1001
THINGS TO DO WITH YOUR
APPLE® IIIGS®
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 Frochnow. 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 HERO Jr 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),
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.
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:

```
The Stock Market, 5.
name of article/book

Business Today, 6/84.
name of magazine/book

category #1

5, 6/84, 1, 5, Smith.

volume date category author

category #2

1, Smith

storage location
```

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 scan 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-
1001 Things to Do With Your Apple IIgs

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 retyping 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.

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- 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 the name as you misspelled it and again as spelled correctly; the program will automatically correct this error throughout the text.

- 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.

TELEPHONE TIMER

When you are making long distance telephone calls, whether for conversations or telecommunications, keeping track of elapsed time can save you 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.

Listing 1-1: Cook of the House Program

10 REM COOK OF THE HOUSE
20 HOME
30 PRINT TAB(12); "IT'S DINNER TIME"
40 PRINT: PRINT: INPUT "HOW MANY GUESTS WILL THERE BE TONIGHT?" ; G
50 PRINT "HOW MANY SERVINGS COULD THE ORIGINAL RECIPE MAKE?" ; S
60 I = G / S
70 X = I: HOME
80 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 T, OK"
120 PRINT "OK, 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), 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

Listing 1-2: Timer Program

10 REM TIMER
20 HOME
30 KEY
40 PRINT CHR$(7)
50 PRINT: PRINT: PRINT TAB(17); "TIMER"
60 PRINT: PRINT "AT THE PRESS OF ANY KEY, YOUR II GS WILL BECOME A VERY HEAVY STOP WATCH."
70 PRINT: PRINT "WHEN YOU ARE READY... JUST PRESS A KEY."
80 GET Z#: PRINT CHR$(7)
90 HOME
100 FOR X = 10 TO 59
110 VTAB 10: PRINT TAB(10) CHR$(95)
120 NEXT X
130 HTAB 10

Apple IIgs Applications for Everyone

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
capabilities far exceeding those of commercially available models.

GREENETING 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 even-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 calorie or nutrient content of various foods could be stored and subsequently referenced for determining the nutritive value of 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-

Listing 1-3: Decision Maker Program

```
10 REM DECISION MAKER
20 HOME
30 FOR X = 1 TO 12: PRINT CHR$(42): NEXT X
40 FOR Z = 1 TO 10000: NEXT X
50 PRINT "DECISION"
60 PRINT : PRINT : FOR X = 1 TO 14: PRINT CHR$(42): NEXT X
70 FOR Z = 1 TO 1000: NEXT X
80 PRINT "MAKER"
90 FOR X = 1 TO 100
100 S = PEEK (-16365) $ S = PEEK (-16365)
110 NEXT Z
120 FOR Z = 1 TO 2000: NEXT X
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 = 4 THEN S = PEEK (-16365): FOR Z = 1 TO 1
200 IF X = 1 OR X = 4 OR X = 5 THEN PRINT CHR$(7)
210 PRINT : PRINT
220 FOR Z = 1 TO 5000: NEXT X
230 IF X = 1 THEN PRINT TAB(10) "YES"
240 IF X = 2 THEN PRINT TAB(9) "NO"
250 IF X = 3 THEN PRINT TAB(1) "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
```
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-

---

**Table 1-1. Energy Consumption Table.**

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

---

**Table 1-2. Recommended Caloric Intake Table.**

<table>
<thead>
<tr>
<th>Category</th>
<th>Age (years)</th>
<th>Weight (kg)</th>
<th>Height (cm)</th>
<th>Energy needs (with range) (kcal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infants</td>
<td>0-0.5</td>
<td>6</td>
<td>3</td>
<td>60-24: 3 kg × 115 (95-145) kg × 48</td>
</tr>
<tr>
<td></td>
<td>0.5-1.0</td>
<td>9</td>
<td>20</td>
<td>60-24: 8 kg × 105 (80-135) kg × 44</td>
</tr>
<tr>
<td>Children</td>
<td>1-3</td>
<td>13</td>
<td>29</td>
<td>90-35: 1300 (900-1900) 5.5</td>
</tr>
<tr>
<td></td>
<td>4-6</td>
<td>20</td>
<td>44</td>
<td>112-44: 1700 (1500-2300) 7.1</td>
</tr>
<tr>
<td></td>
<td>7-10</td>
<td>28</td>
<td>62</td>
<td>132-52: 2400 (1600-3300) 10.1</td>
</tr>
<tr>
<td></td>
<td>15-18</td>
<td>66</td>
<td>145</td>
<td>176-69: 2800 (2100-3900) 11.8</td>
</tr>
<tr>
<td></td>
<td>19-22</td>
<td>70</td>
<td>154</td>
<td>177-70: 2900 (2500-3500) 12.2</td>
</tr>
<tr>
<td></td>
<td>23-30</td>
<td>70</td>
<td>154</td>
<td>178-70: 2700 (2300-3100) 11.3</td>
</tr>
<tr>
<td></td>
<td>31-57</td>
<td>70</td>
<td>73</td>
<td>178-54: 2400 (2200-2800) 10.1</td>
</tr>
<tr>
<td></td>
<td>58+</td>
<td>70</td>
<td>154</td>
<td>178-70: 2050 (1650-2450) 8.6</td>
</tr>
<tr>
<td>Females</td>
<td>11-14</td>
<td>46</td>
<td>101</td>
<td>157-62: 2200 (1500-3000) 9.2</td>
</tr>
<tr>
<td></td>
<td>15-18</td>
<td>55</td>
<td>129</td>
<td>163-64: 2100 (1200-3000) 8.8</td>
</tr>
<tr>
<td></td>
<td>19-22</td>
<td>55</td>
<td>129</td>
<td>163-64: 2100 (1700-2500) 8.8</td>
</tr>
<tr>
<td></td>
<td>23-50</td>
<td>55</td>
<td>129</td>
<td>163-64: 2000 (1600-2400) 8.4</td>
</tr>
<tr>
<td></td>
<td>51-75</td>
<td>55</td>
<td>129</td>
<td>163-64: 1800 (1400-2200) 7.6</td>
</tr>
<tr>
<td></td>
<td>76+</td>
<td>55</td>
<td>129</td>
<td>163-64: 1600 (1200-2000) 6.7</td>
</tr>
<tr>
<td>Pregnancy</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lactation</td>
<td></td>
<td></td>
<td></td>
<td>+ 300</td>
</tr>
</tbody>
</table>

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

---

**Listing 1-4: Pulse-Calc Program**

```plaintext
10 REM PULSE-CALC
20 HOME
30 TEXT
40 FOR X = 1 TO 120: PRINT CHR$(64); NEXT X
50 PRINT TAB(15) "PULSE RATE"
60 PRINT TAB(15) "CALCULATOR"
70 FOR S = 1 TO 100: P = PEEK (-16336): NEXT S
80 FOR X = 1 TO 2
90 FOR S = 1 TO 200: P = PEEK (-16336): P = PEEK (-16336): P = PEEK (-16336): NEXT S
100 FOR S = 1 TO 1000: P = PEEK (-16336): NEXT S
110 NEXT X
120 FOR S = 1 TO 2000: P = PEEK (-16336): P = PEEK (-16336): P = PEEK (-16336): NEXT X
130 FOR X = 1 TO 2000: PRINT CHR$(64); NEXT X
140 PRINT "COUNTRY YOUR NUMBER OF PULSES OVER A 15 SECOND TIME PERIOD."
150 PRINT "I WILL TIME YOU."; FOR X = 1 TO 2000: NEXT X
160 PRINT "PRINT "STOP, HOW PULSES DID YOU COUNT":P"
170 FOR X = 1 TO 2000: NEXT X
180 PRINT "PRINT "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
```
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 on 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 own.

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:

\[
N = D + M + Y([0.625M + 1]) + [Y/4]
\]

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

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).

