. Countless studies have shown that computerized education makes learning more interesting and more effective. The task of learning school subjects has become colorful, individualized, and in some cases, exciting. The students have instant feedback from the Apple IIGS so that they know whether their answers are right or wrong and they can continue to build from that point.

Apple programs designed for drill and practice are usually capable of providing questions at various levels of difficulty. For example, simple multiplication problems with single digit, double digit, or triple digit multiplication can be provided. In this way, the student learns his basic multiplication tables before tackling 472 × 952. The IIGS can either randomly generate these problems or choose them from a large collection stored in memory. As the student masters a certain number of problems at the beginning level, he can advance at his own pace to succeeding levels. If he encounters any difficulty at a particular level, the Apple IIGS will provide more of the same kinds of problems or offer help. The IIGS can even be programmed to remember what level a student has achieved and can be-

gin from that point the next time that he uses the program.

Each time the student answers a question, the IIGS informs him whether the answer is right or wrong. If the answer is correct, the student can be rewarded with a picture of a smiling face, a colorful, animated display, or an encouraging message. If the student responds incorrectly, the Apple IIGS offers a gentle correction, which may be humorous, in order to keep the learning experience enjoyable rather than painful.

Apple drill and practice systems have been applied to every educational area, from preschool to college level. Some programs make use of computer graphics for those situations in which "a picture is worth a thousand words." Newer systems make use of random-access video disk players, in which short video segments can be selected by the Apple.

Certainly, one of the best ways to learn about computer operation and programming is to purchase an Apple IIGS. Not only can a child learn how to program computers, but she can also learn how to think logically and how to draw conclusions based on fact analysis. The ability to define and analyze a problem during the creation of a program requires many human thought factors that can be applied in situations devoid of computers. Children and adults both need to become familiar with computer operation, capabilities, and programming as preparation for life in an increasingly computerized world.

Software publishers have discovered that there's no faster way to a parent's wallet than to sell the notion that using an Apple IIGS will improve a child's mind. If you intend to purchase a commercially available software package, ask for a demonstration prior to presenting your hard-earned cash. Your best bet is to consult the local magazine stand before you make the final purchase decision. Look for competent reviews of the products that you feel are worthy of your attention. After you have completed your research, then and only then should you lay down your cash.

APPLICATION IDEAS

The educational uses for Apples are unlimited. A few of the possible ways of using a IIGS for instructing yourself, your children, or your friends, include the following. If you are excited by the prospect of marketing your own software, you might wish to incorporate these ideas into the programs that you sell:

- Create a program describing how to program computers in BASIC or another language such as assembly language, FORTRAN, etc. with step-by-step examples.
- Create a story-building program for youngsters in which the computer randomly selects individual story parts and combines them to produce a different story each time. Questions could be asked to test reading comprehension, grammar, and writing skills. For example, the program could produce a personalized story for a child using his or her name. Occasionally, questions such as this should be displayed:

Johnny, should I write the next sentence as

1. "Johnny and I went to the park."

or

2. "I and Johnny went to the park."

If the child answers correctly, the computer reply could be "O.K., that's correct," and a wrong answer could be explained—"No that's wrong. The person who is talking should place the 'I' last, after the names of other people."

- Create an I.Q. builder program to familiarize people with the types of questions and problem solving methods used on tests such as the Scholastic Aptitude test, Civil Service tests, and the American College Assessment test. Research has shown that familiarization with the tests can improve performance considerably. Sample questions are readily available in test-preparation books.

- Create a future-potential evaluation program designed to quiz high school or college students about their talents, interests, and abilities. The program could direct them toward promising careers based upon this information.
- Computerize psychological questionnaires, which are often found in popular magazines and books for recreational and education use. Tests particularly suited for computerization are those requiring tedious calculation to analyze. For instance, this quiz is designed to test your "happiness quotient" and could be easily computerized:

Answer each question as true or false.

1. My work is usually fulfilling or interesting.
2. I have a good ability to relax.
3. I can enjoy happiness in little things easily.
4. I seldom envy other people.
5. My moods have great fluctuation.
6. I have a great desire to change either my location, family situation, or job.
7. I usually sleep well and don't feel tired in the morning.
8. I periodically "blow my top" without knowing the real reason.
9. I am usually a pessimistic person.
10. I cannot have happiness without others being around me.

Scoring:

Start with zero, add one point for each true answer to questions 1, 2, 3, 4, 7 and add one point for each false answer to questions 5, 6, 8, 9, 10. Multiply the total by 10 to determine percentage happiness (average score is approximately 50).

An ambitious programmer could program the computer to print out an analysis of the subject based on his answers. Such a program would make use of stock phrases to be used for many possible combinations of answers and could read like this:

If you don't derive much pleasure from little things or if you regularly lose your temper (3 and 8), you should give some attention to your attitudes. Is your social situation the cause of the trouble (6) or is it your job situation (1)? Often, the simple recognition of this difficulty will serve to clear up the situation. The person who is truly happy can find happiness while alone (10) and isn't envious (4). The moody person (5 and 9) can often benefit from the advice of a counselor.

- Create a spelling program that would allow you to input and store words. Words would be randomly selected and flash on the screen from .1 to 10 seconds. The player must then type in the word from memory.

COMPUTER-ASSISTED INSTRUCTION

Computer-assisted instruction (CAI) refers to the use of a computer as a teaching device. Graphics, text, and questions can all be presented on the screen. A simple CAI program is designed to ask a question, wait for a response, determine whether or not the answer is correct, and keep track of your progress (see Listing 5-1). One incorrect answer is allowed for each question before the correct answer is given.

In this program, you may create your own questions by making an Applesoft BASIC DATA statement. Each DATA statement contains at least two elements that are separated by commas. The first element is the actual question, while the second element represents the correct answer. You can add as many DATA statements as you need after line 270, and then replace the last number in the FOR statement of line 110 with the total number of questions.

COMPUTER TUTOR

You can use your Apple IIGS to assist you in the memorization of lists, names, and vocabulary words. For instance, the Apple IIGS could quiz you in a flashcard fashion from a vocabulary list, displaying each randomly selected word individually on the screen. Once you have studied the word and attempted to recite its definition, press the return

Listing 5-1: Cai Tutor Program

```
10  REM  CAI TUTOR
20  HOME
30  TEXT
40  PRINT  CHR$ (7)
50  PRINT : PRINT  TAB( 12)"I AM YOUR TUTOR"
60  PRINT : PRINT "TODAY WE WILL LEARN ABOUT COMPUTERS"
70  PRINT : PRINT "YOU WILL BE GIVEN TEN QUESTIONS"
80  PRINT : PRINT "PRESS ANY KEY TO BEGIN": GET Z$
90  HOME
100 X = 0
110  FOR Q = 1 TO 10
120  READ Q$,A$
130  PRINT Q$
140  INPUT R$
150  IF R$ = A$ THEN  PRINT "CORRECT": PRINT  CHR$ (7);:X = X + 1: NEXT Q

160  IF R$ <  > A$ THEN  PRINT "SORRY, THE ANSWER IS ";A$: NEXT Q: GET Z$

170  HOME
180  PRINT : PRINT "YOU ANSWERED ";X;" QUESTIONS CORRECTLY": FOR S = 1 TO
     X - 1: PRINT  CHR$ (7);: NEXT S
190  PRINT : PRINT "WANT TO TRY AGAIN (Y/N) ?": GET Z$
200  IF Z$ = "Y" THEN  RESTORE : GOTO 90
210  HOME
220  END
240  DATA  WHAT DOES CPU MEAN, CENTRAL PROCESSING UNIT, HOW MANY BYTES AR
     E IN 1 KBYTE, 1024, WHAT IS THE NAME OF YOUR COMPUTER, APPLE IIGS
250  DATA  HOW MANY COLORS ARE IN YOUR IIGS, 4096, HOW MANY THINGS CAN YO
     U DO WITH YOUR  IIGS, 1001, WHAT TYPE OF DISKS DOES THE IIGS USE,
     FLOPPY
260  DATA  WHAT BUTTON COMBINATION RESTARTS THE IIGS, OPEN APPLE-CONTROL-
     RESET, HOW MUCH RAM DOES THE IIGS HAVE, 256K, WHICH KEYS CONTROL SCR
     EEN MOVEMENT, CURSOR KEYS
270  DATA  WHAT IS THE NAME OF THE LITTLE ANIMAL  SITTING NEXT TO YOUR I
     IGS, MOUSE
```

key. The definition could be automatically displayed, and if you made an error, you would be able to correct yourself. When the test concludes, a percentage of correct versus incorrect answers could be printed on the monitor's screen.

The high school or college student should find computerized quizzes helpful in memorizing such information as:

1. Historical names, dates, and places—presidents, authors, inventors, etc.
2. Parts and functions of the anatomy
3. Mathematical or chemical formulas
4. Verses in literature
5. Spellings or definitions of difficult words
6. Trigonometric identities
7. Geography—states, capitals, countries
8. Technical and scientific terminology
9. Anglo/metric unit conversions
10. Constellation recognition (see Listing 5-2 and Fig. 5-1)

Listing 5-2: Astronomy Quiz Program

```
10  REM  ASTRONOMY QUIZ
20  HCOLOR= 3
30  HOME
40  TEXT
50  PRINT : PRINT  TAB( 13)"ASTRONOMY FLASH"
60  PRINT : PRINT  TAB( 17);: FLASH : PRINT "CARDS"
70  PRINT : NORMAL : PRINT "YOU WILL BE SHOWN FIVE CONSTELLATIONS.  YOUR
     GOAL IS TO CORRECTLY IDENTIFY EACH OF THEM."
80  PRINT : PRINT "PRESS ANY KEY TO BEGIN.": GET Z$
90  PRINT : PRINT : PRINT : PRINT
100 X = 0
110  FOR Q = 1 TO 5
120  HGR
130  FOR P = 1 TO 7
140  READ A,B
150  HPLOT A,B
160  NEXT P
170  READ A$
180  INPUT R$
190  IF R$ = A$ THEN  PRINT : PRINT : INVERSE : PRINT "CORRECT";: NORMAL
     : PRINT  CHR$ (7);:X = X + 1: PRINT : PRINT : NEXT Q
200  IF R$ <  > A$ THEN  PRINT : PRINT : FLASH : PRINT "SORRY, THE ANSWER
      IS ";A$: NORMAL : PRINT : PRINT "PRESS ANY KEY": GET Z$: PRINT :
     PRINT : PRINT : NEXT Q
210  HOME
220  TEXT
230  PRINT : PRINT "YOU IDENTIFIED ";X;" CONSTELLATIONS RIGHT.": PRINT
     CHR$ (7);
240  PRINT : PRINT "DO YOU WANT TO TRY AGAIN (Y/N)? ": GET Z$
250  IF Z$ = "Y" THEN  RESTORE : GOTO 20
260  TEXT
270  HOME
280  END
290  DATA  50,25,75,18,100,30,100,45,140,45,140,30,50,25,THE BIG DIPPER
300  DATA  50,18,100,30,80,52,75,55,70,58,50,85,100,80,ORION
310  DATA  75,20,50,35,158,73,150,75,125,90,120,95,75,20,GEMINI
320  DATA  115,15,50,30,105,40,25,50,100,60,25,50,50,30,VIRGO
330  DATA  115,15,120,28,115,38,105,55,98,40,95,25,98,40,BOOTES
```

EDUCATIONAL SIMULATIONS

Because of the ability of the Apple IIGS to perform calculations rapidly, it is well suited to be used for educational and mathematical simulations. Simulations for educating grade school individuals include the following:

The Manhattan Indian Problem. This simulation teaches the principle of compounded interest. As the story goes, the New World settlers paid the Indians $24 for the entire island of Manhattan in 1626. Today, this property is worth millions of dollars. The main question is, what would have happened if these same settlers had deposited the $24 in a savings account at 6 percent interest compounded daily? How much would that account be worth today? An Apple IIGS generated chart listing the value of the account after each decade of

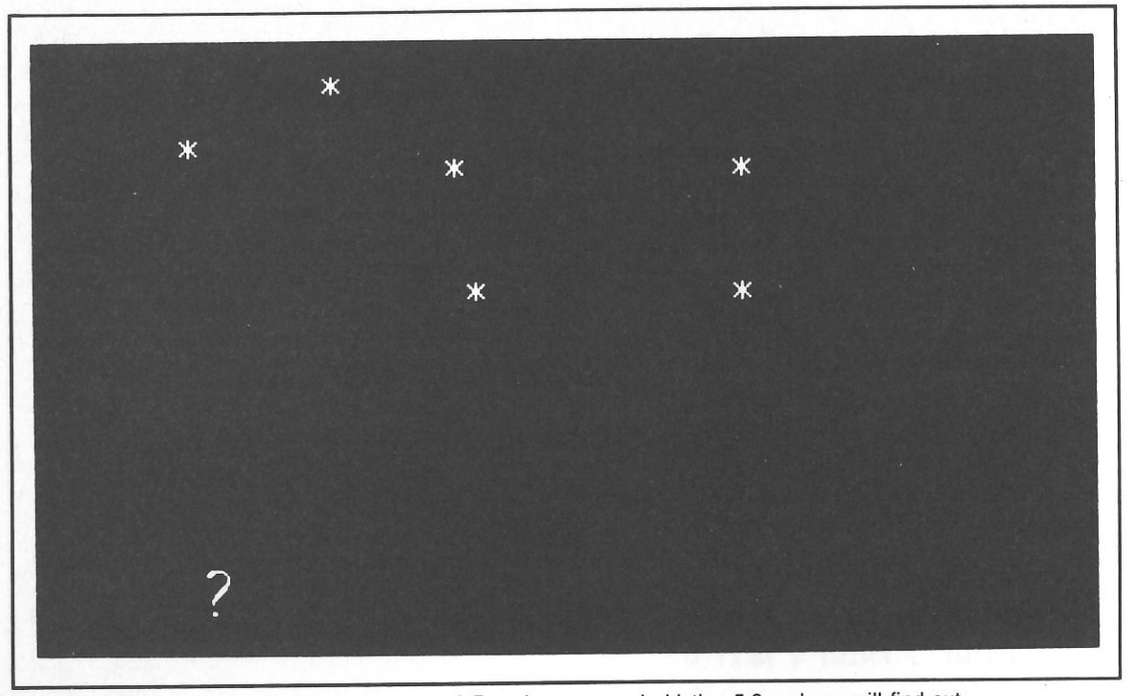


Fig. 5-1. What is the name of this constellation? Run the program in Listing 5-2 and you will find out.

interest gathering would serve as an illustration of the geometric growth rate involved with the answer to the Manhattan Indian Problem.

Use the formula $A_1 = A(1 + r)^n$ where A_1 = value acquired (capital + interest), A = original investment, v = interest rate, and n = number of years.

The Growth of an Amoeba Colony. This simulation represents the growth of a colony of amoebas (microscopic, unicellular protozoans) in a jar with a limited food supply. The reproduction rate will cause the colony's population to double per unit of time. The formula for geometric progressions is:

$$S = a \times \frac{q^n - 1}{q - 1}$$

where S = sum, a = the first term (in this case = 1), q = the ratio for successive values (in this case = 2 because the colony doubles with each generation).

Pollution and a limited food supply, however, will decrease the colony's size at an increasing rate. Otherwise, within one month's time, a single amoeba dividing at a rate of five times per day would produce a volume of organisms equal to one million times the volume of the sun, provided that the food and space were available in a controlled environment. A numerical listing or plot of the colony's population versus time could be generated by the Apple IIGS. Will the colony ever reach a state of equilibrium? Along similar lines, simulations on a larger scale, such as the ecology of a forest, could be undertaken.

The Laws of Physics. A demonstration of some of the laws of physics could take the form of

a graphical illustration of planetary orbits, acceleration due to gravity, and the motion of a pendulum.

Large-Scale Simulations

Simulations on a large scale that require extensive preparation have also been accomplished on the Apple IIGS. These include the following:

The Acoustics of a Room. The acoustics of a room could be mathematically simulated, if such parameters as the dampening effects of the walls, the shape of the room and its contents, and the location of the sound source were provided. This could be useful to the architect or audiophile. For example, in designing a small stereo-listening room or studio, concentrations of standing waves cause unequal resonances in different spots within the room. In order to reduce the nonuniformity of standing waves at lower frequencies, room proportions must be carefully controlled to ensure optimum diffusion of sound. Standing waves in a rectangular room are governed by a simple equation that could be modeled on your IIGS:

$$f(n_l, n_w, h_h) = (c/2\,[(n_l/l)^2 + (n_w w)^2 + (n_h/h)^2]^{1/2}$$

where c = velocity of sound, and l = length, w = width, h = height of the room; the n's are the mode numbers—the lowest mode number (n = 1) represents the lowest frequency resonance appearing, governed by the dimension, and the higher n's represent higher frequency resonances. In order to calculate the frequency of a standing wave along one axis of the room, you must set the n values for the two other axes equal to zero. For example, if $n_l = 1$ and the others equal zero, the formula will give the lowest frequency standing wave along the length of the room. When two terms are non-zero, the standing waves are tangential. In order to obtain uniformity, the tangential waves are the most desirable, the oblique waves are next, and the axial waves are the least desirable. Therefore, by using this equation you can adjust a room's dimensions to provide the most even spacing of axial standing waves together with a preference for tangential waves. This allows the greatest degree of uniformity in frequency.

A Simulation of World Dynamics. This simulation, which is similar to Jay Forrester's "Limits to Growth" computer simulation, could be accomplished on a smaller scale. World dynamics involves the interaction of population, pollution, and resources to predict future outcomes.

A Simulation of Astronomical and Physical Theories. This kind of simulation could possibly be accomplished with an Apple IIGS, although the memory requirements would be very large and the simulation could run for hundreds of hours. See the article, "Doing Physics with Microcomputers," in *Physics Today* (Dec 1983. pp.25-28). The author describes a Monte Carlo simulation of the three-dimensional Ising model for the study of phase transitions.

A Simulation of Automotive Fuel Economy. This simulation could include such factors as fuel injection, fuel additives, and pollution monitors.

A Simulation That Stages Your Own World Series or Super Bowl. You could use statistical techniques to simulate a game or series of games using star athletes whose simulation performance would be based on their career averages.

ADDITIONAL CAI IDEAS

Examples of teaching programs for a variety of different levels are listed below:

Elementary Math Flashcards. Programs designed to increase both speed and efficiency in basic mathematical skills.

Word Problems. A program designed to output "random" mathematical word problems for practice.

Rhymes and Riddles. In this learning game, young children could try to unscramble words to form a line from a nursery rhyme or an answer to a riddle.

Fractions. A program that drills students in recognizing common denominators and adding and multiplying fractions.

Spelling. A program that teaches the student how to recognize commonly misspelled words.

Roots. A guessing/learning game in which the student must guess the square or cube root of a random number.

Ballistic. A program in physics that helps the student learn how to calculate the path of a projectile.

Gasvol. A plotting/calculating program that draws pressure/volume diagrams of a gas.

Logic Reasoning. This program tests the student on conditional statements, hypotheses, conclusions, deduction, fallacies, and definitions.

Balance. A drill program on balancing chemical equations.

Metric. An exercise in converting units between United States measurements and their equivalents in the metric system.

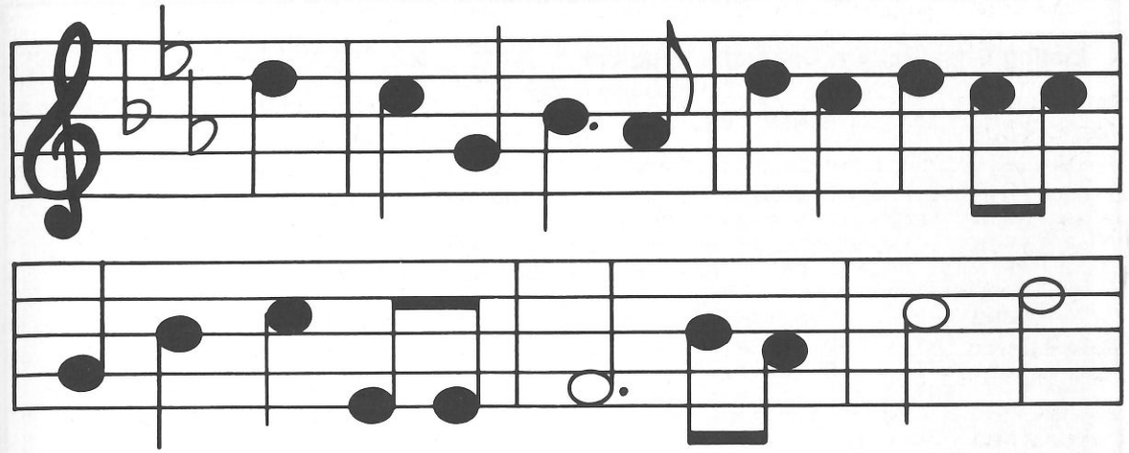
Bases. A demonstration program for teaching how to do conversions from one numerical base system to another.

Multiplication Drill. A random generation of single digit multiplication problems for practice in memorizing the multiplication tables.

Speed Reading/Tachistoscope. A program that helps you learn to read faster. Lines from a piece of literature could be stored in DATA statements in an Applesoft BASIC program and flashed singly on the screen. The amount of time that you are given to read each line should be gradually decreased until a speed of several hundred words per minute is obtained.

A tachistoscope can be used to improve your perception and short-term memory. Psychologist G. Miller reports that anyone should be able to see from five to nine letters in any given brief exposure, whether 1/100 of a second long or 1/2 of a second long, which shows the limitation in our ability to perceive visual information in brief exposures. In addition, we are able to comprehend many more letters displayed by the tachistoscope if they form a familiar word instead of an unfamiliar or foreign word. A tachistoscope program could be written for a science fair project. The program should offer adjustable speeds, familiar and unfamiliar words, and a final display of the words for confirmation.

Chapter 6



Hobby Applications

Your Apple IIGS can make hobbies, from arts and crafts to photography, easier, quicker, and more creative.

THE ARTS

It does not seem possible that your IIGS can create original artwork until you consider the mathematical basis as well as randomness of some art forms. Art is an area in which the Apple IIGS can be used in many different ways—and many of these ways have not yet been discovered.

The Visual Arts

The IIGS can serve both as a source of inspiration and as a tool for the artist or craftsperson. Below are some of the areas in which the IIGS can be used.

Mathematical Functions. Plotting or graphing a mathematical function can often produce interesting geometrical designs. The Apple IIGS, equipped to plot a grid in full color, each color indicative of the value of the function at each individual point, produces fantastic geometrics. The designs generated can be used in knitting or embroidering, or for producing a geometrical painting. A plotter or graphic printer can be used for output.

Alteration of a Design. A given design (e.g., a drawing of a human face or a flag) transformed into a series of points on a grid can be manipulated using a mathematical algorithm to produce "modern art" effects. Additionally, one design may be gradually transformed into another, through a series of plots, producing a fascinating result reminiscent of animation.

Kaleidoscope. A kaleidoscopic pattern can be produced by plotting a continuous set of lines that wander randomly horizontally and vertically across the screen. Other lines are plotted by "reflecting" the wandering line, drawing in a mirror-like fashion. An example is shown in Listing 6-1 and Fig. 6-1.

Random Art Patterns. For the ultimate in simplicity, a program could generate random numbers that, in turn, would cause graphics characters on the screen to turn on or off or would control a

Listing 6-1: Pattern Generator Program

```
10  REM  PATTERN GENERATOR
20  HOME
30  TEXT
40  PRINT : PRINT  TAB( 11)"PATTERN GENERATOR"
50  PRINT  CHR$ (7): PRINT  CHR$ (7);
60  PRINT : PRINT "PRESS ANY KEY TO STOP THE GENERATOR"
70  PRINT : PRINT "PRESS ANY KEY TO BEGIN.": GET Z$
80  HCOLOR= 3
90  HGR2
100 X =  INT ( RND (1) * 279)
110 Y =  INT ( RND (1) * 191)
120 S =  INT ( RND (1) * 8 + 8)
130  FOR A = 0 TO 272 STEP S
140  FOR C = 1 TO 7
150  HCOLOR= C
160  HPLOT A + C,0 TO X,Y TO 280 - A - C,191
170  NEXT C
180  NEXT A
190  FOR B = 0 TO 184 STEP S
200  FOR C = 1 TO 7
210  HCOLOR= C
220  HPLOT 279,B + C TO X,Y TO 0,192 - B - C
230  NEXT C
240  NEXT B
250  FOR Z = 1 TO 5000: NEXT Z
260 K =  PEEK ( - 16384)
270  IF K <  = 127 THEN  GOTO 80
280  POKE  - 16368,0
290  TEXT
300  HOME
```

pen plotter in "random-walk" fashion. This, however, may exceed the confines of what is considered art. One hobbyist reports using his computer to randomly combine picture elements and then print "landscapes" using a plotter.

A/D Converters. Use of an analog/digital converter to digitize and transform real-world events can produce interesting results. For example, one hobbyist interfaced a human dancer to his Apple IIGS by applying a dozen mercury switches to the dancer's body. The dancer's movements caused the switches to open and close, producing digital signals for the IIGS. The computer, in turn, created "choreographed music" from the signals.

Anamorphic Art. Anamorphic images are those that appear distorted, but when viewed with a special device or from a unique perspective appear normal. An example of such a special device is a cylindrical mirror placed in the center of the image. The Apple IIGS can be used to transform a set of points describing a "normal" image into an anamorphic equivalent. For examples of anamorphic art, see Fred Leeman's, *Hidden Images: Games of Perception, Anamorphic Art, Illusion*, New York, Harry N. Abrams, Inc., 1975.

Crossword Poetry. An interesting "crossword" of the words from a poem or piece of literature can be created by the IIGS. A program to

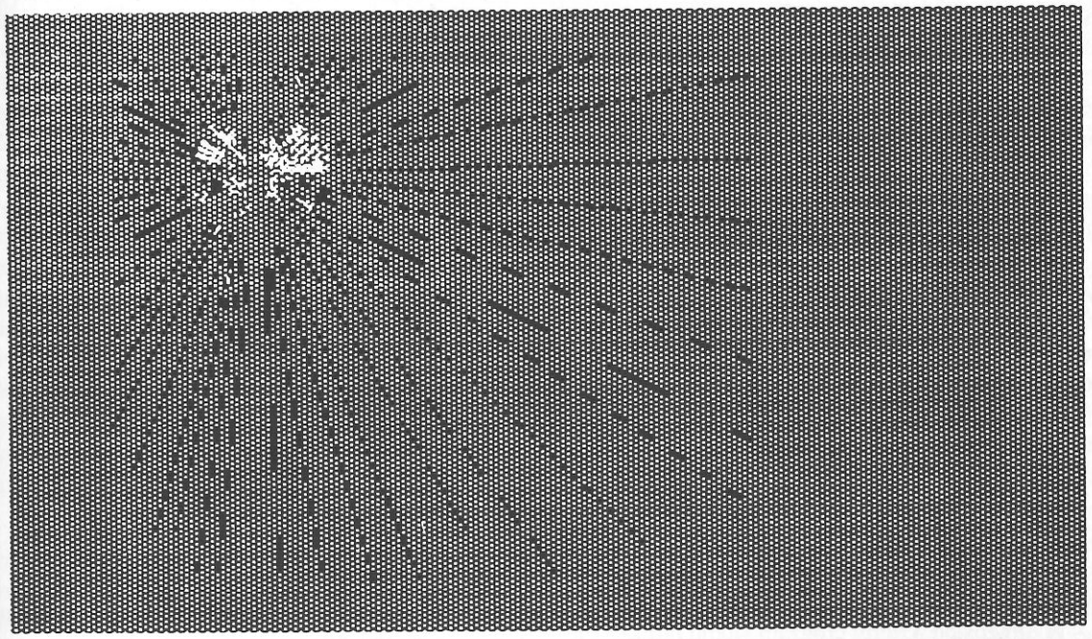


Fig. 6-1. At last—a program that you can run without reading any manuals or mastering complex command sequences. Contained within the Listing 6-1 is a beautiful pattern generator that will entertain and fascinate you for hours, days, weeks, and years.

create such "art" would scan each word and determine how that word could fit in crossword form with adjacent words:

```
  WHO       BUT
    A             WHEN THE LEAVES
    SEEN            A  R
THE                 N  E
    WIND?           G  M
      E               B
      I               L
      T               I  THE WIND
      H               N       S
      E       I       G
      R                PASSING-
NOR                   THROUGH
     YOU
```

READ AS

"Who has seen the wind?
Neither I nor you.
But when the leaves hang trembling,
The wind is passing through."

