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COMPUTE!

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August, 1981
Issue 15
Vol. 3, No. 8
63379

The Journal For Progressive Computing™

Keyword For The PET/CBM

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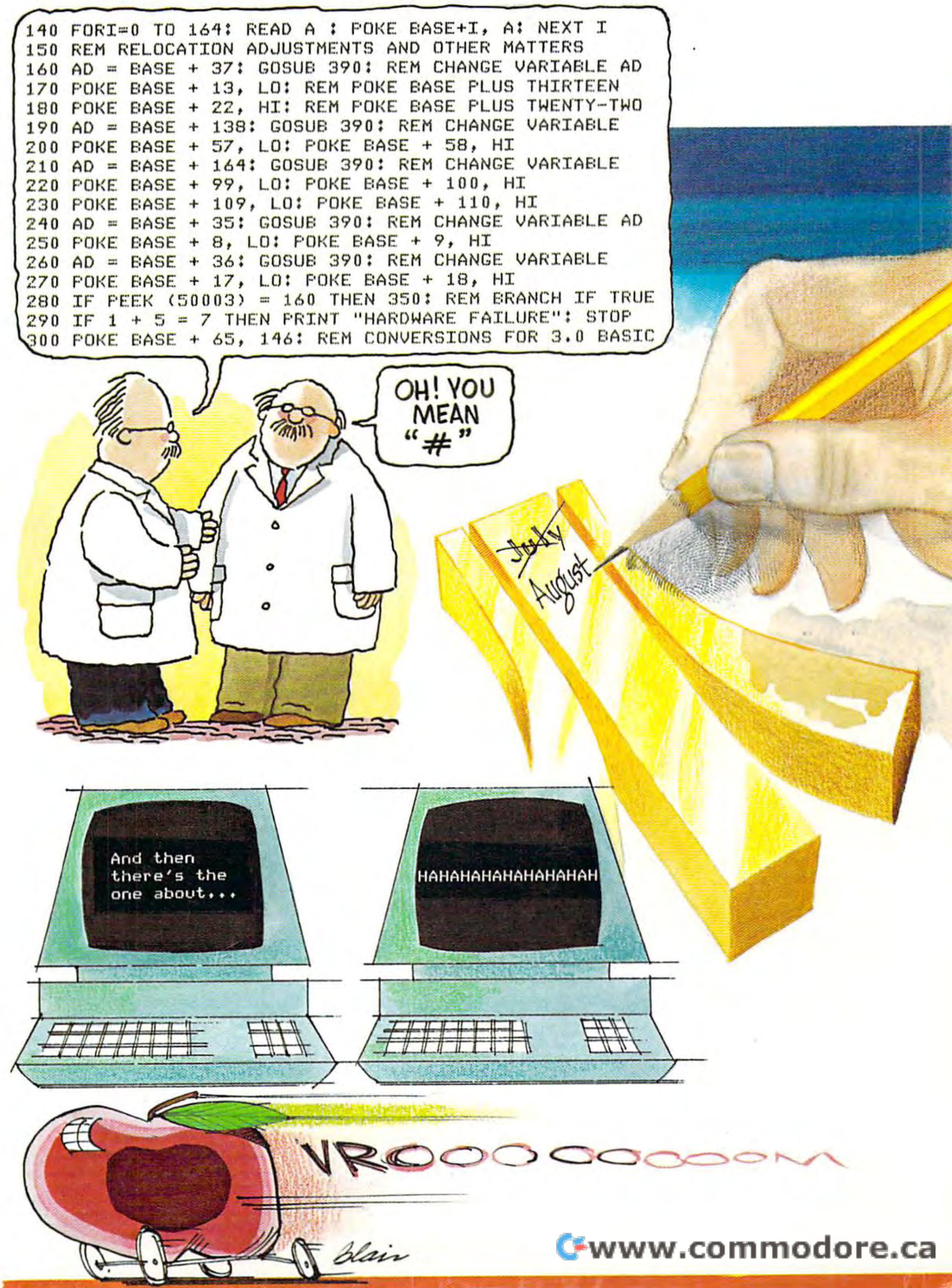
BASIC Oneliners: Minimize Code And Maximize Speed

Apple Disk Motor Control From Your Program



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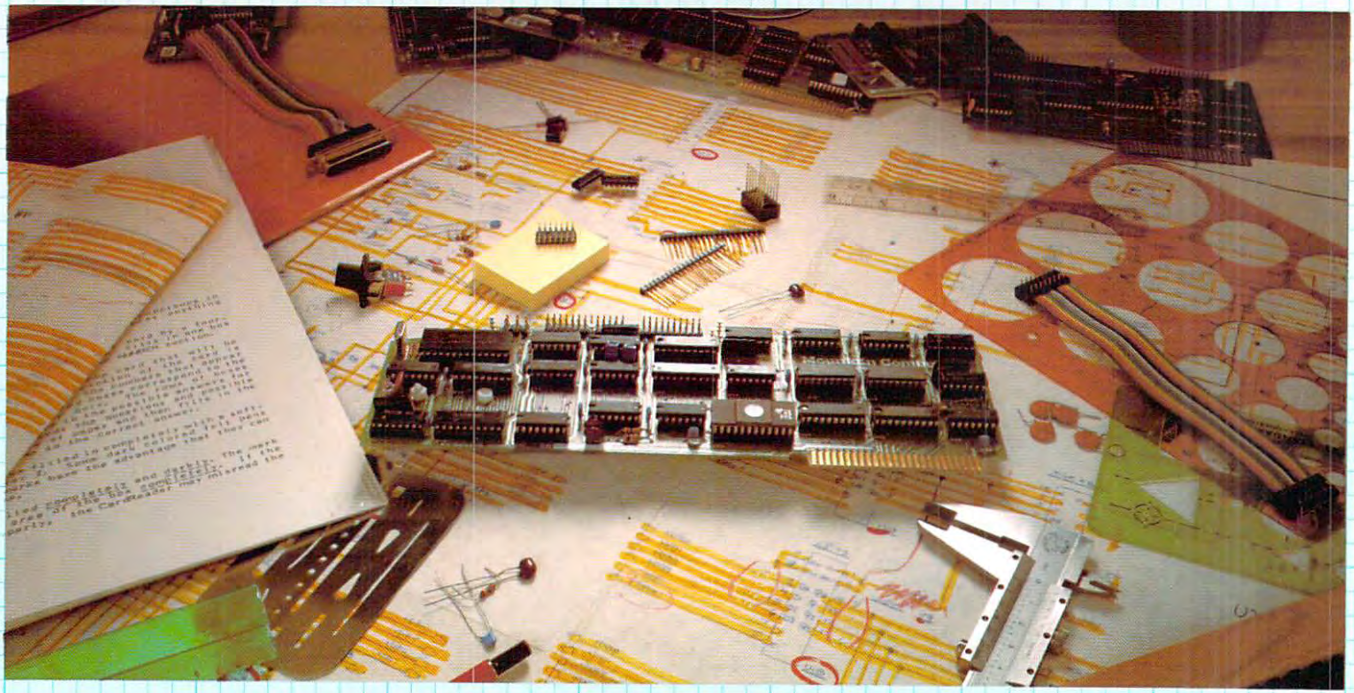

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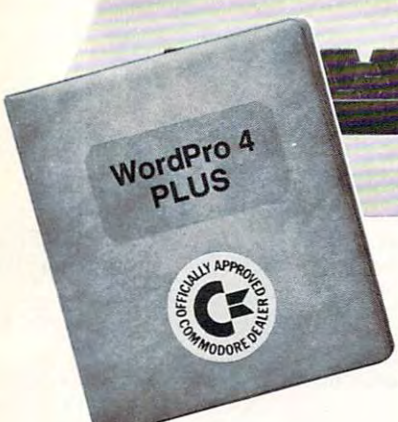

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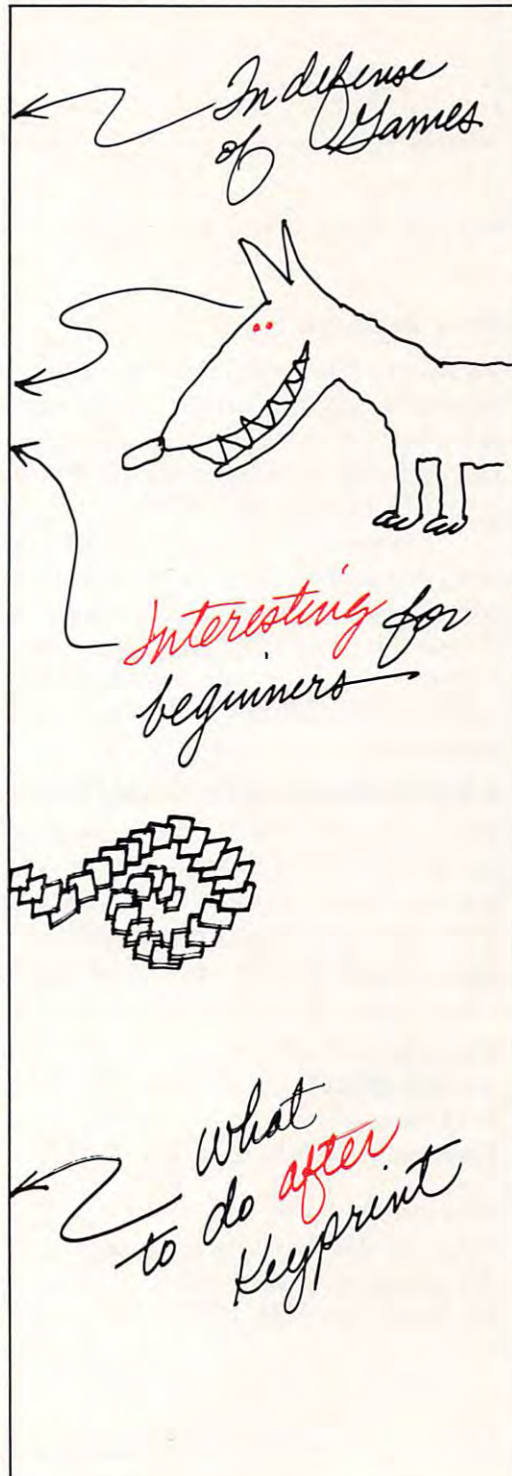
Table of Contents

August, 1981, Vol. 3, No 7



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The Editor's notes...