**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 sales flyers. 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 ba-
sic 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 im-
portant 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 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 appli-
cations requiring a stopwatch. The capabilities that
your IIgs has, but a stopwatch doesn’t, are the au-
tomatic 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-
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
1 yard = 0.9144 meters

4 feet = 1 yard
1 foot = 0.3048 meters
1 inch = 2.54 centimeters
### Table 1-4: Uses for Database Management System

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

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

Wall Paper Estimator

\[ N = \frac{8640}{W \times (H + R)} \]

\[ P = \frac{S}{W \times N} \]

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

\( S \) = the width of the wall to be covered

\( P \) = the number of double rolls needed

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

\[ Y = \frac{L \times W \times T}{324} \]

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

### 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.

### 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 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 homeowner 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 an 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 brokers.

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:

- Sparks, L. E., Investment Analysis with Your Microcomputer, 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:

\[
\text{Ending Price} - \text{Starting Price} \over \text{No. of trading days} \times 100
\]

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:

\[
\text{INDEX} = \frac{\sum x_i y_i}{y}
\]

where \(x_i\) = stock price
\(y_i\) = number of shares traded at \(x_i\)
\(y\) = 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:

\[
V_p = \frac{VE_p^2}{E_p^2}
\]

where \(V_p\) = current value per share
\(E_p\) = projected earnings
\(E\) = projected percent change of P/E ratio
\(V_p\) = 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:

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

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

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 \((x \ldots)\) on another variable \((y)\). The total variation in \(y\) may often be better explained through the use of multiple \(x\) variables \((y = \ldots)\), 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

**Business and Financial Applications**

**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 financial risk 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 shareholder'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 Ratio. 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 liquidation of the control of the firm if additional equity must be raised.

Cash Convertibility 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 overutilization of assets, and a low ratio may indicate an excessive investment or idle assets.

Gross Operating Margin. 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 Margin. 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-
ways in which you can use your Ilos 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:

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

Where $I$ = intrinsic value

$TC = $ total corporation capital

$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 estimates 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 entering 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 right 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" compilation 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.

$$ Z = .012 \times \frac{(G - L) \times L}{(W - I)} + .014 \times \frac{P \times (L + I)}{W} + .033 \times \frac{P \times (L + I)}{W} - .006 \times \frac{W \times M}{L} + .996 \times \frac{S}{I} $$

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
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 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**

\[
\beta = \frac{\text{Covariance of market and stock risk premiums}}{\text{Variance of market risk premium}}
\]

**Variances**

\[
\text{Variance} = \sum_{\text{time}} \left( \frac{\text{market risk premium-ave}}{\text{market risk premium}} \right)
\]

**Covariances**

\[
\text{Covariance} = \sum_{\text{time}} \left( \frac{\text{(SRP-ave. SRP)}}{\text{(MRP-ave. MRP)}} \right)
\]

**Risk Premiums**

\[
\begin{align*}
\text{SRP} &= \text{stock risk premium} \\
\text{MRP} &= \text{market risk premium} \\
\text{risk premium} &= \text{rate of return} - (\text{risk free rate of return}) \\
\text{risk free rate of return} &= \frac{1}{12} \times \text{annual rate of a 3 month T-bill} \\
\text{rate of return} &= \text{price at month start} \\
\end{align*}
\]

**Portfolio Beta**

\[
\text{Beta} = \sum \left( \frac{\text{(stock beta) \times \text{market value of a stock}}}{\text{total market value}} \right)
\]

**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 ratio (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:

\[
\text{100} \times \frac{3}{10} = 10.2 \times 110 = 1122.
\]

**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 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.

<table>
<thead>
<tr>
<th>GIVEN</th>
<th>Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n$</td>
<td>$456$</td>
</tr>
<tr>
<td>$i$</td>
<td>7</td>
</tr>
<tr>
<td>$r$</td>
<td>9</td>
</tr>
<tr>
<td>$R$</td>
<td>11.12</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Formula</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n = \frac{\log F}{\log (1 + \delta)}$</td>
<td>Number of periods</td>
</tr>
<tr>
<td>$i = -\frac{P}{F (1 - \delta)}$</td>
<td>Interest rate per period</td>
</tr>
<tr>
<td>$p = \frac{F}{R (1 + \delta)^n - 1}$</td>
<td>Present value</td>
</tr>
<tr>
<td>$P = \frac{F}{(1 + \delta)^n}$</td>
<td>Future value</td>
</tr>
<tr>
<td>$F = \frac{P}{(1 - \delta)^n}$</td>
<td>Uniform payments</td>
</tr>
</tbody>
</table>

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 10s 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
- Corporate 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:

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

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:

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

where $R$ = the true interest rate

$F_i$ = 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.

$$ P = \frac{R \times N}{i} \left(1 - \frac{1}{(1 + i)^{n^y}}\right) $$
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 nominal interest rates, the amount of the loan, years, and the interest rate. With recent swings in interest rates, knowing what you will be paying at any given interest rate can be very important; a difference of half a 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 contract. A yearly amortization program could calculate a schedule of payments, the annual debt service, the mortgage constant, the remaining balance, the payment to principal, and the interest rate. 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 remaining balance, the interest 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**
  \[ P = \frac{R \cdot N}{i} \left(1 - \frac{1}{(1 + \frac{i}{N})^N}\right) \]

  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**
  \[ R = \frac{P \cdot N \cdot i}{1 - \left(\frac{i}{N + 1}\right)^{-N}} \]

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

- **Term of a Loan**
  \[ Y = -\frac{\log \left(\frac{1 - P \cdot i}{N \cdot R} \right)}{\log \left(1 + \frac{i}{N}\right)} \cdot \frac{1}{N} \]

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

**Depreciation Calculations.**

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

1. **Straight line depreciation**
   \[ D = \frac{PV}{n} \]

2. **Sum-of-the-years-digits depreciation**
   \[ B_k = \frac{S + (n - k) D_k}{2} \]

3. **Variable rate declining balance depreciation**
   \[ D_k = \frac{PV \cdot \frac{R}{n} (1 - R)^{k-1}}{n \cdot (n + 1)} \]

**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.**
- **Amortity 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

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

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

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.

Business and Financial Applications

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.
2. A file of each check (with its number, purpose, date, 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.
3. 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
- Total

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.

<table>
<thead>
<tr>
<th>EXPENSE</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
</tr>
</thead>
<tbody>
<tr>
<td>RENT</td>
<td>650</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>FOOD</td>
<td>323</td>
<td>351</td>
<td>357</td>
<td>371</td>
<td>290</td>
<td>251</td>
<td>410</td>
<td>336</td>
</tr>
<tr>
<td>CLOTHES</td>
<td>154</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>UTILITIES</td>
<td>57</td>
<td>56</td>
<td>50</td>
<td>59</td>
<td>62</td>
<td>51</td>
<td>53</td>
<td>59</td>
</tr>
<tr>
<td>CREDIT CARD INTEREST</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ENTERTAINMENT</td>
<td>143</td>
<td>100</td>
<td>58</td>
<td>13</td>
<td>24</td>
<td>45</td>
<td>125</td>
<td>54</td>
</tr>
<tr>
<td>GASOLINE</td>
<td>100</td>
<td>110</td>
<td>90</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>97</td>
<td>90</td>
</tr>
<tr>
<td>MORTGAGE INTEREST</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MISCELLANEOUS EXPENSE</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CAR EXPENSES</td>
<td>28</td>
<td>0</td>
<td>44</td>
<td>0</td>
<td>98</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL EXPENSE</td>
<td>998</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NET INCOME</td>
<td>2445</td>
<td>627</td>
<td>653</td>
<td>543</td>
<td>574</td>
<td>447</td>
<td>683</td>
<td>675</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXPENSE</th>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
</tr>
</thead>
</table>

| FOOD                  | 24% |
| Transportation        | 15% |
| Clothing, personal care | 13% |
| Taxes                 | 12% |
| 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. As of 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 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). Promotions 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 C 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 facets and years. The spreadsheet can include graphs 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 BASC program could compute these for a given situation and determine which alternative offers the better investment.

\[
\text{taxable yield} = \text{tax-free yield} \times (1 - \text{federal tax bracket})
\]

\[
\text{tax-free yield} = \text{taxable yield} \times (1 - \text{federal tax bracket})
\]

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 5.2 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 IIgs. 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 lists 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, Quasar, 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 each service and ensure greater accuracy. Furthermore, an indexing service using an 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 and price 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 wasted 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 an 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 IIOS 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 IIOS 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 IIOS.