Textile Patterns. By combining the video graphics characters found on your IIGS into patterns, a textile appearance can be created. This may be considered art in itself or used as a model for tapestry design. A simple program could select five graphics characters at random and then print out a full line of each graphic character. This pattern would then be repeated. Surprisingly good results can be obtained. A more sophisticated program could combine different graphics characters within the line in symmetric fashion. Similarly, new quilting patterns could be designed mathematically.

Perspective Drawing Aid. Given a set of points describing the (x,y,z) dimensions of objects in a picture, the Apple IIGS could use matrix manipulations to produce a new set of points describing the picture from another perspective or viewpoint. Additionally, if video graphics or plotting capabilities are available, the new picture could be plotted. Perspective transformations are useful in technical illustration and other art forms as well.

As an example of the perspective transformations that can be accomplished using a large array of points, let (x,y) be a coordinate pair under the "old" coordinate system. Let (x_θ,y_θ) be the center coordinates of the new system rotated through angle θ in relation to the old system. The new coordinates (x′,y′) can be calculated with these equations:

$$x' = (x - x_\theta) \cos \theta + (y - y_\theta) \sin \theta$$
$$y' = -(x - x_\theta) \sin \theta + (y - y_\theta) \cos \theta$$

A dimension scaling program would request the largest dimension of the object and the largest dimension of the drawing of the object. The scaling factor is the ratio of these values. The program would eliminate the headaches of creating a scale drawing by multiplying the input dimensions of the object by the scaling factor to arrive at the scaled down dimensions for the drawing.

Computer as Sculptor. One hobbyist has created a computer-controlled router that can sculpt material in accordance with a set of programmed points (x,y,z). The IIGS controls the rotation of the sculpturing material (y axis) and the horizontal/vertical (x and y axes) motion of the router by means of servomechanisms. Eliminating one axis, the computer could also control a lathe to produce sculptured furniture legs of exacting proportions.

Computer Painting. A commercial computer-controlled airbrush system is being used to create murals from photos or other graphic images. The image is digitized through the use of a TV camera and A/D converter. Then, the image is painted in much larger proportions by the use of a special x,y plotting system that uses an airbrush in lieu of a pen. An enterprising hobbyist could construct such a system.

Computer Posters. Everyone has seen the "computer portraits" popular at carnivals and shopping malls, in which a television picture of a subject is digitized and output on a printer. One hobbyist has circumvented the expense of a television digitizer by taking an ordinary photograph and placing a fine grid over it. He assigns each square in the grid a brightness level and manually inputs this information. The IIGS prints dark characters or blocks for the squares with a low brightness level and vice versa for squares with a high brightness level. Through this tedious process, he creates computer-generated posters and portraits without the expense of a television camera and video image digitizer.

The Verbal Arts

What usefulness could there be in creating poems with the Apple IIGS? Unlike humans, computers have the capability of being "completely" random. They are free from the "inspirational" selection of words when composing a poem. Completely is in quotation marks because there will always be some bias introduced by the programmer. A computer-generated poem can serve as a stimulus for the human poet. He can elaborate on the poem and extract inspirational clues in composing his own poetic works.

One crude method for generating computer poetry makes use of the following format in randomly selecting words from large lists of nouns, verbs, adjectives, definite articles, prepositions, conjunctions, and adverbs:

Title:	Adjective + Noun (singular)
First Line:	Adjective + Noun (plural) + Adverb + Verb (plural, present tense) + Adjective + Noun (plural)
Second Line:	Adjective + Noun (plural) + Verb (plural, present tense) + Adverb + Adjective + Noun (plural)
Third Line:	Article (definite, such as the) + Noun (singular) + Verb (singular, present tense) + Preposition + Article (definite) + Adjective + Noun (singular)
Fourth Line:	Noun (plural) + Verb (plural, present tense) + Preposition + Article (definite) + Noun (singular)

In order to ensure some continuity, the second adjective and second noun of the first line may be repeated as the first adjective and first noun of the second line.

Granted, some computer-generated poems make more sense than others. If you select words related to the same subject matter for your lists of the different parts of speech, the resulting poem might seem almost human-generated. It is sometimes more fun, however, to list completely unrelated terms for the creation of computer-generated nonsense verses.

Along similar lines, an aphorism generator could create aphorisms (short, pithy sayings) using the form, "_____ is the _____ of _____." Each blank would be replaced with a randomly selected noun.

The Musical Arts

Within the field of music, the Apple IIGS can be used in a number of different areas. Some of these areas are listed below.

Music Education. Possible music education applications include the following:

1. A graphic, flashcard-style quiz that could display notes and other musical notation on the scale for identification and practice in reading music.
2. A quiz on pronunciations and definitions of musical terms (e.g., *andante, diatonic,* and *staccato*).
3. A musical staff drill. A graphic keyboard and staff could be presented, and the IIGS could select the note on the staff corresponding to the key that is pressed. Key signature drills could be done in a similar manner.
4. A basic ear-training skills program. The Apple IIGS could quiz students on recognition of pitches, intervals, chords (major, augmented, diminished, and minor), and scales (major, natural minor, harmonic minor, and melodic minor, whole tone, and chromatic).
5. A name-the-tune game. A tune produced by the IIGS can teach identification by sound of the degrees of the scale, using *solfeggio* syllables or scale degree numbers.
6. A wrong note program. Pitch error detection can be practiced within various combinations of four-voiced chord types. Following the selection of a chord type, the IIGS can visually represent the chord and play the sound with one incorrect note. The student must identify the wrong voice and its corresponding pitch.
7. Harmony drills. Apple IIGS-produced aural diatonic chord progressions can be taught on various levels of difficulty.
8. A write-that-tune game. The IIGS plays a random or preprogrammed series of notes that the student must then reproduce on a video staff or on an interfaced musical keyboard.
9. Chord progression practice. Students can predict chord progressions and receive feedback from the IIGS in the form of subsequent visual and aural output.
10. Guitar chords practice. Students can practice finger placement required to produce guitar chords, with visual and aural feedback.
11. Famous composers and their music quiz. A quiz-style program could teach famous composers' names, pronunciations, and compositions with the aural output of excerpts from those works reproduced by the Apple IIGS.
12. Transposition practice. The student is

presented with a short melody to transpose to a randomly selected key. The IIGS verifies the correct transposition.

13. Tuner program. Two tones, which are separated by less than one half-step, are produced by the Apple IIGS. The student tunes these tones to match each other by selecting an increase or decrease in one of the tones.
14. Rhythm practice. The student could practice playing rhythm patterns on a keyboard. The IIGS can analyze these patterns for accuracy, play the passage the way it should be played, and even demonstrate how the student's response differed from the expected response.
15. Composition package. This type of program, given the notes of a composition, can display the piece in standard musical notation and actually play it. The student can experiment with tempo, timbre, and musical envelopes. Having control of timbre and musical envelopes permits composition of a piece performed by three voices resembling the clarinet, flute, and oboe and demonstrates the interaction between voices.

Music Composition. In the past, programs designed to compose music were based more on random numbers than on true musical principles. Therefore, the tunes that were produced could, at best, be compared to a child randomly banging on piano keys. Lately, however, progress has been made in developing more complex programs that adhere to the "rules of thumb" for composing particular types of music. One program, which used the following rules, was somewhat successful in composing "pop" music.

Basic melody requirements:

1. The first note must be one that is not a fourth, a flatted fifth, a minor second, or a ninth.
2. An ascending minor second progresses to a second, and a descending minor second progresses to the tonic. An ascending flatted fifth progresses to a fifth, and a descending fifth progresses to a fourth.
3. Not more than five notes in descension or ascension are permitted without a complementary movement.
4. The melody should consist of 35 to 60 notes.
5. The release begins on a subdominant major note.
6. Melodic leaps must not be larger than a major tenth.
7. A melodic leap may not be followed by another melodic leap larger than a major sixth.
8. No more than three consecutive melodic leaps are allowed.
9. No ascending or descending passage may contain more than one melodic leap.

Rather than subjecting purely random notes to these compositional rules, a probability distribution used in conjunction with a random number generator could help to produce notes that would more likely fit these rules. Table 6-1 illustrates how this might be accomplished. The name for each interval is given along with the corresponding keyboard distance a note is from the last note. The next column gives a probability for selection of that particular interval. This probability of selection value can be changed according to the composer's wishes. The next two columns give the range of numbers, generated by a random number generator, that corresponds to the probability of selecting a given + or – interval. In this way, a random number generator selecting numbers from 1-100 can provide a given probability distribution of notes.

In order to further ensure the choice of "good" notes, second or third order probability distributions could be specified. In other words, for each possible preceding interval (10), a probability distribution would exist for the purpose of choosing a particular value for the next interval. For instance, in traditional music, a tritone is usually followed by a stepwise interval (e.g., a whole or half step). Therefore, the second order probability distribution

Table 6-1. The Probability Distribution for the Random Selection of Notes.

INTERVAL	NO. OF NOTES AWAY FROM LAST NOTE	PROBABILITY OF SELECTION	RANDOM NUMBER RANGE IN + DIRECTION	RANDOM NUMBER RANGE IN – DIRECTION
Unison	0	4%	49-52	49-52
Half Step	±1	14%	53-59	42-48
Whole Step	±2	12%	60-65	36-41
Minor Third	±3	10%	66-70	31-35
Major Third	±4	8%	71-74	27-30
Perfect Fourth	±5	12%	75-80	21-26
Tritone	±6	2%	81	20
Perfect Fifth	±7	14%	82-88	13-19
Minor Sixth	±8	6%	89-91	10-12
Major Sixth	±9	6%	92-94	7-9
Minor Seventh	±10	4%	95-96	5-6
Major Seventh	±11	2%	97	4
Octave	±12	6%	98-100	1-3

for a tritone would be heavily weighted toward a stepwise interval in selecting the next note of the composition.

The program in Listing 6-2 simulates a keyboard.

Additional possibilities for using your Apple IIGS in music composition include the following:

1. Produce a stricter set of rules for composition than those given above; rely less on randomness.
2. Develop programs to compose in assorted mu-

Listing 6-2: Happy Organ Program

```
10  REM  HAPPY ORGAN
20  TEXT
30  HOME
40 F = 0:D = 10
50  PRINT : PRINT  TAB( 8)"THIS IS THE HAPPY ORGAN"
60  PRINT : PRINT "WITH THE HAPPY ORGAN, YOU WILL SELECT:  1) NOTES  2) D
    URATION"
70  PRINT : PRINT "PRESS ANY KEY TO BEGIN.": GET Z$
80  HOME
90  PRINT : PRINT  TAB( 8)"THIS IS THE HAPPY ORGAN"
100  FOR X = 1 TO 23: PRINT  TAB( 8) CHR$ (95);: NEXT X
110  PRINT : PRINT : PRINT  TAB( 12)"SELECTION MENU:": PRINT : FOR X = 1 TO
    23: PRINT  TAB( 8) CHR$ (95);: NEXT X: PRINT
120  PRINT : PRINT "PRESS THE KEY, FOR YOUR SELECTION-"
130  PRINT : PRINT "1=DURATION (+) [2= DURATION (-)]"
140  PRINT "A, B, C, D, E, F, G=NOTES  S=STOP"
150  GET K$
160  IF K$ = "1" THEN D = D + 10
170  IF K$ = "2" THEN D = D - 10: IF D = 0 THEN D = 10
180  IF K$ = "A" THEN  GOTO 260
```

```
190  IF K$ = "B" THEN  GOTO 270
200  IF K$ = "C" THEN  GOTO 280
210  IF K$ = "D" THEN  GOTO 290
220  IF K$ = "E" THEN  GOTO 300
230  IF K$ = "F" THEN  GOTO 310
240  IF K$ = "G" THEN  GOTO 320
250  IF K$ = "S" THEN  HOME : END
260  FOR S = 1 TO D:P =  PEEK ( - 16336): NEXT S: GOTO 80
270  FOR S = 1 TO D:P =  PEEK ( - 16336):P = PEEK ( - 16336): NEXT S: GOTO
     80
280  FOR S = 1 TO D:P =  PEEK ( - 16336):P =  PEEK ( - 16336):P =  PEEK (
      - 16336): NEXT S: GOTO 80
290  FOR S = 1 TO D:P =  PEEK ( - 16336):P =  PEEK ( - 16336):P =  PEEK (
      - 16336):P =  PEEK ( - 16336): NEXT S: GOTO 80
300  FOR S = 1 TO D:P =  PEEK ( - 16336):P =  PEEK ( - 16336):P =  PEEK (
      - 16336):P =  PEEK ( - 16336):P =  PEEK ( - 16336): NEXT S: GOTO 80

310  FOR S = 1 TO D:P =  PEEK ( - 16336):P =  PEEK ( - 16336):P =  PEEK (
      - 16336):P =  PEEK ( - 16336):P =  PEEK ( - 16336):P =  PEEK ( - 16
     336): NEXT S: GOTO 80
320  FOR S = 1 TO D:P =  PEEK ( - 16336):P =  PEEK ( - 16336):P =  PEEK (
      - 16336):P =  PEEK ( - 16336):P =  PEEK ( - 16336):P =  PEEK ( - 16
     336):P =  PEEK ( - 16336): NEXT S: GOTO 80
330  GOTO 80
```

sical styles including classical, rock and roll, and children's music. Computer musicians have applied statistical analysis to various styles and composers to determine characteristic probability distributions. Random numbers subjected to these probability criteria can produce music reminiscent of the original style.

3. Develop programs to compose tunes for given lyrics by using the timing of each syllable to time the duration of the notes accordingly. The ambitious programmer might try to link a lyric producing program with a music composing program. Some unusual results would, undoubtedly, be produced.
4. A popular melody could be mathematically transformed to produce a new melody, and this new melody would likely be more tuneful than compositions based on random number generators or probability distributions. The original melody would be numerically encoded such that each note and note duration has a unique number. With the melody so encoded, an algorithm could be applied to each note, translating that note into another. The simplest such algorithm could reflect each note around a central value, transforming high notes into low ones and vice versa. The program could also use a mathematical formula, but extensive experimentation would be necessary.

   The following formula is useful as a part of a musical tone generating program based on the numbering of notes according to octave (V), where middle C is in the fourth octave, and according to position within the octave where C = 1, C# = 2 . . . B = 12.

$$\log_2 \frac{f}{55} = V + \frac{P-2}{12}$$

   where f = frequency in Hz (hertz)

5. Given the score of a music piece written for a solo instrument (e.g., the piano), the Apple IIGS could transpose and analyze melodies, bass, and counter rhythms to produce sheet music versions for other instruments.
6. An Apple IIGS connected to a player piano via a solenoid interface could digitally record songs that you play or song notes that you input. The song could be stored on a disk and recalled to be played at normal speed, faster, slower, with staccato, or even backward.
7. A IIGS can be programmed to produce a polyphonic synthesizer effect along with continuous beat patterns. The IIGS can also be used to perform mixing functions.
8. From a given composition, a simplified version could be extracted by the IIGS (the melody is usually carried by the highest notes and the bass by the lowest) and printed in standard musical notation. Also, a given piece of music could be arranged so that all chords are broken up into varying arpeggios.
9. Given a melody, the Apple IIGS could be programmed to compose a bass counter-melody.

Computer Controlled Synthesizers. In 1982, a group of synthesizer manufacturers developed a standardized interface, called MIDI (Musical Instrument Digital Interface), to enable communications between synthesizers and computers. Each synthesizer key is encoded in a fashion similar to an ASCII (American Standard Code for Information Interchange) computer keyboard. For each synthesizer key struck, a series of codes is transmitted including a NOTE ON signal, a PITCH signal, a VELOCITY signal, and other signals specifying pitch blends, key release, and front panel changes. This information can be sent to any other MIDI synthesizer so that two or more keyboards can perform in exact synchronization, although the ADSR (Attack, Decay, Sustain, Release) envelopes are different on each machine.

Special codes can indicate that only specified synthesizers are to respond to an incoming code. This information can also be sent to the Apple IIGS, which can be used as a polyphonic sequencer or imitator of a multitrack tape recorder (see Fig. 6-2). The IIGS may record, edit, store, and play back your music or play music entered through the keyboard. A composer can quickly change tempo pitch, instruments, and accents with the aid of such a system, which is capable of producing a flawless rendition.

HOBBIES

The Apple IIGS can perform invaluable services for those involved in all hobbies.

Photography

The serious photographer should investigate the use of the Apple IIGS to obtain more precise values for such things as development times, light exposures, and filters through the use of mathematical formulas. For example, the standard exposure meter assumes that: 1) for any emulsion, the curve of the density versus the log of the exposure yields a straight line and is characterized by a single factor—speed, and 2) time and intensity of light are interchangeable to provide a certain exposure (reciprocity). Actually, these assumptions are only approximations of true values. In extreme cases, reciprocity does not work; the density versus log of the exposure curve is not linear, and emulsions have differing contrasts and latitudes. A reference manual describing the mathematical calculations of photography should describe the formulas used to take these factors into account.

Other ways in which photographers can use the Apple IIGS include the following areas:

1. Exposure compensation is useful in the darkroom to calculate the exposure required to compensate for a change in photo enlargement magnification. Using the inverse square law, if you have data on a "perfect" print expressed as enlarger head height above the easel (H_o) and time of exposure (T_o), the formula for computing the new time of exposure (T_N) at the new height (H_N) with the same aperture is:

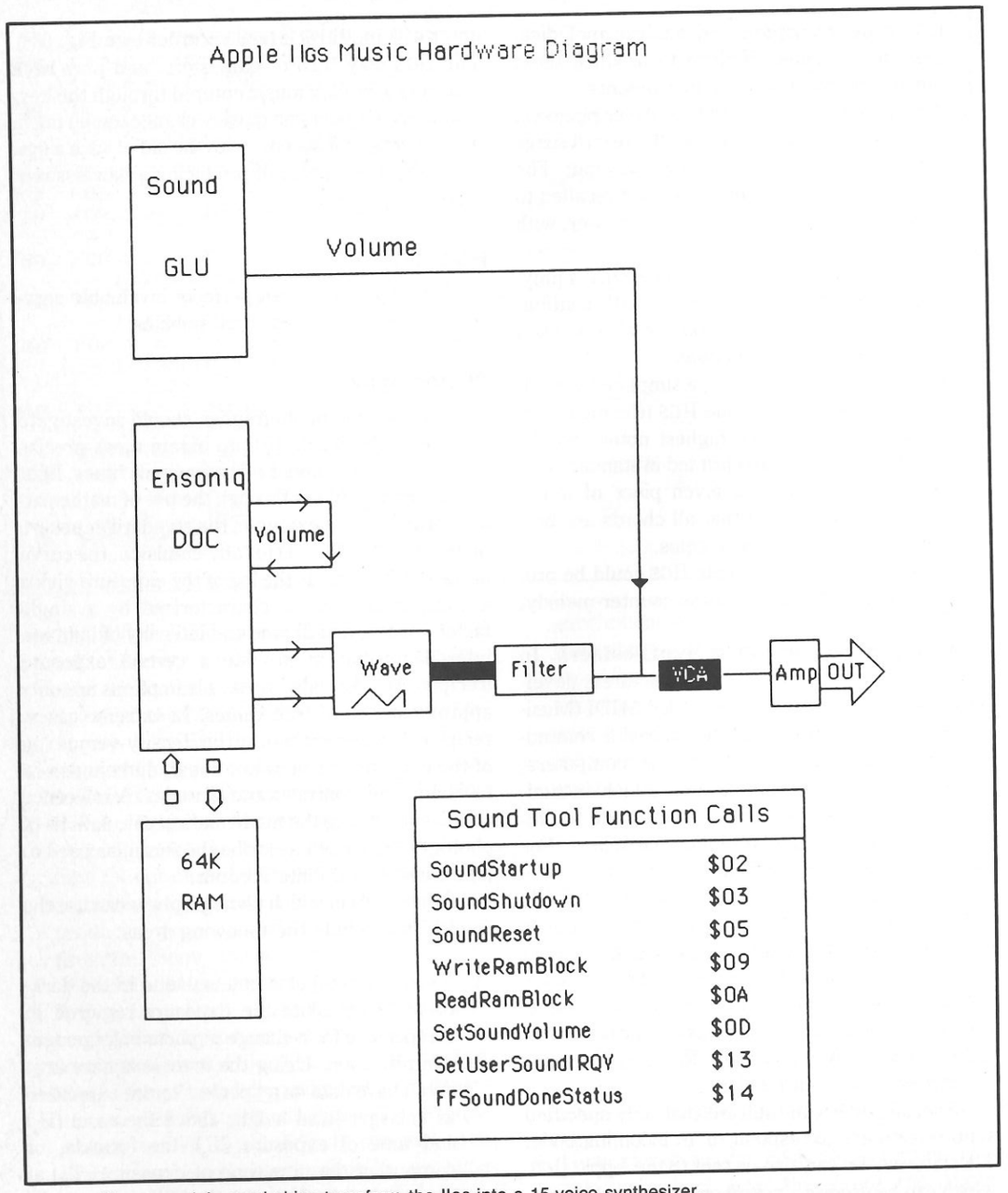


Fig. 6-2. Three special sound chips transform the IIGS into a 15-voice synthesizer.

$$T_N = \left(\frac{H_N{}^2}{H_O}\right) \times T_O$$

A useful program could calculate exposure times for a range of specified heights at all available f-stops to permit easy enlargement of a negative to a given size.

2. Fill-in flash computation is used to determine the correct lens f-stop when a flash is used in the presence of strong ambient light to fill in undesired shadows.
3. If you intend to do specialized photography requiring home-built equipment, the IIGS could be useful in optical and dimensional calculations.
4. Automated control of darkroom equipment, including such features as temperature correction for chemicals, timer, and development calculator, could expedite the development process. Alternatively, the computer could serve as a timer and a reminder for steps to be taken in the development process.
5. An inventory of slides or photographs could be stored on disks, and topics could be indexed and cross-referenced. In order to create a slide show on a particular topic, you can use the IIGS to determine all relevant slides and output a listing of each slide along with its location.
6. A simple switching interface to a cassette recorder and slide projector could automate a complete audiovisual slide presentation. An exotic audiovisual light show could also be controlled in a similar manner.
7. Focal length conversions from one camera to another, based on the diagonal or horizontal angle of view, could be programmed.
8. A program could be written to calculate film speed (ASA), flash ECPS value, or flash guide number, given the other two values. Once the flash guide number is known, the maximum f-stop setting for the distance from the flash to the subject can be calculated, using the formula:

$$\text{f-stop} = \frac{\text{Guide number}}{\text{distance}}$$

The published flash guide number is for one speed of film only. If you use a different film with a different speed, the new guide number can be obtained by using the following formula:

$$NG = OG \cdot \sqrt{\frac{NF}{PF}}$$

where NG = new guide no.
OG = old guide no.
NF = new film speed.
PF = published film speed.

9. Close-up photography values for subject distance, required lens focus setting, or depth of field could be calculated given the other two values.
10. The depth of field indicates the distance from some point in front of the subject to some point in back of the subject for which a given photograph will be acceptably in focus. An Apple IIGS program could mathematically determine how the desired near and far distances can be obtained, in terms of the f-stop setting and distance setting to use. The hyperfocal distance, or the nearest distance for which a lens can be focused to give satisfactory definition of infinity, is given by:

$$H = \frac{F^2}{f \cdot d}$$

where H = hyperfocal distance
F = focal length of lens
f = f-stop
d = diameter of circle of confusion

11. A photograph of your Apple's monitor display-

ing text or graphics could be used to title home slide shows or movies. A recommended procedure is to darken the room completely, use a tripod, and shoot with a film such as KODAK Professional Film Ektachrome 50 Tungsten EPY.

BASIC programs that aid computing many photographic values can be found in contemporary photography magazines, such as *Popular Photography* and *Modern Photography*.

Animated Films. Although the Apple IIGS is capable of displaying high-resolution real-time animation on its own, an animated film could be made using screen or printed graphics. A three dimensional rotation of an object is a popular film subject that can be programmed with relative ease. A plotter can be used for drawing the figures you design on your IIGS. These figures form the individual images that must be photographed to create your final animated film.

Amateur Radio

The ham radio or citizen's band radio enthusiast could use an Apple IIGS to assist with his hobby in these ways:

Morse Code Tutor. Apple IIGS users interested in passing the Morse code test to become amateur radio operators could use their Apples to quiz themselves both visually and audibly. The visual representation of Morse code is a series of dots and dashes (e.g., · · · · · · · · ·). The standard method of learning Morse code is to first study the visual representations and then to transcribe an audio transmission at a gradually increasing rate. Your Apple IIGS could be programmed to aid you in this tutorial procedure. Likewise, a program similar to the general CAI program described in Chapter 5 could be used to requiz you on the codes you have missed.

Message Displayer. By using a Morse code decoder/sender interface between the radio and your Apple IIGS, messages that are received and sent could be displayed on the monitor as English text, by programming the IIGS to perform the translation between Morse code signals and the English language.

Message Monitor. The Apple IIGS could monitor a specified frequency for a particular audio signal or coded message. Transmissions immediately following this signal would be recorded digitally, making it unnecessary to attend to the radio constantly to receive a message. Received messages could also be forwarded automatically on another frequency to another station in a network.

Message Relay. A stored message could be sent at the proper time if the station operator was unable to send it personally.

Controller. Add intelligence to your test equipment or radio with a controlling microprocessor. Test sequences could be performed automatically.

Station Log Maintainer. Maintain your station log automatically. All entries could be stored and classified, and special reports could be generated (e.g., the number of countries contacted and the number of repeat contacts). As an example of the usefulness of a station log maintainer, if you hear someone and you would like to verify the last date of contact, you could type in his name or call letters and find this information from a database of log entries.

Error Correcting Code Senders. Error correcting codes could be automatically generated to improve communications.

Contest Record Keeper. Several ham radio contests have utilized Apples to keep track of all contacts.

Collections

Some people make a hobby of collecting items such as coins, books, magazines, stamps, or antiques. The Apple IIGS can help you organize and present your collection.

Collection Inventory. If your collection consists of many items, such as hundreds or even thousands of stamps, it is certainly a good idea to catalog each item. A database program, as described in

Chapter 1, is ideal for maintaining large collections of any kind.

In addition to storing an individual record specifying all pertinent information on each item, the IIGS would also be able to catagorize, cross-index, and generate special lists of items. A special list could include all items that have a particular characteristic (e.g., a list of all British stamps or all stamps issued in 1986).

The fields to use in setting up a stamp collection database might look like this:

1. Catalog number
2. Name or identifying title
3. Denomination
4. Subject
5. Original cost
6. Condition
7. Date issued
8. Quality
9. Current value
10. Country of origin
11. Descriptive information and history
12. Where purchased
13. Miscellaneous comments

Using a database program, you could request the sum of all records in a field, such as field 5 or field 9, to determine the original cost or the current value for the entire collection.

Collection management on your Apple IIGS gives you more time to enjoy the fun of collecting without the bother of record keeping. Additionally, a copy of your inventory disk could be stored in a safe location in the event that an insured collection is destroyed.

Collection Narrator. Hobbyists with collections will find that their Apple IIGS makes an excellent visual narrator for a collection. For example, a stamp collector created a file of his entire collection and made the information concerning each item randomly accessible. Interested persons can be instructed how to obtain information on a particular item, or the IIGS can present a continuous display of each item in sequence. This technique can save you from monotonous repetition of information to visitors at an exhibition. Similarly, businessmen at expositions could put their Apples to use explaining products.