Robert Lock, Editor/Publisher

Dear Readers,

In the midst of moving our offices to larger quarters, getting caught up in our production schedule, and finally convincing ourselves that our growth is keeping up with yours, I'd like to provide a totally reflective editorial.

I suppose I should preface these remarks with a promise that we'll reopen the question of software and copyright protection in the September issue. Please keep your comments coming. And my sincere thanks for the time and consideration obvious in your recent responses.

A Reflective Note On COMPUTE!'s Columnists

We have many of the best writers in this industry as COMPUTE! supporters. Most have been a part of the vision of this user resource magazine since our beginning less than two years ago. All are unique, all are versatile, all are enthusiastic.

I realized this week, while contemplating our growth, the tremendous value to me of the simple mechanism of Editor's Feedback cards. This issue we're sharing. You'll find them replaced by several Author's Feedback cards. If you've never written your favorite columnist a letter, take the time to drop him or her a note. And thanks again, not only for your support of **COMPUTE!**, but also for your support *as* **COMPUTE!** We're that kind of magazine — our columnists share a belief that this industry of ours will soon touch — visibly — the lives of much of the world. And all encourage that.

Send a postcard. They'll appreciate it, and grow stronger from your feedback. I know I have in the last two years. Thanks!

Robert Lock

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Ask The Readers

Robert Lock And Readers

Here are this month's questions... If you have an answer to any question here (or a question of your own), send it to "Ask The Readers," **COMPUTE!** Magazine, P.O. Box 5406, Greensboro, NC 27403.

"I am MOST happy to see articles beginning to appear that deal with the newer disc DOS (especially DOS 2.1). I am looking forward to more, I would particularly like to find a "map" that would tell me where the flag is that tells DOS 2.1 when the disc has been inserted, and assorted things like that.

Another important area that has not been covered by ANYBODY (including COMMODORE) is maintenance of the disc drives! My 8050 has been operating in a NON-airconditioned environment for nearly a year now with virtually NO maintenance! I find it hard to believe that it is not due for a "grease job & oil change" soon. The poor thing faithfully serves 2 PETs, an ancient 2001 (with 24K Expandapet & an MTU Integrated Video Memory), and a newer 'religious' 2001 (holy main PCB that I wired around to bring it up to 32K). Both units use BASIC 3.0, one has a DISC-O-PRO/TOOLKIT). I want to do right by it — HOW?

I just got hold of an English PET magazine — WOW the ROMs that they advertise! Why haven't US companies been producing like that?

I'd also like to mention that a friend of mine recently purchased AB Computers' PAPERMATE (on my advice) and got the same good service that I got last year when I bought PAPERMATE (good software at a reasonable price I won't copy for a friend)." R. Vanderbilt Foster

Here are some excellent ideas. The CBM disk drives are full of still unexplored code, waiting to be mapped. Also, **COMPUTE!** is looking into the question of drive maintenance — we hope to provide some definitive answers soon. Anyone with experience in this area, please share your views.

"An electronics instructor at our school is interested in purchasing film, filmstrips, cassettes, and videos to explain computer capabilities and functions for his students. Do you have sources of such information?" Rita Norton

---

"I wonder if you could give me some helpful information on a problem that I have with my computer system. I have an ATARI 800–48K RAM computer.

I recently purchased an ATARI Assembler Editor cartridge and I have had trouble ever since. Here's what happens: on page 68 of the Assembler Editor Users Manual is an Example No. 1 program.

I type this program into my computer and save on tape recorder 410 model. It appears to me that it seems to be being recorded on the 410 recorder. I get about 12 tone beeps while listening to the TV speaker while saving the assembler program and then it stops.

Then I replace the Assembler Editor cartridge with the BASIC cartridge and attempt to load the program from the tape recorder. But after about 3 tone beeps, the recorder stops and the screen will display either a dark screen or an endless loop of fast moving, what appears to be lowercase characters and graphic symbols. Almost too fast to read.

I have spoken to the ATARI people in Caifornia several times — received their errata manual — followed the corrected instructions and still have no success in loading tape program into the computer.

I haven't gotten past the Example 1 program on page 68 or the Assembler Editor Users Manual. If I don't solve this problem I might just drown the Assembler cartridge in the Potomac River. HELP!!!" Tony Pilato

Several readers have raised this question. See if this solves the problem for you — before heading for the river.

```
100 GRAPHICS 0:TRAP 230
110 PRINT "Insert tape, press RETURN"
120 OPEN #1,4,0,"C:"
130 GET #1,X:GET #1,X
140 GET #1,X:GET #1,Y
150 START=X+256*Y
160 GET #1,X:GET #1,Y
170 FINISH=X+256*Y
180 PRINT "Code being loaded at ";START
190 FOR I=START TO FINISH
200 GET #1,X:POKE I,X
210 NEXT I
220 PRINT "Code ends at ";FINISH
230 CLOSE #1
240 END
```

"Is there any way of saving a PET/CBM program and have its variables and strings saved with it, in such a way that it can be reloaded and continue processing, from a

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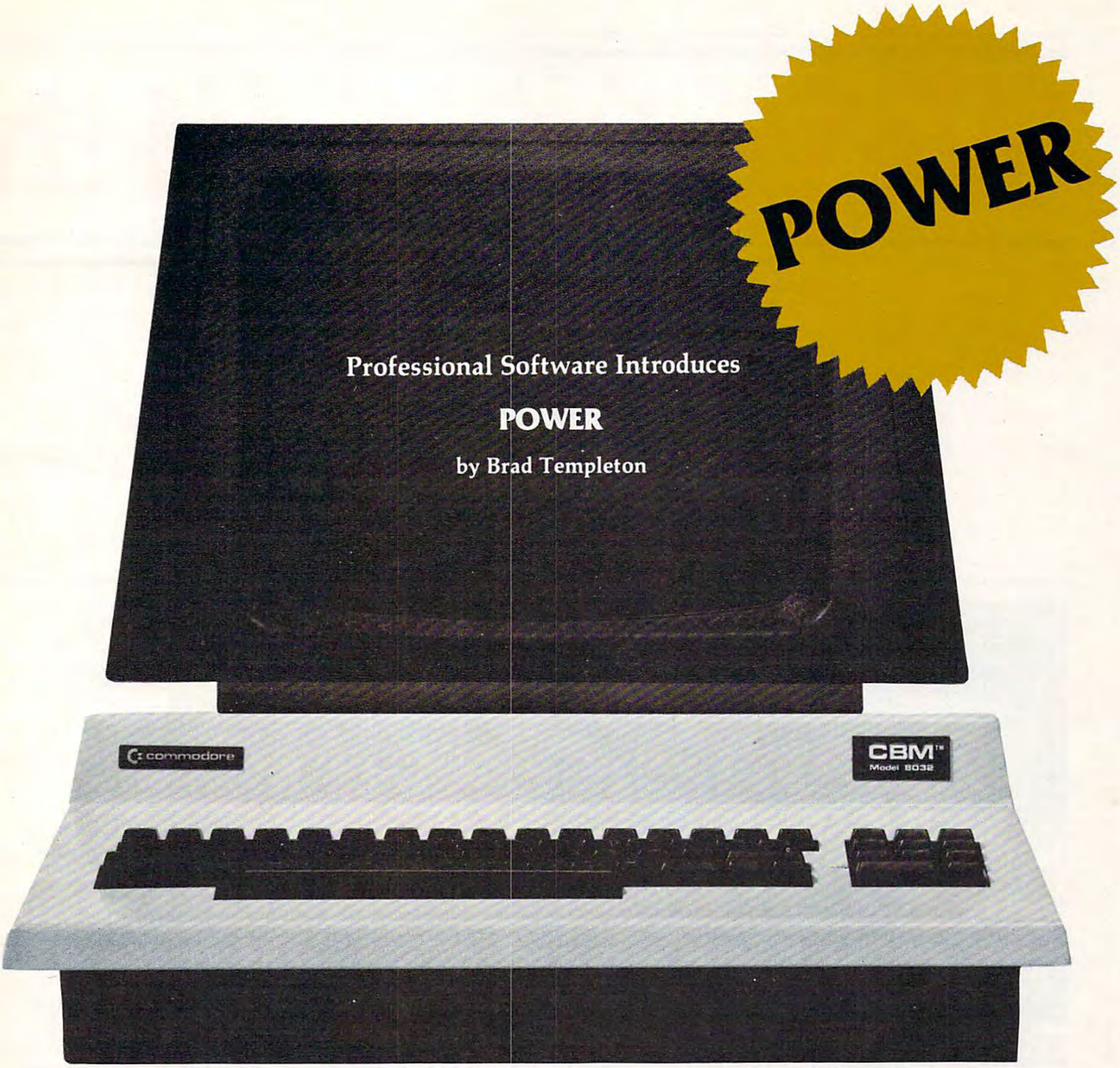

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main menu?