**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 an IIOS 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.)? 252
- 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

**Business and Financial Applications**

<table>
<thead>
<tr>
<th>Depreciation (yr. #1)</th>
<th>$6000.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deductible interest</td>
<td>$6581.25</td>
</tr>
<tr>
<td>Real estate tax (yearly)</td>
<td>$1300.00</td>
</tr>
<tr>
<td>Total: (yr. #)</td>
<td>$21531.30</td>
</tr>
<tr>
<td>Total income (yr. #)</td>
<td>$13500.00</td>
</tr>
<tr>
<td>Net deduction (yr. #)</td>
<td>$8031.25</td>
</tr>
<tr>
<td>Tax advantage (yr. #)</td>
<td>$3212.50</td>
</tr>
</tbody>
</table>

**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, $V_0$, 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.

$$NPV_k = V_0 + \sum_{j=1}^{k} \frac{C_j}{(1 + i)^j}$$

**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-
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.

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.

Break Even Analysis

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

\[ P \times K = FC + (VC \times Q) \]

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.

\[ EOQ = \frac{\sqrt{KL}}{M} + S \]

\[ C_{\text{min}} = \frac{\sqrt{KL}}{M} \]

\[ N = \frac{L}{EOQ} \]

where

- \( EOQ \) = the economic order quantity in units
- \( C_{\text{min}} \) = 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: Break-even Calc Program

10 REM BREAK-EVEN CALC
20 HOME
30 TEXT
40 PRINT : PRINT TAB(15) "BREAK-EVEN"
50 PRINT : PRINT TAB(15) "CALCULATOR"
60 PRINT : PRINT "I WILL CALCULATE THE BREAK-EVEN 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 * Z# = F + (V * N#) THEN PRINT : PRINT N#" IS A BREAK-EVEN PRODUCTION CT.": GOTO 170
160 PRINT : PRINT N#" IS NOT A BREAK-EVEN 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 salesmen 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 IIcs 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 IIcs, 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, are 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 (amount from what you owe) accounts payable for $50.

b. Credit (amount from what you have) cash on hand for $50.

c. Debit (cost 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 file 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
Repairs RNT
Bad debts BDB (for the charge-off 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
Receivable
Inventory
Prepaid expenses
Supplies
Equipment
Investments
Miscellaneous

3000. Total
8500.

LIABILITIES AND EQUITY

Payables
Notes
Long term payables
Proprietor
Drawing

PBL (amounts owed on an account)
NOT (borrowed money)
LTP (amount invested in business and net income)
PRP (amount invested in business and net income)

5000. Notes
500. Receivables

Cash Total
3000. Total
8500.

EQUITY

Proprietor
Total (Liabilities + Equity)

Revenues (credit to add, debit to subtract)

Gross receipts
Other revenue

RCP
REV

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

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

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 businessman or professional could use this 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.
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.

<table>
<thead>
<tr>
<th>pounds</th>
<th>0.00</th>
<th>10.0</th>
<th>20.0</th>
<th>30.0</th>
<th>40.0</th>
<th>50.0</th>
<th>60.0</th>
<th>70.0</th>
<th>80.0</th>
<th>90.0</th>
<th>100.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>rate</td>
<td>1.90</td>
<td>2.09</td>
<td>2.28</td>
<td>2.47</td>
<td>2.66</td>
<td>2.85</td>
<td>3.04</td>
<td>3.23</td>
<td>3.42</td>
<td>3.61</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.86</td>
<td>3.09</td>
<td>3.34</td>
<td>3.58</td>
<td>3.82</td>
<td>4.06</td>
<td>4.30</td>
<td>4.54</td>
<td>4.78</td>
<td>5.02</td>
<td>5.26</td>
</tr>
<tr>
<td></td>
<td>4.57</td>
<td>4.84</td>
<td>5.11</td>
<td>5.38</td>
<td>5.65</td>
<td>5.92</td>
<td>6.19</td>
<td>6.46</td>
<td>6.73</td>
<td>7.00</td>
<td>7.27</td>
</tr>
<tr>
<td></td>
<td>7.54</td>
<td>7.81</td>
<td>8.08</td>
<td>8.35</td>
<td>8.62</td>
<td>8.89</td>
<td>9.16</td>
<td>9.43</td>
<td>9.70</td>
<td>9.97</td>
<td></td>
</tr>
</tbody>
</table>

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 at 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
- Client fees
- Composition and printing costs
- Production (film and TV) costs

Advertising:

- All aspects of work
- Client fees
- Composition and printing costs
- Production (film and TV) costs
| **Space and time buying** | **Building contractor:** Measuring land sites, amounts and costs of roofing, flooring, siding, etc. Electrical loads and needs Figuring gutters, windows, screen sizes Water pressure, plumbing Work schedules and transportation |
| **Statistics in market research** | **Building maintenance:** Supplies and power Waste disposal Comparative costs among suppliers Shipping charges Foreign size conversions Cost relative to markup at retail Profit potential Quantitative measurements Composition of solutions and compounds Rates of reaction Volumetric and gravimetric analysis Calculations of materials, labor time, charges, and so on by bricklayers, masons, carpenters, plasterers, plumbers, etc. |
| **Agriculture:** Yields per acre Livestock growth and feeding Livestock food supplements Crop mix and rotation Fertilizer ratios | **Chemists and lab technicians:** Analyzing products and processes Conducting experiments and tests Writing reports and papers Designing experiments and procedures |
| **Appraisers:** Comparative values Quantities Summations | **Construction trades:** **Operative and craft workers:** Electricians, plumbers, carpenters, masons, bricklayers, etc. Building, grading, and excavation work Construction and maintenance of buildings and structures |
| **Architects:** Strength of materials Loads, stresses, and strains Geometrical configurations | **Dieticians:** Food quantities and costs Nutritional and caloric values |
| **Artists and designers:** Supplies and materials Scale reductions and expansions | **Educators—teachers:** Grading homework and examination papers Classroom games and instructions in arithmetic, English, etc. |
| **Attorneys:** Client fees by hours worked Terms of contracts Tax calculations Bankruptcy dispositions | **Employment counselors:** Working conditions, wages, and salaries Fringe benefits Labor supply and openings |
| **Auto salesmen:** Optional equipment costs Discounts and prices Used car allowances | **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. |
| **Auto service and repair:** Towing and road service costs Costs of materials and labor Estimates | **Jewelers:** Pricing and costs Composition of precious metals Gem weights and sizes Land areas, planting and fertilization schedules Land fill Cost of items less discounts Shipping and insurance costs Invoices prepared for suppliers and clients Statistics of opinion and field testing Extent and nature of competition Prescribing or utilizing medications, anesthetics, prosthetic devices, etc. Operational costs of services Supplies inventories and costs Geometric configurations Measurements and conversions Alternative designs Absenteeism rates, efficiency Vacations, illness rates Wage rate compliances | **Business and Financial Applications** | **Interior decorating:** Amounts and costs of fabrics, rugs, carpeting, drapes, wallpaper, etc. Discounts for quantity Shipping times and charges |
| **Hotel and inn keepers:** Supplies and labor Occupancy rates Concession profits and activity Group discounts and catering | **Geologists:** Land measurements Chemical analysis and assays Mineral depletion rates |
| **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 | **Hotel and inn keepers:** Market research: Medical, dental, and other health services: Pattern makers: Personnel administration: |
| **Banking:** Interest, assets, annuities, insurance Foreign exchange Collateral Trust and pensions | **Insurance salesman:** Premiums, dividends on policies Annuities |
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