Astronomy

Potential applications for your Apple IIGS in amateur astronomy include the following:

1. Locate and identify stars by the calculation of declination, sidereal hour angle from observed altitude, azimuth, and time.
2. Record observations efficiently on the Apple IIGS for quick retrieval.
3. Interface the telescope's drive mechanism to a microprocessor controller for automatic photographic observations. For more information, see *InfoWorld*, Volume 5, Number 47, pp. 45-46, *Sky and Telescope*, January 1981, p. 71, and *Build Your Own Telescope* by Richard F. and Sally Daley, TAB BOOKS Inc.
4. Convert between astronomical units, kilometers, light years, and parsecs.
5. Calculate and plot orbits of satellites and planets.

Gardening

Writing a garden analysis program for one-time use would not be a good idea, but your friends and neighbors might also be able to use such a program. Who knows? You might even be able to sell your completed software to a local garden supply store. A complete garden analysis program is more complicated than it appears, however. These are some of the factors to consider:

1. pH, water, soil density, and sunshine levels of the plot.
2. Desired pH, water, soil density, and sunshine levels for the plants to be planted.
3. Nitrogen, phosphorus, and potassium contents in the soil compared to plant requirements.
4. The size of the garden.

Proper planning will allow you to position certain vegetables that ward off insects next to others that need this protection. The space needed between adjacent plants should also be considered. Specific plant requirements and the harvest times of the vegetables could be printed, along with a graphic presentation of the garden plot.

Additional outputs could explain how to form a compost heap and how to use fertilizer. One gardener uses his Apple IIGS to track precipitation dates and amounts, temperatures, and garden chores to be done. Tables of times to plant, spray, and prune can also be stored for ready reference and to simplify planning.

Sports

A file of team and player statistics, players' names and numbers, and play-off results could be stored on the Apple IIGS for quick retrieval by the sports fan. Sports statistics could be compiled, graphed, and analyzed. Probability forecasting of score and point spreads, based on the past performance of opposing teams, could be accomplished. The IIGS could also "learn" from its mistakes, by retaining the outcomes of many games in a programmed database.

At local sporting events, an Apple IIGS could be useful in maintaining scores, team records, and player statistics as the game progresses. This information could then be used by an announcer or for permanent records.

Sports, such as bowling and golf, that involve tedious calculations of averages and other statistics for a league are well suited for Apple IIGS bookkeeping. Sell such a computation service to your local bowling alley or golf course.

Fishing

Potential applications for serious fishermen include the following:

1. The analysis of weather patterns and times in order to forecast the ideal time to fish.
2. The recording of weight and species of catch, locations fished, weather, tides, depth, and temperature. Use this statistically correlated data for future reference.
3. The computation of high and low tide times.
4. The computation of sunrise and sunset times.

The Computation of the Times of Sunrise and Sunset and High and Low Tides. Pilots, as well as fishermen, will find a sunrise and sunset calculating program useful. In order to keep such a program as simple as possible, sunrise data from previous days should be entered, thereby eliminating the need for complex calculations. The same would be true for a high- and low-tide program. The times for future sunrises, sunsets, and high and low tides may then be projected by linear regression or moving average calculation.

For those inclined to astronomical calculations, the time of sunrise, sunset, and high and low tide may be more accurately calculated by the consideration of the changing inclination of the earth to the sun and the time of rotation for the earth.

Biorhythms and Extrasensory Perception

Those involved in exploring the more speculative aspects of human existence will find the IIGS useful in the pursuit of these pastimes.

Biorhythms. Biorhythms are purported to be the cycles in the emotional, physical, and intellectual states that govern a person's behavior. Dozens of Apple programs have been written to generate personalized biorhythm charts, but interesting variations are still possible. These potential innovations include:

1. Plotting or numerically comparing the biorhythms of two or more friends.
2. Computing the average of the three biorhythm cycles.
3. Generating a biorhythm chart in the form of a standard calendar.
4. Judging the reliability of biorhythms by objectively analyzing your three cycles at the end of each day and then making a statistical comparison and plotting these data versus your biorhythm.
5. Investigating the use of histograms and other means of presenting data to output biorhythms.

Extrasensory Perception. Those interested in ESP have written testing programs by using random number generators. In these programs, you are asked to predict the number or other value that the Apple will choose next.

Additional Hobby Applications

Hobbyists will find Apples useful in all of the following areas:

Designing Recreational Vehicles. A hang glider or ultralight aircraft enthusiast who is considering the design of a new airfoil could find a detailed computer-simulated wind tunnel test beneficial. The proposed design could be mathematically described to the IIGS. Similar simulations could be applied to boats, as well as other motorized vehicles.

Model Building. A simple, time-saving program could calculate the scaling factors for model builders by dividing the length of the model by the length of the object that is to be modeled. Next, each dimension of the object would be input and the corresponding dimension for the model would be calculated by multiplying the original dimension by the scaling factor.

Model Railroading. Model railroading enthusiasts with a large train layout may wish to automate the trains, lights, and switches with a controlling microprocessor. One hobbyist went so far as to print train schedules, print tickets, and analyze a model freight business on his Apple IIGS.

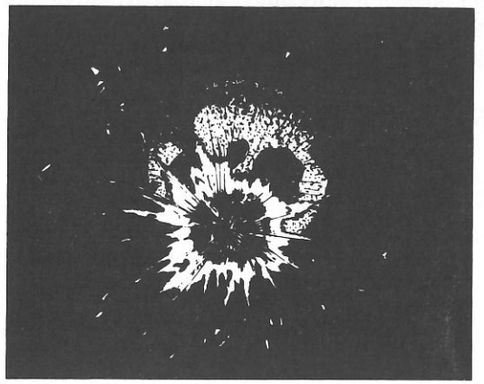
Scuba Diving Plan. A simple program could calculate one of these four diving parameters, given the other three:

1. Time underwater, in minutes.
2. Surface air consumption rate in cubic feet per minute.
3. Depth in feet.
4. Total air volume of your diving tank in cubic feet.

Geneological Storehouse. A few hobbyists have obtained a large amount of geneological information that can only be handled efficiently with a IIGS. Additionally, having specified characteristics for each family member instantly available eases the task of further geneological research.

Aquarium Maintenance. One hobbyist uses his Apple IIGS to compute the amounts of chemicals that are necessary for maintaining a seawater aquarium environment. In order to obtain the exact values over a range of temperatures and conditions, several calculations are required.

Chapter 7



Apple IIGS Games and Recreational Applications

According to various polls, the most popular applications for Apple IIGS computers are entertainment and games. Some IIGS owners even proclaim game playing to be their primary application for their computers. Despite the advent of inexpensive and easy-to-use productivity software, games will continue to be popular fare for most Apple IIGS owners.

Games are not only fun, but they often have the added benefit of being educational. There are, of course, the standard games that simply teach hand-eye coordination, but there are also commercially available games that develop abilities to react creatively, solve problems logically, and make decisions. There are even a few games that aid in teaching computer programming.

Learning to program games of their own, however, is one of the best educational challenges for Apple IIGS owners. Games encourage imaginative and constructive programming and responses.

There are at least eight major categories of games that have been successfully adapted to the IIGS:

Fantasy and Adventure Games. Fantasy and adventure games lead the player step by step through an imaginary world to find a special treasure, solve a mystery, or outfox an evil wizard. The player must learn how to overcome the many obstacles that the game throws at him to prevent his success at solving the game's elaborate puzzle. These adventure games are usually text-based and depend on imagination instead of screen graphics to carry the story, although more elaborate adventure games use vivid graphics to support their stories. In response to text that appears on the screen, the player must type in English commands, such as "go east," to control the action of a character within the game. It is this heavy dependence on text within these games that make them relatively easy to program. The only programming obstacles are controlling the many possible outcomes of game situations and recognizing a variety of player responses to the game's text and questions.

"Video" Games. This is an extremely popular genre of IIGS games. Video games, which are exciting and challenging to the player's hand-eye

coordination, place the player against continually increasing enemy hoards. The player's only option is to learn to shoot more quickly and accurately than the enemy.

Strategy and Battle Games. For those who prefer a more enlightened approach to gaming, strategy games offer complex rules and tactics to employ in fighting battles against a human or computer-controlled opponent. Many strategy and battle games make extensive use of graphics to display battlefields and tokens representing each side, while some still rely on physical game boards.

Card Games. If you occasionally have difficulty rounding up enough people for a game of cards, you can find plenty of opponents within your Apple IIGS. Programs are available that allow your IIGS to play against you at bridge, poker, black jack, and gin.

Board and Word Games. Among the popular board games that have been converted to run on the Apple IIGS are chess, backgammon, and checkers. Crossword-like games, some of which have up to 50,000 word vocabularies, have also been made available for IIGS users.

Gambling Games. Las Vegas type gambling games, from roulette to one-armed bandits, have been adapted to the IIGS. These games offer the thrill of "gambling" without the risk of emptying your bank account.

Sports Games. Football, basketball, baseball, car racing, and skiing are among the sports that have been successfully simulated on the Apple IIGS. These high resolution games provide both excellent animation and playing times that rival the real sports.

Party Games. Popular party games, from charades to spin the bottle, have been programmed for the IIGS.

BOARD AND STRATEGY GAMES THAT YOU CAN PROGRAM

Although most of the popular live-action or real-time commercial games currently on the market required extensive time and effort to develop, many entertaining games can be written for the IIGS by the beginning programmer. A sampling of game ideas to tackle in Applesoft BASIC follows.

Many popular board and logic games take on an added dimension when computerized, especially if the Apple is programmed to be the opponent. Some of the many possibilities include the following games:

Tricolor. Tricolor is a game played on a hex "board" with hexagonal cells colored red, white, and blue displayed on the Apple's screen (see Fig. 7-1). Each of the two players begin with 18 playing pieces, called stacks, with one player using white stacks, and the other, black. At the start of the game, white places his stacks on hex places 1-18 and black places his stacks on hex places 44-61.

The playing pieces are called stacks because, throughout the game, stacks are merged to create piles of multiple pieces. The maximum number of cells that a stack can traverse in a particular direction in a single move is determined by the number of pieces in a stack (e.g., one cell for a stack with one piece, two cells for a stack with two pieces, and three cells for any larger stack).

The combat strength of a stack depends on both the number of pieces in the stack and the color of the cell on which it rests. Taking the strength of a single white stack on a white cell as the unit, the strength of a two cell stack on a white cell is two units, and the strength of any larger stack on a white cell is three units. The strength of a stack on a blue cell is twice what it would be on a white cell, and a stack on a red cell is worth three times as much as it would be on a white cell.

Players take alternate turns, each moving a single stack along a diagonal or horizontal line as far as he wishes, within the range of the stack. The player can move either an entire stack or only a portion of a stack. Occupied cells may not be jumped, but a player may move his stack onto a cell occupied by another stack owned by himself or by an opponent. If the stack is his own, the stacks are merged. If, however, the opponent owns the other stack, an

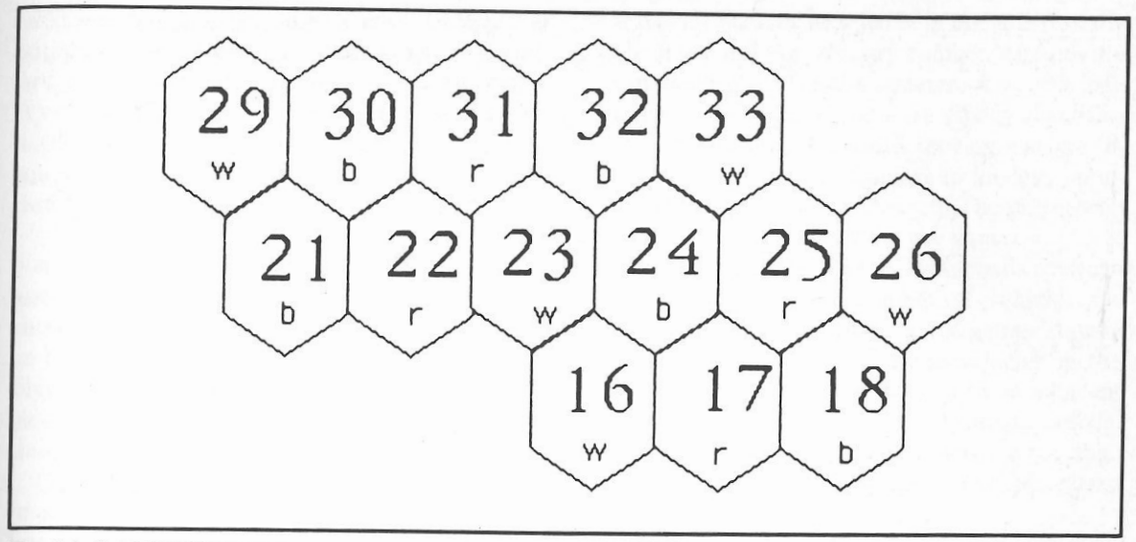


Fig. 7-1. A partial Tricolor game board.

"attack" has been initiated. A stack may attack an opposing stack only if the attacking stack is stronger. If it is more than twice as strong, the opposing stack is "killed" and all hostile pieces in the stack are removed from play; friendly pieces are added to the winning stack. If the attacking stack is not more than twice as strong, it "captures" the opposing stack by combining it with itself. If a capture or kill can be made during a player's turn, it must be made. The game ends with the capture or killing of all of one player's pieces.

Black Sheep. Black sheep is a two-player game (one white and one black) that is played on a graphic chessboard. White begins the game with four white checkers that are placed on the four black squares on one side of the chessboard. Black uses one black checker and places it on either of the middle black squares on the opposite side of the board. The white pieces may only move forward to the opposite side; black may move forward or backward. Both colors may only move one square at a time and only on the diagonal.

Players take alternate turns with black moving first. The object for black is to reach the opposite side of the board without being "trapped." The object of white is to trap black before it reaches the other side of the board. Black is trapped when it is surrounded with white pieces in such a way that there is no adjacent diagonal unoccupied square for black to move to. It would be challenging to develop a strategy that would allow the computer to play either side.

Bridge-It. In the game of Bridge-it, the first player is designated as O and the second player as X. Using the grid shown in Fig. 7-2, the players take turns putting a connecting line between two horizontally or vertically adjacent markers of the player's symbol. The O player attempts to build a connected "bridge" from the bottom to the top of the board, while the X player simultaneously attempts to build a bridge from the left to the right side of the board. The first player who successfully builds a bridge wins the game.

Hex. Hex is a game similar to Bridge-it, but Hex is played on a board composed of hexagons, with eleven hexagons on each side. Two opposite sides of the board are named black, while the other two sides are named white. The hexes at the four junctions between the sides are neutral. One player has black pieces and the other player has white

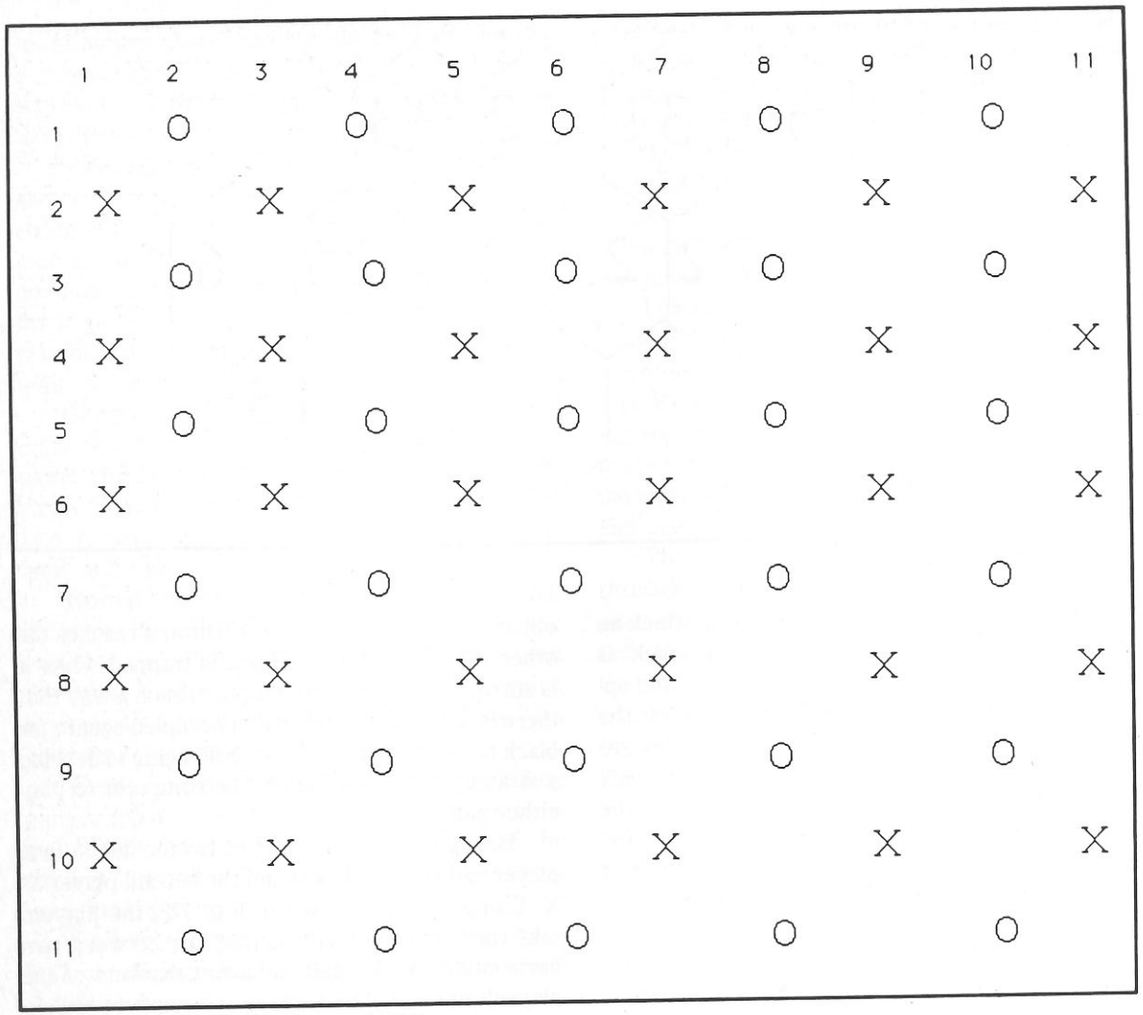


Fig. 7-2. A complete Bridge-it game board.

pieces. Alternate turns are taken, with each player placing one of his pieces on any unoccupied hexagon. The object for both players is to complete a continuous chain of his pieces between the two sides labeled with his color.

Cross Capture. Cross Capture is played on a chessboard. At the start of the game, a set of randomly distributed letters is put on the board, with no more than one character per square. Most of the board remains empty. Players take turns choosing one of the letters and all other letters on the board that fall into a given category become the property of that player. One category may be defined as all of the letters in the same horizontal, diagonal, or vertical row as the chosen letter or as all of the letters within a certain proximity of the chosen letter (e.g., one space away). The player who possesses the most letters at the end of the game is declared the winner.

Ticktacktoe Variation. An interesting ticktacktoe variation is played as follows. Each player puts his three pieces on a ticktacktoe board such that piece ownership alternates around the periphery of the board. Following this setup, each player is allowed to move one of his pieces to an adjacent square. The winner of the game is the first to align three pieces in a row.

Tuknanavuhpi. Tuknanavuhpi is a Hopi Indian chase game played on a 4 × 4 board with diagonals drawn in each of the 16 squares. Pieces should be moved on the points where lines meet on the board, not on the squares. Each of the two players has twenty playing pieces placed on their side of the board. The middle of the board is initially empty.

Players take alternate turns moving their pieces in any direction along the lines on the board, from one intersection to another adjacent intersection. As in checkers, pieces are captured by jumping over any of the opponent's pieces. The winner is the player who has captured all of his opponent's pieces.

Nim. The rules of Nim are simple; from a pile of any number of items (13 is the usual number), players take turns picking one, two, or three items. The player forced to pick up the last item loses the game. A winning strategy for the second player is to ensure that with every move you leave the pile with the number of objects equal to nine, five, or one.

Nim Variations. Here are a few games that can be mathematically analyzed in a manner similar to the way Nim has been analyzed:

- Rectangular Dominoes: players take turns placing dominoes on a chess-type board or a board of arbitrary size (8 × 8 is fine). The board is of a size such that a domino placed horizontally or vertically on it will cover up exactly two squares. The first player places his dominoes horizontally, the second player places his vertically; dominoes may not overlap. The winner of the game is the player who makes the last possible move.
- Welter: the board for this game consists of an arbitrary number of squares in one line (usually about twenty). An arbitrary number of tokens are randomly placed in the squares, with only one token in each square (there are usually about five tokens). Players take turns moving a single token to any unoccupied square to the left, jumping over other tokens if desired. The player who makes the last move wins the game.
- Traffic Jam: represents one-way roads between towns. An arbitrary number of vehicles are placed on the board to set-up the game. Players take turns moving one of the vehicles in the proper direction from one town to an adjacent town. The game continues until a traffic jam develops, in which no further moves are possible; the player who makes the final move is declared the winner.
- Tsyanshidzi: this is the Chinese national game in which players may select from two piles of objects either an arbitrary number of objects from one pile or the same number of objects from each pile, but no fewer than one object from each pile. As always, the player taking all remaining objects wins. This game requires a more complex analysis than the simple game of Nim does.
- Acey-ducey: in this game the computer "shuffles" a card deck and deals two cards. The player then bets against the computer, wagering that the next card dealt will fill in between the first two cards in rank. Can you determine the mathematical strategy behind a winning program?

Neutron. Neutron is a two-player game played on a 5 × 5 grid. At the start of the game, white owns the five pawns at the top and black owns the five pawns at the bottom. The neutron (n) begins at the center and is neutral. Each player's turn has two parts. First, the player must move the neutron in any direction, and then the player must move one of his pawns in any direction. The winner is the first player to maneuver the neutron to his own back row, whether by moving it by himself or by forcing the opponent to do so. You can also win by stalemating an opponent—that is, by

trapping him so that he cannot complete his turn. For example, if the neutron is completely surrounded with black pieces, then the white player cannot complete his turn and black wins. One further point to remember is that any time that a pawn or neutron is moved, it must be moved as far as it can go in a straight line, within the confines of the represented board. Furthermore, as a handicapping feature, the white player moves first, but is not permitted to move the neutron on his first move.

Hexpawn. This game is played on a 3 × 3 grid, similar to the one used in ticktacktoe. The two players place their three playing pieces on opposite sides of the board. The pieces are moved in a manner similar to the way pawns are moved in chess. By moving a pawn one space diagonally, it is possible to capture and remove an opponent's playing piece. Players alternate turns, and the winner is the first player to reach the opponent's side of the board, or the remaining player when the opponent has no legal moves available.

COMPUTER QUIZZES

Computer quiz games can be instructive as well as fun, if clever programming techniques are employed. Examples of these techniques include the following:

- Having a large data base of questions from which a few are randomly selected to produce a new set of questions for each quiz
- Automatically recording the score and rewarding the player with graphic or musical interludes for good scores; new scores may be compared with old scores or with those of other players
- Providing explanations of missed answers
- Allowing for the selection of questions according to the player's level of ability or providing for an automatically-adjusting level of difficulty based upon performance

Assorted suggestions concerning topics for quiz games include the following:

- Names and capitols of states or countries, possibly using computer graphics to draw maps
- Vocabulary words
- I.Q. tests
- Personality and aptitude tests
- Foreign language vocabulary or grammar
- Preschool skills including comparing and counting random shapes, words, and numbers, and copying letters, words, and numbers
- Practice questions for examinations such as the SAT, GMAT, MCAT, LSAT, and ACT
- Analogies
- Spelling bees
- Verses from literature or the Bible
- Trivia questions for trivia lovers, on science fiction, movies, and history
- Basic math skills
- Chemical equation balancing
- English grammar
- History of the United States, the Renaissance period, or World War I

GAMES THAT USE WORDS

You can program a wide variety of games and activities that are based on words, including the following:

- *Cryptograms*, or coded messages, could be displayed for you to decode; clues could be provided.
- Word search puzzles ad infinitum may be computer generated, either from a word list or as a random matrix similar to the popular Boggle™ game. A program to determine the locations of all words in the puzzle could also be implemented. You could also have the computer assist in creation of a crossword puzzle. Choose a topic and enter words; the computer will automatically fit the common letters together to form a crossword grid. Next, enter an obscure or humorous clue for each word. The completed crossword can be saved for later use or printed and sent to friends.

- Word guessing games, similar to twenty questions, can be computerized. In these games, the player asks the computer questions to determine what word has been randomly selected. Replies for the many possible questions a human could pose must be stored; thus there are difficult programming challenges. The dialogue with one such program went like this:

  (c = computer, h = human)
  h: Does it grow?
  c: To answer that question might be misleading.
  h: Can I eat it?
  c: Only as food for thought.
  h: do computers have it?
  c: Strictly speaking, no.
  c: The word is "Knowledge."

- A word game similar to the popular Mastermind™ game would involve the computer's selecting a three-letter word from a large list. The player would guess by entering a three-letter word and would be told whether or not the computer's word contained any of the letters in the word the player guessed and whether or not those letters were in the correct position. The object is to guess the computer's word in the least number of tries.
- In the game of Confound, the computer outputs 15 letters (consonants and vowels). The players must form the longest word possible using these letters. The computer serves to keep score and checks to ensure that no letters were used improperly, that is, used more often than they appear in the list.

MAGIC

Although computers are almost magic in themselves, real magic tricks performed by the Apple IIGS are quite entertaining for youngsters or party guests. Here are some suggested IIGS magic tricks:

Micro Mentalist. The IIGS becomes a mind reader in this magic trick. As the magician, you must ask your audience to provide you with a common personal item, such as a watch or key chain. Then, you ask the Apple IIGS to identify the item, which it does with alarming accuracy. The secret of this trick lies in the manner in which this question is asked. You, in fact, identify the item for the IIGS by typing in a question that will match the correct answer—different questions represent different answers. For example, the question "What item am I holding," could indicate a watch. The IIGS simply matches the question that you enter with an identical programmed question and, consequently, the name of the desired object.

The Break in the Chain. This trick is performed with a complete, 28 piece set of dominoes. Before the trick is performed, the magician removes one of the dominoes (it cannot be a double) from the set and enters the two domino numbers into the program. The audience members are given the remaining pieces of the set and are asked to complete a single domino chain, as in regular play. Once the chain is completed, the numbers on the two ends of the chain are noted. The magician enters a question, such as "What are the two domino numbers," into the IIGS. The Apple then responds by correctly displaying the two previously stored numbers.

PROGRAMS FOR YOUNG CHILDREN

Programs that make liberal use of graphics and that are designed to be foolproof against accidental inputs are excellent learning tools for young children. These programs can be made to teach not only a particular subject matter, but also to familiarize children with using the Apple's keyboard and cursor controls. Suggestions for educational children's games include the following:

- Matching Games: children can match letters, words, and shapes.
- Drawings Machine: a joystick controller or arrow keys permit drawing on a video screen. A

library of shapes including squares, triangles, and circles can also be used to construct pictures.

- Face Maker: children can create their own funny face on a video screen by selecting eyes, ears, a nose, hair, and a mouth from a collection of possibilities.
- Storybook: using the keyboard, children can write their own stories, which the computer then interprets and animates on the screen. Stories can involve stored images such as houses, trees, people, and cars, which may then be animated to illustrate a sentence such as "The girls walked from home to school."

SIMULATION AND ADVENTURE GAMES

Simulations of real-world situations can be represented on the Apple IIGS in high resolution and with realistic animation. Some of the many programming possibilities include the following:

Pool Table. A graphically animated pool playing game would serve to teach the principles of elastic collisions and angular geometry.

Motorcycle Jump. A simulation in which a motorcycle must leap a certain distance in order to land safely would illustrate projectile motion.

Navigation. A simulation in which the participant must find the way to an island, using a radio direction finder in a sailboat, would teach the principles of navigation.

Detective. The participant would assume the role of a detective in this simulation. A valuable gem has been stolen from a museum and five persons are suspected of the crime. The use of deductive reasoning is the only way in which the detective can solve this crime.