I have tried saving the BASIC vital pointers, from location 122 to 135 (original ROMs) and saving all of memory. I would then reload all of the memory and restore the pointers and it would still not work.

Can someone please help me?" John Lemkelde

"I am an Amway distributor and am looking for a distributor software package for the Apple II+ computer. I have gotten several brochures based upon other computers; however, as sales representative with two companies which handle Apple, I tend to lean to it — that's the one I'm more familiar with." McBee Barbour

---

"I have an Atari 800 and have taught myself to write programs for it. However, I want to use a sort program to alphabetize a list of names and I can't work it out.

I would appreciate it if you would ask your readers if they can help me, or have **COMPUTE!** *publish such a program if there is a demand for one. I have tried sorts written for other computers, but they don't work on the Atari."* Irwin Kaplan

You are probably trying to use sort programs written for Microsoft BASIC (Atari's BASIC is significantly different). **COMPUTE!** will soon be publishing an Atari machine language sort.

"I am writing a program for a CBM 8032 which involves input of possibly large data sets by the user. Is there a way to 'trap' an overflow error, caused by erroneous entry of a datum, so the BASIC program won't bomb out completely? I would like a way to allow 'graceful' recovery by the user, so he won't have to start his data entry again from the beginning if he makes such an error." Don Barr

---

"I have a problem — maybe someone out there knows the answer.

I bought the "VOTRAX TYPE'N TALK" text to speech synthesizer for my ATARI 800 computer. Does anyone know how to program and interface the synthesizer to the ATARI 800?

They (VOTRAX Company) must think I have ESP. The 30 page booklet they provide doesn't tell you much on programming or whether or not the synthesizer is even compatible with ATARI or any other computer for that matter.

I'm only a computer hobbyist, not a programmer. $345 is nothing to sneeze at on something I don't know how to use." Edward A. Sweeney

---

"A keypad for entering repetitive numerical data is certainly a convenience. Is the Atari 'keypad' used in the video game computer compatible with the Atari 800 and can it be used for this purpose?" Jerry Stern, M.D. ©

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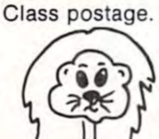

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Computers And Society

Some Speculations On The Well-Played Game, Part 2...

David D. Thornburg
Innovision
Los Altos, CA

Last month I responded to a **COMPUTE!** guest editorial by Alfred D'Attore in which he suggested that the major legitimate use of personal computers in schools was for the generation of rote drill and practice exercises. From my perspective, based on several years experience conducting workshops, talking with teachers, and, most importantly, talking with children, I have observed that there is a great deal of benefit in having carefully chosen computer games in the classroom.

This month I want to explore two issues. First, I want to describe some games which I have found to be both enjoyable to students and well stocked with educational content. Second, I want to explore some of the possible hidden reasons behind some teachers' reluctance to allow computers in the classroom.

The games I will describe represent only a small sampler of high quality educational software. There are many more games which are both high in intrinsic motivation and which provide practice in traditional school subjects.

Because I have acquired these games from many sources over the years, and because these games reside on various computers, I want to make a brief disclaimer. First, I am not the author of any of these games, nor, in most cases, do I know who the author is. Second, several of these games appear under several names in the marketplace. I have made no attempt to identify the originator of any of these games, nor do I know the copyright status of any of them. I am describing these games only to illustrate their value in the classroom. Any reader who wishes to generate an implementation of any of these games has the personal responsibility for first determining the copyright status of the game.

Since Mr. D'Attore was most concerned with math drill, I will cover that area first. As many of you know, there are many games which require various levels of computational skill. Here are two of my favorites:

Knockdown – This game is an excellent tool for providing drill. The game can be played against the computer or against another player. Each player has a number line with the numerals one through nine on it. Each player takes turns having the computer roll a pair of dice. The player then takes the numeral corresponding to the sum of the points on the dice. If that number has already been taken, or is larger than nine, then the numerals corresponding to each die are taken. If one or both of *these* numbers is covered, then any other two numerals which generate the same sum can be taken. Play alternates until one player cannot complete a move. The second player then continues playing until he or she is similarly stuck. The player with the highest score (determined as the sum of the covered numerals) wins.

... describe some games which I have found to be both enjoyable to students and well stocked with educational content.

During the course of the play, each player gets several opportunities to add two numbers as well as to perform relational tasks, such as figuring out that 3 + 4 is the same as 2 + 5.

I have used this game in a first grade classroom where it was well received by both students and teacher alike. Several weeks later I was conducting a school-wide workshop at the same site and several first grade students specifically asked me if I would let them play this game again.

Not a bad response for a pure math drill game!

Maxit – My first exposure to this game came from the PET version written by Harry Saal. I have since seen implementations under different names on the Interact and on the Atari computers. A nice board-game version called "Tally Up" is made in Israel.

In Maxit, a square grid is formed of randomly chosen numbers. In some implementations of this game, both positive and negative numbers are used. Play is against the computer or against another player. At the start of the game, a marker is placed randomly on the grid. The first player is allowed to move the marker horizontally, choosing a number to capture. Choosing the number fixes the column from which the other player (or the computer) must take a number. Once a number is taken, it is added to the player's score. When the next player chooses a number from the column, this fixes the row from which the first player must take the next number. A sample grid is shown

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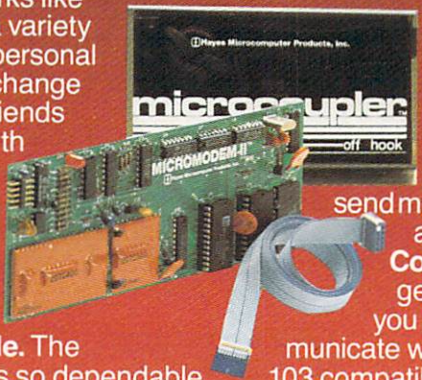

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below:

3	4	3	0	2
7	1	4	3	8
5	*	6	4	1
1	5	9	4	2
0	1	9	8	1
2	1	6	5	0

The asterisk is the starting marker position.

Suppose it is the first player's turn. To maximize the score, the player could take the 6. However, the second player could then take a 9 for a net gain of 3 points. If the first player took the 5, the second player could only gain 2 points by taking the 7, in which case the first player could take the 8 and stick the second player with very low numbers.

As you can see, the game can be played at many levels. All computer-based versions I have seen play perfect games at one level of "look-ahead." Since many of the children I have seen are able to attain this level of play fairly easily, evenly matched games can be achieved with a small amount of practice.

While most players do not consciously add up each possibility and analytically determine the best choice, many people do perform the subtraction of the present choice from the probable next move in order to assess the validity of each choice. In addition to providing incentive for acquiring simple subtraction skills, this game also hones children's intuition in numeric relationships. Many children make explicit statements of their reasoning process during the play of the game; e.g., "Well, if I take the 9 he has to take the 4, but then he can stick me with the -10 and take the 15."

I have seen children spend hours on this game.

Among *reasoning* games which help develop intuition in the solution of multi-variable constraint problems, my favorites are the simulations Lemonade (from the Minnesota Educational Computer Consortium) and Hammurabi.

In both of these games the player is given control of an economic environment based on a model which has a certain level of uncertainty built into it. In Lemonade, the player runs a lemonade stand and has to purchase advertising and raw stock for each day's transactions. After setting a price, the results of the day's sales are determined. Generally, increased advertising increases sales, an increase in prices decreases sales, and so on. Chances of rain (and occasional hot summer days) are just two of the many external factors which are used to make this game more challenging.

Hammurabi (sometimes called Kingdom) has been around for ages. This simulation involves the planting, harvesting, and sale of grain, with resource management being the major goal. Success brings more workers to the city (thus requiring that they be fed), shortages of grain cause starvation, thus reducing the work force available to plant the next year's crop.

Both of these simulations are easy enough for most school age children to handle. While aiding in the development of general reasoning ability, these games help develop decision-making intuition, and the ability to make trade-offs.

Many more strategy games are useful in the classroom as well. Games such as Othello (a.k.a. Reversi, Roman Checkers) and Mastermind (or Logicolor) come to mind. The point is that there are hundreds of games which are well suited for use in the classroom. The well stocked school should have many games to choose from. Games like Hurkle, Hangman, Wumpus, Quest, Stars, Darts, Concentration, etc. can all find utility in the classroom for the acquisition and reinforcement of various skills in math, language, and general reasoning.

A curriculum which is too inflexible to allow the use of these games should probably not be using computers in the classroom at all.

A curriculum which is too inflexible to allow the use of these games should probably not be using computers in the classroom at all.

The second topic for this month is my speculation on the origins of the concern I have heard expressed by teachers who want to keep computers out of the classroom. While many of the teachers I meet are quite excited about the use of personal computers, there are some who are adamant in their refusal to consider the use of this technology.

Many of the reasons given arise from important and potentially valid concerns. Are computers going to be under-used, high priced gimmicks, as some of the early and heavily-pushed audio/visual equipment was? Can a teacher, working against a fixed lesson plan, depend on the availability of textbook-specific software to provide an integrated program of instruction? The answers to these and other questions provide some valid points of concern which will diminish the use of computers in certain schools. It is not sufficient to say that, someday, these problems will be solved. Teacher's workloads and budgets leave little time for conducting sky-blue experiments. And yet there is one area where computers are most appropriately used in our schools, and that is in the development of computer literacy. The fact is that computers are here to stay. This technology is too powerful and too ubiquitous to be left out of the school curriculum much longer.