states to suppliers
Commissions
Taxes and commissions
Inventory and turnover
Pricing—markups and markdowns
Petty cash, travel expenses
Postage costs
Budget, production, sales reports
Employer's personal finances
Correspondence and memo verification
Profits, expenses, P/E ratios working capital, depreciation, growth rates, dividends, etc.
Technical and fundamental analyses
Margin costs and availability
Dividend and interest yields
Commissions earned
Growth rates, price changes, balanced portfolios
Welfare availability versus family needs
Family budgeting
Land measurements
Discounts on fares, tours, hotels
Commissions earned
Distances and costs per distance
Converting foreign currencies, kilometer distances, etc.
Billing airlines, steamship lines, bus compa-

Business and Financial Applications

Trucking and shipping:
Load capacities by weight and volume
Distances, time schedules, costs
Equipment inventory and maintenance
License fees and taxes
Printers' measurements
Plates and etchings
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 II GS Number
Crunching: Mathematical and Statistical Applications

One of the biggest assets of the Apple II GS is its ability to perform complicated and tedious mathematical calculations with unerring diligence. Your II GS 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 II GS AS A SOPHISTCATED 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

<table>
<thead>
<tr>
<th>Listing 3-1: Desktop Calculator Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 REM DESKTOP CALCULATOR</td>
</tr>
<tr>
<td>20 HOME</td>
</tr>
<tr>
<td>30 TEXT</td>
</tr>
<tr>
<td>40 X = 10: Y = 0: C$ = &quot;&quot;: D$ = &quot;&quot;: E$ = &quot;&quot;: DIM A(35)</td>
</tr>
<tr>
<td>50 VTAB 1: HTAB 9: FOR X = 1 TO 9</td>
</tr>
<tr>
<td>60 PRINT CHR$(95): NEXT X</td>
</tr>
<tr>
<td>70 VTAB 3: HTAB 9: FOR X = 1 TO 9</td>
</tr>
<tr>
<td>80 PRINT CHR$(95): NEXT X</td>
</tr>
<tr>
<td>90 VTAB 15: HTAB 9: FOR X = 1 TO 9</td>
</tr>
<tr>
<td>100 PRINT CHR$(95): NEXT X</td>
</tr>
<tr>
<td>110 FOR Y = 2 TO 15: VTAB Y</td>
</tr>
<tr>
<td>120 HTAB 8: PRINT CHR$(124): NEXT Y</td>
</tr>
<tr>
<td>130 FOR Y = 2 TO 15: VTAB Y</td>
</tr>
<tr>
<td>140 HTAB 18: PRINT CHR$(124): NEXT Y</td>
</tr>
</tbody>
</table>

57
Apple IIgs Number Crunching: Mathematical and Statistical Applications

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 | Enter first number
0 | 0 | These are the four registers
2 | 4 | Enter second number
0 | 0 | as new numbers are
2.5 | 0 | input, preceding inputs shifted through the registers.
0 | 0 | 4 | 2.5 \( \times 4 \) was calculated and put in the first position in the display.
0 | 10 | enter third number
0 | 0 | 4 | 2.5

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

**Function** | **Description**
--- | ---
+ | multiplication
/ | division
- | subtraction
\( \sqrt{ } \) | 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 \( x \)
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 \( y = a + bx \),
\[
b = \frac{\sum XY - n\bar{X}\bar{Y}}{\sum X^2 - n\bar{X}^2}
\]
\[
a = \bar{Y} - b\bar{X}
\]
where \( \bar{X} = (\sum X)/n \), \( \bar{Y} = (\sum Y)/n \)

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?"
area of right tail = \( \frac{1}{2}(1 + a_1 x + a_2 x^2 + a_3 x^3 + a_4 x^4 + a_5 x^5) \)

where:
\[ a_1 = 0.196854 \]
\[ a_2 = 0.115194 \]
\[ a_3 = 0.000344 \]
\[ a_4 = 0.019527 \]
\[ t = \text{t value} \]
\[ d = \text{no. degrees of freedom} \]
\[ x = (t^2(1 - 2/d) - 79(2/9 + t^2/29) - 29d)^{-1/2} \]
\[ | \varepsilon(x) | < 2.5 \times 10^{-4} \]

**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 IIc 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 IIc 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 IIc 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 greater than two could also be solved.
- 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.

- Gaussian 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 \(P(x) = a_n x^n + a_{n-1} x^{n-1} + \cdots + a_1 x + a_0\) may be evaluated at a point \(x\) with complex coefficients.

- Polynomial root finding: Barrow’s method is well suited for computer evaluation of quadratic 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 potter/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 formulas:

\[
\begin{align*}
\rho &= \sqrt{x^2 + y^2} \\
\theta &= \arctan(y/x) \\
\rho &= r \cdot \cos(\theta) \\
y &= r \cdot \sin(\theta)
\end{align*}
\]

where \(x, y\) are Cartesian coordinates, \(r, \theta\) are polar coordinates.

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

**Listing 3-2: Trig Calculator Program**

```
10 REM TRIG CALCULATOR
20 HOME
30 TEXT
40 LET X = 0: Y = 8: CS = "0": DS = "1": ES = "1": DIM A(35)
50 VTAB 11: HTAB 9: FOR X = 1 TO 9
60 PRINT CHR$(95): NEXT X
70 VTAB 8: HTAB 9: FOR Y = 1 TO 9
80 PRINT CHR$(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$(129): NEXT Y
150 VTAB 5: HTAB 10: PRINT "7 8 9 A": VTAB 5: HTAB 28: PRINT "A=ATN"
160 VTAB 7: HTAB 10: PRINT "4 5 6 C": VTAB 7: HTAB 28: PRINT "C=LOS"
170 HTAB 9: HTAB 10: PRINT "1 2 3 L1": VTAB 9: HTAB 28: PRINT "L=LOG"
180 HTAB 11: HTAB 10: PRINT "5 0 Q": VTAB 11: HTAB 28: PRINT "S= SIN"
190 VTAB 13: HTAB 10: PRINT " E -" "
```

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Apple IIc Number Crunching: Mathematical and Statistical Applications
The Solution of Simultaneous Equations

The IILs 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:

\[ \begin{align*}
5x &= 4y + 24 \\
2.5y &= 6x - 4
\end{align*} \]

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
evaluation of integrals is Simpson’s Rule:
\[
\int_a^b f(x)dx \approx \frac{h}{3}(f(a) + 4f(a + h) + 2f(a + 2h) + 4f(a + 3h) + \ldots + 2f(a + (n-2)h) + 4f(a + (n-1)h) + f(b))
\]
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.

\[
y = y_1 + \frac{(y_2 - y_1) \cdot (x - x_1)}{(x_2 - x_1)}
\]

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 calculi 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:

\[
p = p^4 + 4p^3q + 6p^2q^2 + 4pq^3 + q^4
\]

where
\[
\begin{align*}
p &= \text{probability that stronger team will win} \\
q &= \text{probability that weaker team will win} \\
x &= \text{conditional probability particular to a sport for example, for basketball this value has been calculated to be } 0.408
\end{align*}
\]

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 cathetuses (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 \( x^2 - n \cdot y^2 = 1 \) 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.

\[
\pi = 4 - \frac{4}{3} + \frac{4}{5} - \frac{4}{7} + \frac{4}{9} - \frac{4}{11} + \ldots
\]