Wall Street. A stock market simulation would allow players to buy and sell stocks according to market conditions. The IIGS is programmed to determine the price for each stock while also acting as broker and bookkeeper.

World Conflict. This simulation would place each player as the head of a nation. Players must decide whether they should go to war, form cartels, or make concessions and compromises. The IIGS could select the conflicting situations (e.g., oil embargoes, assassinations, nuclear threats).

Decision. A simulation of corporate management and big business could place each player as a top executive. Each executive has the authority to produce the product of his choice and sell the product at the best market price. Throughout the game, prices fluctuate according to the law of supply and demand.

Fire. The object of this simulation is to subdue a raging forest fire with chemicals, backfires, and other firefighting techniques. The success of the player depends on quick decisions concerning how to control a geometrically increasing fire.

Adventure. The object of this simulation is survival during a desperate attempt to locate buried treasure on an island.

Careers. This simulation game places the player in a new occupation in order to enable him or her to experience decision making, conflicts, opportunities, and financial stress from different viewpoints in a variety of careers.

Grid Search. A search game that pits a destroyer against a submarine, for example, could be programmed. The game would use a 10 × 10 grid that must be selectively searched by the ship or the submarine in its efforts to locate and attack the other vessel. Similarly, a game in which a spy searches for hidden documents while avoiding hidden enemy agents could also employ this same grid-searching technique.

Laser Tank. The player and a computer-controlled opponent each has a laser-firing tank and a base. The object of the game is to be the first one to destroy the opponent's base while avoiding the opponent's fire. Obstacles litter the battlefield and laser fire is destructive only at a limited range.

Robotwar. The purpose of this simulation is to teach computer programming. Two opposing players are instructed to secretly design programs, written in a custom language, that would create and control destructive robots. The programs would be entered, and the video display of the combat field would be constantly refreshed. The object could be to hit the opposing robot five times to win.

Robotwar II. In this game, you must avoid your opponent, the IIGS, which controls annihilating robots. An electrified, lethal fence defines the playing field.

The Apple's robots will destroy you if they come close. These robots will destroy themselves, however, if they run into the fence. Your objective is to evade the robots until they have all been destroyed by the fence.

VIDEO GAMES

Because of the Apple's high resolution graphics (see Fig. 7-3), color (see Fig. 7-4), and excellent sound capabilities, this computer is well suited to the creation of action-packed video games. Although games written in Applesoft BASIC do not execute as fast as the real, assembly language arcade versions, they do counteract the speed limitation with an easily implemented final product. Here are some ideas that you might want to write Applesoft BASIC versions of:

Maxwell's Demon. Two chambers are connected through a passage and a gate. Bouncing molecules fill one of the chambers. Your challenge is to move all of the molecules into the other chamber.

Hockey and Tennis Type Games. These Apple IIGS games could be controlled with joysticks and act just like their arcade cousins.

Tanks. This game tests your ability to launch projectiles and strike another object.

Pinball. Once again, joysticks are used to move the flippers on this recreation of the analog pinball machine.

Lunar Lander. This game involves a lunar landing spacecraft that is governed by rocket thrust, a limited fuel supply, and the moon's gravitational pull.

Football, Baseball, and Basketball. An animated display of players, ball positions, and the playing field would be used to duplicate the action of these sports.

Racetrack. The object of this automobile racing game is to finish the race in the least amount of time.

Skydiver. The player in this game must control the jump time and the opening of the chute for a perfect landing.

Robot Bowl. This bowling game carries a twist in that the Apple player is really a robot. Therefore, the robot must be given instructions as to the weight of the ball, time of release, and angle of approach.

Shooting Gallery. Several moving targets of different point values are placed in front of an Apple-controlled gun.

Golf. A golf game with a complete set of graphical holes would let the players choose the clubs that they will use, the power of the swing, and the angle at which the ball will be hit.

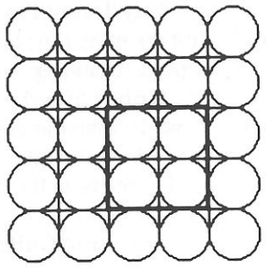
Verti-Bird. Land the maneuverable helicopter onto its landing pad. You must exactly land on the spot 240 × 187 to win (see Listing 7-1 and Fig. 7-5).

RECREATIONS INVOLVING THE APPLE ITSELF

There are many exciting programming challenges that can be directed at the IIGS. Your goal in each program is roughly the same: write as simple an Applesoft BASIC program as you can that solves a given problem. In order to start you off on the right foot, here are several programming challenges that are only for the strong of heart and mind:

1. Calculate Pi to a degree of accuracy in excess of 500,000 decimal places.
2. Create a program that can only be stopped by turning off the Apple.
3. Find the largest prime number.
4. Create a modem re-dialer that can't be interrupted.

Apple IIGS Graphics Routines



A 25 pixel screen sample.

— Rectangle

— Point

— Pixel

Graphics Calls

GrafPort
  Example- InitPort
Cursor Handling
  Example- SetCursor
Pen Mode
  Example- ShowPen
Font and Text
  Example- TextSize
Rectangles
  Example- FillRect
Pixel Transfers
  Example- PaintPixels
Points
  Example- LocalToGlobal
Utilities
  Example- Random

Fig. 7-3. A complete ROM-based graphics toolkit can be used for quickly drawing, moving, and filling on-screen graphics.

Apple IIGS Color Routines

320 Mode Color Table *		
Pixel	Color	Value
0	Black	000
1	Red	F00
2	Green	0F0
3	Blue	00F
4	Teal	088
6	Brown	066
7	DarkGray	555
8	LtGray	AAA
9	Orange	F80
12	Yellow	FF0
13	Magenta	F0F
14	Cyan	0FF
15	White	FFF
*Obtained with InitColorTable		

SCB = Scan line Control Byte, where

7 — Mode
6 — Interrupt
5 — Fill
4 — Reserved
3 2 1 0 — Color Table

Color Routines

InitColorTable
SetColorTable
GetColorTable
SetColorEntry
GetColorEntry
SetSCB
GetSCB
SetAllSCBs

Fig. 7-4. The SCB (scan-line control byte) manipulates the vivid and diverse IIGS color table.

Listing 7-1: Verti-Bird Program

```
10  REM  VERTI-BIRD
20  TEXT
30  HOME
40  PRINT : PRINT  TAB( 15)"VERTI-BIRD"
50  PRINT : PRINT "IN THIS GAME, YOUR JOB IS TO LAND THE   HELICOPTER ON
    THE LANDING PAD."
60  PRINT : PRINT "YOU ARE FIGHTING THE CLOCK...SO HURRY!"
70  PRINT : PRINT "USE THE CURSOR KEYS TO CONTROL THE      VERTI-BIRD."
80  PRINT : PRINT "PRESS ANY KEY TO BEGIN.": GET Z$
90  HGR2 :Z = 0
100  FOR X = 7676 TO 7702
110  READ A
120  POKE X,A
130  NEXT X
140  POKE 232,252: POKE 233,29
150  HCOLOR= 1:X = 50:Y = 176
160  HPLOT 220,187 TO 275,187 TO 250,190 TO 220,187
170  HCOLOR= 3
180  ROT= 0
190  SCALE= 2
200  DRAW 1 AT X,Y
210 S =  PEEK ( - 16336)
220 K =  PEEK ( - 16384)
230 K = K - 128
240  IF K = 11 THEN  GOTO 300
250  IF K = 8 THEN  GOTO 400
260  IF K = 21 THEN  GOTO 500
270  IF K = 10 THEN  GOTO 600
280  XDRAW 1 AT X,Y:Y = Y + 1: IF X > 240 AND Y > 173 THEN  GOTO 700
285 Z = Z + 1: IF Z = 1200 THEN  GOTO 700
290  IF Y = 177 THEN Y = 176
295  GOTO 200
300  XDRAW 1 AT X,Y
310 S =  PEEK ( - 16336)
320 Y = Y - 3: IF Y <  = 1 THEN Y = 2
330  POKE  - 16368,0
340  GOTO 200
400  XDRAW 1 AT X,Y: HCOLOR= 1: HPLOT X + 10,Y: HCOLOR= 3
410 S =  PEEK ( - 16336)
420 X = X - 1: IF X < 1 THEN X = 1
430  POKE  - 16368,0
440  GOTO 200
500  XDRAW 1 AT X,Y
510 S =  PEEK ( - 16336)
520  IF Y < 174 THEN X = X + 1: IF X > 255 THEN X = 255
530  POKE  - 16368,0
540  GOTO 200
600  XDRAW 1 AT X,Y
610 S =  PEEK ( - 16336)
620 Y = Y + 3: IF Y > 176 THEN Y = 176
630  POKE  - 16368,0
640  GOTO 200
```



```
700  POKE  - 16368,0
710  TEXT : HOME
720  PRINT  CHR$ (7)
730  IF Z = 1200 THEN  PRINT : FLASH : PRINT "YOU'VE RUN OUT OF TIME.":
     NORMAL : GOTO 750
740  PRINT : PRINT "CONGRATULATIONS, YOUR FINAL SCORE IS    ";Z
750  PRINT : PRINT "TRY AGAIN (Y/N)?": GET Z$
760  IF Z$ = "Y" THEN  RESTORE : GOTO 90
770  IF Z$ = "N" THEN  HOME : END
780  IF Z$ <  > "Y" OR Z$ <  > "N" THEN 710
1000  DATA  1,0,4,0,41,45,45,45,221,27,46,21,46,45,245,63
1010  DATA  183,58,36,183,63,44,60,32,100,5,0
```

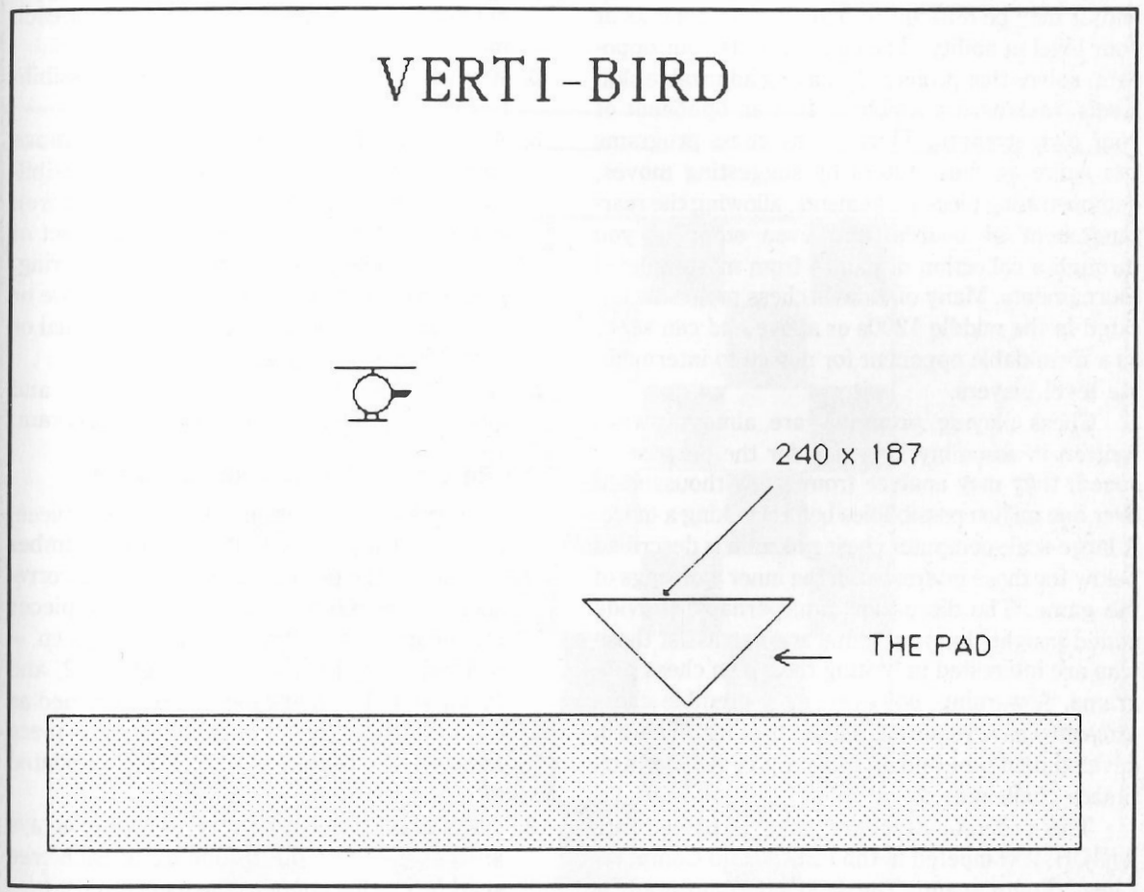


Fig. 7-5. Verti-Bird is an arcade-type game that utilizes the IIGS's color, graphics, and sound capabilities. In order to win at Verti-Bird, you must land the helicopter on its landing pad. You will only receive the proper credit when you have touched the exact pixel spot of 240 × 187. This is a delicate maneuver that very few pilots will get exactly right. If you find that you lack this "right stuff," try hopping the verti-bird over to the landing pad. This will help you, but it still won't be easy. By the way, one of the best recorded scores is 97. See if you can top it.

5. Compact ASCII data files into the smallest possible amount of disk space.
6. Make a copy-protection scheme that can be used to protect your files.

COMPUTERS AND CHESS

Chess is one of the most popular computer recreations for several reasons. First, it requires an advanced level of computer programming, described by some as "artificial intelligence," that enables a computer to emulate human thought. Second, it may be difficult to find chess opponents at your level of ability. The computer, as your opponent, solves that problem by having adjustable skill levels, making it possible to find an opponent of your own strength. Third, many chess programs can serve as chess tutors by suggesting moves, demonstrating piece movements, allowing the rearrangement of boards, and even stepping you through a collection of games from masters-level tournaments. Many of today's chess programs are rated in the middle 1200s or above and can serve as a formidable opponent for novice to intermediate level players.

Chess playing programs are almost always written in assembly language for the purpose of speed; they may analyze from a few thousand to over one million possibilities before making a move. A large-scale computer chess program is described below for those interested in the inner workings of the game. The discussion can, perhaps, provide added insights for your game and can assist those who are interested in writing their own chess programs. A warning, however: most credible chess programs have required thousands of man-hours in development time and are truly a programmer's ultimate challenge.

The program described here is named OSTRICH; it competed in the First World Computer Chess Tournament. The OSTRICH program is composed of three modules: BOOK, which provides standard book opening moves for up to the first five moves, CHESS, which is the main program used during most of the game, and END GAME, which takes over in rook/king or queen and king/king end games. CHESS, the main module, is comprised of approximately 9000 instructions, which are divided into five subprograms:

1. A subroutine for the control of input and output and for the control of the size of the search tree. The *search tree* refers to the branching search for all move possibilities that the computer performs before making each move. The size of the tree indicates the depth or number of moves ahead that will be considered for each move.
2. A subprogram to generate all move possibilities or search the tree.
3. A subprogram to arrange each possible move on a hierarchy scale according to its plausibility (each move is given a plausibility score). Following this initial ordering, another set of routines is called upon to improve the ordering.
4. A subprogram to calculate a terminal score or to evaluate the chessboard at each terminal or branching point in the tree.
5. A subroutine to update all arrays, lists, and pointers used by the remainder of the program.

The Reference Arrays Used by Chess

1. The lists of the locations of each chess piece: an 8 × 8 array holds an identification number for each of the pieces on the board, in a corresponding memory location. The white pieces are identified as follows: King = 6, Queen = 5, Rook = 4, Bishop = 3, Knight = 2, and Pawn = 1. The black pieces are identified as the negative of the corresponding white piece number. The board's position array is updated after each move.
2. The piece location arrays: two separate arrays are generated at the beginning of each tree search. The list contains the names and corresponding locations of the white pieces; the other does the same for the black pieces.
3. The possible moves list: a list of possible moves

Listing 7-2: Game Board Program

```
10  REM  GAME BOARD
20  HGR2
30  HCOLOR= 3
40  HPLOT 50,50 TO 130,50 TO 130,130 TO 50,130 TO 50,50
50 Y = 50
60  FOR L = 1 TO 8
70 X = 50: IF L = 2 OR L = 4 OR L = 6 OR L = 8 THEN X = 60
80  FOR Z = X TO X + 10
90  HPLOT Z,Y TO Z,Y + 10
100  NEXT Z
110 X = X + 20: IF X < 130 THEN  GOTO 80
120 Y = Y + 10
130  NEXT L
```

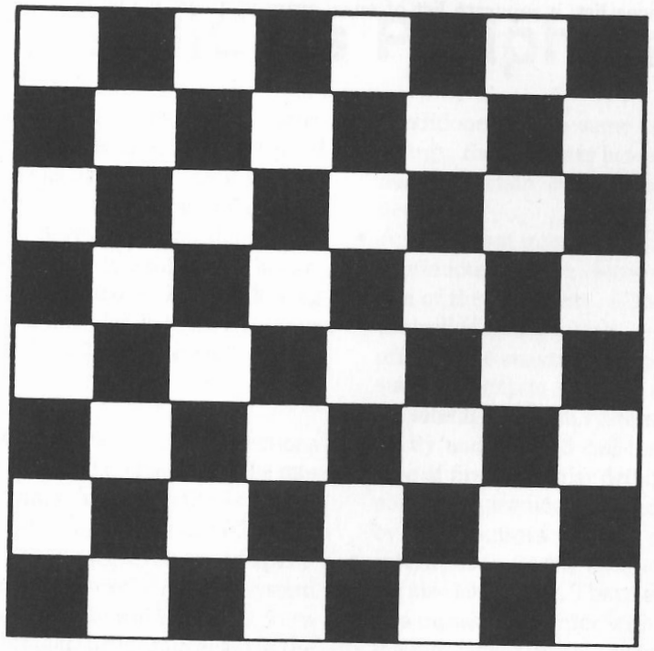


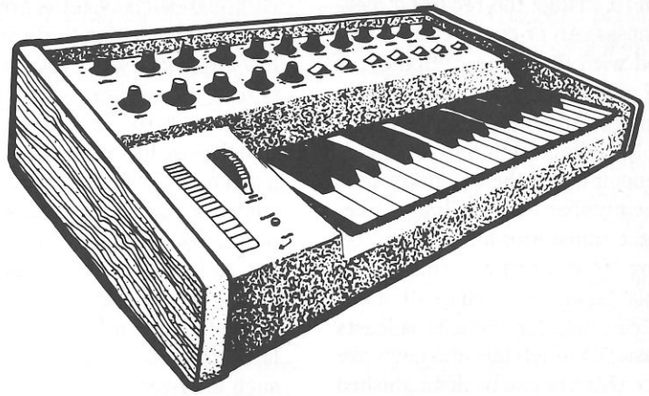
Fig. 7-6. A chess game board that was drawn with the program in Listing 7-2.

for *ply* 1 (ply refers to the depth searched), ply 2, and ply 3, corresponding to each initial move, is generated. Additionally, memory is reserved to indicate which moves will result in a capture.

4. The control piece array: this array stores the squares that each piece "controls" as well as the pieces that control a particular square. Thus, it is possible to determine the power of each piece along with what pieces are in control of the specific square in question.
5. The change array: all changes made at a node in the search tree are stored in this array when control advances to a new node. The purpose of the list is to expedite the restoring of positions.
6. The pinned pieces list: a listing of all pinned pieces is maintained in this array.
7. The en prise pieces list: a separate list of en prise pieces at each search node is maintained.
8. The Alpha and Beta cut-offs lists: two lists, one of the last eight moves resulting in alpha refutations and the other of beta refutations, are maintained.
9. The ply 3 plausibility list: CHESS maintains a list of the best ply 3 move for each possible ply 2 opponent's move for each ply 1 move investigated.
10. The principal variations list: each principal variation originating in the tree search is stored in this list.
11. The position records list: this listing of all moves since a recent capture or pawn move is used to determine whether a draw should be made because of repetition.

A short chess game board construction program is given in Listing 7-2 (see Fig. 7-6).

Chapter 8



Connecting Apple IIGS's Peripherals

The potentials for computer control and monitoring of the home are nearly endless. Only a few of the possible applications have been put into practice with the incorporation of microprocessors into household appliances. Several industry demonstration homes have been built to exhibit this household microprocessor control. The following suggestions have been included in these homes or have been suggested by leading industry forecasters and futurists:

- Climate control is just one of the many functions provided by the home computer system. The rate of temperature change and humidity is noted, and the air conditioner or heater is turned off before the house is at a preset level; the temperature will "coast" to the desired level. The system also times the thermostat. In winter it turns down the temperature at night, turns it up again in the morning, and then turns it back down while you go off to work; in the summer it controls the air conditioner in the same manner. To conserve energy, the hot water heater is also turned down during certain hours when hot water isn't needed.
- A vocal input interface to the home computer is continuously active, waiting for a command by one of the occupants. All appliances and lights controlled by the system can be switched on and off by voice command or can be programmed to start and stop at selected times.
- An intelligent alarm system will turn off all electricity and gas and call the fire department in case of fire. A burglar detection system calls the police if an intruder is detected ultrasonically or by other sensors.
- Interfaces to stereo, televisions, and telephones are also interesting. The telephone controller acts as a message recorder with additional features. If a message is taken, the unit can be instructed to call someone at another number and deliver the message. A telephone call to the machine it-

self can allow you to change the recorded message, play back messages, or control any of the devices connected with the home computer. A telephone file of commonly used numbers is stored in the computer. Additionally, you can dial numbers by simply calling them out vocally; if a busy signal is encountered the computer continually redials the number until the line is free.

- The stereo interface transforms an ordinary stereo into a "jukebox" from which recordings may be selected and played at the touch of a button. A special device can monitor radio broadcasts and record all music; commercials and news are not recorded (voice patterns can be distinguished from music). You can preprogram the volume level and the type of music you want to have recorded for special purposes such as musical interludes and background music for dinner. A given song can be played a selected number of times, or the computer may be programmed to skip to the next song on a record or cassette.
- The television interface will turn on the set at selected times or record shows on videotape; a directional antenna or satellite dish is automatically turned for the best reception.
- You can use a voice synthesizer to audibly awake you in the morning with "Good Morning Mr. P. It's 8 A.M.," and then summarize your itinerary for the day.
- An automatic system can release fresh food and water for pets left at home for a long period, can sense when the animal has not eaten the food, and can notify the veterinarian to check the home.

Some other applications currently being used by hobbyists include the following:

- Voice or sound synthesizers are incorporated into games to provide dialogue or sound effects.
- Voice input computers are used for recording information called out by an operator. One hobbyist uses such a system to make simple calculations in his home workshop while his hands are full. Although such systems are usually limited to a vocabulary of about thirty words, some hobbyists have managed to develop automatic "dictation-taking" typewriters for limited purposes (a word capacity of 100 is considered maximum).
- A hobbyist has used his small computer to replace over 7000 mechanical relays necessary to control a pipe organ in his home. Similarly, computers could be used to light the keys on an organ to help you learn to play a song. Although a commercial piano player has been developed to digitally record music played and play it back later, the cost is high. If you were to implement such a system with your computer, additional features could be added; speed, sustain, attack, and other features could all be varied.
- One hobbyist is using a microprocessor to create intelligent test equipment that can automatically perform a set of test routines on a given circuit. This is an interesting application for amateur radio operators. A calculating oscilloscope is able to compute exact items for rises, perform integrals and differentials, compute peak areas, RMS values, and peak to peak distances, and do n-point averaging; all data can be stored.
- With the addition of silver contacts and a small amplifier, your computer could serve as a biofeedback monitor or lie detector. Galvanic skin resistance, temperature, or heartbeat could all be measured with the use of the proper instruments.

The capabilities of an Apple IIGS allow sophisticated analysis and conversion of waveforms not obtainable with standard biofeedback equipment. An assembly language program could be written to convert alpha brain wave signals, which are in the range of 8-12 Hz, into audible sound by raising all of the frequency components of the brain wave signal to the audible range, while preserving the ratios between the frequencies. Such a program could then be used for a variety of unique applications; for example, for converting your voice from a very deep level into a high-pitched level or for

dealing with any situation requiring the conversion of analog signals. You can envision future digital music players that have the added capability of altering songs through the use of hardwired computer circuits.

- A New Hampshire resident uses his home computer to control his wood stove; he reports a 10 to 30 percent improvement in efficiency.
- A digital/audio file in which a standard cassette interface is used to record digital information between songs (audio) could be used to index songs, prompt a vocal announcement by a voice synthesizer, or control volumes, speakers, times, or mixing.
- Hobbyists have connected computers to exercise equipment, such as jogging pads or exercise bikes, to keep track of energy expended, speed, or time. These special input devices could also be used as controllers for special video games.
- Special software and hardware configurations could permit two or more opposing players to use separate but interconnected computers in such a manner that they cannot see each other's gamefield. Games of this type (*multiplayer* games) are gaining in popularity on computer networks.
- Chess fanatics who also happen to be gadget fanatics would take delight in a computer-interfaced chessboard capable of sensing the movement of pieces. A robotic arm, of course, would move pieces for the computer.
- Personal computers can be used to generate titles for home video or film movies that can involve animated color graphics. Titles for slide shows could also be made by photographing the screen.
- Along similar lines, your computer could flash subliminal messages over television programs for behavior modification. These would last 1/30 of a second and assail your subconscious with messages to help you control your weight, deal with stress, smoking, or alcoholism, or become motivated toward success. Messages such as "I exercise" and "I am successful" could be repeated every minute.
- Radio scanner buffs can interface their computer to a scanner via CompuScan™, a Bearcat product, allowing them to monitor up to 200 channels. The computer can display the frequency and the description of the channel received on a video monitor.
- Weather sensors such as electronic anemometers, thermometers and barometers can be interfaced with a computer to provide automatic weather monitoring.

HOUSEHOLD CONTROL DEVICES

Interfaces that allow a IIGS to help you out around the house are commercially available, from the firms listed below. For those readers with a hardware bent and solder for blood, there are schematics for a simple control latch system and A/D (Analog/Digital) converter included at the end of this chapter.

These firms have been divided into two groups, depending on the type of products that they offer: the one listed under "Apple IIGS System," offers a product that is designed to work specifically with the IIGS, and those in the "Dedicated Systems" category offer products that are made for home control applications, but they lack a direct IIGS interface. These dedicated systems can be interfaced, however, to Apples through some elaborate electronic restructuring.

Apple IIGS System

X-10, 185A Legrand Avenue, Northvale, NJ 07647; (800) 526-0027. The X-10 Powerhouse, offered by X-10, is a combination home security/home control system that interfaces directly with your Apple IIGS. The X-10 Powerhouse uses your standard 110V outlet to send digitally encoded signals to remote X-10 Modules that control household appliances. Once programmed by your IIGS,

the X-10 Powerhouse can be disconnected from the computer and function in a stand-alone fashion with a battery back-up.

Dedicated Systems

Anova Electronics, Three Waters Park Drive, San Mateo, CA 94403; (415) 572-9686. Anova sells three dedicated, microprocessor-based systems for home control. These systems can be used to remotely control, via the telephone, appliances and protection systems.

Audio Command Systems, 46 Merrick Road, Rockville Center, New York, NY 11570; (516) 766-2627. This firm offers remote control devices including low-voltage lighting control systems, motorized drapery controllers, stereo components, and robots.

BSR, Route 303, Blauvelt, NY 10913; (914) 358-6060. This firm is the founder of home control system market. The BSR System is used by a variety of different manufacturers as an OEM (original equipment manufacturer) component of their system. The BSR controller encodes a signal on the 60-cycle alternating current of the house's electrical system. This eliminates the need for special wiring throughout the house. Each controlled appliance is plugged into a remote unit that may be turned on and off by the main control box of the BSR system.

Leviton, 59-25 Little Neck Parkway, Little Neck, NY 11362; (212) 229-4040. Leviton manufactures electronic control devices that enable computer control of lighting and appliances.

Technicom International, 23 Old Kings Highway South, Darien, CT 06820; (202) 655-1299. This firm offers the Energy Control System (ECS) which can control up to eight devices in the home using BSR remote modules.