There are those teachers who say that the

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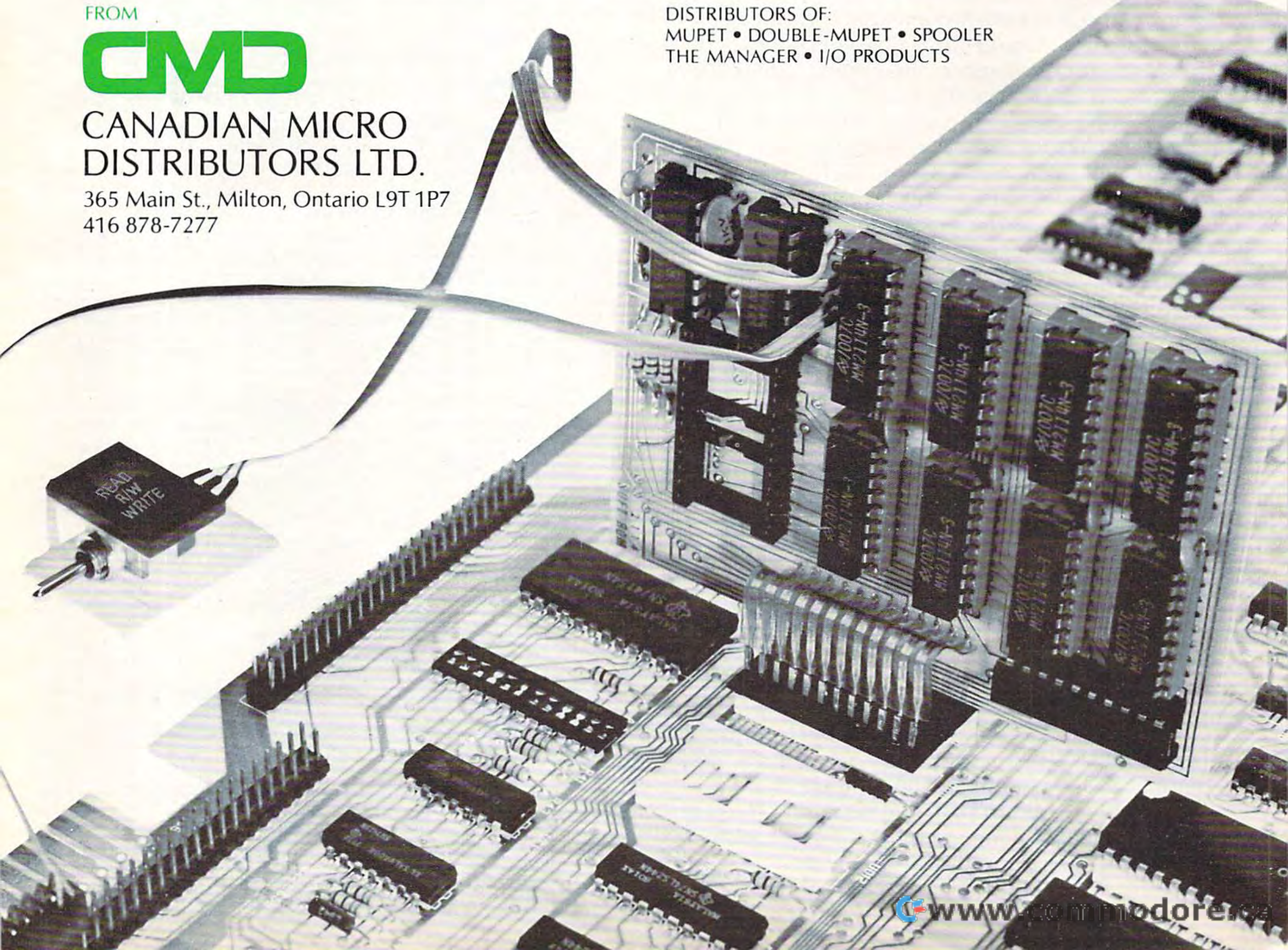

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computer is a waste of the child's time. The fervor with which I have heard this argument expressed suggests that many of these teachers have deeper fears regarding this technology than they are prepared to acknowledge.

Some youngsters gain mastery of the computer before the teacher does. Some teachers feel threatened by this. Perhaps an even deeper cause for computer-phobia among some teachers is the concern that the computer gives the student too much control over the school environment. When discoveries are being made by a child who is programming his own computer, there is no clear way for many teachers to measure, or even monitor, the student's progress. It is probably not easy for a teacher with no programming skills to share the joy of a child who has successfully created an animation of a ball moving across the screen. The more a teacher is concerned with the acquisition of specifically measurable skills in highly compartmentalized areas, the less likely she or he will be able to appreciate the tremendous amount of "learning" which takes place during the child's time with the machine.

Perhaps an even deeper cause for computer-phobia among some teachers is the concern that the computer gives the student too much control over the school environment.

From the perspective of the child, the creation of the truly low-cost computer and the associated creation of the consumer computer industry will allow our children to gain mastery of these devices anyway. It remains for the schools to decide what role, if any, they want to have in providing educational opportunities for our children in this area.

Frank Herbert Made Simple...

I have received a great many letters from readers of my review of "Without Me, You're Nothing" by Frank Herbert. Those of you who wrote, called, or electronic-mailed responses to me shared my concern for the lack of technical accuracy I noticed in the book. Of special concern was Mr. Herbert's constant use of "disk driver" when he was referring to a disk drive.

I am especially indebted to Dan Howard, from Oakland California, for pointing out that a "Disk Driver" is the pilot of a flying saucer!

Many thanks to Dan and the many others of you who took the time to write. After all, without *you*, this column is nothing! ©

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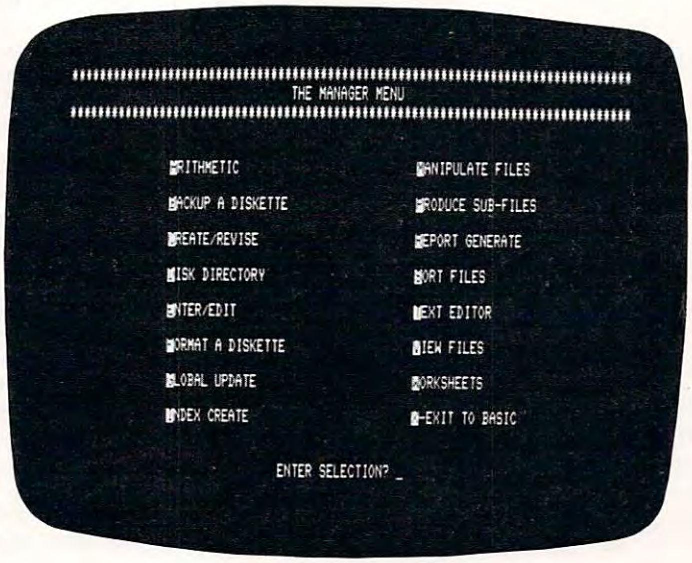

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The Beginner's Page

Richard Mansfield
Assistant Editor

Subroutines are one of the most important tools used in computer programming. They are, simply, small programs. (The words *routine* and *program* mean essentially the same thing.) Subroutines nestle within larger programs and provide essential services to the host program. Often a subroutine is *called* by the host many times during the *run* of the program.

The key difference between subroutines and larger programs can be illustrated by the fact that the human thinking process works the same way: large jobs are broken into smaller jobs. Each smaller task can then be solved as a separate unit. If we were not able to think in this way, we would not be able to think at all.

Subroutines and Pizza

The power of subroutines derives from two important factors: *repeatability* and *portability*. If you make a telephone call to order a pizza, your mind first breaks the problem down into sub-problems (some of them are so small that you are not even conscious that they are involved). You walk to the telephone, dial the number, hear a busy signal, replace the receiver, dial again, place your order, give your home address, and replace the receiver again. In this entire "program," your brain was mainly using subroutines.

Within the pizza-ordering job are many small jobs. Both replacing the receiver and dialing had to be done twice within the program. This is repeatability. The instructions for replacing the receiver, walking, recognizing busy signals, and so forth, would not appear *each time they were used* within a program. Rather, they are written only once, and in one place, and can be used whenever needed. Subroutines are also portable. They do not belong specifically to one particular task. They can be lifted out of one program and inserted into a different program. Dialing is also a subroutine when calling the police.

Whenever you are doing something "unconsciously," like driving, or walking to the phone, you are on auto-pilot and you are thinking about something else altogether. Long ago, your brain set aside a zone called "how to walk" and you do not need to figure out these complex muscle interactions each time you get off a chair. Instead, you call a subroutine. Your brain, like a computer, already knows how to perform many of the often-repeated jobs which, once learned, need not be "programmed" again. In the same way, you will want to build a library of subroutines for your computer.

When you first get a computer, it knows many subroutines (BASIC is a library of subroutines), but you will find that your own programming efforts will result in a growing collection of short, common routines. You might be writing a game which simulates a financial disaster and need to round some numbers to two decimal places. Before trying to write that section of the program, you

GENERAL GLOSSARY

K. Kilobyte. 1024 bytes (units of computer memory).

6502 or **CPU.** The chip (a piece of plastic with a lot of electronics inside it) within the CBM that "thinks." As opposed to the chips that "remember" such as RAM and ROM chips.

RAM. Read/write memory (can be changed).

ROM. Read Only Memory. A permanent memory. BASIC is in ROM so that when the computer is turned off, it can still remember BASIC.

Disk. A magnetic disk for storing data. Looks like a limp 45 RPM record. Also called "floppy." Used in a machine called a Disk Drive.

MODEM. MOdulator-DEModulator. Allows a computer to call other computers on the telephone and send or receive information.