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: (53,30) is the starting pair of numbers.

\[
\begin{align*}
A & : (30, 21) \\
B & : (21, 9) \\
A & : (9, 3) \\
B & : (3, 0) \\
& \text{B wins or the game could have been} \\
A & : (30, 21) \\
B & : (21, 9) \\
A & : (9, 3) \\
B & : (3, 0) \\
& \text{The Two Move Game: in the first half of this game, the two players secretly enter four non-negative numbers totaling the same number into the cells of a 2 by 2 matrix:} \\
& \begin{bmatrix}
x_1 & x_2 \\
x_3 & x_4 \\
y_1 & y_2 \\
y_3 & y_4 \\
\end{bmatrix}
\]

The entries are then exposed and a third 2 by 2 matrix is developed in which the entries are \(x_i, y_i\). 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 minimize. 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:

\[
\begin{align*}
& x & x & x & x & x & x & x & x & x & x & x \\
& x & x & x & x & x & x & x & x & x & x & x \\
& \text{The players take alternate turns drawing lines between two points. The first player to draw an equilateral triangle or square loses. A mathematical strategy exists to win this game.} \\
\end{align*}
\]

See Listing 3-4 and Fig. 3-3.
Computing Probabilities. You could use your Apple IIs 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 deaths 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 x 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

\[
\% \text{ chance} = 100 - 100 \times \left( 1 - \frac{365}{365} \right)^{x-1}
\]

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 Possibility: an equation expressing the probability of an accidental nuclear mis-
sile launch by the United States or the Soviet Union falsely triggering World War III is as follows:

\[
PA = 1 - (1 - \frac{\text{probability}}{100})^h
\]

where \( PA = \) Probability of the Apocalypse (for percent chance, multiply \( PA \times 100 \)

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 IIs 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.

|------------|----------|----------|-----------|-----------|----------|----------|-----------|-----------|----------|----------|-----------|-----------|----------|----------|-----------|-----------|

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 IIcs 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.

<table>
<thead>
<tr>
<th>Wind change</th>
<th>Barometric condition</th>
<th>Forecast code</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>SW</td>
<td>L</td>
</tr>
<tr>
<td>S</td>
<td>SE</td>
<td>E</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F</td>
</tr>
<tr>
<td></td>
<td></td>
<td>M</td>
</tr>
</tbody>
</table>
Wind change Barometric condition Forecast code

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>3</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>NE</td>
<td>SE</td>
<td>4</td>
<td>H</td>
</tr>
<tr>
<td>NE</td>
<td>N</td>
<td>5</td>
<td>J</td>
</tr>
<tr>
<td>NE</td>
<td>E</td>
<td>6</td>
<td>K</td>
</tr>
<tr>
<td>NE</td>
<td>W</td>
<td>7</td>
<td>L</td>
</tr>
<tr>
<td>NW</td>
<td>SW</td>
<td>8</td>
<td>N</td>
</tr>
<tr>
<td>NW</td>
<td>NW</td>
<td>9</td>
<td>A</td>
</tr>
</tbody>
</table>

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. Sumner: 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 fail 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 aneroid 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 position 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:

\[ H = (0.14 + 0.47 \times V) \times (36.5 - T) \]

where

\[ V = \text{wind velocity (m/sec)} \]
\[ T = \text{temperature (Centigrade)} \]

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:

\[ H = \frac{B + h \times s \times m}{2} \]

where

\[ B = \text{Btu/sq ft} \]
\[ h = \text{hrs/day} \]
\[ s = \text{sq. ft of collector} \]
\[ m = \text{max. efficiency} \]

Keep in mind that it takes 500 Btu 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:

\[ A = \frac{0.625 (m - 1) W}{Z} \]

where

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

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

\[ H = \frac{kA(t - t)T}{d} \]
1001 Things to Do With Your Apple IIgs

where

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

*To calculate fuel requirements use the formula

\[ C = \frac{H(t_a - t_b)N \times S \times q}{100,000 \times (t_i - t_o)} \]

where

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

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:

\[ ^\circ F = \left(\frac{9}{5}\right) \times (^\circ C + 32) \]
\[ ^\circ C = \left(\frac{5}{9}\right) \times (^\circ F - 32) \]

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.
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.
5. Protein electrophoresis: given integration counts of a number of protein fractions, the percentage of each may be found.
7. Oxygen saturation and content. Oxygen content and saturation in the blood may be found given: \( P_{O_2}, P_{CO_2}, \) 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*  
*Mathematical 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.
ENGINEERING APPLICATIONS

Professionals and hobbyists will have several uses for IICs 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 IICs 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(P) nets can be transformed to P(T) nets 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:

\[ L = \frac{0.001 \times 2.303 \log_{e}(2 \times D/d - D/c)} \]

where,

\[ L = \text{inductance (\mu H)} \]

\[ D = \text{distance in cm between the centers of wires} \]

\[ d = \text{diameter of wire (cm)} \]

\[ c = \text{conductor length (cm)} \]

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 5(T) parameters expressed as magnitudes and angles can be transformed to a set of 5(Y) 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.
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:

$$f_r = \frac{L - R_C^2C}{2\sqrt{LC}(L - Rc/C)}$$

where $L = 1/(4\pi^2C)$, $C = 1/(4\pi^2FL)$, $R_s = \text{series resistance of inductor}$, $R_C = \text{effective series resistance of capacitor}$, and $f_r = \text{resonant frequency}$.

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:

$$L = 0.21 \times [2.303 \times \log_{10}(41/d) - 0.75]$$

where,

L = inductance ($\mu$H)
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.

$$E = I \times R$$

where

E = voltage
R = resistance (ohms)
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:

$$\frac{E_{OUT}}{E_{IN}}$$

1001 Things to Do With Your Apple IIgs
1001 Things to Do With Your Apple IIgs

410 IF A# = "2" THEN PRINT : INPUT "HOW MANY VOLTS ";E; PRINT : INPUT "HOW MANY OHMS"; R
420 IF A# = "3" THEN PRINT : INPUT "HOW MANY AMPS"; I; PRINT : INPUT "HOW MANY OHMS"; R
430 PRINT "THE POWER EQUALS " ;F; PRINT "PRESS A KEY TO BEGIN"; GET #
440 GOTO 160
450 REM HOME
460 GOTO HOME
470 PRINT : PRINT "WHICH EQUATION DO YOU WISH TO USE: 1)R=E/I 2)I=R/E"
480 IF A# = "1" THEN PRINT : INPUT "HOW MANY VOLTS "; I; PRINT : INPUT "HOW MANY AMPS"; R
490 IF A# = "2" THEN PRINT : INPUT "HOW MANY VOLTS "; E; PRINT : INPUT "HOW MANY WATTS"; P
500 IF A# = "3" THEN PRINT : INPUT "HOW MANY WATTS"; P; PRINT : INPUT "HOW MANY VOLTS"; E
510 PRINT : PRINT "THE RESISTANCE EQUALS " ;R; PRINT "PRESS ANY KEY TO BEGIN"; GET #
520 GOTO 160
530 REM HELP
540 HOME
550 PRINT : PRINT "IN EACH MENU CATEGORY, YOU WILL BE PRESENTED WITH A CHOICE OF DIFFERENT EQUATIONS."
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 #
590 GOTO 70

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

\[ L_1 = L_2 \div L_3 \]
\[ L_4 = L_5 \div L_6 \]
\[ L_7 = L_8 \div L_9 \]
\[ L_9 = L_7 \div L_6 \]

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 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 calculator design
- DC bias analysis
- Waveform limits determination
- Plotting of waveforms
- Plate resistance/transconductance calculations
- Gauss calculations
- Reactance chart calculations
- Design of controlled rectifier circuits