The Use of Home Control Systems

Users of these control systems report actual applications as diverse as energy conservation, keeping various rooms at desired temperatures for different times of the day, sprinkling the lawn according to a predetermined ground moisture level, securing doors, signaling a baby's movements in a crib, making and logging telephone calls, detecting the seepage of water into a basement, opening and shutting drapes, and starting a roast for dinner through a remote telephone signal.

The control system can be arranged in such a manner that one Apple controls the entire house or with a network of Apples interconnected via RS-232C interfaces.

MUSIC

There are numerous music and speech synthesizers available for the IIGS. Possible uses for these include:

- Use them with games for special sound effects.
- Use them with a music composing program to generate and play original music continuously.
- Use a music synthesizer as programmable drummer to accompany other instruments. Various drum sounds, speeds, and patterns including Latin, swing, jazz, waltz, and march, could be programmed. The metronome, cymbals, and other percussion devices could also be imitated.
- Use a voice synthesizer to "sing" the vocals of a music piece, producing a unique composition.
- Use the standardized MIDI to connect a home computer to one or more electronic musical synthesizers to play or digitally record your compositions on a standard electronic keyboard. Comprehensive information on MIDI is available from: MIDI Users Group, P.O. Box 593, Los Alto, CA 94022, phone (408) 253-4684.

Additional applications in the area of music include the following:

- If you have a plotter or a graphic printer, your musical compositions or those of the computer could be produced in standard musical notation.
- Loops of the proper speed and duration will generate a specific audible frequency on an AM radio placed next to a CPU. A machine language or BASIC program to make use of this effect could produce sounds that resemble music.
- If music is digitized with the use of an A/D converter, it can be altered in various ways. Here are some examples:
  - Selected voices or instruments could be removed/added after an analysis of frequency content.
  - The music could be played at any selected rate without a change in pitch, or could be played backwards for special effect. You could transform a given composition into another style of your choice.
- Today's color organs, which produce a pulsating light in response to music, rely upon analog circuits and often do not produce good results. A dedicated microprocessor could be used to control the lights instead, resulting in a more favorable response.

AN EXTERNAL DEVICE CONTROLLER FOR YOUR COMPUTER

The project described below will enable the electronic enthusiast to construct an economical interface for the IIGS. For those who lack the desire or ability to make this circuit, commercially available boards for the Apple can be purchased for under $200.

This interface can connect your Apple with up to sixteen external devices. Once these connections have been made, your IIGS can control all sixteen devices simultaneously.

This interface switches on and off a small amount of current which controls the relays that in turn can control larger electrical loads (see Fig. 8-1). The powerful IIGS will have no problem driving this interface.

The interface consists of three modules: a 16-channel demultiplexer, a 16-bit memory, and 16 transistor amplifier drivers. The final construction cost will be in the neighborhood of $30. The final interface is designed to connect directly to a parallel Centronics port. This port will have to be added to the IIGS prior to the connection of the constructed interface.

The four low-order bits of data coming from the parallel output port are input to the demultiplexer. In turn, the demultiplexer selects the appropriate output pin and pulls it low. For example, if the four bits are 0000, then channel zero will be selected and pin one will be pulled low. Since only 16 individual signals are possible with four bits per signal, 16 is the maximum number of channels that can be selected.

Each output signal switches the state of one of the sixteen flip-flop chips. Therefore, the flip-flops act as a 16-bit memory that continuously maintains the status of each channel. Signals sent to one flip-flop will alternatively toggle the corresponding channel on and off. The fifth bit of the data byte is first buffered, and then it is connected to the reset pin of each flip-flop. Consequently, all channels may be reset (turned off) simultaneously through the use of the fifth bit.

The software must output the signal corresponding to the correct channel to control the devices that are connected to this interface. The channel cannot be switched on and off continuously, however, by selecting that channel over and over again. This restriction is due to the flip-flop's switching structure. Flip-flops can only switch on the rising edges from the demultiplexer, which occurs only if the multiplexer has been changed to select a different channel. Therefore, to switch a given flip-flop on and then off, follow these steps: 1) select the channel with the proper data byte, 2) select any other channel, including an unused channel, 3) wait for the first channel to toggle on, and 4) reselect the first channel to turn that channel off.

AN A/D CONVERTER FOR YOUR COMPUTER

This analog-to-digital converter has many applications for use with a Apple IIGS, including the

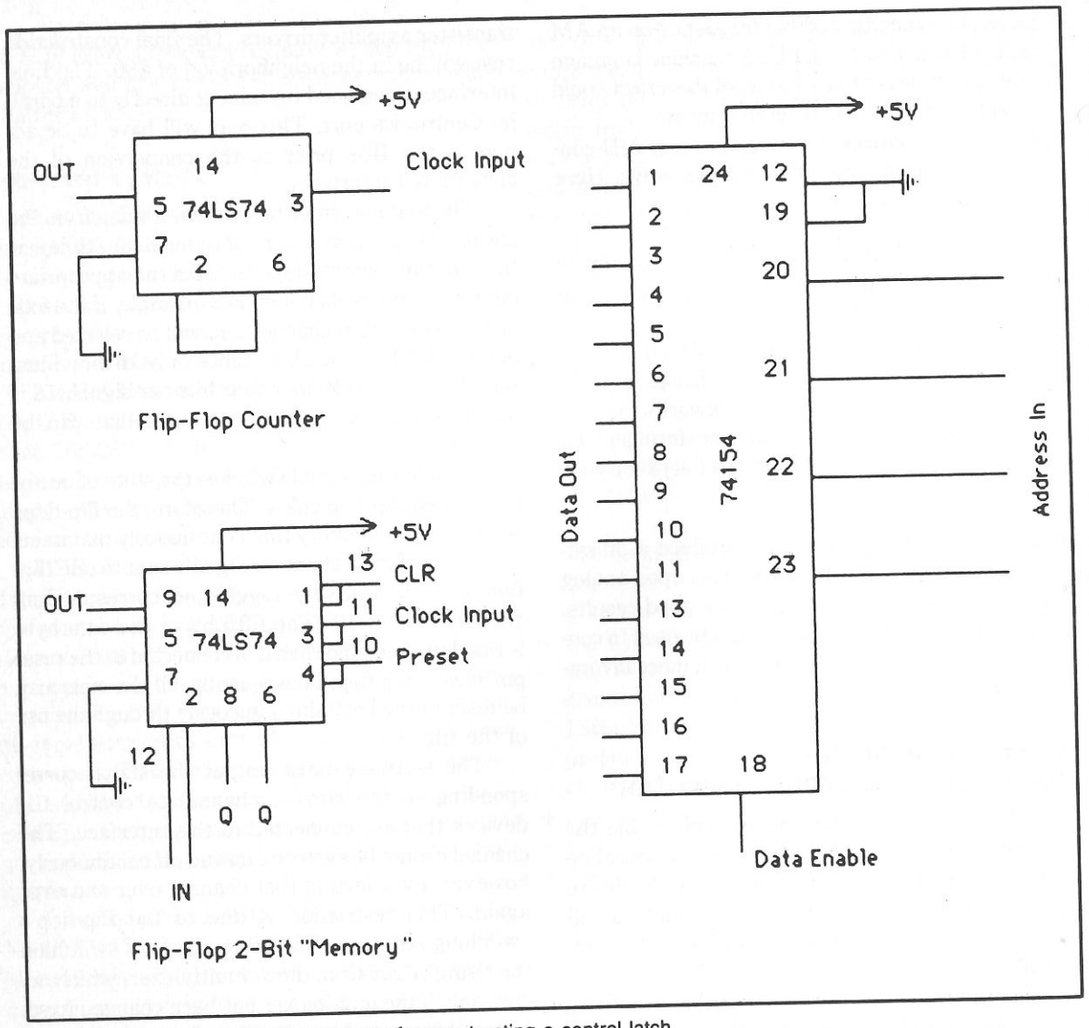


Fig. 8-1. The schematic parts necessary for constructing a control latch.

automation of test equipment and the control of robots.

The eight-channel interface described here is designed for use in converting signals in the range of .1 Hz to 100 Hz, which is sufficient for the applications listed here (see Fig. 8-2). The "sample-and-hold" principle is used in this design to store an analog signal as a capacitor charge until it is processed. The two power supplies that are necessary for this circuit should fall between 4.5V to 6.5V and 12V to 15V, respectively.

An assembly language software description is provided below:

1. Initialize the pointer.
2. Load the next byte for output.

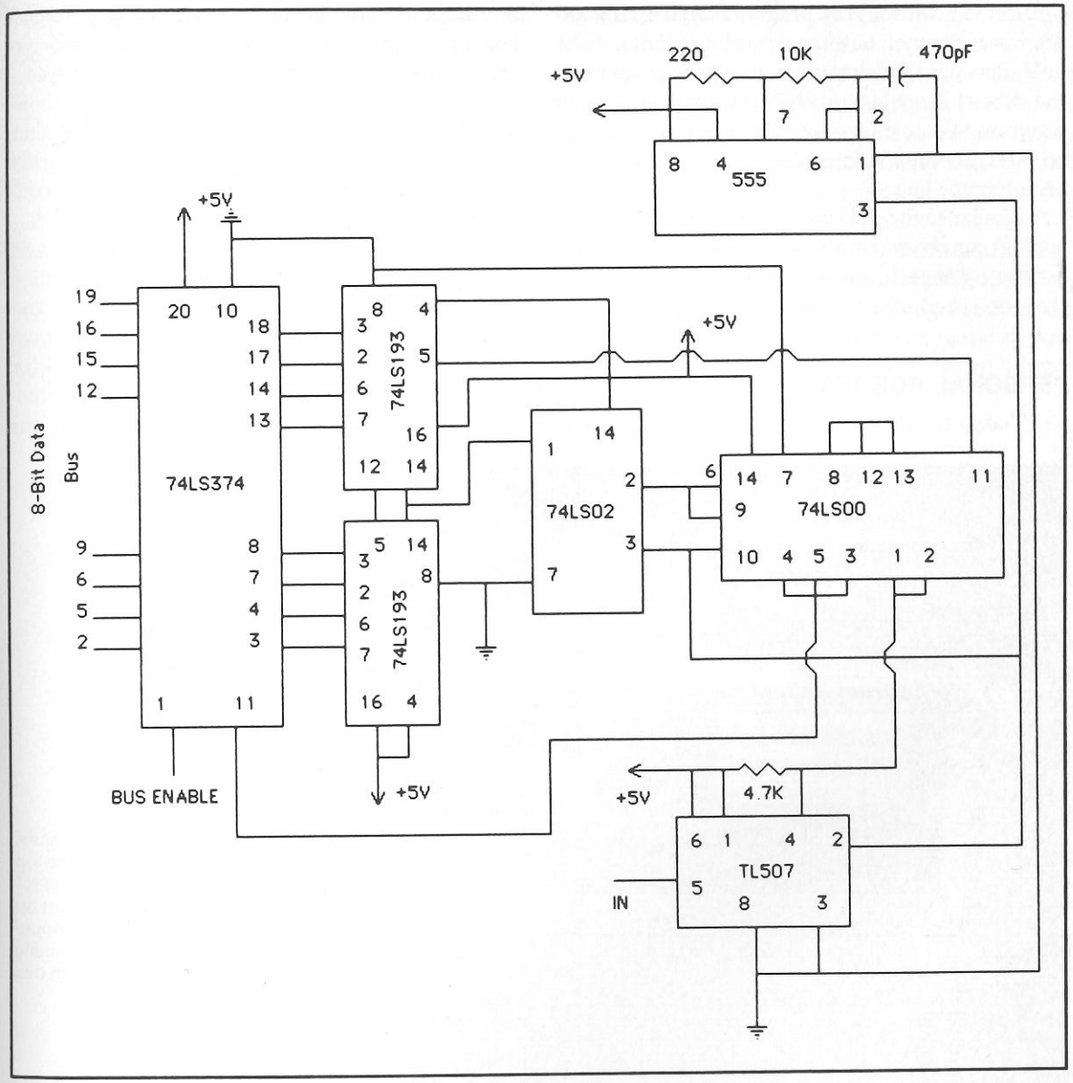


Fig. 8-2. A complete schematic for an A/D converter using a 74LS374 Decoder IC.

3. Output the byte.
4. Set the accumulator equal to the pointer.
5. Select the next channel and enable the sample-and-hold process.
6. Turn off the sample-and-hold strobe.
7. Turn off the selected sample-and-hold.
8. Decrement the value of the pointer.
9. If the pointer is greater than or equal to zero, then loop back to Step 2. Otherwise, return to the main program.

As you can see, the program sequentially addresses a channel, outputs the voltage that is to be held, disables that channel, repeats the process for the other channels, and then returns to the main program. You can arrange the program to act as an interrupt handler signaled by a clock strobe on an interrupt line.

Similar to the A/D converter, a D/A (digital-to-analog) converter can also be built or purchased for producing speech, music, sound effects, and control the speed of a motor.

PERSONAL ROBOTS

Today the development of personal robots is at a stage that duplicates the position of personal home computers in the early 1970s. Robotics is a young field with great potential, open for exploring. Personal robotics is discussed here as a control application for your IIGS, considering that many robots are available on the market that rely on external microprocessors for at least partial control over their actions.

State-of-the-art robots can locomote, talk, and perform crude manipulator functions. Capabilities such as setting the table, mowing the lawn, and making meals are impractical actions for a personal robot. A personal home robot is ideally suited for the tasks of home security, companionship, and mobile computing. While science fiction crowds our

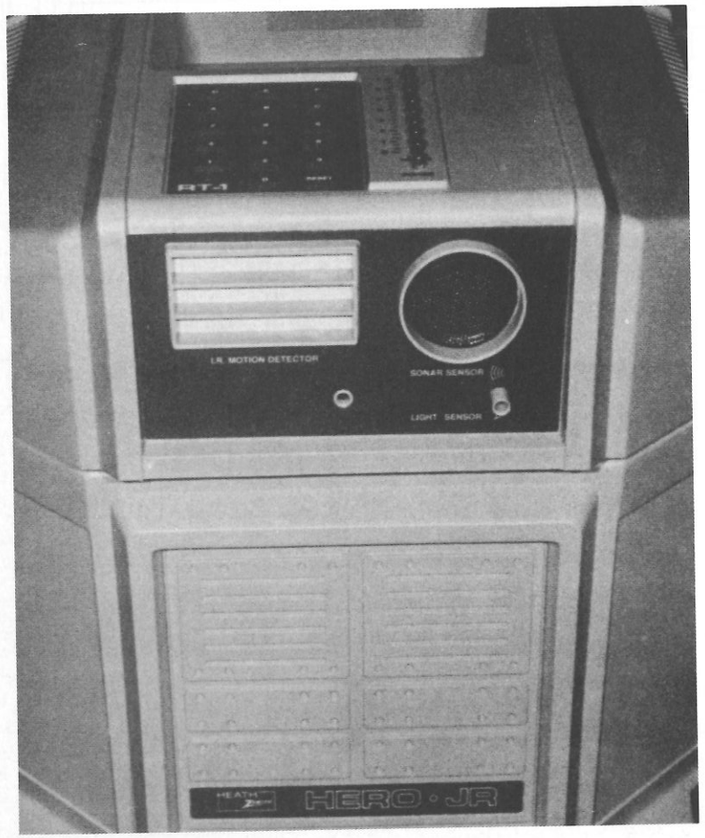
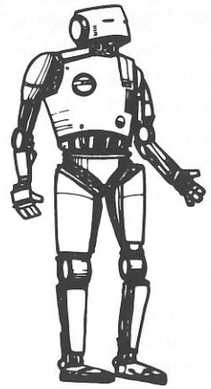


Fig. 8-3. A Heath HEROjr personal robot. A 17-key keypad, located on the top of HEROjr's head, is used for direct robot programming. An RS-232C port on HERO's back, however, provides Apple IIGS access to all levels of personality programming that are possible with this robot.

imagination with thoughts of robotic slaves, the reality is fixed firmly on the robot being placed in the home as a tool or appliance, and nothing more. Even the massive robots operating on Detroit assembly lines execute only a single, preprogrammed, designated task.

HEROjr, manufactured by Heath/Zenith Corporation (see Fig. 8-3), has demonstrated its stamina by being a long-term survivor of the brief boom in home robotics that occurred during the early 1980's. Advertised as a friend, companion, and security guard, HEROjr uses its built-in sensors to seek out human companionship or to recognize intruders. Plug-in cartridges add new personalities to this robot by teaching it how to perform such activities as singing or asking riddles. The HEROjr cartridge of most interest to the Apple IIGS owner, however, is the HEROjr BASIC cartridge. If you have installed a standard RS-232C serial port on your IIGS and you have a terminal program handy, then you can interface your Apple to your robot for simplified programming of the robot's capabilities. In this way, your IIGS becomes a sophisticated tool that eliminates the tedium of programming the HEROjr via a primitive (that is, compared to your IIGS's keyboard) hex keypad on the robot's head.

Chapter 9



Artificial Intelligence and Networking

In his book, *Future Shock*, Alvin Toffler describes a future home computer system named OLIVER. OLIVER's primary purpose is to help the owner deal with decision overload. In one scenario, OLIVER functions exactly like its contemporary IIGS cousin. In another scenario, however, OLIVER is able to perform speech recognition functions coupled to a rudimentary expert system ability. Actually, none of OLIVER's attributes are beyond the capabilities of your Apple IIGS. The only barrier to obtaining OLIVER's qualities with the IIGS is constructing the proper hardware and purchasing the necessary software.

FUTURISTIC APPLICATIONS THAT ARE FEASIBLE NOW

While *Future Shock* contains many startling predictions about the human condition in the future, most of its computer-related speculations are now possible. The following list describes applications that the IIGS is currently capable of handling with the proper hardware and software:

Medical Monitoring. A specially designed microcomputer constantly checks your body functions. Information such as nutritional and caloric intake, pulse rate, blood pressure, and weight loss or gain are entered into a program that monitors your metabolism. The program is then able to dictate visits to the doctor when certain programmed conditions are met.

Furthermore, telecommunications with larger medical databases gives this computer a vast source of expert medical opinion. Therefore, answers to virtually any medical questions or crisis can be handled quickly and at the on-site facility.

Information Research. Your IIGS can easily "hook-up" to hundreds of different computerized information systems. For example, news agencies, stock market brokerage firms, and international libraries are all within reach of your Apple. By using a modem, full-service companies like CompuServe provide vital links with many of these enormous databases. Additionally, your IIGS/mo-

dem combination can tap the Library of Congress's computerized card catalog system and receive information concerning thousands of references.

Personalized News Service. An Apple IIGS online with a news service is able to select news items by category and store them for review at a later time. The United Press International wire service provides all of the major national and international news. These news items are coded by category and they are, therefore, easier to locate by the telecomputing Apple user.

Travel Information. A travel service database, filled with information regarding flights, schedules, prices, availability, and reservations, is able to supply all of the information that is necessary for you to plan your next vacation via your IIGS.

Stock Market Quotes. A continual Dow-Jones listing service supplies stock market quotes to the Apple IIGS through a modem. This service is a strong ally in the pursuit of a profitable stock market venture.

Educational Programs. Many comprehensive educational programs that utilize video playback systems for the presentation of television images are being developed for the IIGS. These video images are then combined with educational programming to provide a unique learning experience.

Business Extensions. The advent of the IIGS has made travel to the office virtually unnecessary for certain individuals. All of the business work is handled through the computer and the modem.

Computer Networks. Just like the popular "analog" bulletin boards found in college dormitories and grocery stores, the computer variety is filled with hundreds of digital "pieces of paper." As with any telecommunications, your IIGS will require both a modem and telecommunications software prior to accessing these computerized bulletin boards.

Conversely, you can start your own computer bulletin board system (BBS). You will need your IIGS, special bulletin board software, and an auto-answer modem. As your BBS grows, you will need vast amounts of computer storage. A hard disk is the best method for achieving both the required storage room and the speed needed for accessing data.

Intelligent Devices. A IIGS interfaced with household devices is the basis for a complete home management system. Climate control, solar energy system control, videocassette recorder timing, and cooking control are all done simultaneously with the properly equipped IIGS.

Artificial Intelligence. Artificial intelligence (AI) is a greatly misused term that carries a variety of different meanings. The first rudimentary chess playing programs were created as substitute human players possessing enormous move options. These programs spawned the artificial intelligence movement, which ranges from elementary psychologist programs to diagnostic expert systems. While many of the more sophisticated AI programs are restricted to the larger, industrial computers, there are several small AI pieces of software that are available for the IIGS.

For further information concerning the growing AI field, please consult the following references:

Brulé, J., *Artificial Intelligence: Theory, Logic, and Application*, TAB Books, Inc., Blue Ridge Summit, PA 17214.

Holtz, F., *LISP—The Language of Artificial Intelligence*, TAB Books, Inc., Blue Ridge Summit, PA 17214.

Jenkins, R., *Supercomputers of Today and Tomorrow: The Parallel Processing Revolution*, TAB Books, Inc., Blue Ridge Summit, PA 17214.

Morone, J. and M. Hilbush, *Experiencing Artificial Intelligence: An Interactive Approach for the Apple,* TAB Books, Inc., Blue Ridge Summit, PA 17214.

Townsend, C. and D. Feucht., *Designing and Programming Personal Expert Systems*, TAB Books, Inc., Blue Ridge Summit, PA 17214.

Tracton, K., *Programmer's Guide to LISP*, TAB Books, Inc., Blue Ridge Summit, PA 17214.

NETWORKING

The world is your neighbor via your IIGS. Within the past few years there has been a tremendous growth in networking. *Networking* is the connecting of computers to other computers through the use of modems and the telephone system. Based on the present increase in modem traffic, networking is an Apple application that is increasing explosively.

What services are currently available from networks for the Apple? One of the more important applications is the creation of a home banking system. This system will enable you to conduct all of your banking duties through your Apple IIGS. The only roadblock preventing the widespread acceptance of this computerized, home banking system is the banking industry's reluctance to adopt this method.

Another, more readily available, networking activity is in the area of information processing. Data about everything from sport scores to encyclopedia articles can be quickly obtained through a modem. You are able to exchange information, unique IIGS programs, and even electronic mail with any of the thousands of Apple network users. Very little in the way of extra equipment is necessary for tapping a network's potential. The most important piece of hardware that you will need is a modem.

Modems

A *modem* (which stands for modulation/demodulation) is an electronic device that allows communications between computers using a serial transmission protocol. Modems translate the electronic voltage signals from the computer into audio tones that may be sent through an ordinary telephone system. Likewise, the modem is able to take modem-converted audio tone and translate them into the 1 and 0 voltage levels of the computer.

Modems designed for the Apple IIGS range in cost from $50 to $695. This enormous difference is due to the modems' features and construction. Therefore, when selecting your modem, find one that offers the features that you need, instead of buying a modem based solely on price.

A direct-connect modem interfaces directly with your household telephone system, usually through a modular jack. Alternatively, an acoustic-coupled modem physically holds your household telephone's handset in a special cradle. In terms of their reliability, the direct-connect modem is superior in receiving and transmitting signals virtually error-free.

The other consideration when purchasing your modem is the speed of data handling. Data handling speed is discussed in terms of bits per second (bps). This bps rate is also known as the *baud* rate. Baud rates for Apple modems are available in three speeds: 300 bps, 1200 bps, and 2400 bps. Choose a speed that matches both your software and your patience. For example, the transmission of a 5K byte file would take roughly 2.5 minutes at 300 bps, 1/2 minute at 1200 bps, and 1/4 minute at 2400 bps.

Terminal Programs

In order to make your modem function properly with your Apple, you will need to purchase a terminal or communications program. Many manufacturers pack the appropriate software with their modems. Terminal software enables you to send and receive messages and programs between your IIGS and the network. Additionally, this software has provisions for storing all of the data that you receive in a memory buffer for subsequent saving onto a floppy disk.

Available Networks

There are two major networks of broad interest—CompuServe and The Source. Both of

these services offer a variety of informational subject matter, which is outlined in Figs. 9-1 and 9-2.

Local Networks. A listing of several Apple-oriented bulletin board systems is provided below. Each BBS follows a standard communication protocol (usually, 300 or 1200 bps, 1 stop bit, 7 or 8 bit word length, and even or no parity, unless otherwise stated):

Agnet	(402)472-1892
Apple Cider	(718)482-0089
Apple Sauce	(718)268-2062
Big Apple	(212)662-0100
BIX	(800)227-BY-TE (or 2983)
Chelsea Square	(212)807-1257
Down the Rabbit Hole	(805)984-3547
Earth News Central	(718)934-0774
The Game Grid	(818)701-6380
Peripherals Plus	(214)530-0009
Reeses Pieces/Nibbles & Bits	(319)296-3125
SNJ Apple-Line	(609)795-3887
Women's BBS	(212)885-0969

DATABASES

Vast information is available to every Apple owner through computerized databases and a modem. Just about everything that is available in print is available on a database. There are in excess of 1300 public databases, which operate on a fee basis. Additionally, there are over 6000 private databases maintained by colleges, trade associations, and businesses.

Most databases provide abstracts of materials that have already been published in journals, magazines, and newspapers. A few provide only citations of the author's name, title, and publication. There are many databases, however, that do provide the full text of each article.

The greatest advantage to the use of databases is their comprehensive indexing and cross-referencing. These features enable you to conduct a rapid search of thousands of periodicals, journals, and textbooks. Conversely, you can often search through every word of an article in order to determine if the article is on the subject that you requested. These features provide information-gathering capabilities that transcend many of those that are possible through the more traditional approaches.

A Sampler of Information Networks

BRS/After Dark

BRS, 1200 Rt. 7, Latham, NY 12110; (800) 2-ASKBRS. BRS, which stands for bibliographic retrieval service, is an on-line database that offers abstracts of books and magazine articles in science, finance, education, energy, and general reference.

CompuServe

CompuServe, Consumer Information Service, 5000 Arlington Center Blvd., P.O. Box 20212, Columbus, OH 43220; (800) 848-8199 or (614) 457-0802 in Ohio. This service offers hundreds of databases for both the consumer and business markets, including news, entertainment, electronic mail, programming languages, and user groups.

Delphi

General Videotex Corp., 3 Blackstone St., Cambridge, MA 02139; (617) 491-3393. This consumer-oriented utility offers services and information similar to those offered by The Source and CompuServe.

Dialog Information Retrieval Service

Dialog Information Services, Inc., 3460 Hillview Ave., Palo Alto, CA 94304; (800) 227-1927. This service offers a large collection of databases about business, government, current affairs, and the environment.