IEEE-488. Pronounced I-triple-E. A standard interfacing (connecting) scheme to add peripherals (disk drives, printers, etc.) to a computer.

ASCII. Pronounced ASK-EE. American Standard Code for Information Interchange. Assigns a number (0-255) to each letter of the alphabet and other familiar symbols such as quotes, commas, etc. This is how the computer, which deals in numbers only, can also manipulate text. After A=65 and B=66, the computer can easily alphabetize.

Machine language. As opposed to BASIC and other "higher-level" languages — machine language (ML) is the *computer's* language, it's way of seeing a list of instructions (a program). What BASIC does is to stand between the human and the machine and translate English words into ML. PRINT, for example, is transformed into a long list of ML instructions which can communicate the idea of PRINTing to the 6502 "brain" of the computer.

Monitor. Or "machine language monitor" is a program which helps to simplify machine language programming. Several popular "extensions" add power and versatility to the monitor. Original ROM CBM's do not have a built in monitor.

Assembler. A program which makes machine language programming even easier by recognizing alphabetic information and translating it into true, numeric machine language.

Hexadecimal. Or "hex," is a way of counting which uses groups of 16 rather than the familiar decimal 10. When it gets to 9, it starts using A through F. It is sometimes convenient in ML work.

Garbage collection. Sometimes the computer must get rid of old strings (text variables) which are not needed anymore by a program. This frees some memory. In 4.0 BASIC this takes only seconds, but in other BASICS it can lock up the computer for minutes, with no explanation.

Integer. A whole (not fractional) number.

Floating point. A way for the computer to store long numbers efficiently, in a few bytes. FP can handle numbers from -10^{38} to 10^{38} on CBM. This is the ordinary type of numeric variable used by default in most computers. It gets its name from the fact that a decimal point can float around within numbers to represent various fractions.

Interrupt, Interrupt Request, or **IRQ.** Every "jiffy" (sixtieth of a second), the CBM stops whatever it's doing, jumps to a special little program, and then jumps back and continues whatever it was doing. Among other things, it checks to see if the STOP key is down. Other computers relate to interruptions in other ways, but all 6502 machines have this mode.

Crash (or **lockup**, or **endless loop**). The cursor usually disappears and the computer will not respond, even to the STOP key.

Parallel (and **Serial**) **Interfacing.** The two primary ways to connect devices to allow data to be accurately sent between them. Parallel is more expensive and faster. It sends an entire byte at a time (eight bits simultaneously) and needs thicker cables since it must have a minimum of nine wires. Serial sends data a bit at a time.

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For insight into some of the basic principles underlying **ISAAC NEWTON** see Godel, Escher, Bach by Douglas R. Hofstädter, Chapter XIX and Martin Gardner's "Mathematical Games" column in **Scientific American**, October, 1977 and June, 1959. $24.95

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remember that this same rounding job was part of your income tax program. It is far simpler to lift the rounding routine out of the other program than to figure out how to program it all over again. Your financial disaster game and income taxes have nothing in common (well...), but the same subroutine can be taken from your library for both of the larger, unrelated programs.

The Rounding Subroutine

```
30000 ZQ=INT (ZQ * 100) / 100
30010 RETURN
```

Looking at the rounding subroutine, we can see a couple of odd things about it — it starts with line number 30000 and it uses a variable named ZQ. These are both good programming habits. When you are building your library of subroutines, you will want to be able to merge them easily into the larger, host programs. To do this, you will want to give them high line numbers, the highest permitted by your version of BASIC. In this way, you can stick them easily onto your other programs without needing to renumber your lines.

Interestingly, some people advocate the opposite — they suggest putting subroutines at the *start* of programs. Their reasoning is that the host program will run faster since it looks for a subroutine by going through the program from the lowest line number on up. This would be fine — as long as you always start programs with a line number such as 100 to leave room for any added subroutines. Many programmers start with line 100 to also allow space for DATA tables, REMark statements, and so forth. The essential thing is to decide on a reasonable style and stick to it each time. This permits you to more easily understand your programs when reviewing or modifying them later. It also makes the main components of *all* your programs (initialization, tables, subroutines, main loop) second nature to you. (We will explore these four primary program components in the next issue.)

The other odd thing about the rounding subroutine is the variable name "ZQ." It is chosen because it is so unlikely sounding that you will probably never pick it to use as a variable name in a host program. You would run into problems if your subroutine used a variable which was also being used by the host program for something unrelated. For example, if the subroutine caused a variable such as "N" to be defined as 53.25 and your host program were also using the variable "N" for the number of days in a week ... it would be a mess. So, before you GOSUB to the subroutine, you change the host program's variable into the subroutine's variable (ZQ=N) and, when you get back from the GOSUB, you give the result back to N again. The subroutine "call" would look like this:

```
150 ZQ=N: GOSUB 30000: N=ZQ
```

Subroutines have a major impact on programming style and they must be handled carefully. Books have been written on the subject of good programming practices. In general, it is less important that you follow arbitrary "practices" than that you develop consistent programming habits. Of course, it would be ideal if the rules of program composition had settled down into a universally accepted canon of guidelines. Many fine minds are presently occupied by attempts to develop a "best" programming language which will, it is hoped, force programmers to write clear, easily understood, and efficient programs.

Pessimists argue that the grammars of the world's languages never settle down in this fixed way, that BASIC has taken hold and will never yield, or that even a fixed set of linguistic rules cannot eliminate confusing, wasteful, or illogical programming. In addition, some feel that clarity and efficiency are mutually exclusive goals (when efficiency is defined in terms of memory space and speed of program execution). Nevertheless, these dark possibilities aside, it is surely worthwhile to attempt to be clear and efficient in your own programs.

Recursion

You are bound to see this term sooner or later. You would look for it in vain in most dictionaries — even unabridged editions will not list it. The word came into computing from both mathematics and logic. It means different things to each of those disciplines and, you guessed it, there is a third meaning in programming lingo. It has a meaning very close to recur, but it is a peculiar kind of recurrence. It means a subroutine that "calls" *itself*. This mind-bending idea is sometimes not allowed by a computer language — FORTRAN, for instance prohibits recursion. Most programming style experts suggest that you avoid it. (They also suggest you avoid GOTO, whenever possible, and self-modifying programs, but we'll deal with that another time.)

To visualize a subroutine which uses itself, we can write a slightly more complex subroutine:

```
150 ZQ=N: GOSUB 30000
............
30000 ZQ=ZQ/2
30010 IF ZQ>5 THEN GOSUB 30000
30020 RETURN
```

This complicated situation will cause a series of GOSUBs until the number is finally lower than five. You can see the problem here: we might have a large number of GOSUBs nested within each other for the computer to keep track of. (The computer remembers an "address" when it GOSUBs, so it can RETURN later and pick up where it left off.) So, when the program finally gets to RETURN ... where does it go? Back to the original GOSUB on line 150? Or back to line 30010?

The computer keeps track of these "return addresses" by stacking them up (in its *stack*) as the

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GOSUB's come in (and removing each one when a RETURN is completed). Only the more twisted among us will ever want to enter the house of mirrors that this sort of self-referential programming involves. It is fine to have one subroutine call another subroutine. We can all easily see that the subroutine of walking calls the subroutine of balancing on our feet. But recursion, walking that calls walking, is hard to visualize.

So, at least until later, forget recursion. If, on the other hand, you enjoy Alice-in-Wonderland thinking, and most of us do in certain moods, you might want to look into recursion a bit more deeply. There is a fine book dealing with self-referential systems which is excellent brain exercise: **Godel, Escher, Bach: An Eternal Golden Braid**, by Douglas R. Hofstadter. It asks that you try to imagine things like starting to walk while you are walking. ©

Basically Useful BASIC

Checking Randomness Of Random Number Generator

Rick Keck
Overland Park, KS

Many computer programs make use of a random number generator to provide a random stimulus for use by programs. A random number generator is often used in setting up game situations. This ensures a different set-up or "situation" each time the game is played. More professional uses of the random number generator include its use as a stimulus for statistical analysis. Whatever the use may be, random number generators have become an important part of any computer system and are used by a variety of software applications.

Today, computer systems have a built in random number generator. A common name for the built in function is RND. Thus to use it to retrieve a random number, an invocation of the function would be made as follows: RND(.52819446). This would return a value greater than zero but less than one. This first value used to get the random number generator going is referred to as a "seed." All numbers used in calculating another random number can be the results from the previous random number retrieval. Hence, a program can be set up so that the random number generator "feeds" itself.

You can make your own random number generator and use it instead of the one the computer has. Random number generation theory is a field of its own with many books written on the subject. Generally speaking, a combination of mathematical operations (multiplication, division, addition) is performed with prime numbers along with a user-provided number which varies in value each time the function is used.

This brings about the important question "How good is my random number generator?". This can be determined by finding out how "random" the values are that it returns. The best way to find this out is to test it with an analytical program that will show whether a random number generator has a tendancy to return values in one range over values of another range. Ideally, the resulting value range count numbers generated by the program shown would all be nearly equal in value. Be sure to test your random number generator a few times with a different "seed" value each time to ensure a valid testing. ©

"How good is my random number generator?"