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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 CODES"
70 PRINT : PRINT "I WILL HELP YOU DETERMINE THE COLOR CODES FOR ANY RESISTOR."
80 PRINT : PRINT "PRESS ANY KEY TO BEGIN."; GET #
90 HCOLOR= 6
100 TEXT : HOME
110 PRINT : INPUT "WHICH DO YOU WISH TO SOLVE FOR: 1) COLOR 2) VALUE 3"
120 IF A# = "1" THEN 160
### Civil Engineering

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

- Moment of inertia calculation
- Vector statics
- Section properties

### 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

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#### Resistor Color Codes

<table>
<thead>
<tr>
<th>First Band</th>
<th>Second Band</th>
<th>Third Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Brown</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Red</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Orange</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Yellow</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Green</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Blue</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Violet</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Gray</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>White</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

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.
1001 Things to Do With Your Apple IIgs

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

Chemical Engineering

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

Machine Design

- 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.)

\[
\text{RPM} \times \text{No. Cylinders} \times \frac{1}{120} = \text{Ignition Pulse Frequency}
\]

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-
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 prospects 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.”
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. In your social situation the cause of the trouble (6) 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). 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 for 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.
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-American unit conversions
10. Constellation recognition (see Listing 5-2 and Fig. 5-1)

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8. Technical and scientific terminology
9. Anglo-American unit conversions
10. Constellation recognition (see Listing 5-2 and Fig. 5-1)

EDUCATIONAL SIMULATIONS

Because of the ability of the Apple IIe 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 IIe generated chart listing the value of the account after each decade 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:

\[ f(n_1, n_2, h) = \frac{c}{2} \frac{1}{(n_1)² + (n_2)² + (n_3)²} \]

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 \( n_1 = 1 \) 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 craftsperoson. 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 continuous 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
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 create such "art" would scan each word and determine how that word could fit in crossword form with adjacent words:

**WHO**

A BUT WHEN THE LEAVES

E S N

**THE**

N E

**WIND**

M G

**E**

L B

**T**

G M

**H**

I N

**F**

G I

**R**

E G

**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 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 \((x',y')\) be the center coordinates of the new system rotated through angle \(\theta\) in relation to the old system. The new coordinates \((x',y')\) can be calculated with these equations:

\[
x' = (x - x_0) \cos \theta + (y - y_0) \sin \theta
\]
\[
y' = -(x - x_0) \sin \theta + (y - y_0) \cos \theta
\]

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 \((y, z)\) and the horizontal/vertical \((x, y, z)\) 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)
Third Line: Adverb + Adjective + Noun (plural, singular) + 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, "__ of __ is the __."

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 barable, 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 be used to identify 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 ensembles. 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 flattened 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 flattened fifth progresses to a fifth, and a descending fifth progresses to a fourth.
3. Not more than five notes in descent or ascension are permitted without a complementary movement.
4. The melody should consist of 35 to 60 notes.
5. The release begins on a dominant 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 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-
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 bass 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 an standardized interface, called MIDI (Musical Instrument Digital Interface) to enable communication 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 responsive 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 choose the 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 parameter 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 (Hd) and time of exposure (T), the formula for computing the new time of exposure (T') at the new height (H) with the same aperture is:
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 EOPS 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:

\[ T_N = \left( \frac{H_n}{H_o} \right)^2 \times T_o \]

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:

\[ H = \frac{F^2}{f \times d} \]

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 plot 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 Display. 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 categorize, 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 IIgs 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.

Genealogical Storehouse. A few hobbyists have obtained a large amount of genealogical 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 genealogical 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 II GS Games
and Recreational Applications

According to various polls, the most popular applications for Apple II GS computers are entertainment and games. Some II GS 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 II GS 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 II GS 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 II GS:

**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 II GS games. Video games, which are exciting and challenging to the player's hand-eye
coordination, place the player against continually increasing enemy boards. 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 depict battlefields and silhouettes 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 require 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 AppleScript 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 hexplaces 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 "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. 7-0, 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.
### Ticktacktoe Variation

An interesting tick-tacktoe variation is played as follows. Each player puts his three pieces on a tick-tacktoe board such that piece ownership alternates around the perimeter 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.

**Tickkannaunph.** Tickkannaunph is a Hopi Indian chase game played on a 4 x 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 Dominos:** players take turns placing dominos on a chess-type board or a board of arbitrary size (8 x 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 dominos horizontally, the second player places his vertically; dominos 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 fall 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 x 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 stalemateing an opponent—that is, by
crapping him so that he cannot complete his turn. For example, if the neutron is completely surrounded by 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.

Hexapawn. This game is played on a $3 	imes 3$ grid, similar to the one used in tic-tac-toe. 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:

- Names and capitals of states or countries, possibly using computer graphics to draw maps.
- Vocabulary words.
- IQ tests.
- Personality and aptitude tests.
- Foreign language vocabulary or grammar.
- Preschool skills including counting and recognizing 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 and anagrams may be computer generated, either from a word list or as a random matrix similar to the popular Baggle™ 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 creating a crossword puzzle. Choose a topic and enter words; the computer will automatically fit the common letters together to form a crossed word 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, but there are difficult programming challenges.

The dialogue with one such program went like this:

<table>
<thead>
<tr>
<th>(c = computer, h = human)</th>
</tr>
</thead>
<tbody>
<tr>
<td>h: What is the word?</td>
</tr>
<tr>
<td>c: Is it a color?</td>
</tr>
<tr>
<td>h: No.</td>
</tr>
<tr>
<td>c: Is it a fruit?</td>
</tr>
<tr>
<td>h: No.</td>
</tr>
<tr>
<td>c: Is it a food?</td>
</tr>
<tr>
<td>h: No.</td>
</tr>
<tr>
<td>c: Is it a tool?</td>
</tr>
<tr>
<td>h: No.</td>
</tr>
<tr>
<td>c: Is it a type of transportation?</td>
</tr>
<tr>
<td>h: Yes.</td>
</tr>
<tr>
<td>h: Car.</td>
</tr>
</tbody>
</table>

**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 II's keyboard and cursor controls. Suggestions for educational children's games include the following:

- Matching Games: children can match letters, words, numbers, and shapes.
- Drawing Machine: a joystick controller or arrow keys permit drawing on a video screen. A
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 programing 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 clear 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 the 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 threat).

**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 growing fire.

**Adventure.** The object of this simulation is survival during a desperate attempt to locate buried treasure on an island.

**C allers.** 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 game that pits a destroyer against a submarine, for example, could be programmed. The game would use a 10 x 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.

**Robot War.** The purpose of this simulation is to teach computer programming. Two opposing players are instructed to secretly design programs, written in a common 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.

**Robot War II.** In this game, you must avoid your opponent, the IIgs, which controls an annihilating robot. 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. Boeing 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 tennis or curling games.

**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.

**Race Track.** The object of this automobile racing game is to finish the race in the least amount of time.

**Skydive.** 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 x 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 modern re-dialer that can’t be interrupted.
Apple IIgs Graphics Routines

- Rectangle
- Point
- Pixel

A 25 pixel screen sample.