Dow-Jones News/Retrieval

Dow-Jones and Company, P.O. Box 300, Princeton, NJ 08540; (800) 257-5114. This business-oriented service provides financial information, including

CompuServe
5000 Arlington Center Blvd.
P.O. Box 20212
Columbus, OH 43220
(800) 848-8199

AAMSI Medical Forum
AID calculations
AMEX prices (MQUOTE)
ASCMD SIG
ASI Monitor
AVSIG.
Academic American Ency
Access
Access phone numbers
Adult education
Adventure game
Advertisers, TODAY
Advertising:
For sale
Notices
TODAY Magazine
Want ads
Advertising, classified:
St. Louis Post-Dispatch
Advice:
Aunt Nettie
African weather
Agribusiness
Agricultural news
Air travel:
Firstworld travel:
Firstworld Travel Club
Official Airline Guide
Pan Am
Travel Fax
Air travel delays
Aircraft
Airline guide
Airport delay guide
Amateur Radio
Analogies test
Annual reports
Apple, programs for
Apple User's Group
Appliances for sale
Arcade (SIG)
Art Gallery
Articles, computer
Asian weather
Assoc. Press Access
Assoc. Viewdate Wire
Astrology Game
Astronautics
Atari Forum
Athletic equipment
Athletic's Outfitter
Atlas, shopping service
Attorneys
Author's (SIG)
Auto information:
Gov't publications
Investors Diversified
Popular Science
AutoNet
Autos, buying
AutoNet
St. Louis Post-Dispatch
Aviation:
ASI Monitor
EMI Flight Planning
NSW Aviation Weather
Official Airline Guide
Peak Delay Guide
Aviation Rules & Reg
Aviation Safety Inst
Aviation (SIG)
Aviation weather
Bacchus Data Services
Banking, electronic
Banks:
Central Trade Bank
First Tennessee Bank
Huntington National Bank
Shawmut Bank of Boston
Benshi game
Baseball (AP wire)
Basic CompuServe
Beef prices
Belmont Golf Association
Belmont's golf (SIG)
Billing, reviewing
Biorhythms
Blackjack game
Biles language
Book, ordering:
Fifth Avenue Shopper
Howard Sams Books
Book, reviews
AAMSI, medical journals
Rainbo's Review
Boston, Shawmut Bank
Bridge game
Brokerage
Budgeting, home:
CompuServe
Gov't publication
Bulletin Board
Business, farming
Business Information Wire
Business news:
AP Viewdata Wire
Business Wire
Canadian, U.S. Int'l
CompuServe
Middlesex Daily
St. Louis Post-Dispatch
Washington Post
CB Interest Group
CB Radio simulation:
Access to
Instructions
Introduction
CB Society
CEMSIG
CP/M user's group
Cameras for sale
Canadian:
Business news
Currency exchange
Stocks
Canning, home
Car care
Care, comparison
Cattle prices
Central Trade Bank
Changing password
Changing terminal type
Charges, monthly
Checking, banking
Child care
Children, education
Children's games
Cinema news
Clarke School for Deaf
Classified Ads:
St. Louis Post-Dispatch
Clothing, fashion
Clothing, sport
Cocoa news
Coffee news
College cost program
Color computer (SIG)
Color graphics
Columbus area:
Banks
Chamber of Commerce
Education
SIG
Command level
Commentaries:
Investment
Video
Commodities calendar
Commodities future
Commodities glossary
Commodity News Service:
Agricultural news
Commodity prices
Economic news
Futures industry news
Futures market prices
General news
Metals news
Weather
Commodore newsletter
Commodore VIC (SIG)
Comm. Industry Forum
CompuServe command
Comp-U-Store
Computer, books
Computer club news:
Computers & Electronics
The Micro Advisor
Computer Magazine Index
Computers & Electronics
Concentration game
Consumer items for sale
Consumer news:
Software
Continuing education
Cooking (SIG)
Corporate news release
Copper futures prices
Copper news
Cotton futures prices
Cotton news
Court cases, aircraft
Cross Assemblers
Cruise line
Current rates
Database, how to use
Database searches
dataFamiliae
Decwars game
Decwars (SIG)
DEFALTS, setting
Department of State
Disk area
Document delivery
Document retrieval
Documentation ordering
Dress
Drugs
Drugs, medicine
EMI Flight Plans
Earnings forecasts
Economic news
Editorials:
Washington Post
Education:
Academic Encyclopedia
Clarke School for Deaf
The College Board
The Multiple Choice
Education, family
Educational games:
Super Brain Challenge
Witty Write-Ins
Educator's (SIG)
Electronic banking
Electronic Bounce Back.
Electronic Heath Catalog
Electronic mail

Fig. 9-1. The subject matter offered by CompuServe. Continued to page 146.

Time used
TODAY, advertisers
Trading, commodities
Travel:
Department of State
Firstworld Travel Club
Norwegian Am. Cruises
Official Airline Guide
Pan Am
Travel Fax
TravelVision
Worldwide Exchanges
Travel, abroad:
Department of State
Firstworld Travel Club
Norwegian Am. Cruises
Official Airline Guide
Pan Am
Travel Fax
Travel, advisories
Travel, airline guide
Travel Fax
Travel (SIG)
Traveler, airport guide
TravelVision
Treasury bills, yields
Trivia:
Kids
Movie
Radio
Unlimited test
UCSD Pascal Group
USDA Grades
USDA standards:
Meat
Poultry
U.S. Department of State
U.S. News:
Middlesex Daily
St. Louis Post-Dispatch
Washington Post
Used cars, buying
User directory
User information
User's programs
VIC 20 (SIG);
Vacationing
Value Line Database
Vegetables
Veterinarians Forum
Victory Garden
Video Information
Videotex, views on
VIDTEX executive
Viewpoint, CompuServe
Want ads (Bullet)
War games:
Decwars
Megawars
Space War
Washington, D.C. area:
Middlesex Daily
St. Louis Post-Dispatch
Washington Post
Washington Post
Water, ground
WaterLine
Weather:
AP Viewdata Wire
African weather
Asian weather
Aviation weather
European weather
Extended forecasts
N. American weather
S. American weather
Sports forecasts
State forecasts
What's New
Wheat prices
Wine guide
Wire service news:
(see Associated Press Access)
Word processors
Work-at-Home (SIG)
World news:
AP Viewdata Wire
Associated Press
Washington Post
Worldwide Exchanges
Yachts
Associated Press News Access
Financial wire:
Middlesex Daily News
St. Louis Post-Dispatch
Washington Post
Sports:
Middlesex Daily News
St. Louis Post-Dispatch
Washington Post
U.S. News:
Middlesex Daily News
St. Louis Post-Dispatch
Washington Post
Washington News:
Middlesex Daily News
St. Louis Post-Dispatch
Washington Post
World News:
Middlesex Daily News
St. Louis Post-Dispatch
Washington Post

current and historical quotations from major stock exchanges, commodities, media general reports, and financial disclosures on thousands of American corporations.

ITT Dialcom

ITT Dialcom, Inc., 1109 Spring St., Silver Spring, MD 20910; (301) 588-1572. This service offers a variety of databases with information about medicine, government, energy, and travel.

The Knowledge Index

Dialog Information Services, Inc., 3460 Hillview Ave., Palo Alto, CA 94304; (800) 528-6050. This service offers a subset of Dialog's more consumer-oriented databases, including business, engineering, psychology, education, magazines, and computer information.

NewsNet

NewsNet, 945 Haverford Rd., Bryn Mawr, PA 19010; (800) 345-1301. This service offers the full text of over 100 newsletters on a variety of subjects and electronic mail connections with the newsletter's publishers.

Nite-Line

National Computer Network, 1929 Harlem Ave., Chicago, IL 60635; (312) 622-6666. This service offers financial and business databases.

Orbit Informational Retrieval System

SDC Information Services, 2500 Colorado Ave., Santa Monica, CA 90406; (800) 412-7229. This service offers reference databases covering business, chemistry, engineering, and electronics.

The Source

Source Telecomputing Corp., 1616 Anderson Road, McLean, VA 22102; (800) 336-3366. This service is a large general-interest utility offering consumer information, electronic mail, conferencing, and programming languages.

The Source
1616 Anderson Road
McLean, VA 22102
(800) 336-3366

ADVANCED APPLICATIONS & PROGRAMS
ADVICE COLUMN
AIRSCHEDULES
  Domestic
  International
  Inter-City
ASTROLOGY LIBRARY
AWARE FINANCIAL SERVICE GLOSSARY
BARTER-TRADE NETWORK
BUSINESS & FINANCE
  Analysis Programming
  Annuities Analysis
  Aware Financial Service
  Spreadsheet
  PURCHASE VS. PRODUCTION COMPARISON
  BUSINESS PROGRAMS
  Complete Listing
  Amortization of Loans
  Amortization of Loan UNK Term
  Annuity Debt Payment
  Balancing Checkbook
  Capital, Cost of Equity
  Cashflow, Present Value
  Commission, Sales Report
  Depreciation Schedule
  Equipment, Lease vs. Purchase
  Equity Capital, Cost of
  Inter-Industry Flow of Goods & Services
  Interest, Bonds
  Interest, Loans
  Sales Commission Report
CALCULATOR
CAREER NETWORK
CLASSIFIED ADS
COMMODORE BUSINESS MACHINES
COMMUNICATIONS
  CHAT
  Chat (live conversation with other subscribers)
  TELECONFERENCING
  SOURCEMAIL
  To Check Mailbox
  To Read Letters
  To Scan Correspondence
  To Send a Letter
  General Information
  Commands in Mail
  Cross-Referenced Names
  Operation of SourceMail
  Timed-Mail Delivery
  To Send a MAILGRAM
  MISCELLANEOUS COMMUNICATION SERVICES
  Contents of THE SOURCE
  Personal Appointment Schedule
  THE SOURCE Announcements
  THE SOURCE Toll Charges
  Suggestions for THE SOURCE
  Subscribers Currently On-Line
  TYMNET/TELENET Access Numbers
  Subscriber Directory Services
  The Common-Interest Directory
  To Add Your Name and Number
CONSUMER INFORMATION
DINING OUT; WASHINGTON, D.C.
  NEW YORK CITY
  CONTINENTAL U.S. & CANADA
DISCOUNT SHOPPING SERVICE (COMP-U-STORE)
  Instructions
  Overview
  Bargains (the monthly listing)
  Auction
  Product and Manufacturer List
  Begin Shopping

Covering the following product categories:

Appliances	Fine China	Sterling
Cameras	Furniture	Televisions
Cars	Pianos and	Video
Crystal	Organs	Recorders
Figurines	Specialty Items	Watches
	Stereo & Audio	

EDUCATION
ENERGY SAVING NEWS & TIPS
FINANCIAL MARKETS
  UNISTOX REPORT INDEXES
  Alphabetically
  By Time
  Dividends, Earnings
  Earnings Reports
  Exchange Rate
  Federal Land Bank Bonds
  Futures, Treasury Bills
  Futures & Options
  Glossary of Stock Investment Terms
  Indexes, Stock Market Daily Avgs
  Moody's Index
  Standard & Poor's Index
  AMERICAN STOCK EXCHANGE
  Bonds
  Closings (All Stock Exchanges)
  Ten Most Active
  Weekly Composite Prices
  Weekend Bond Prices
  BONDS
  AMEX Daily Listing
  Bond Yield Computations
  Bond Price, Accrued Interest Computations
  Federal Land Bank, Daily
  NYSE Daily Listing
  Treasury OTC, Daily
  World Bank, OTC, Daily
  Treasury OTC, Weekend
  Weekend Listings
  Commodities
  METALS
  Metals News
  Gold News
  Gold Spot Prices
  NY/Chicago Mkt Prices
  NY/London Mkt Prices
  Platinum
  Silver Coins
  Silver Prices
  Silver News
  MONEY MARKET NEWS AND COMMENTS
  Afternoon Lead
  Futures
  Markets at a Glance
  Night Lead
  Noon Lead
  NYSE Trends
  Opening Lead
  Stock Pulse
  What the Market Did
FINANCIAL MODELING
  FOR BUSINESS PLANNING
FINANCIAL NEWS
GAMES
  Adventure
  Backgammon
  Blackdragon
  Cards
  Blackjack
  Super Blackjack
  Bridge
  Poker
  Tricks
  Checkers
  Chess
  Children's Programs
  Civil War
  Craps
  Draw
  Farmer
  Fill in Letters
  Football
  Golf
  Govern Sumeria
  Guess Computer's Number
  Hangman
  Horse Race
  I-Ching
  IQ Test
  Life
  Lunar Landing
  Market A Product
  Mastermind

Fig. 9-2. The subject matter offered by the Source. Continued on page 148.

- Maze Generation
- Mind Reading
- NIM
- Patrol Streets (game)
- Poster
- Puzzles
- Rule Sumeria
- Score Four
- Sinners
- Slalom
- Slot Machine
- Sonnets
- Statistics
- Star-Trek
- Super Adventure
- Target Practice
- Tic Tac Toe
- Toro
- Tricks
- Vegas
- Wumpus Hunt

INFORMATION ON DEMAND
INFORMATION ON UPDATES TO THE SOURCE
MANAGEMENT CONTENTS
- Overview
- Instructions
- The List of Journals
  - On the following Journals:
    - Across the Board
    - Administrative Management
    - American Demographics
    - INC
    - Institutional Investor
    - Journal of Retailing
    - The Banker
    - Business and Society Review
    - Business Week
    - Cash Flow Magazine
    - Dun's Review
    - Federal Reserve Bulletin
    - Financial Executive
    - Forbes
    - Fortune
    - Futurist
    - Harvard Business Review
    - Medical Economics
    - Mergers & Acquisitions
    - Monthly Labor Review
    - Office, The
    - Practical Accountant
    - Sloan Management Review
    - Taxes
    - Venture
    - Vital Speeches
    - Wharton Magazine

MEDIA GENERAL STOCK ANALYSES
- Overview
- Instructions
- Categories of Stock Comparison
- Definitions of Data Items
- Industry Groups Numbers List
- Creating Portfolio Files

Stock Analysis and Tables
MEDICAL ADVICE
MENU TO MANY DATA BASES ON THE SOURCE
MOVIE REVIEWS BY JAY A. BROWN
NEWS
PERSONAL CALENDAR & NOTEBOOK
PERSONAL FINANCE
POLITICAL ACTION REPORT
PORTFOLIO MANAGEMENT
PROFESSIONAL BOOK CENTER
PUBLISHERS WEEKLY
- BESTSELLERS LIST

RADIO PROGRAMS TO ORDER
RAYLUX FINANCIAL SERVICES
SCIENCE & ENGINEERING
SELF-PERCEPTION
SMITHSONIAN EXHIBITS
- AND TOURING EXHIBITS

SPECIAL APPLICATIONS
STUDENT AID
TAXES
- Assets
- Calculation of Income Statement
- Computing Taxes
- Contributions
- Credits
- Debts
- Deductions
- Dependents
- Depreciation Schedule
- Donations
- Expenses
- Income Statement, Pro Forms
- Income Tax
- Taxes

TRAVEL CLUB
UNISTOX
UNITED PRESS
- INTERNATIONAL (UPI)

USER PUBLISHING
VOICEGRAM
WEATHER
WINE
WISDOM OF THE AGES

The Definitive Source

Link-Up, 143 Old Marlton Pike, Medford, NJ 08055. This is the definitive telecommunications publication currently available. A one year subscription to this online service consists of 11 issues covering new bulletin board services, hardware, software, books, and databases.

Chapter 10

Askey Louis
Auman Glen
Avey Mana
Baer Egar
Bard Ellis
Barlup Helen
Basorea Edwina
Cosey Sid
Covalt Mark
Freena Merla
Gsel Tim
Hamilton Angela
Kerman Ed
Loche Ron
Lundio P. Ron

Useful Utility Programs

Although your IIGS may not offer some of the useful features found on larger, more expensive systems, programs can be written to simulate many of these absent features. Such a piece of software is often referred to as a utility program. The category of utility programs also includes commonly used routines or subprograms that can be incorporated into a larger program. Through the use of utility programs, your Apple IIGS can emulate its immense cousins.

MULTIPURPOSE PROGRAMS

Many of the following suggestions are already available as commercial products for your IIGS. Therefore, you have two options: write your own program or buy the ready-made product.

- Diagnostic programs: programs that test all of the statements and commands found in BASIC are useful in determining whether or not BASIC has loaded properly for execution. Programs to test memory by filling and reading all locations are also helpful.
- Base conversion programs: this kind of program is useful in assembly language programming.
- Multiple-precision routines: scientific users of small computers (and some business users) need multiple-precision capability.
- Memory-map programs: a machine-language program to output a memory map would be valuable.
- Menu selection programs: a machine-language routine to automatically find and execute any programs that are on-line would make life easier for some operators.
- Routines for handling fractions instead of decimals for greater precision in certain applications could be created.
- Vector graphic assembly language routines could be useful.

Additionally, the useful reference manual that

accompanied your IIGS will provide you with other utility program ideas.

UTILITY SUBROUTINES

Below are some practical routines that deal with screen manipulation and matrices:

Listing 10-1: Formatted Output Program

```
10 REM  FORMATTED OUTPUT
20 INPUT "ENTER YOUR TEXT.  TO END,
   ENTER THE WORD END.   ";X$
25 IF X$ = "END" THEN END
30 X = LEN (X$)
40 T = (40 - X) / 2
50 PRINT  TAB(T)X$
60 GET Z$
70 GOTO 20
```

Listing 10-2: Matrix Arrays Program

```
10 REM  MATRIX ARRAYS
15 HOME : PRINT : PRINT "YOU TYPE
   THE ENTRIES OF A 4 BY 5 MATRIX,
   AND THE COMPUTER WILL FIND THEM
   BY   THEIR COORDINATES."
16 PRINT : PRINT "ENTER 9999 TO
   END "
20 DIM M(4,5)
30 FOR X = 1 TO 4
40 FOR Y = 1 TO 5
50 INPUT N
55 IF N = 9999 THEN END
60 M(X,Y) = N
70 NEXT Y
80 NEXT X
90 INPUT "ROW ";X
95 IF X = 9999 THEN END
100 INPUT "COLUMN ";Y
110 IF Y = 9999 THEN END
115 PRINT M(X,Y)
120 GOTO 90
```

Listing 10-3: Shape Table Program

```
10  REM  SHAPE TABLE
20  FOR X = 7676 TO 7689
30  READ Y
40  POKE X,Y
50  NEXT X
60  POKE 232,252: POKE 233,29:
    HGR2
65  HCOLOR= 3
70  FOR R = 0 TO 32
80  FOR S = 1 TO 255
90  ROT= R
100  SCALE= S
110  DRAW 1 AT 140,96
120  FOR Z = 1 TO 10: NEXT Z
130  XDRAW 1 AT 140,96
140  NEXT S: NEXT R
150  GOTO 60
160  DATA  1,0,4,0,54,63,36,37,8,
     46,40,54,63,0
```

File Handling Routines

The listings below are sequential file handling routines.

Listing 10-4: Create Sequential File Program

```
10  REM  CREATE SEQUENTIAL FILE
15  REM  REMEMBER YOU CAN'T REUSE
    THE FILENAME 'DATAFILE
20  PRINT  CHR$ (4);"OPEN DATAFILE"
30  PRINT  CHR$ (4);"WRITE DATAFILE"
40  INPUT D$
50  PRINT D$
60  IF D$ = "END" THEN  PRINT  CHR$
    (4);"CLOSE DATAFILE": END
70  GOTO 40
```

Listing 10-5: Read Sequential File Program

```
10  REM  READ SEQUENTIAL FILE
20  PRINT  CHR$ (4);"OPEN DATAFILE"
30  PRINT  CHR$ (4);"READ DATAFILE"
40  INPUT D$
50  PRINT D$
60  IF D$ = "END" THEN  PRINT  CHR$
    (4);"CLOSE DATAFILE": END
70  GOTO 40
```


Chapter 11

```
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                        MERRYCHRISTMASMER
                      MERRYCHRISTMASMERRYCH
                        MERRYCHRISTMA
                      MERRYCHRISTMASMER
                    MERRYCHRISTMASMERRYCH
                  MERRYCHRISTMASMERRYCHRIST
                MERRYCHRISTMASMERRYCHRISTMASM
              MERRYCHRISTMASMERRYCHRISTMASMERRY
                MERRYCHRISTMASMER
                MERRYCHRISTMASMERRCH
                MERRYCHRISTMASMERRYCHRIST
                MERRYCHRSITMASMERRYCHRISTMASM
              MERRYCHRISTMASMERRYCHRISTMASMERRY
            MERRYCHRISTMASMERRYCHRISTMASMERRYCHRIS
          MERRYCHRISTMASMERRYCHRISTMASMERRYCHRISTMA
        MERRYCHRISTMASMERRYCHRISTMASMERRYCHRISTMASMER
                              MERRY
                              MERRY
                              MERRY
                              MERRY
```

Miscellaneous Applications

There are a number of different applications that don't fit into any of the previously discussed chapters. These applications have been grouped under the potpourri heading of this final chapter.

COMPUTERS AND THE HUMANITIES

Professional scholars of history, language, literature, anthropology, and archeology will find the IIGS useful in storing, organizing, analyzing, and indexing data.

History

The historian can encode information of the following types on an Apple IIGS:

1. Census records
2. Congressional voting records
3. Election statistics
4. Court records and decisions
5. Ship sailing records—these records have historical, geneological, and economic significance
6. Diplomatic records
7. Journalism statistics

Language

The IIGS can be used to deal with languages in at least two different ways.

Translations. It is possible to program an Apple IIGS to act as a crude translating machine, capable of recognizing foreign vocabulary words and providing the English equivalent. Sentence structure and overall meaning are much more difficult to program, however. Pocket translating machines and spelling checker programs serve as models for such a program. The ultimate goal is to provide the interpretable English equivalent for a given foreign phrase. An even more sophisticated program would check for idiomatic expressions and provide a correct translation, as opposed to a literal translation. The translating program in Listing 11-1 may prove to be educational to those with a minimal familiarity with the language involved.

Listing 11-1: English-German Translator Program

```
10 REM  ENGLISH-GERMAN TRANSLATOR
20 TEXT
30 HOME
40 DIM G$(10)
50 PRINT : PRINT  TAB(6)"AN ENGLISH-GERMAN TRANSLATOR"
60 FOR X = 1 TO 10
70 READ G$(X)
80 NEXT X
90 PRINT : INPUT "ENTER AN ENGLISH WORD.  TO END THE       PROGRAM,
   TYPE END.   ";E$
100 FOR X = 1 TO 10 STEP 2
105 IF E$ = "END" THEN END
110 IF E$ < > G$(X) THEN NEXT X: GOTO 90
120 PRINT : PRINT "THE GERMAN EQUIVALENT IS ";G$(X + 1)
130 GOTO 90
140 DATA  HELLO, GUTEN TAG, GOOD-BYE, AUF WIEDERSEHEN, MONDAY, MONTAG,
    BIRD, VOGEL, COMPUTE, ERRECHNEN
```

Compilation of Dictionaries. The dialects and languages of a speech community can be entered into a computer database for ease in compiling a dictionary.

Literature and Writing

There are a number of ways in which you can use your IIGS to help you in writing and analyzing literature.

Grammar Checker. Apple IIGS programs are available for scanning your word-processed files in search of grammatical inconsistencies. These errors cover punctuation, split infinitives, and synonym misuse. Caution should be exercised in following the suggestions from this program.

Thesaurus. An online thesaurus can provide rapid, timesaving access to alternative word choices. The limited dictionaries of a computer thesaurus, however, can handicap its thorough integration with a word processor.

Automatic Table of Contents/Index Generator. In preparing text on a word processor, the author must flag each keyword with a special code for subsequent indexing and table of contents construction. After this chore has been performed, this program will search for each occurrence of the keyword and log its page number, its alphabetical place in an index, and its place in the table of contents.

Writer's Outline Utility. This specialized word processor has a database ability. The writer begins by entering all of the relevant ideas pertaining to the writing assignment into the outline program. Specific categories are formed as the outline's structure starts to take shape. Finally, the writer finishes the assignment by elaborating on the categories developed by the outline program.

Spelling Checker. Numerous spelling checker programs are available for the IIGS. These are capable of inspecting documents for errors with a special dictionary consisting of 30,000 to 200,000 words. The user has the option of adding or deleting words. Additionally, specialty dictionaries for word-intensive professions (e.g., medicine, law, and the sciences) can be created.

Analysis of Literature. Computers can be used to prepare statistical analyses of literature that you have typed using your word processor. Such a program would calculate the number of lines, number of sentences, number of words, number of syllables, average word length, average sentence length, and the reading level based upon any of the standard formulas developed by Flesch, Fry, Raygor, Dale Chall, or Spache. For instance, the Fog index (FI) is given by

$$FI = \left[\frac{\text{total no. words}}{\text{total no. sentences}} + \frac{\text{no. ``hard'' words} \times 100}{\text{total no. words}} \right] \times 4$$

where "hard" words are considered to be those words with three or more syllables, except proper names, compounds of short words (for example, down-and-out), and words in which the third syllable ends in es or ed (for example, arrested). Those who use the Fog index suggest that an FI value of 20 or more indicates an advanced or difficult reading level, and that an FI of 10 or less is best for dealing with the masses.

The use of computers for the analysis of literature in this manner is controversial. Teachers sometimes find that these statistics provide useful guidelines when they are creating material they plan to use in reading classes and when they are writing on a specialized subject-matter that must be understood by students whose reading skills are not highly developed. Misuse of these statistics can occur, however, when publishers demand that authors use them to "clean up their text" as a condition of publication.

An Apple IIGS can also be used to construct a concordance table, listing all words used in a piece of text and their absolute or relative frequency of use; the list can be sorted alphabetically or by frequency. See *Microcomputing*, page 60, June 1981 for a sample BASIC program. Word-class distribution statistics, measures of redundancy of vocabulary (averages, medians, and so on), numbers of modifiers, adverb/verb and auxiliary verb/verb ratios, clause length statistics, distribution of clause types (simple, compound subject, and so on), distribution of sentence openers (prepositional phrase, subordinated clause, and so on), and style of sentence structure could also be analyzed by a more complex program. This information can be used to statistically determine whether works of indefinite authorship are typical of a given writer (for example, works by Bacon and Shakespeare are compared) since these parameters tend to remain constant for a given author.

Literature Database. A specialized database could store important manuscripts and be used to index, cross-reference, and search for keywords quickly and efficiently.

AID TO THE HANDICAPPED

The use of Apples as aids to the handicapped is an appropriate application; only the leading edge has been explored, but the potential is tremendous. Examples of these applications include the following areas.

The IIGS can act as an intelligent typewriter for the handicapped. One system was used by a paraplegic to communicate with others; the computer scanned the alphabet, and, once the particular letter was reached, the patient made a movement to acknowledge the correct letter, and a printout was made. In this manner, words and sentences were produced.

Along similar lines, voice synthesizers and decoders are especially helpful for those who cannot interact with a computer through a video terminal.

A computer with a dot matrix printer can be used to convert input text into braille text. Each line of text would be reversed in the computer's memory and the braille equivalent would be printed in its mirror image. By turning the output over, the impressions left by the printer will form the braille text.

Other areas in which the Apple IIGS can help the handicapped include the following:

- Sensory enhancement or translation: clarification of audio or visual information, or translation of video information to and from audio information.
- Manipulator controls: powered prostheses or

robots for individuals with severe motor impairment.

- Information amplification for the motion impaired: increase the amount of information that can be relayed with a given number of keystrokes, for example, a shorthand translator, as described in the first chapter.
- Recreation and development aids: games and educational programs allowing handicapped persons a reliable means to control, explore, and manipulate objects or learn about them.
- Communication aids: telephone dialers, computer-aided writing and filing systems, and phone communication through the use of speech synthesizers, for example.
- Security/monitoring systems: mechanisms for controlling locks and windows, emergency call systems, medication reminders, and monitoring systems that will periodically demand a response and signal if the individual fails to answer its queries.
- Information resource/management: inability to quickly manipulate and scan materials may prevent the handicapped from making effective use of dictionaries, phone lists, calendars, filing systems, and books. These functions can be paralleled through the use of specifically designed microcomputer-based interfaces that work with residual physical and sensory capabilities.

TEST YOUR TYPING SPEED

Those learning to type will appreciate a measurement of their lightning-fast digits.

MAINTENANCE OF ORGANIZATION RECORDS

Clubs and other organizations may find it worthwhile to purchase a IIGS to ease the paperwork crunch. Anyone who develops software for this application may be able to sell it to other organizations or charge for his or her computing services.

CO-OP SCHEDULING AND FINANCES

An Apple IIGS analysis of costs and duties can help divide these responsibilities more fairly between members of communal residences or cooperative organizations. A duty roster in calendar form, as well as a financial summary of the amounts owed, could then be printed out.

TAILOR'S CALCULATIONS

Alterations to dress and suit patterns can be mathematically determined by your IIGS. If you have a dot matrix printer, the altered pattern could be printed.

PHONE CODE

A relatively simple program could be written to produce a listing of all of the possible letter combinations on the phone dial for a given phone number. Businesses may then use this listing to produce an appropriate, easy-to-remember word that represents their phone number. In fact, an interesting word may appear for you to use with your own telephone number.

BRAINSTORMER

A few years ago, a large sphere, containing thousands of plastic squares with a different word printed on each, was sold as a "brainstormer." The idea behind this device was to rotate the sphere, mix up the words, and then peek through a window at whatever words appeared. From this combination of adjectives and nouns, the user was supposed to come up with a new invention or idea. The "brainstormer" was said to be useful in stimulating ideas. For instance, if the words "television" and "game" appeared, a properly prepared mind could have made the intuitive leap to invent video games. Tracing this line from history, you could create your own computerized "brainstormer" by programming a large array of randomly-accessed nouns and adjectives to appear on the Apple's monitor.