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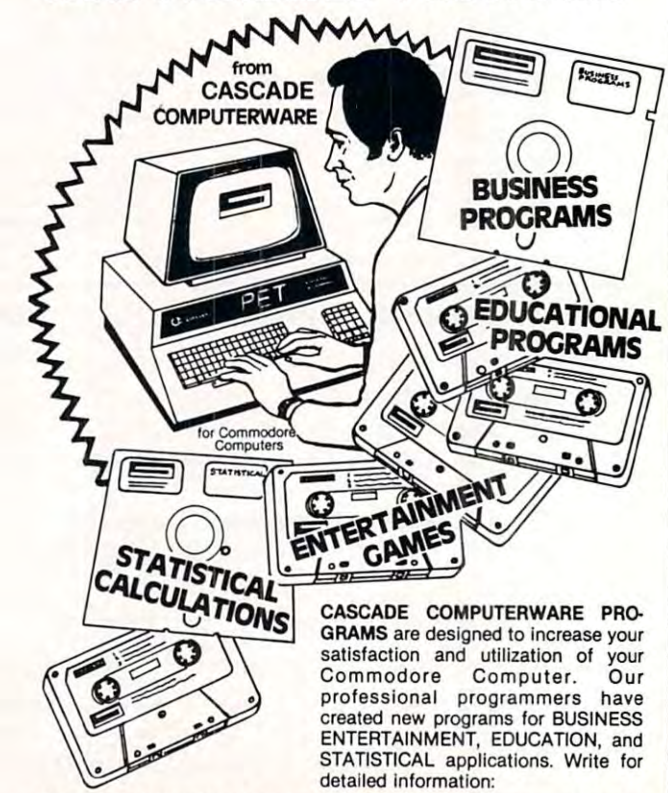

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Trenton: The Original Computer Festival

Jim Butterfield
Toronto, Canada

The Trenton Computer Festival was a going concern back in 1976 (yes, Virginia, there were microcomputer systems then) and is still going strong. This year it was held on the weekend of April 25th. It tends to be an informal gathering. The commercial exhibit area is modest in size, the flea market is huge, and there's good opportunity to set up shirt-sleeve sessions in one of the many available classrooms.

Touching upon a few highlights that caught my eye ...

The PET/CBM Forum: Is there a compatability problem?

Ron Kushnier, the forum chairman, opened the panel discussion with a history of Commodore products and commented on compatibility of the various lines. He solicited attendees' opinions on whether there was a need for greater liaison on present and future systems to ease the pain of program adaptation.

The panelists were generally optimistic and felt that past evolution hadn't really been a major stumbling block to progress. A sampling of panelist opinion: "*The IEEE bus isn't completely implemented in the CBM/PET; despite its limitations (which can be gotten around) it's a valuable feature of the product line*" — Chet Nowicki. "*You quickly get used to coding to allow for the various machine configurations*" — Frank Covitz. "*We should welcome the changes, since changes mean progress*" — Elizabeth Deal. "*VIC and Mini-Mainframe systems will herald new changes ... but you'll write better programs if you code to be fairly machine-independent*" — Jim Butterfield. "*We've* all had difficult moments — but things today look good in terms of support and information" — Gene Beals.

The group was small but enthusiastic; and when the forum's allotted time was up the whole session moved over to an empty classroom and kept going for an extra hour.

One of the objectives set out by Ron in his opening remarks was the possibility of setting up a steering group whose purpose would be to co-ordinate questions of change and compatibility. The session ended without a clear position on this; it was assumed the panel members formed a good basis for the steering group, but it wasn't established how such a group would function, or how badly it was, in fact, needed.

The questions didn't end with the meeting, however. Ron passed out questionnaires which solicited opinions from attendees, and will be looking over the situation and recommending further action. If you have a comment on the subject, or would like to fill out the questionnaire yourself, you should contact: Ron Kushnier, 25 Wendy Way, Richboro, PA 18954, Phone (215) 364-2711.

The Long-awaited MTU-100 Systems: Still waiting.

Rumours said that the MTU-100 system might be shown at Trenton. Not so: but MTU were talking in confidence to a few selected people. Details are still confidential on this 6502-based system, but it's not hard to make some close guesses as to what the system will finally look like. All you have to do is to look at the current MTU catalogue and you can see the trends ...

MTU have made a name for themselves on high-resolution graphics for the 6502, and on music synthesis hardware and software. They have introduced floppy disk controller boards, and a comprehensive 6502 disk operating system called CODOS. Memory expansion has always been part of MTU's hardware offerings, and a recent MTU memory system ("The Banker") is built for "... the 18 bit address bus 6502 based systems of the future". Eighteen bit addressing on a 6502? That would mean you could fit up to 256K of memory. How is it done? MTU aren't talking ... yet.

So ... with a little cutting and pasting on MTU's existing catalogue, we come up with a system that will have up to 256K of memory, a strong disk system with both hardware and software, and built-in high-resolution graphics and full sound capability. It sounds quite tantalizing.

The Osborne I: A new style of packaging.

The Osborne I is a Z-80 machine, so a detailed summary would be out of place here. It was on display for one day only. The fascinating thing about this machine is the way it is packaged, both physically and price-wise.

The complete system — disks, CRT and keyboard — folds together into a portable package that is compared with an attache case. It's a rather oversize attache case, but nevertheless, the whole thing is truly portable. The screen is rather small, and has a 40-character line width; I understand that larger screens can be fitted externally. There's no printer, which is rather disappointing.

More interesting than physical size is the pricing philosophy. For an advertised price of

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$1795, you get not only the computer, keyboard, screen and disks ... you also get two major software packages: a word processor and a financial worksheet program.

This type of software "bundling" may have an impact throughout the industry. Users typically don't want to buy boxes — they want working systems, and a package that includes software may be well-received. Other manufacturers may need to ponder the Osborne approach.

The Osborne system, with its Z-80, will interface CP/M; and this will give the user access to a large public domain library. It's hard to say whether this will generate extra commercial interest, but a lot of S- 100 hobbyists perked up at the mention of CP/M.

General Impressions

Frank Covitz and Cliff Ashcraft were at Trenton to demonstrate their latest achievements in computer music synthesis. For those who have not been exposed to the Diatonic Duo, they put on a virtuoso display of 6502-synthesized instruments and music. Listeners familiar with their work will find their latest exploits of interest: using a Fast Fourier Transform program developed by MTU they have been analyzing real world sounds and then resynthesizing them ... with the result that Frank strikes a key on his PET and the machine sings "Listen!".

Hal Chamberlin of MTU was also present at the music synthesis session and played some of his off-line generated music: the computer works much longer to make up the music than its actual playing time. Result: sound of remarkable quality.

A firm called Robot Mart was selling robot arms for $289. The mind boggles: I can visualize the PET reaching around and turning itself off. I quite liked an Atari game called NERD, which was a quiz for which there were no correct answers. MTU's visible memory was shown for 80-column CBM machines.

The flea market was huge. It was largely home-brew oriented, but there was a choice of everything from books to lapel pins.

In one corner of the flea market area, a lonely vendor was sitting by a fairly recent CBM system with a sign: Greatly Reduced! I asked him if he was moving on to another machine, or getting out of home computers. The reply: it had to be sold as part of a divorce settlement.

I thought about that one for a moment, and then asked: "Was the computer in any way responsible for the divorce?" The answer was affirmative: financial problems, including the computer, brought the whole situation about.

I knew the PET was a versatile machine ... but being named, more or less, as co-respondent? ©

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BASIC Oneliners: Minimize Code And Maximize Speed

G. H. Watson
Physics Department
University of Delaware
Newark, DE

Editor's Note: While this article refers to the PET, many of the suggestions apply to all BASICs. ...RM

"I wish this would run faster!" Whether you analyze data or play games, sooner or later you will wish that your BASIC programs were faster. A frequently-used program which is time inefficient is wasting your valuable time with each use. Perhaps you've begun to speed things by deleting REM statements and spaces. What else may be done? My suggestion is to pack as much as possible into each line of the BASIC program.

By cramming each line we will be able to delete many lines from the program. With fewer lines the program will take up less memory and execute faster. The reasons are as follows:

1) Five bytes of RAM (programmable memory) are used for each line in addition to its contents: two bytes for the line number, two bytes for the line link (memory location of next line), and one byte to signify the end of the line. Every line we eliminate will save five bytes. OK, only four bytes; one byte will be used for a colon which is needed as a delimiter between multiple statements.

2) When a GOTO or GOSUB is encountered, the line number to which the program transfers must be found by beginning at the first line number in the program and searching through each consecutive line number until a match is made. In general, if there are fewer line numbers the program will run faster. For the same reason, subroutines which are called many times should be placed at the beginning of the program instead of at the end (TEST 1).

3) Programs execute faster when there are fewer line transfers. By keeping control in one line as much as possible, needless time-consuming hopping is avoided (TEST 2).

Obviously most BASIC programs are not one line in length. There are three serious limitations to the minimum number of lines which may represent a program.

1) The BASIC *editor* is the set of ROM subroutines which transfer BASIC statements entered from the keyboard into programmable memory and allows editing of a program. The editor limits the length of each BASIC line to two screen lines (80 characters). Since BASIC statements (several characters in length) are represented in memory by keywords (one byte) the line will usually be shorter than 80 bytes. The maximum length of a BASIC line which can be run is 255 bytes. A different editor could allow longer lines than the current screen editor (see R. Baker's COMPACTOR in **COMPUTE!** Sept./Oct. 1980).

2) The conditional statement IF..THEN.. drops program control to the next line when the IF.. fails. Each IF..THEN.. requires a succeeding line number.

3) Each GOSUB or GOTO requires a line number to which program control is transferred.

...BASIC statements are stored in memory as keywords by the editor.

By examining possible ways of sidestepping these limitations, we can stuff BASIC lines and make a faster running program. Limitation 3) is strict and may be avoided only through reduced use of GOSUB and GOTO. Most of my suggestions will deal with overcoming limitation 1) by placing as much as possible in each line.