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

Apple IIgs Color Routines

320 Mode Color Table *

<table>
<thead>
<tr>
<th>Pixel</th>
<th>Color</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Black</td>
<td>000</td>
</tr>
<tr>
<td>1</td>
<td>Red</td>
<td>F00</td>
</tr>
<tr>
<td>2</td>
<td>Green</td>
<td>0F0</td>
</tr>
<tr>
<td>3</td>
<td>Blue</td>
<td>00F</td>
</tr>
<tr>
<td>4</td>
<td>Teal</td>
<td>088</td>
</tr>
<tr>
<td>5</td>
<td>Brown</td>
<td>066</td>
</tr>
<tr>
<td>6</td>
<td>DarkGray</td>
<td>555</td>
</tr>
<tr>
<td>7</td>
<td>LtGray</td>
<td>AAA</td>
</tr>
<tr>
<td>8</td>
<td>Orange</td>
<td>F80</td>
</tr>
<tr>
<td>9</td>
<td>Yellow</td>
<td>FFF</td>
</tr>
<tr>
<td>10</td>
<td>Magenta</td>
<td>FFF</td>
</tr>
<tr>
<td>11</td>
<td>Cyan</td>
<td>FFF</td>
</tr>
<tr>
<td>12</td>
<td>White</td>
<td>FFF</td>
</tr>
</tbody>
</table>

*Obtained with initColorTable

SCB = Scan line Control Byte, where

Color Routines

InitColorTable
SetColorTable
GetColorTable
SetColorEntry
GetColorEntry
SetSCB
GetSCB
SetAllSCBs

Fig. 7-3. A complete ROM-based graphics toolkit can be used for quickly drawing, moving, and filling on-screen graphics.

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 I#
90 IF I# = 0 THEN STOP
100 FOR X = 7676 TO 7702
110 READ A
120 POKE X,A
130 NEXT X
140 POKE 232,252; POKE 234,29
150 HCOLOR= 1; X = 50; Y = 176
160 HPLT 220,187 TO 275,187 TO 250,190 TO 270,187
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 UNT0 300
250 IF K < 9 THEN GOTO 400
260 IF K = 21 THEN GOTO 500
270 IF K = 19 THEN GOTO 600
280 XRDAW 1 AT X,Y; X = X + 1; Y = Y + 1: IF X > 240 AND Y > 173 THEN GOTO 700
285 Z = Z + 1: IF Z = 1200 THEN GOTO 200
290 IF Y = 177 THEN X = 176
295 GOTO 200
300 XRDAW 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
350 XRDAW 1 AT X,Y: HCOLOR= 1: HPLT X + 10,Y: HCOLOR= 3
360 S = PEEK ( - 16336)
370 X = X - 1: IF X < 1 THEN X = 1
380 POKE - 16368,0
390 UNT0 200
400 XRDAW 1 AT X,Y
410 S = PEEK ( - 16336)
420 IF Y < 174 THEN X = X + 1: IF X > 255 THEN X = 255
430 POKE - 16368,0
440 UNT0 200
500 XRDAW 1 AT X,Y
510 S = PEEK ( - 16336)
520 IF Y > 176 THEN X = X + 1: IF X > 255 THEN X = 255
530 POKE - 16368,0
540 GOTO 200
600 XRDAW 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

Fig. 7.4. Verti-Bird is an arcade-type game that utilizes the Ilgs'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 x 187. This is a delicate maneuver that very few pilots will get exactly right. If you find that you lack this "right stuff," try hoping 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 OS
TRIC; it competed in the First World Computer Chess Tournament. The OS
TRIC 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 subroutine to generate all move possibilities or search the tree.
3. A subroutine 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 subroutine 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 x 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 challenge.
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**

<table>
<thead>
<tr>
<th>Line</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>REM GAME BOARD</td>
</tr>
<tr>
<td>30</td>
<td>HCOLOR = 3</td>
</tr>
<tr>
<td>40</td>
<td>HPL0T 50,50 TO 150,50 TO 150,150 TO 50,150 TO 50,50</td>
</tr>
<tr>
<td>50</td>
<td>Y = 50</td>
</tr>
<tr>
<td>60</td>
<td>FOR L = 1 TO 8</td>
</tr>
<tr>
<td>70</td>
<td>X = 50: IF L = 2 OR L = 4 OR L = 6 OR L = 8 THEN X = 40</td>
</tr>
<tr>
<td>80</td>
<td>FOR Z = X TO X + 10</td>
</tr>
<tr>
<td>90</td>
<td>HPL0T Z,Y TO Z,Y + 10</td>
</tr>
<tr>
<td>100</td>
<td>NEXT Z</td>
</tr>
<tr>
<td>110</td>
<td>X = X + 20: IF X &lt; 150 THEN G0TO 80</td>
</tr>
<tr>
<td>120</td>
<td>Y = Y + 10</td>
</tr>
<tr>
<td>130</td>
<td>NEXT L</td>
</tr>
</tbody>
</table>

---

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 IIIGS'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 futuroists:

- 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 telephone 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 testing, perform integrals and differentials, compute peak areas, RMS values, and peak to peak distances, and n-point averaging; all data can be stored.
- With the addition of silver contacts and a small amplifier, your computer could serve as a bi-feedback 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 digitized 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 flush 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 computers 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; 600-526-0027. 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 393, 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.


Technicom International, 23 Old Kings Highway South, Darien, CT 06820; (203) 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.

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 output 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) resellect 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 an Apple IIGs, including the
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.
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 imagination with thoughts of robotic slaves, the reality is 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-
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 $659 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, a 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 speed is also known as the baud rate. Baud rates for Apple IIgs 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
1001 Things to Do With Your Apple Ics

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):

A Sampler of Information Networks

CompuServe

CompuServe, Consumer Information Service, 5000 Arlington Center Blvd., P.O. Box 20021, Columbus, OH 43220; (614) 489-8199 or (614) 457-0812 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.

Databases

Vast information is available to many Apple users 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 request. 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 Rf. 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, and general reference.

CompuServe

CompuServe, Consumer Information Service, 5000 Arlington Center Blvd., P.O. Box 20021, Columbus, OH 43220; (614) 489-8199 or (614) 457-0812 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) 237-1927. 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) 237-5114. This business-oriented service provides financial information, including stock prices, financial data, and company news.
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.

The Banques
Business and Society
Review
Business Week
Cash Flow Magazine
Dun's Review
Federal Reserve Bulletin
Financial Executive
Fortune
Fortune
Futurist
Harvard Business Review
Medical Economics
Wharton Magazine

MEDIA GENERAL STOCK ANALYSES
Overview
Instructions
Categories of Stock Comparison
Definitions of Data Fields
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

Margins & Acquisitions
Identity Labor
Review
Office, The
Practical Accountant
Stem Management
Review
Taxes
Venture
Vital Speeches
Wharton Magazine

BESTSELLERS LIST
RADIO PROGRAMS TO ORDER
RAYLIX FINANCIAL SERVICES
SCIENCE & ENGINEERING
SELF-PERCEPTION
SMITHSONIAN EXHIBITS
AND TOURING EXHIBITS
SPECIAL APPLICATIONS
STUDENT AIDS
TAXES

Assets
Calculation of Income Statement
Computing Taxes
Contributions
Credit
Debt
Deductions
Dependents
Depreciation Schedule
Donations
Expenses
Income Statement, Pro Forms
Income Tax
Taxes
TRAVEL CLUB
UNITED STOCK
UNITED PRESS
INTERNATIONAL (UPI)
USER PUBLISHING
VOICE PROGRAM
WEATHER
WINE
WISDOM OF THE AGES

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 subroutines 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

```plaintext
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 28
70 GOTO 20
```

### Listing 10-2: Matrix Arrays Program

```plaintext
10 REM MATRIX ARRAYS
15 HOME : PRINT : PRINT "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 PRINT "ROW ":X$
95 IF X$ = "END" THEN END
100 INPUT "COLUMN ":Y$
110 IF Y$ = "END" THEN END
115 PRINT M(X,Y)$
120 GOTO 90
```