A similar program could be called an "idea stimulator." Instead of miscellaneous words randomly appearing, a special set of adjectives or phrases, describing possible improvements to an invention, would be displayed on the screen. The following list of brainstorming questions could be arranged by your IIGS and individually called to the screen.

Brainstormer programs needn't be limited to products and inventions. One cartoonist reports the use of a computer program that randomly mixes cliches, locations, props, and various character types for possible cartoon ideas.

Brainstorm Chart for Products, Processes, and Services

In what other way can it be made more effective?
Is there a surer way to do it?
Is there a cleaner way to do it?
Is there a safer way to do it?
Is there a more durable form?
Is there an easier way to do it?
In what other way can it be improved?
Can the distribution be improved?
Can it be made portable?
Can something be added to enhance its value?
Can it be adapted to some other use?
Can it be made more attractive?
Is there a cheaper way to do it?

Inventor's Idea Stimulator

An inventor's idea stimulator program, which would be very useful to those who have a creative mind, could be written. A large listing of "idea words" would be shuffled and displayed three at a time. The object is to apply your thinking to these words in relation to another idea.

SOURCE INDEX

Addresses of manufacturers, institutions, organizations, and other sources of information or products can be stored in computer form and indexed for future reference. Any source of information or materials that you don't have use for at present, but might need in the future, should be stored with this system. These sources can later be indexed under the material they can provide.

PEOPLE MATCHING

Computers have prepared seating charts for dinners, arranged blind dates, matched carpools, and paired athletes according to individual characteristics. Digital cupid playing, however, is best taken tongue-in-cheek and relegated to an entertainment status.

GREETING CARD PRODUCER

Some clever hobbyists have written programs to produce assorted types of greeting cards, announcements, and invitations on their dot-matrix printers (see Fig. 11-1). These cards can be personalized and incorporate computer art into their final composition. Another hobbyist uses her Apple IIGS to produce Christmas gift wrapping paper by printing Christmas designs on colored tractor paper.

CONTESTS

For those who actively pursue sweepstakes, a IIGS can be used to fill out multiple contest entry forms with your name and address. This technique would only be applicable where an unlimited number of similar entries were legal.

HANDWRITING ANALYSIS

A few major corporations are now using handwriting analysis as one instrument for evaluating prospective employees. The humorous shopping mall handwriting analysis "computers" do little more than print out a random evaluation from a database of stock personality traits. You could write a program that would print out the standard interpretations for handwriting characteristics. Unfortunately, the characteristics would themselves have to be encoded for your Apple to handle prop-

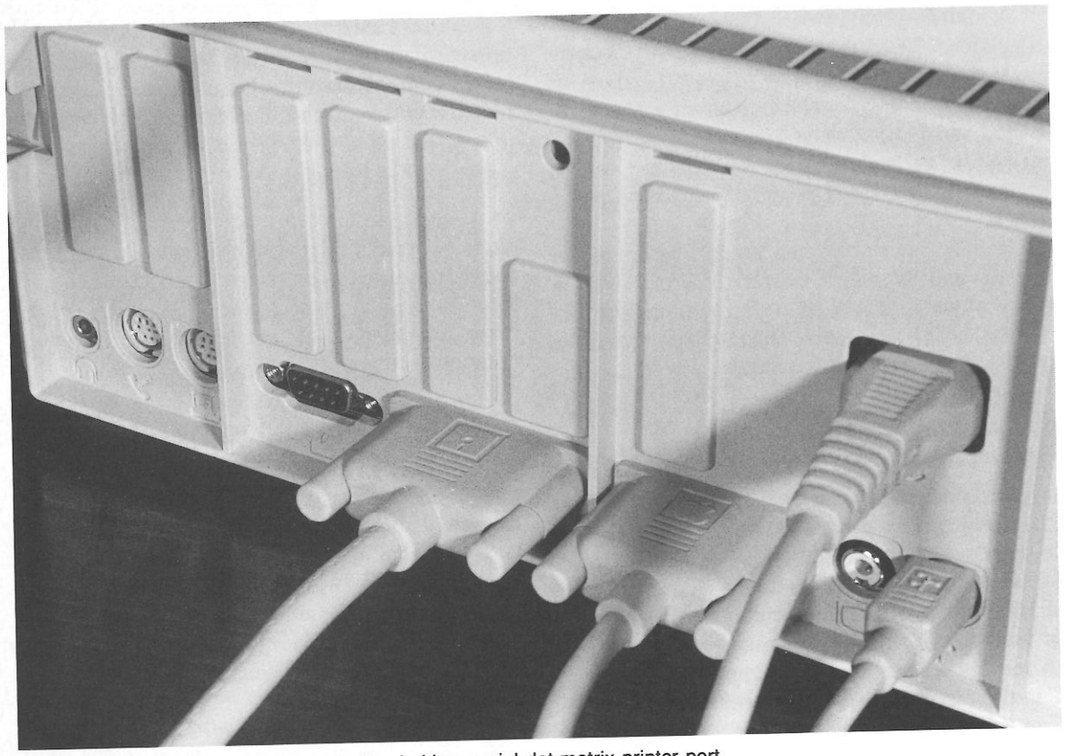


Fig. 11-1. The rear panel of the Apple IIGS holds a serial dot matrix printer port.

erly. Unless you have the time for a lengthy study of handwriting, this matter will have to be left to the handwriting experts.

FIFTY MISCELLANEOUS APPLICATIONS

In order to further exemplify the scope of applications that are available to Apple users in all walks of life, the following reader-contributed list contains fifty of the more unusual computer-related activities:

- Design and animation of marching band patterns.
- Maintenance and inventory of equipment and instruments in small laboratories.
- Membership tracking for small organizations with the addition of dues accounting, questionnaire analysis, and mailing list capabilities.
- TV pattern generator for electronic technicians.
- Artistic pacifier for toddlers based on random graphical patterns, as a form of the stimulation necessary for the development of a normal IQ.
- Banner and sign generator to prominently display your message, created on ordinary lineprinters.
- Posters and calendars from lineprinter output.
- Translations of foreign words done by portable computers for travelers (or for educational purposes).
- Analysis of the cost-saving benefits of various solar collector designs.
- Calculation of home improvement costs by determining gallons of paint, rolls of wallpaper, or square yards of carpeting for a given job.

- Car maintenance reminder for routine tuneups and parts replacement according to miles driven.
- Car pool record keeping program which records car usage by driver, destination, and date with the ability to print schedules for each member.
- Bendo Kagawa, a Zen priest in Japan, uses his personal computer to help people meditate.
- Bob Waltz's personal computer at Smithers-Oasis can tell you all you ever wanted to know about geranium growing.
- Three Harvard professors writing a physiology text use their personal computers to exchange chapters by phone.
- Edward Adler arranged for his computer to rock his baby's cradle every time she cried.
- Architects can sketch new designs on personal computers that rival design systems formerly costing millions of dollars.
- For training purposes, companies are now using personal computers to instruct employees in everything from advanced optics to photocopier repair.
- A psychologist is using his computer to teach people self-relaxation techniques and self-hypnosis.
- The rock group Earth, Wind, and Fire used a computer to set off flash pots and explode small bombs on stage during their pyrotechnic rock performances.
- A German firm is using a personal computer to create new sweater patterns.
- Daryl Faud's personal computer sifts through hundreds of bacterial strains to assist in recombinant DNA experiments.
- Dr. Terry Pundiak uses a voice interface with his computer to give antismoking lectures.
- Experimental systems that are being developed to read ordinary text to the blind are based on personal computers.
- Boy Scouts across the nation are using personal computers for help in earning the Computer merit badge.
- Dr. Michael Lamb has adapted his personal computer for anesthesia monitoring during surgery.
- Colossal Pictures Corporation used a personal computer to create the title sequences for *The Black Stallion* and *One From The Heart.*
- Psychologist John McPhee developed a program to analyze Rorschach Inkblot Tests on his personal computer.
- The Sports Car Club of America, San Francisco office uses a PC personal computer to track race results instantly.
- David Curtis turned his personal computer into a lie-detector and analysis machine.
- One hobbyist creates personalized Christmas letters by using a word processor, cutting the time required in half.
- A bar-code reader allows a hobbyist to rapidly input information concerning supermarket items purchased. A pantry inventory can easily be created.
- One thrifty personal computer owner devised a program to randomly match each person in his extended family for exchange of gifts.
- One family uses their system as a message board to store, word-process, and display messages to other family members.
- Traveling salesmen use their portable computers to maintain expense accounts.
- One hobbyist created a "drunkometer" program to evaluate residual cognitive function in those under the influence of alcohol.
- A nighttime and vacation check-off program to remind the hobbyist that nights and vacations exist for a purpose and ensure that all necessary duties have been taken care of could be a godsend to obsessive programmers.
- A citrus grower uses his personal computer to continuously monitor temperature and soil conditions to alert him of changes and automatically control heaters and sprinklers.
- An instrumentalist uses his personal computer to accompany him on the flute.
- A wrestling coach no longer tussles with the problem of pairing 500 boys by age and weight; he uses his personal computer.
- A personal computer owner who was about to

marry created a database to map out chapel seating for 100 wedding guests and table arrangements for 220 lunch guests and to do tabulations on no-shows. He also kept a record of those who gave gifts and what they sent.

- A new minister was given information concerning the personal and familial problems of his flock stored in a database created by the retiring minister.
- Chicago Alderman Lawrence Bloom kept a database of 6,000 voters on his computer. Precinct workers could make personalized calls and say "Alderman Bloom helped you get rid of that abandoned car. Now he needs your help."
- Carter Scholz used his personal computer to compute the lengths of a set of tuned wind chimes.
- The Osvoz family of New York use their personal computer to maintain database of family medical information, including blood types, allergies, dates of checkups, poison antidotes, eyeglass prescriptions, insurance policies, checkup reminders, height, and weight.
- Professionally prepared programs are available to plan a vacation trip for you. Given the starting point and the destination, miles, costs, routes, and itinerary can be computed automatically.
- Dave Adams, a businessman, uses his personal computer with a modem to access on-line airline schedules and make reservations. The Source and CompuServe, among other networks, offer this service.
- Automotive expense records, including the following information, may be tracked using your personal computer: loan or lease payment records, accumulated gasoline costs, MPG average, maintenance and repair records, insurance records, depreciation, automotive tax deductibles, and accumulated cost per mile to operate.
- Bill Strozier uses his personal computer to operate a passive solar heating system in his home. The computer controls the opening and closing of movable partitions and shades and an air circulation system. Other personal computer owners have controlled active solar heating collectors, directed air or liquid to areas where it was needed, and analyzed the performance of the system.
- One hobbyist uses a program to organize his elaborate home workshop; he maintains a tool and equipment inventory and lists of parts and supplies, projects completed, and future projects (with tentative starting dates).
- Bird watcher Edward Mair uses a personal computer to store his lifetime, year, state, property, and feeder lists for exchanging information with other birdwatchers across the nation via a network.
- Several executives, computer programmers, and writers can now do their work at home, rather than traveling to the office, thanks to personal computers linked with their company's computer via modems.

Appendices

Appendix A

Apple IIGS Software Guide

Activision Home Computer Software, Inc.

2350 Bayshore Frontage Road
Mountain View, CA 94043
(415) 960-0410

Paintworks Plus
The Music Studio
Writer's Choice elite
Shanghai
Hacker II
Tass Times in Tone Town

Activision produces one of the most extensive lines of entertainment and game software for the IIGS, including Paintworks Plus, an exciting graphics program that features animation abilities. Activision is also making a noteworthy contribution to business productivity with its excellent word processing package, Writer's Choice elite.

Baudville

1001 Medical Park Drive, S. E.
Grand Rapids, MI 49506
(616) 957-3036

816/Paint

This is a graphics painting program that works extensively with the Apple IIGS' super-high-resolution graphics mode. This program features the mouse interface and image scaling, rotation, stretching, and 4000+ color palette selections.

Broderbund

17 Paul Drive
San Rafael, CA 94903
(415) 479-1700

The Drawing Table
The Print Shop
Fantavision
The Toy Shop
Airheart

The Broderbund line of Apple IIGS software is heavy with graphics-oriented programs that make full use of the IIGS' super-high-resolution graphics

mode. Of special note is Airheart. This game was written exclusively for taking advantage of the Apple's graphics abilities.

Chang Labs

5300 Stevens Creek Blvd.
San Jose, CA 95129
(408) 246-8020

Rags to Riches

This is a popular business accounting program for the Apple Computer Macintosh that has been converted to the IIGS environment.

DataPak Software, Inc.

14011 Ventura Blvd., #507
Sherman Oaks, CA 91423
(818) 905-6419

GraphicWriter

A primitive page layout program that will introduce the user to elemental desktop publishing skills.

Electronic Arts

1820 Gateway Avenue
San Mateo, CA 94404
(800) 245-4525

DeluxeMusic Construction Set
DeluxePaint II

A truly superb series of entertainment software that uses all of the excellent sight and sound capabilities found on the Apple IIGS. Electronic Arts plans to expand this series with other Deluxe titles currently under development. Furthermore, many of the current Electronic Arts game titles, including the dynamite Skyfox (see Fig. A-1), can be played on the IIGS.

Megahaus

5703 Oberlin Drive
San Diego, CA 92121
(619) 450-1230

PageWorks

This program lets you place graphics and text together on the same page. The results can then be printed on either an Apple Computer ImageWriter II or LaserWriter printer.

MicroProse Software

120 Lakefront Drive
Hunt Valley, MD 21030
(301) 667-1151

Silent Service

Known for their impressive line of combat simulators, MicroProse Software takes the IIGS user into the South Pacific circa 1943 with Silent Service. As the commander of an American submarine, your mission is to destroy enemy shipping without succumbing to the same fate.

PBI Software, Inc.

1111 Triton Drive, #201
Foster City, CA 94404
(415) 349-8765

Visualizer

Like many of the other new Apple IIGS software products, Visualizer is a graphics-oriented package. In this case, the product is business graphs. Bar, plotted, and pie graphs can either be drawn from direct data entry or imported from AppleWorks files.

Roger Wagner Publishing

10761 Woodside Avenue, Suite E
Santee, CA 92071
(619) 562-3221

Fig. A-1. Skyfox is typical of the many outstanding Apple *//e* and *//c* games that will work on the Apple IIGS.

Carousel
Merlin 16
MouseWrite

Carousel is a software/memory management program. Functioning like Switcher for the Macintosh, Carousel is able to quickly shuttle programs in and out of the IIGS' system memory with greater efficiency than the current DeskTop. Merlin 16 is an assembler that will give the programmer a foot to stand on while writing machine-level programs for the IIGS. Finally, MouseWrite is a primitive word processing program that supports the mouse interface, print spooling, and increased RAM features found on the Apple IIGS.

TML Systems

4241 Bay Meadows Road
Jacksonville, FL 32217
(904) 636-8592

TML Pascal

This is a Pascal compiler adapted to the IIGS from the Macintosh.

VIP Technologies

ISD Marketing
2651 John Street, Unit 3
Markham, Ontario L3R 2W5 Canada

VIP Professional

This integrated software package contains a spreadsheet, database, and graphics illustration program. Many of the same commands and macros found in Lotus 1-2-3 are duplicated in VIP Professional. This program is also able to import files from AppleWorks and Multiplan.

Appendix B

Apple IIGS Peripheral Guide

Apple Computer, Inc.
20525 Mariani Avenue
Cupertino, CA 95014
(408) 996-1010

AppleColor RGB Monitor
Apple 3.5 Drive
Apple IIGS Upgrade
ImageWriter II
LaserWriter

These peripherals are brought to you by the makers of the IIGS.

Applied Engineering
P. O. Box 798
Carrollton, TX 75006
(214) 241-6060

MS-DOS Expansion Board

This board plugs into one of the IIGS' expansion slots and provides the ability to run IBM-type software. An Intel 8086 MPU running with a 7.14 MHz clock speed is featured on this board along with 640k bytes of RAM and an IBM-format disk controller.

AST Research
2121 Alton Avenue
Irvine, CA 92714
(714) 553-0340

SprintDisk
AST 2000

The SprintDisk is a memory expansion board that is able to increase your Apple's internal system memory up to one megabyte. There is also the ability to use this added RAM as a RAM disk. The AST 2000 is a 20 megabyte hard disk drive that is equipped with a 20 megabyte tape backup fea-

ture. This drive supports both ProDOS and DOS 3.3.

CH Products

1225 Stone Drive
San Marcos, CA 92069
(619) 744-8546

Mach IV

This is the joystick of preference for use with the Apple IIGS. The Mach IV can even be used as a substitute for the Apple mouse in many of the programs described in Appendix A.

Datadesk International

7650 Haskell Avenue, Suite A
Van Nuys, CA 91406
(800) 826-5398

Turbo-ADB Keyboard

This is an IBM-style keyboard that can be substituted for the stock IIGS keyboard. An interesting feature of the Turbo-ADB is the built-in joystick port and 15 function keys. These function keys can be used to perform many of the mouse-activated menu items found on the IIGS DeskTop.

MIDIdeas, Inc.

1111 Triton Drive, #205
Foster City, CA 94404
(415) 573-0580

SuperSonic
The Conserver
OctoRAM

This expansion board turns the sound output of the IIGS into a true stereo line-level signal. There are also dual 0.5 watt amplifiers on the SuperSonic for directly driving a pair of 8 ohm speakers or a pair of stereo headphones. If you feel that your IIGS is suffering from the heat of prolonged use, The Conserver is a fan cooling unit that will minimize heat-related power failures. Finally, OctoRAM is an expansion board that is able to add up to 8 megabytes of RAM to your IIGS.

Orange Micro

1400 N. Lakeview Avenue
Anaheim, CA 92807
(714) 779-2772

RAMPak 4 GS
ProGrappler

Up to 4 megabytes of RAM space can be added to your IIGS with the RAMPak 4 GS memory expansion board. This card is inserted into one of the Apple IIGS' expansion slots. The ProGrappler, on the other hand, is a parallel printer port expansion board that connects any parallel printer to the Apple IIGS. This board also features a "snapshot" printing capability that is able to print any image from the IIGS monitor onto a connected parallel printer.

RC Systems, Inc.

121 West Winesap Road
Bothell, WA 98012
(206) 672-6909

Slotbuster II

One of the finer multifunction expansion boards that is available for the IIGS. The Slotbuster II gives the Apple IIGS a parallel printer port, a standard serial printer port, a standard modem port, an X-10 port, a speech synthesizer, and a printer buffer. All of this on only a single expansion board.

X-10 (USA)

185A Legrand Avenue
Northvale, NJ 07647
(800) 526-0027

X-10 Powerhouse
X-10 Modules

The X-10 Powerhouse and Modules combine to form a home control and security system that is integrated with the IIGS.

Appendix C

Apple IIGS BASIC Command Summary

ABS
ASC
ATN
CALL
CHR$
CLEAR
COLOR=
CONT
COS
DATA
DEF FN
DEL
DIM
DRAW
END
EXP
FLASH
FN
FOR
FRE
GET
GOSUB
GOTO
GR
HCOLOR=
HGR
HGR2
HIMEM:
HLIN
HOME
HPLOT
HTAB
IF
IN#
INPUT
INT
INVERSE
LEFT$
LEN
LET
LIST
LOAD
LOG
LOMEN:
MID$
NEW
NEXT
NORMAL
NOTRACE
ON
ONERR GOTO
PDL
PEEK
PLOT
POKE
POP
POS
PR#
PRINT
READ
REM
RESTORE
RESUME
RETURN
RIGHT$
RND
ROT=
RUN
SAVE
SCALE=
SCRN
SGN
SIN
SPC
SPEED=
SQR
STOP
STR$
TAB
TAN
TEXT
TRACE
THEN
USR
VAL
VLIN
VTAB
WAIT
XDRAW

Appendix D

A Brief Tour of the Apple IIGS Environment

It all started in the garage of Steve Wozniak's parents in April 1976. There was born the great-grandparent of the Apple IIGS—the Apple I bare board computer. Housed in a typical business-styled briefcase, the Apple I represented the beginning of today's Apple Computer, Inc. and was the forebear of a current market-offering of several different computer models. Many hardware changes have marked the history of the Apple computer line, beginning with the Apple II+. Quickly, offshoots from this initial personal home microcomputer were designed by Apple Computer. Named the Apple III and the Lisa, neither of these new product lines was greeted with any large degree of market success.

EARLIER APPLES

Realizing their error in marketing strategy, Apple introduced a new computer supported by a consumer-oriented philosophy. The computer was the Apple *II*e, and the philosophy was succinctly put as "Apple II, forever." In essence, this motto translated into continued support for an established computer design. This support was put to a test with the introduction of the Apple *II*c. The *II*c was a portable Apple lacking the sophistication found on the *II*e. A poor reception by the buying public sent Apple back to the drawing board.

The year 1984 marked the release of an entirely new Apple computer line. This line was initiated with the Macintosh. The Macintosh was a complete departure from the 'Apple II forever' creed of the late 1970s. Actually, the enormous financial success of the Macintosh provided a rebirth in the idle Apple II. Therefore, as early as May 1986, the Apple IIGS was being designed. A total of ten scant years separates the design of the original Apple I from the design of the revolutionary Apple IIGS (see Fig. D-1).

The MPU

One way of looking at the entire line of Apple computers is through the development of the MPU, or microprocessing unit. The MPU is the central

Fig. D-1. The main Apple IIGS housing. The mouse is not visible in this picture.

brain of every personal home microcomputer, including the Apple IIGS. An MPU is a small hardware package that is made from a silicon material that is known as a *semiconductor.* This semiconductor is able to replace thousands of transistors, resistors, and capacitors. Due to the MPU's ability to combine thousands of different discrete components into a single package, the term *integrated circuit*, or IC, is used for discussing semiconductors like an MPU.

In the first Apple II+, a 6502 MPU was used. This powerful microprocessor could handle data that was 8 bits wide. Therefore, a single byte's worth of data could be manipulated by the 6502 during a single clock cycle. This 8-bit tradition was continued in the Apple *IIe* and the Apple *IIc*. A different MPU was used, however, for handling this data flow. The 65C02 MPU found in the enhanced *IIe* and the standard *IIc* differed from the 6502 in two areas. First, the 65C02 used less power than the 6502. This power savings was a result of the CMOS (Complementary Metal Oxide Semiconductor) technology used in the construction of the 65C02. The second improvement over the 6502 was found in the 65C02's instruction set. Basically, an MPU's instruction set is an elemental language that is used for executing all of the computer's operations. In the 65C02, 27 additional instructions were

added to the standard instruction set found in the 6502. Therefore, the 65C02 was able to operate all Apple II+ software, plus utilize some exciting new programming features that were unique to the *IIe* and the *IIc*.

An entirely new microprocessing unit was used in the Macintosh computer line. The Macintosh's Motorola 68000 MPU sports a 16-bit wide data path. This increased processing ability handles data at a much faster rate than on the 8-bit 6502. Unfortunately, the 68000 is unable to operate software that has been written for either the 6502 or the 65C02. This presented Apple designers with a problem.

In order to remain competitive in the tough home computer market, Apple Computer needed to release a new Apple II design. Based on the computing power of the Macintosh, the Apple designers wanted their new 'II' to have the following features:

- A 16-bit wide data processing path
- A fast clock speed
- 256k bytes of RAM
- expandable RAM; up to at least 4 megabytes of memory space
- super-high-resolution graphics
- a full-feature ROM (Read Only Memory)

Of course, any new Apple II computer would also have to be able to execute programs from the existing Apple II software base. Actually, it was this final feature that prevented the Apple designers from creating a new Apple II. Up until 1986, there wasn't any 16-bit MPU that was also capable of running 6502 software.

Finally, the arrival of the Western Digital 65SC816 MPU (also known as the 65816 or 65C816) provided the bridge that was missing between a true 16-bit environment and 6502 compatibility. In its own right, the 65SC816 has some impressive performance features:

- CMOS design; low-power comsumption
- 16-bit data registers
- 24-bit internal address bus
- 36 new instructions; a 91 member instruction set
- 11 new addressing modes
- variable clock speed
- emulation of 6502 and 65C02 8-bit MPUs

THE APPLE IIGS

When packaged with the other Apple design "dream" features, the Apple IIGS was brought to life. Originally called the Cortland, the Apple IIGS has many new features that are alien to previous Apple II models (see Figs. D-2, D-3, D-4, and D-5). These include:

- A new 16-bit microprocessor. Called the 65SC816, this MPU has greater data-handling capabilities than any other Apple II computer.
- A faster clock speed. The IIGS normally functions at a speed of 2.5 MHz, but the original 1 MHz of the II+, *IIe*, and *IIc* can also be used on the Apple IIGS.
- A standard memory size of 256K bytes RAM.
- Memory expansion to 8 megabytes of RAM. This increase in RAM must be done in 256K increments.
- A detached keyboard. Unlike the II+, *IIe*, and *IIc*, the IIGS has a mobile keyboard that is connected to the main CPU (Central Processing Unit) housing through a 30-inch coiled cord.
- A new Apple DeskTop Bus port. This connector is found in the detached keyboard and is used as a mouse interface and attachment site for other I/O (Input/Output) devices (see Fig. D-6).
- Time and date stamps are provided by a built-in clock. This battery-operated clock always displays the correct time and date after it has been set.
- A connection for an RGB (Red-Green-Blue) monitor. Analog RGB monitors can be plugged into this port.
- Color text and border. This feature is only found on RGB monitors.
- Super-high-resolution graphics. Up to 640 × 200

Fig. D-2. Just like the keyboard on the Apple *IIe* and *IIc*, four arrow or cursor keys are located under the right shift key on the IIGS.

pixels with 4 colors from a palette of 4096 colors are possible in this new display mode (see Fig. D-7).

- New sound production. A 15-voice digital synthesizer is a new IC found in the IIGS. Digital sound samples are stored in a 64K byte dedicated RAM storage area.
- ROM-based utility software. A Control Panel resident utility is callable from any program location through a three-key press: Open Apple-Control-Esc (see Fig. D-8).
- AppleTalk network built-in. An I/O port for connecting to an AppleTalk LAN (Local Area Network) is available on the IIGS' back panel.
- Internal expansion slots. There are seven internal expansion slots for holding Apple II expansion boards (see Fig. D-9).
- A standard Apple II game port. The IIGS has both an internal and an external game port for using standard Apple II control devices.

Four areas in this new environment that will be of most interest to the new Apple IIGS owner are the super-high-resolution graphics mode, the new sound capabilities, the built-in clock, and Apple II software compatibility.