A) As I've mentioned, BASIC statements are stored in memory as keywords by the editor. In many cases, the editor understands an abbreviated form of the statement — the first letter of the statement followed by the shifted second letter; e.g. OPEN may be entered as oP. Be careful if different statements begin with the same two letters; e.g. READ may be entered by rE. RETURN must be entered as reT. (No abbreviation is available for INPUT.) This is a great saving of line space — PRINT TAB(9) is ?T sh A 9), five characters in place of ten.

Care must be used with this technique. If a line is entered with many abbreviations and then LISTed, it may fill more than two screen lines. If a change is made in the line the editor will transfer only 80 characters. To make changes properly, the line must be reduced again, via abbreviations.

B) The 80 character limit to line length includes the line number. By reducing line numbers from the 10000's to 100's you will save 2 characters on each line, making room for more instructions. Note though, that no RAM memory is saved since

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each line number occupies 2 bytes regardless of size.

In addition, any GOTO or GOSUB statement will be shorter with the lower line numbers. Here RAM memory will be saved since these numbers are stored as ASCII characters. Time will also be saved with the smaller numbers since less time is spent reading the number (TEST 3).

C) By using single character variable names, you save one character in line space and one byte of memory each time the variable is referenced. A slight savings in time results since the second character need not be read by the BASIC interpreter (TEST 4).

D) When an element of an array is used more than once without changing value, time, and possibly space, will be saved by assigning the element to a simple variable (TEST 5). Note that you cannot use this trick when reassigning the element; e.g. A(I,J) = A(I,J)/5 cannot be replaced with A = A(I,J): A = A/5.

E) Eliminate unnecessary parentheses in algebraic and logical expressions to save line space. Sometimes you gain speed (TEST 6); sometimes you lose speed (TEST 7).

F) Replace IF A<>B THEN.. with IF A-B THEN.. and IF A<>0 THEN.. with IF A THEN.. for a small saving in line space and a large saving in time (TEST 8 and 9). When appropriate, one character may be saved by using IF P<Q THEN.. rather than IF Q> = P THEN.. with a slight reduction in time (TEST 10)

G) It is generally recommended to drop variable references after the NEXT statement. One character is saved and the time spent in turning the loop is lowered dramatically (TEST 11). A very slight increase in speed will occur by terminating the NEXT with a colon (TEST 12). NEXT:NEXT is faster than NEXT J,K and the line space saved by the latter is eliminated when the abbreviation nE is used.

H) Make full use of the multiple argument capability of statements where appropriate; e.g. READ M,N instead of READ M:READ N saves space.

I) Print statements will generally work without the semicolon as delimiter; PRINT X;"+";Y"=";Z may be replaced with PRINT X"+"Y"="Z.

K) If a number is used several places in a program it may save space to represent it with a variable. In addition, if the variable table is not exceedingly large, it will be quicker for the PET to look up the variable in the variable table rather than convert the number to binary floating point each time (TEST 13). Note also that often it is quicker and shorter to do a simple operation rather than to convert a number to floating point (TEST 14).

While studying this problem I noticed two cases where a constant need never be defined by a variable. One is the case of pi, where the PET has a special key. Notice how fast it is assigned (TEST 15). I suspect that no conversion is done — the floating point number is stored in the ROMs. Almost unbelievably the other constant is zero. As far as I can tell the period (.) can play the rolls of zero (0) on the PET; e.g. V = 0 may be replaced with V = . (TEST 16). No space is saved but notice the substantial saving in time. Think of how many times the number zero is used in a program! Use this trick and puzzle your friends.

L) Boolean algebra statements may be used to form advanced conditional statements. The additional line needed for two IF..THEN..'s is avoided by using IF..OR..THEN... Where possible, though, I try to avoid these statements as they tend to be slow. Note that IF..THENIF..THEN.. is equivalent to IF..AND..THEN.. and much faster (TEST 17).

If a number is used several places in a program it may save space to represent it with a variable.

M) Use of the ABS statement (absolute value) may save time and space. Replace IF P<2 OR P>2 THEN.. with IF ABS(P)>2 THEN.. and replace IF P>-2 AND P<2 THEN.. with IF ABS(P)<2 THEN.. (TEST 18).

Limitation 2) is a severe one. By its very nature an IF..THEN.. is used to determine failure or satisfaction of a condition. On failure the program automatically drops to the next line, with no way around it.

One possibility is to replace IF..GOTO.. with ON..GOTO... Consider the following example ON X GOTO 220,240. When X = 1 the program will transfer to line 220, when X = 2 the transfer will be to 240, otherwise the program will finish out the line. That is, we can make a conditional branch without dropping to the next line on failure. This has limited utility in replacing IF..GOTO.. since the argument of the ON must be between 0 and 255 to avoid an ?ILLEGAL QUANTITY ERROR. The technique can be used readily on flags and counters with maximum value less than 255. For other types of variables, SGN (sign of) and ABS may be used to keep the argument in range. The following examples are possible although speed and space will be sacrificed because of the extra computations required:

Testing if a flag is set to one —
ON FG GOTO.. for IF FG GOTO..

Detecting a negative number —
ON SGN(X) + 2 GOTO.. for IF X<0 GOTO..

Detecting zero —
ON SGN(X) + 1 GOTO.. for IF X = 0 GOTO..

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Another possibility exists for handling conditionals used to increment or decrement counters. Try the following quick experiment: Enter X = 1 into the PET. -1 will be printed when you enter ?X = 0 is entered. That's right; an expression results in -1 if true and 0 if false. Thus the following are possible ways to avoid IF..THEN..:

Incrementing counter if X = 0
CT = CT-(X = 0) for IF X = 0 THEN CT = CT + 1
(TEST 19)

Decrementing twice if Y<0
CT = CT + 2*(Y<0) for IF Y<0 THEN CT = CT-2

Doubling if Y>1
CT = CT-CT*(Y>1) for IF Y>2 THEN CT = CT + CT

The program continues on the same line whether the expression is true or false. You are limited only by your imagination, although very complicated expressions will be much slower than the simple IF..THEN...

Most of my experience has been in reducing programs used for numerical computations. Many computations involve a number of lengthy FOR ..NEXT loops. Repetition is what takes time, so scrutinize carefully the contents of these loops. When starting to condense a program, begin on the loops; discard operations which may be done satisfactorily outside of the loop. I have had the most success by starting and ending loops on the same line.

I hope that you find your programming bag of tricks heavier now. I have never been able to reduce a significant program to just one line but I'll keep trying. If you succeed or have some additional tricks please drop me a line (of BASIC, that is).

The availibility of an internal timer in the PET allows timing tests to be done conveniently. TI$ is a string of 6 digits representing 24-hour time (102235 – 10 hours, 22 minutes, and 35 seconds) from the time the machine was turned on. The timer may be reset by entering TI$ = "000000". The number TI is also present and measures time in jiffies (1/60 second). TI$ and TI measure the same time, but in different units.

The difference in time taken to execute different operations will usually not be obvious if the operation is performed only once. For this reason I've placed all operations in a FOR..NEXT loop which will exaggerate any differences. By sandwiching the loop between TI$ = "000000" and PRINT TI we may easily make timing tests. Bear in mind that an empty loop also takes time which should be considered when making quantitative comparisons. For reproducible results, perform the tests on a PET immediately after turning it on — don't initialize the DOS WEDGE or the PROGRAMMER'S TOOLKIT as these will affect the execution time.

All results shown for PET BASIC 2.0 (upgrade ROM). Differences which are less than two jiffies may not be significant. ©

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```
     TEST 1:
1 GOTO3                               ...
2 RETURN                              ...
3 TI$="000000"                        ...
4 FORJ=0TO999:GOSUB6:NEXT             4 FORJ=0TO999:GOSUB2:NEXT
5 PRINT TI:END                        ...
6 RETURN                              ...
     TI=149                                TI=132

     TEST 2:
1 TI$="000000"                        1 TI$="000000"
2 FORJ=0TO999                         2 FORJ=0TO999:Y=X:X=Y:NEXT
3 Y=X                                 3 PRINT TI
4 X=Y
5 NEXT
6 PRINT TI
     TI=233                                TI=223

     TEST 3:
1 TI$="000000"                        10000 TI$="000000"
2 IFTI<3600THENJ=J+1:GOTO2            20000 IFTI<3600THENJ=J+1:GOTO20000
3 PRINT J                             30000 PRINT J
     J=1772                                J=1677
```

```
The following tests should be placed between
1 TI$="000000
and
5 PRINT TI
```

```
     TEST 4
3 FORJ=0TO999:AA=BB:NEXT              3 FORJ=0TO999:A=B:NEXT
     TI=149                                TI=143

     TEST 5
2 DIM A(999)                          ...
3 FORJ=0TO999:S=A(J):R=A(J):NEXT      3 FORJ=0TO999:S=A(J):R=S:NEXT
     TI=507                                TI=374

     TEST 6
3 FORJ=0TO999:A=(B*C):NEXT            3 FORJ=0TO999:A=B*C:NEXT
     TI=222                                TI=199

     TEST 7
2 B=2:C=2                             ...
3 FORJ=0TO999:A=1/(B*C):NEXT          3 FORJ=0TO999:A=1/B/C:NEXT
     TI=478                                TI=499