### Listing 10-3: Shape Table Program

```plaintext
10 REM SHAPE TABLE
20 FOR X = 7676 TO 7689
```

### Listing 10-4: Create Sequential File Program

```plaintext
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

```plaintext
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
```

### File Handling Routines

The listings below are sequential file handling routines.

### 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, genealogical, 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.
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 synonymous 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, length, and the reading level based upon any of the standard formulas developed by Flesch, Fry, Raygor, Dale Chli, or Spache. For instance, the Fog index (FI) is given by

\[
FI = \left( \frac{total \, no. \, words}{total \, no. \, sentences} + \frac{no. \, "hard" \, words \times 100}{total \, no. \, words} \right) \times 4
\]

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 Apple 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:

The IIgs can act as an intelligent typewriter for the handicapped. One system was used by a para-legue 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
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 peak 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 newer 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 carpoolers, and paired athletes according to individual characteristics. Digital cupid playing, however, is best taken tongue-in-check 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 incorporated 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-
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 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 Pundlak 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
merry 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.
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 contribu-
tion to business productivity with its excellent word
processing package, Writer’s Choice elite.

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

Baudville
1001 Medical Park Drive, S. E.
Grand Rapids, MI 49506
(616) 957-3036
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 graphics. 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
Sanitee, CA 92071
(619) 562-3221

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.
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) 826-5396

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.

**MIIdeas, 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**

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<th>Command</th>
<th>Description</th>
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<td>Absolute value</td>
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<td>ASC</td>
<td>ASCII conversion</td>
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<td>Arc tangent</td>
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<td>Cosine</td>
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<td>Exponential</td>
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<td>FLASH</td>
<td>Flash screen</td>
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<td>GET</td>
<td>Get character</td>
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<td>GOSUB</td>
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<td>GOTO</td>
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<td>Go to relative position</td>
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<td>HCOLOR=</td>
<td>Set color to relative position</td>
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<td>HGR2</td>
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<td>HIMEM enable</td>
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<td>HLIN</td>
<td>Home line</td>
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<td>HOME</td>
<td>Home position</td>
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<td>HPLOT</td>
<td>High resolution plot enable</td>
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<td>HTAB</td>
<td>Home tab position</td>
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<td>IF</td>
<td>If statement</td>
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<td>IN#</td>
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<td>INVERSE</td>
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<td>LEN</td>
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<td>LOMEN:</td>
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<td>MIDS</td>
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<td>NEW</td>
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<td>NEXT</td>
<td>Next line</td>
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<td>NORMAL</td>
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<td>NOTRACE</td>
<td>Notrace display</td>
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<td>ON</td>
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<td>PDL</td>
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<td>PLOT</td>
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<td>POS</td>
<td>Position statement</td>
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<td>PR#</td>
<td>Print statement</td>
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<td>PRINT</td>
<td>Print character</td>
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<td>ROT-</td>
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<td>RUN</td>
<td>Run program</td>
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<td>SAVE</td>
<td>Save screen</td>
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<td>SCALE=</td>
<td>Scale enable</td>
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<td>SCRN</td>
<td>Screen function</td>
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<td>SGN</td>
<td>Sgn function</td>
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<td>SPC</td>
<td>Spacing character</td>
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<td>Speed enable</td>
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<td>SQR</td>
<td>Square root</td>
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<td>STOP</td>
<td>Stop program</td>
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<tr>
<td>STRS</td>
<td>String function</td>
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<tr>
<td>TAB</td>
<td>Tab character</td>
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<td>TAN</td>
<td>Tangent function</td>
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<td>Trace display</td>
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<td>Then statement</td>
</tr>
<tr>
<td>USR</td>
<td>User function</td>
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<tr>
<td>VAL</td>
<td>Value function</td>
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<tr>
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<td>Virtual line number</td>
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<tr>
<td>VTAB</td>
<td>Virtual tab position</td>
</tr>
<tr>
<td>WAIT</td>
<td>Wait character</td>
</tr>
<tr>
<td>XDRAW</td>
<td>Xdraw function</td>
</tr>
</tbody>
</table>

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Appendix D
A Brief Tour of the Apple II GS 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 forerunner 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 IIe, 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 IIc. The IIc was a portable Apple lacking the sophistication found on the IIe. 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
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 6553816 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 6553816 has some impressive performance features:

- CMOS design; low-power consumption
- 16-bit data registers

A Brief Tour of the Apple IIgs Environment

- 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 6553816, 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
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 are only available on an analog RGB monitor. The first mode is called 320 mode. A total of 320 x 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 x 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 IIc owner. In this example, an Apple DuoDisk 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 IIc 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 IIc software line which functions similar to the Apple Computer Macintosh desktop metaphor.
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 Compatibility**

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, 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.

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.

---

**Fig. D-8:** 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 . . .

Adison-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. Proehnow, *Epson, Epson, Read All
About It!*
- demonstrates the connection and programming
  of Epson dot-matrix printers with Apple II com-
  puters.

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 Ap-
  ple 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 Pro-
gramming
- a superb sourcebook for information on the
  653C816 instruction set.

Leventhal, L., 6502 Assembly Language Pro-
gramming
- includes examples of assembly language pro-
gramming for the 6502 microprocessor.
Leventhal, L. and W. Saville, *6502 Assembly Language Subroutines*  
-a programmer’s book of subroutines for the Apple IIe 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  
Glennview, 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.

-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.

**alphabet**—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 form of a typewriter keyboard, that the computer operator uses to communicate with the computer itself.

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.

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**Typical Parallel Port Pin-out**

<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Strobe</td>
</tr>
<tr>
<td>2</td>
<td>Data Bit 1</td>
</tr>
<tr>
<td>3</td>
<td>Data Bit 2</td>
</tr>
<tr>
<td>4</td>
<td>Data Bit 3</td>
</tr>
<tr>
<td>5</td>
<td>Data Bit 4</td>
</tr>
<tr>
<td>6</td>
<td>Data Bit 5</td>
</tr>
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<td>7</td>
<td>Data Bit 6</td>
</tr>
<tr>
<td>8</td>
<td>Data Bit 7</td>
</tr>
<tr>
<td>9</td>
<td>Data Bit 8</td>
</tr>
<tr>
<td>10</td>
<td>Acknowledge</td>
</tr>
<tr>
<td>11</td>
<td>Busy</td>
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<tr>
<td>12</td>
<td>Paper Out</td>
</tr>
<tr>
<td>13</td>
<td>Select</td>
</tr>
<tr>
<td>16</td>
<td>Initialize</td>
</tr>
<tr>
<td>19 + 25</td>
<td>Ground</td>
</tr>
</tbody>
</table>

Fig. G-2. The pin assignments for a typical parallel Centronics-type printer port.
Typical RS-232C Port Pin-out

<table>
<thead>
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<th>Pin</th>
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</thead>
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<tr>
<td>2</td>
<td>Transmit</td>
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<td>3</td>
<td>Receive</td>
</tr>
<tr>
<td>4</td>
<td>RTS</td>
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<td>5</td>
<td>CTS</td>
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<td>6</td>
<td>DSR</td>
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<td>Ground</td>
</tr>
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<td>CD</td>
</tr>
<tr>
<td>20</td>
<td>DTR</td>
</tr>
<tr>
<td>22</td>
<td>Ring</td>
</tr>
</tbody>
</table>

I  1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16  17  18  19  20  21  22  23  24  25

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.

Glossary

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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   Here is a comprehensive summary of CICS functions, design considerations, and related software products acquint you with the concept of on-line data processing and its established role in current computer design. You'll cover system design, screen painting techniques using SDF to create input/output maps, the use of CEI, VSAM (virtual storage access method), all the CICS commands and how they relate to system design. 272 pp., 204 illus.
   Hard $26.95
   Book No. 2843

□ THE GEM™ OPERATING SYSTEM HANDBOOK—Dave Prochnow
   Here is your chance to discover how GEM can turn your IBM PC/XT/AT or compatible into a Macintosh-like machine with all the easy-use features of mouse and icon control without sacrificing the power, expandability, and large software choice offered by your IBM. You'll be introduced to GEM's portable programming concepts, the GEM programmer's tool kit, and GEM's application programs including GEM Draw, GEM Paint, and GEM Write. 256 pp., 137 illus.
   Paper $16.95
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