Super-High-Resolution Graphics

The super-high-resolution graphics feature of the IIGS comes in two modes. Both of these modes

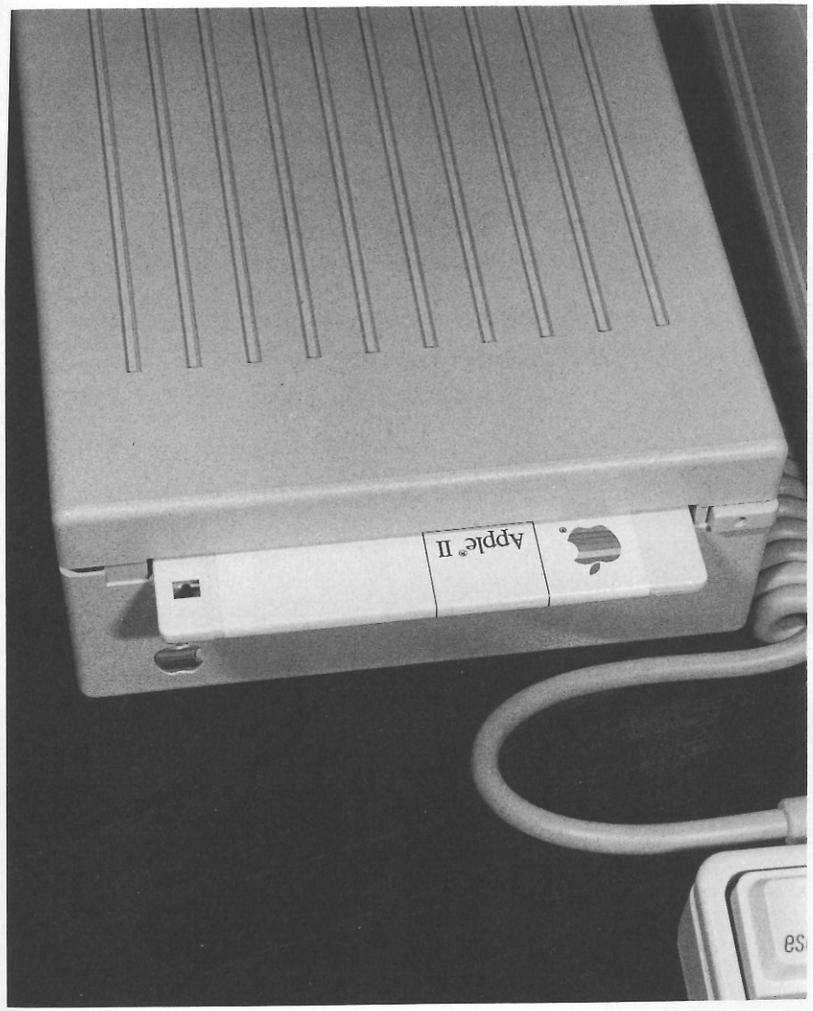


Fig. D-3. Small 800K byte 3.5-inch disks give the IIGS a tremendous data storage ability.

are only available on an analog RGB monitor. The first mode is called 320 mode. A total of 320 × 200 pixels can be displayed in 320 mode with four data bits assigned to each pixel. These data values select colors from a palette of 4096 possible screen colors. Each color in the palette is a 12-bit value. In the 320 mode, 16 colors from 16 different palettes can be presented on a single line. This results in a maximum of 256 on-screen colors.

Many of the same data bit techniques are used in the other super-high-resolution graphics mode—the 640 mode. In the 640 mode, a screen pixel resolution of 640 × 200 pixels is used. Each of these pixels has only two bits in its assignment. This is a significant difference from the 320 mode. Even though the same number of palette color possibilities, 4096, is present, only four colors from four different palettes can be used on a single line. This results in a maximum of 64 on-screen colors in the 640 mode.

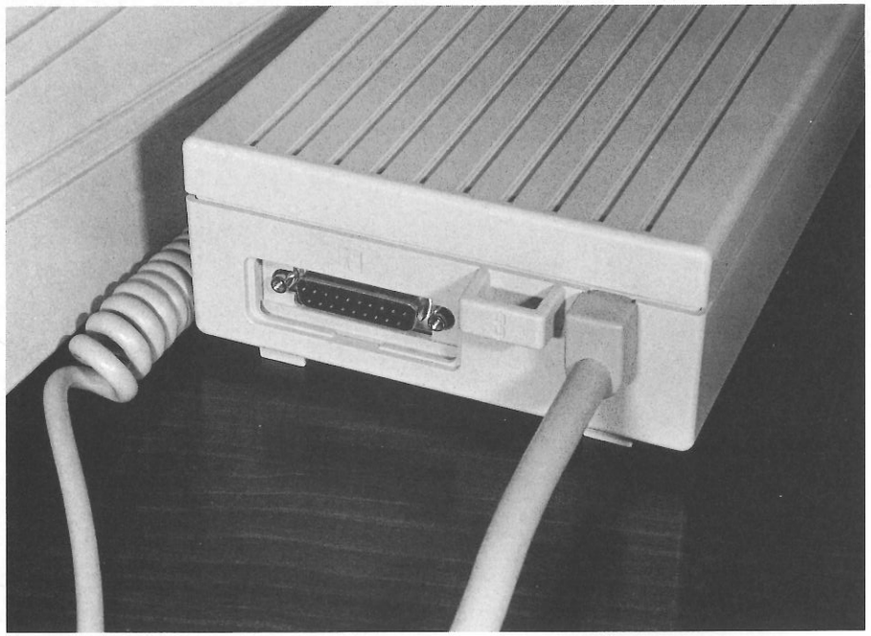


Fig. D-4. A special daisy-chain port is located on the rear of the 3.5-inch disk drive.

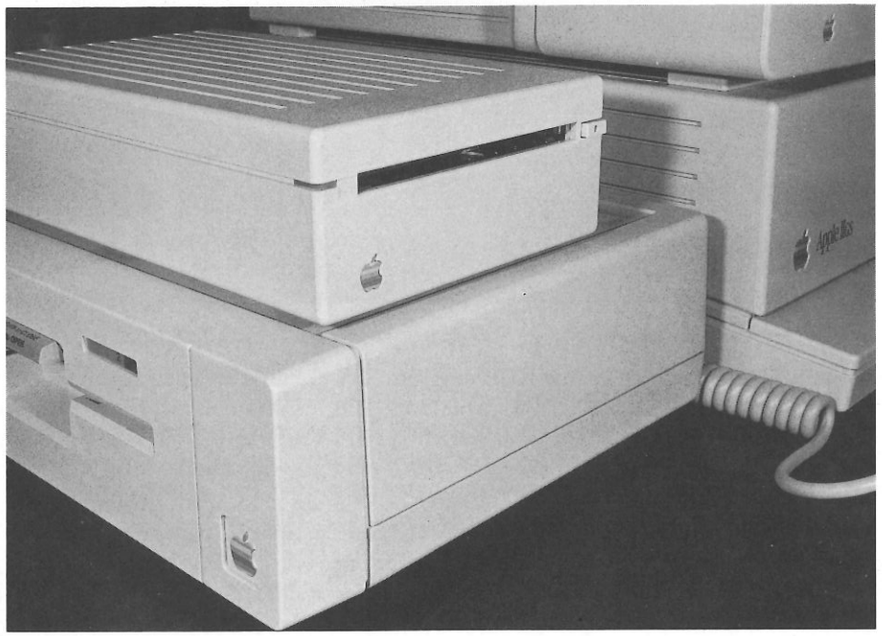


Fig. D-5. Any other Apple-type disk drive can be daisy-chained to the main system 3.5-inch disk drive. This versatility opens up the entire line of current Apple II software to the Apple IIGS owner. In this example, an Apple Duo-Disk Drive has been connected to the 3.5-inch disk drive. When this arrangement is booted, Drive 1 in the DuoDisk Drive is read first.

Fig. D-6. One of many new hardware features on the IIGS is the Apple DeskTop Bus port which is located in the detached keyboard. Two other interesting features in this figure are the combined Open-Apple and Command keys (lower left corner under the Z key) and the Reset button (above the 5 and 6 keys).

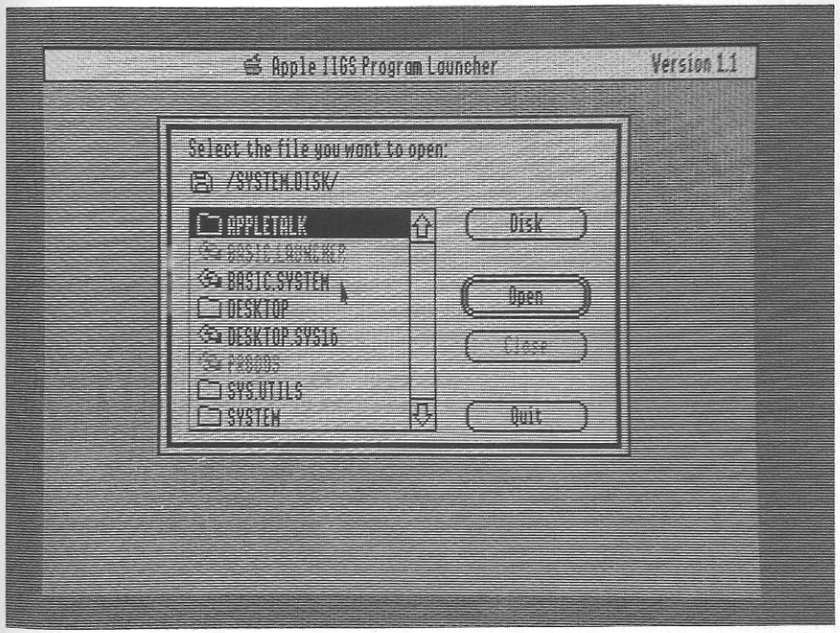


Fig. D-7. Super-high-resolution graphics can only be obtained with an analog RGB monitor connected to the system. Having this feature also opens up a new IIGS software line which functions similar to the Apple Computer Macintosh desktop/icon metaphor.

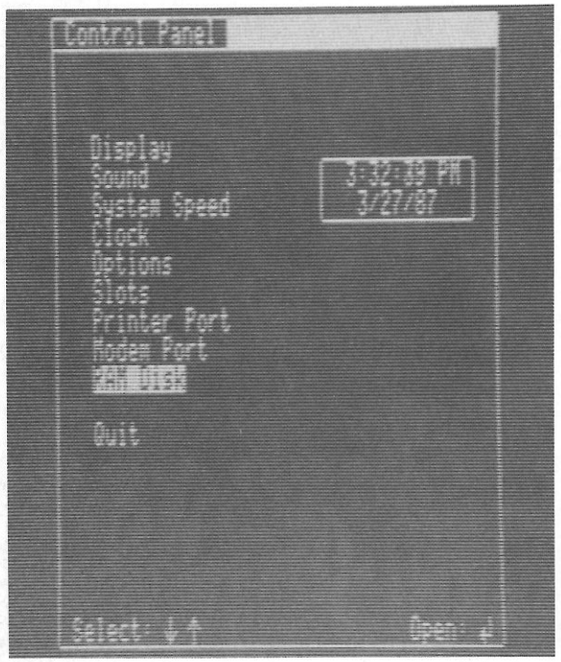


Fig. D-8. The Control Panel is a set of utilities that can be accessed from within any Apple IIGS program.

Sound

Like the enhanced graphics features, sound on the Apple IIGS is greatly improved over the II+, *IIe*, and *IIc*. In these other Apples, sound output was derived from a single bit of data. While this sound production method is supported by the IIGS, there are even better sound features in this computer. A special three-IC set consisting of a DOC (Digital Oscillator Chip), a special 64K byte storage RAM, and a Sound GLU (General Logic Unit) is able to generate 15-voice digital sound.

The DOC is the actual sound synthesizer IC in this three chip set. Made by Ensonig, the DOC produces digital sound waveforms from the digitized sound samples found in the storage RAM. Two oscillators are used for each voice in the DOC synthesizer section. Another oscillator acts as a sound clock. This results in the DOC using 32 oscillators (there is one unused oscillator) for constructing its 15-voice digital output. A digital-to-analog converter circuit is found in the DOC for turning these digital waveforms into an output signal that can drive a speaker.

The Sound GLU acts as an interface between the DOC, the storage RAM, and the IIGS output section. Another function of the Sound GLU is providing a volume control over the standard Apple II single-bit sound output.

The Built-In Clock

Another welcome feature for the IIGS owner is the built-in clock. This clock receives its power from a battery. Therefore, once the user has set this clock from the Control Panel, the time and date will remain intact until the battery fails.

Software Compatability

One issue that was a sore point during the introduction of the Macintosh was the loss of the established 10,000+ Apple II software base. The absence of this feature not only disturbed owners of the Macintosh, but it also eliminated many powerful programs from the library of usable applications. In direct contrast to this lack, the Apple IIGS is able to run almost all of the existing Apple II programs. The word *almost* is an important qualifier. For example, in a test of 100 Apple *IIe* and *IIc* software products, nine programs failed to load properly. This figure results in a nine percent failure rate. Bear this fact in mind when using *IIe* or *IIc* software with the IIGS. Additionally, several modifications of the IIGS were needed to run over 25 percent of the programs that loaded properly.

The following list of modifications is an excellent starting point for solving many of your software incompatibility problems:

- Set the system speed to the slower 1 MHz clock speed.
- Set the display width to 40 columns. Many programs do this automatically, but some fail to make the correct adjustment.

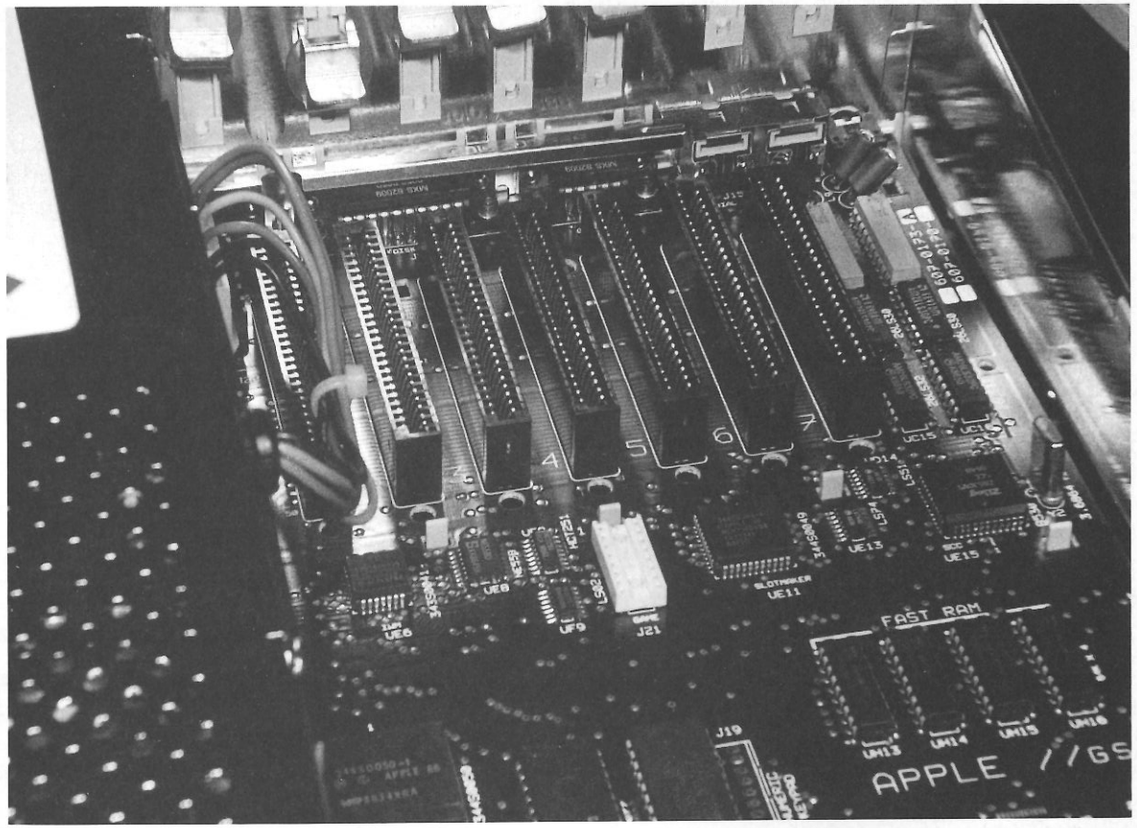


Fig. D-9. Seven expansion slots are located inside the IIGS CPU (eight, including the memory expansion slot). Like the software compatibility issue that is addressed in the text, complete Apple II hardware compatibility is a troublesome point with the IIGS. Several tested cards failed to work correctly with the IIGS. In order to avoid any problems, be sure to consult with your local dealer prior to making any IIGS hardware purchases.

- Turn the Alternate Display Mode off. This setting is only for using the super-high-resolution graphics mode.
- Press the Caps Lock key down, or on.
- Plug an Apple II joystick into the external game port.

That completes our brief tour of the Apple IIGS. If you still have questions pertaining to the operation of the IIGS, consult one of the books listed in Appendix E. Of course, the best source of knowledge will be the IIGS itself. Don't be afraid; nothing that you can do at the keyboard will ruin your Apple IIGS. Remember, experience is the best teacher. Who knows—maybe after several months you will be able to think of 1001 *more* things to do with an Apple IIGS.

Appendix E

For Further Reading . . .

Addison-Wesley Publishing Company, Inc.
Reading, MA 01867

Apple IIGS Technical Reference Manual Series
-an excellent series of books that contains all of the technical IIGS information that was released by Apple Computer.

Knott, J. and D. Prochnow, *Epson, Epson, Read All About It!*
-demonstrates the connection and programming of Epson dot-matrix printers with Apple II computers.

Bantam Books
666 Fifth Avenue
New York, NY 10103

Duprau, J. and M. Tyson, *The Apple IIGS Book*
-the first in a poor series of books that provide very little original information on using the Apple IIGS. Each book in this series also carries a high price tag.

COMPUTE! Books
P.O. Box 5058
Greensboro, NC 27403

Sanders, W., *The Elementary Apple IIGS*
-there is nothing in this book that you wouldn't already know from reading the IIGS Owner's Manual.

Osborne/McGraw-Hill
2600 Tenth Street
Berkeley, CA 94710

Fischer, M., *65816/65802 Assembly Language Programming*
-a superb sourcebook for information on the 65SC816 instruction set.

Leventhal, L., *6502 Assembly Language Programming*
-includes examples of assembly language programming for the 6502 microprocessor.

Leventhal, L. and W. Saville, *6502 Assembly Language Subroutines*
-a programmer's book of subroutines for the Apple *II*e main microprocessor.

Shaffer & Shaffer, Applied Research and Development, Inc., *Special Effects Library*
-this book/software disk combination demonstrates BASIC programming of animation, sound, and graphics for special effects.

Prentice-Hall
Englewood Cliffs, NJ 07632

Lichty, R. and D. Eyes, *Programming the 65816 Microprocessor: Including the 6502 and 65C02*
-this book was supported by Western Digital and contains a highly technical, bias accounting of this MPU.

Scott, Foresman and Company
1900 East Lake Avenue
Glenview, IL 60025

Wood, R., *Connections: Telecommunicating on a Budget*
-offers advice for low cost telecommunications.

Sybex, Inc.
2344 Sixth Street
Berkeley, CA 94710

Labiak, W., *Programming the 65816*
-this is an introductory text to assembly language programming on the IIGS MPU.

TAB BOOKS, Inc.
P.O. Box 40
Blue Ridge Summit, PA 17214

Brecher, J., *65C816 Architecture*
-a detailed look at the Apple IIGS hardware with special notes on programming in various high-level languages.

Haas, L., *Going On-Line With Your Micro*
-an overview of the hardware and software required for telecommunications, as well as the use of bulletin board systems.

Knott, J. and D. Prochnow, *101 Projects, Plans and Ideas for the High-Tech Household*
-shows how to use a computer for designing your home's high-tech environment.

Myers, L., *How to Create Your Own Computer Bulletin Board*
-provides instructions for forming your own computer bulletin board.

Nickell, D., *Forecasting On Your Microcomputer*
-provides forecasting techniques and subroutines that you can use with your computer.

Prochnow, D., *Chip Talk: Projects in Speech Synthesis*
-includes hardware projects for the Apple II that give your computer a voice.

Prochnow, D., *Flight Simulator and Flight Simulator II: 82 Challenging New Adventures*
-complete flight instructions for flying your Apple II in a piston-powered aircraft.

Prochnow, D., *JET: 82 Challenging New Adventures*
-thorough flight instruction in historically significant jet aircraft on Apple II computers.

Prochnow, D., *The GEM Operating System Handbook*
-illustrates how to use a desktop-based operating system with DRI's GEM as an example.

Smith, M., *6502 Machine and Assembly Language Programming*
-a tutorial for BASIC programmers to learn machine and assembly language programming.

Glossary

address—The location in memory where a given binary bit or word of information is stored.
alphanumeric—The set of alphabetic, numeric, and punctuation characters used for computer input.
analog/digital (A/D) conversion—A device that measures incoming voltages and outputs a corresponding digital number for each voltage.
ASCII—American Standard Code for Information Interchange.
assembly language—A low level symbolic programming language that comes close to programming a computer in its internal machine language.

binary—The base two number system, in which 1 and 0 represent the on and off states of a circuit.
bit—One binary digit.
byte—A group of eight bits.

chip—An integrated circuit.
compiler—A program that converts all the statements in a program in a high-level language into machine codes at one time for fast execution.
CPU—Central processing unit; the major operations center of the computer where decisions and calculations are made.

data—Information that the computer operates on.
data rate—The amount of data transmitted through a communications line per unit of time.
debug—To remove program errors, or bugs, from a program.
digital—A circuit that has only two states, on and off, which are usually represented by the binary number system.
disk—The magnetic media on which computer programs and data are stored.
DOS—Disk operating system; a control system that allows the use of general commands to manipulate the data stored on a disk.

firmware—Software instructions permanently

stored within a computer using a read only memory (ROM) device.

floppy disk—See disk.

flowchart—A diagram of the various steps to be taken by a computer in running a program.

hardware—The computer and its associated peripherals, as opposed to the software programs that the computer runs.

hexadecimal—A base sixteen number system often used in programming in assembly language.

input—To send data into a computer.

input/output (I/O) devices—Peripheral hardware devices that exchange information with a computer.

interface—A device that converts electronic signals to enable communications between two devices; also called a port.

interpreter—A program that accepts one statement of a high level language at a time, converts that statement into its machine language equivalent, and then proceeds to the next statement. As implemented on your IIGS, Applesoft BASIC is a high-level language that is interpreted rather than compiled (see Fig. G-1).

keyboard—A series of switches, usually in the

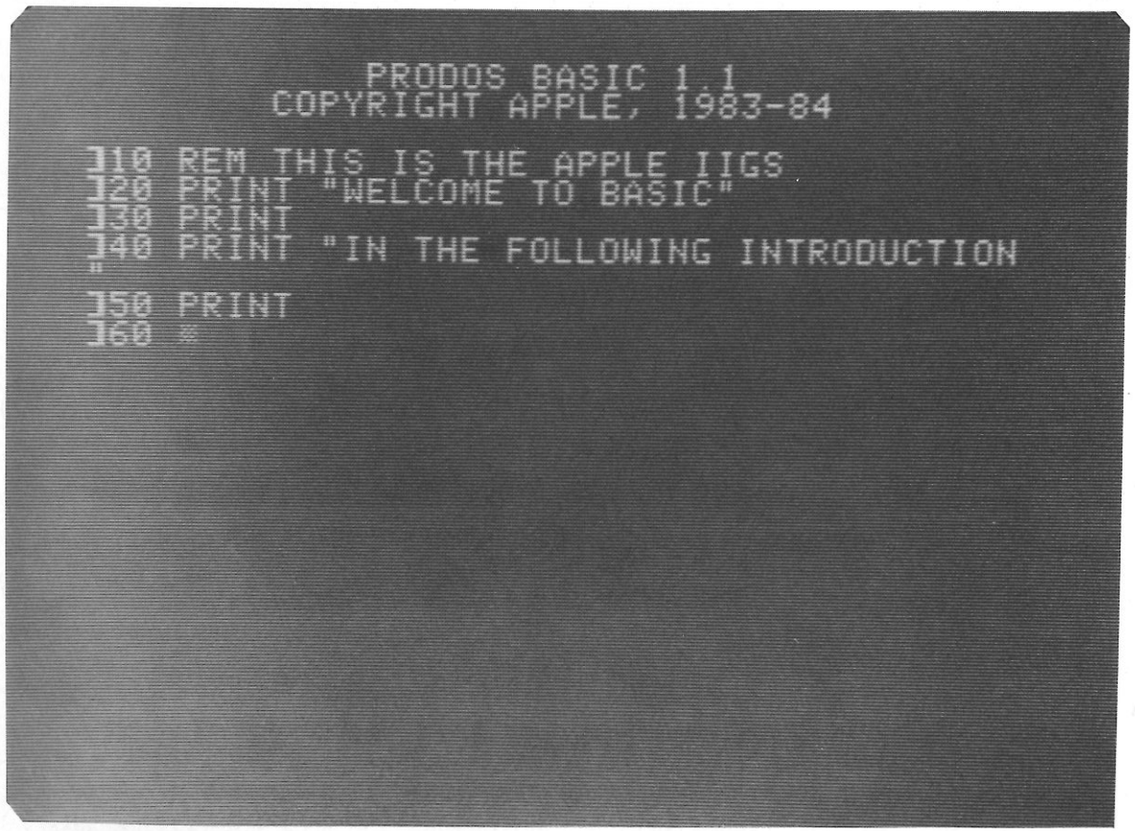


Fig. G-1. Applesoft ProDOS BASIC 1.1 can be accessed directly from the desktop. This simple language was used for all of the programming in this book.

form of a typewriter keyboard, that the computer operator uses to communicate with the computer itself.

languages—The set of words and commands that are understood by the computer and used in writing a program.

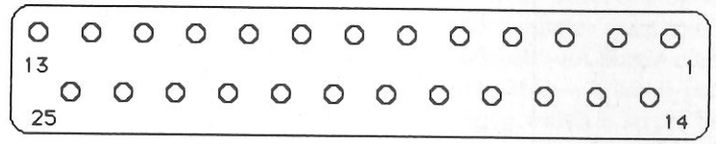
loop—A programming technique that allows a portion of a program to be repeated several times.

machine language—The internal, low level language of the computer.

memory—An area within a computer reserved for storing data and programs that the computer can operate on.

microcomputer—A small computer, such as the Apple IIGS, that contains all of the circuitry it needs to operate on a few internal integrated circuits.

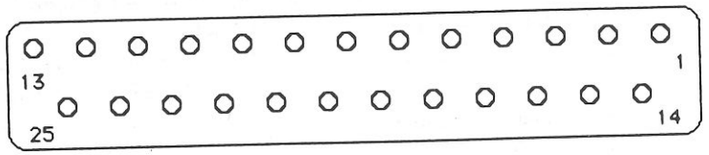
Typical Parallel Port Pin-out



Pin Assignments	
Pin	Name
1	Strobe
2	Data Bit 1
3	Data Bit 2
4	Data Bit 3
5	Data Bit 4
6	Data Bit 5
7	Data Bit 6
8	Data Bit 7
9	Data Bit 8
10	Acknowledge
11	Busy
12	Paper Out
13	Select
16	Initialize
19 + 25	Ground

Fig. G-2. The pin assignments for a typical parallel Centronics-type printer port.

Typical RS-232C Port Pin-out



Pin Assignments	
Pin	Name
1	Ground
2	Transmit
3	Receive
4	RTS
5	CTS
6	DSR
7	Ground
8	CD
20	DTR
22	Ring

IIGS RS-232C Pin-out

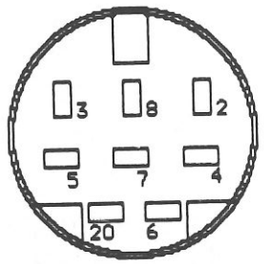


Fig. G-3. A direct comparison between the pin assignments of a standard RS-232C port and the Apple IIGS serial port. In both cases, the same pin reference numbers have been used.

mnemonic—An abbreviation or word that represents another word or phrase but is easier to remember.

modem—A peripheral device that converts digital signals to audio signals, and vice versa; used for telecommunications.

octal—A base eight number system often used in machine language programming.

opcode—An operation code signifying a particular task to be performed by the computer.

parallel port—A data communications channel that sends data out along several wires, so that entire bytes can be transmitted simultaneously, rather than one bit at a time (see Fig. G-2).

peripheral—An external device that communicates with a computer, such as a printer, a modem, or a disk drive.

program—A set of instructions for the computer to perform.

RAM—Random access memory; integrated circuits within the computer where data and programs can be stored and recalled. Data stored within RAM is lost when the computer's power is turned off.

ROM—Read only memory; integrated circuits that permanently store data or programs. The information contained on a ROM chip cannot be changed and is not lost when the computer's power is turned off.

RS-232C—A standard form for serial computer interfaces (see Fig. G-3).

serial communications—A method of data communication in which bits of information are sent consecutively through one wire.

software—A set of programmed instructions that the computer must execute.

statement—A single computer instruction.

subroutine—A small program or routine contained within a larger program.

terminal—An input/output device that uses a keyboard and a video display.

word—A basic unit of computer memory usually expressed in terms of bytes.

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