     TEST 8
2 A=2:B=3                             ...
3 FORJ=0TO999:IFA<>BTHENNEXT          3 FORJ=0TO999:IFA-BTHENNEXT
     TI=206                                TI=177
```

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```
    TEST 9
2 A=2
3 FORJ=0TO999:IFA<>0THENNEXT
    TI=231

...
3 FORJ=0TO999:IFATHENNEXT
    TI=110

    TEST 10
2 P=2:Q=3
3 FORJ=0TO999:IFQ>=PTHENNEXT
    TI=206

...
3 FORJ=0TO999:IFP<QTHENNEXT
    TI=203

    TEST 11
3 FORJ=0TO999:NEXTJ
    TI=79

3 FORJ=0TO999:NEXT
    TI=63

    TEST 12
3 FORJ=0TO9999:NEXT
    TI=684

3 FORJ=0TO9999:NEXT:
    TI=677

    TEST 13
2 A=.875
3 FORJ=0TO999:B=.875:NEXT
    TI=732

...
3 FORJ=0TO999:B=A:NEXT
    TI=143

    TEST 14
3 FORJ=0TO999:B=.875:NEXT
    TI=729

3 FORJ=0TO999:B=7/8:NEXT
    TI=355

    TEST 15
2 A=π
3 FORJ=0TO999:B=A:NEXT
    TI=142

...
3 FORJ=0TO999:B=π:NEXT
    TI=126

    TEST 16
3 FORJ=0TO999:V=0:NEXT
    TI=167

3 FORJ=0TO999:V=.:NEXT
    TI=131

    TEST 17
2 A=1:B=2:C=3
3 FORJ=0TO999:IFA<BANDA<CTHENNEXT
    TI=468

...
3 FORJ=0TO999:IFA<BTHENIFA<CTHEN
  NEXT
    TI=341

    TEST 18
2 P=1
3 FORJ=0TO999:IFP>-2ANDP<2THENNEXT
    TI=537

...
3 FORJ=0TO999:IFABS(P)<2THENNEXT
    TI=256

    TEST 19
3 FORJ=0TO999:IFX=0THENCT=CT+1:
  NEXT
    TI=410

3 FORJ=0TO999:CT=CT-(X=0):NEXT
    TI=362
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CARD GAMES

BRIDGE 2.0 (Available for all computers) — **Price: $17.95 Cassette/$21.95 Diskette**
An all-inclusive version of this most popular of card games. This program both BIDS and PLAYS either contract or duplicate bridge. Depending on the contract, your computer opponents will either play the offense OR defense. If you bid too high, the computer will double your contract! BRIDGE 2.0 provides challenging entertainment for advanced players and is an excellent learning tool for the bridge novice. See the software review in 80 Software Critique.

HEARTS 1.5 (Available for all computers) — **Price: $15.95 Cassette/$19.95 Diskette**
An exciting and entertaining computer version of this popular card game. Hearts is a trick-oriented game in which the purpose is not to take any hearts or the queen of spades. Play against two computer opponents who are armed with hard-to-beat playing strategies. HEARTS 1.5 is an ideal game for introducing the uninitiated (your spouse) to computers. See the software review in 80 Software Critique.

STUD POKER (Atari only) — **Price: $11.95 Cassette/$15.95 Diskette**
This is the classic gambler's card game. The computer deals the cards one at a time and you (and the computer) bet on what you see. The computer does not cheat and *usually* bets the odds. However, it sometimes bluffs! Also included is a five card draw poker betting practice program. This package will run on a 16K ATARI. Color, graphics, sound.

POKER PARTY (Available for all computers) — **Price: $17.95 Cassette/$21.95 Diskette**
POKER PARTY is a draw poker simulation based on the book, POKER, by Oswald Jacoby. This is the most comprehensive version available for microcomputers. The party consists of yourself and six other (computer) players. Each of these players (you will get to know them) has a different personality in the form of a varying propensity to bluff or fold under pressure. Practice with POKER PARTY before going to that expensive game tonight! Apple Cassette and diskette versions require a 32 K (or larger) Apple II.

CRIBBAGE 2.0 (TRS-80 only) — **Price: $14.95 Cassette/$18.95 Diskette**
This is simply the best cribbage game available. It is an excellent program for the cribbage player in search of a worthy opponent as well as for the novice wishing to improve his game. The graphics are superb and assembly language routines provide rapid execution. See the software review in 80 Software Critique.

THOUGHT PROVOKERS

MANAGEMENT SIMULATOR (Atari, North Star and CP/M only) — **Price: $19.95 Cassette $23.95 Diskette**
This program is both an excellent teaching tool as well as a stimulating intellectual game. Based upon similar games played at graduate business schools, each player or team controls a company which manufacturers three products. Each player attempts to outperform his competitors by setting selling prices, production volumes, marketing and design expenditures etc. The most successful firm is the one with the highest stock price when the simulation ends.

FLIGHT SIMULATOR (Available for all computers) — **Price: $17.95 Cassette/$21.95 Diskette**
A realistic and extensive mathematical simulation of take-off, flight and landing. The program utilizes aerodynamic equations and the characteristics of a real airfoil. You can practice instrument approaches and navigation using radials and compass headings. The more advanced flyer can also perform loops, half-rolls and similar aerobatic maneuvers. Although this program does not employ graphics, it is exciting and very addictive. See the software review in COMPUTRONICS.

VALDEZ (Available for all computers) — **Price: $15.95 Cassette/$19.95 Diskette**
VALDEZ is a computer simulation of supertanker navigation in the Prince William Sound/Valdez Narrows region of Alaska. Included in this simulation is a realistic and extensive 256 × 256 element map, portions of which may be viewed using the ship's alphanumeric radar display. The motion of the ship itself is accurately modelled mathematically. The simulation also contains a model for the tidal patterns in the region, as well as other traffic (outgoing tankers and drifting icebergs). Chart your course from the Gulf of Alaska to Valdez Harbor! See the software review in 80 Software Critique.

BACKGAMMON 2.0 (Atari, North Star and CP/M only) — **Price: $14.95 Cassette/$18.95 Diskette**
This program tests your backgammon skills and will also improve your game. A human can compete against a computer or against another human. The computer can even play itself. Either the human or the computer can double or generate dice rolls. Board positions can be created or saved for replay. BACKGAMMON 2.0 is played in accordance with the official rules of backgammon and is sure to provide many fascinating sessions of backgammon play.

CHECKERS 3.0 (PET only) — **Price: $16.95 Cassette/$20.95 Diskette**
This is one of the most challenging checkers programs available. It has 10 levels of play and allows the user to change skill levels at any time. Though providing a very tough game at level 4-8, CHECKERS 3.0 is practically unbeatable at levels 9 and 10.

CHESS MASTER (North Star and TRS-80 only) — **Price: $19.95 Cassette/$23.95 Diskette**
This complete and very powerful program provides five levels of play. It includes castling, en passant captures and the promotion of pawns. Additionally, the board may be preset before the start of play, permitting the examination of "book" plays. To maximize execution speed, the program is written in assembly language (by SOFTWARE SPECIALISTS of California). Full graphics are employed in the TRS-80 version, and two widths of alphanumeric display are provided to accommodate North Star users.

NOMINOES JIGSAW (Atari, Apple and TRS-80 only) — **Price: $16.95 Cassette/$20.95 Diskette**
A jigsaw puzzle on your computer! Complete the puzzle by selecting your pieces from a table consisting of 60 different shapes. NOMINOES JIGSAW is a virtuoso programming effort. The graphics are superlative and the puzzle will challenge you with its three levels of difficulty. Scoring is based upon the number of guesses taken and by the difficulty of the board set-up.

MONARCH (Atari only) — **Price: $11.95 Cassette/$15.95 Diskette**
MONARCH is a fascinating economic simulation requiring you to survive an 8-year term as your nation's leader. You determine the amount of acreage devoted to industrial and agricultural use, how much food to distribute to the populace and how much should be spent on pollution control. You will find that all decisions involve a compromise and that it is not easy to make everyone happy.

CHOMP-OTHELLO (Atari only) — **Price: $11.95 Cassette/$15.95 Diskette**
CHOMP-OTHELLO? It's really two challenging games in one. CHOMP is similar in concept to NIM; you must bite off part of a cookie, but avoid taking the poisoned portion. OTHELLO is the popular board game set to fully utilize the Atari's graphics capability. It is also very hard to beat! This package will run on a 16K system.

AND MORE...

STARTREK 3.2 (Available for all computers) — **Price: $11.95 Cassette/$15.95 Diskette**
This is the classic Startrek simulation, but with several new features. For example, the Klingons now shoot at the Enterprise without warning while also attacking starbases in other quadrants. The Klingons also attack with both light and heavy cruisers and move when shot at! The situation is hectic when the Enterprise is besieged by three heavy cruisers and a starbase S.O.S. is received! The Klingons get even! See the software reviews in A.N.A.L.O.G., 80 Software Critique and Game Merchandising.

BLACK HOLE (Apple only) — **Price: $14.95 Cassette/$18.95 Diskette**
This is an exciting graphical simulation of the problems involved in closely observing a black hole with a space probe. The object is to enter and maintain, for a prescribed time, an orbit close to a small black hole. This is to be achieved without coming so near the anomaly that the tidal stress destroys the probe. Control of the craft is realistically simulated using side jets for rotation and main thrusters for acceleration. This program employs Hi-Res graphics and is educational as well as challenging.

SPACE TILT (Apple and Atari only) — **Price: $10.95 Cassette/$14.95 Diskette**
Use the game paddles to tilt the plane of the TV screen to "roll" a ball into a hole in the screen. Sound simple? Not when the hole gets smaller and smaller! A built-in timer allows you to measure your skill against others in this habit-forming action game.

MOVING MAZE (Apple only) — **Price: $10.95 Cassette/$14.95 Diskette**
MOVING MAZE employs the games paddles to direct a puck from one side of a maze to the other. However, the maze is dynamically (and randomly) built and is continually being modified. The objective is to cross the maze without touching (or being hit by) a wall. Scoring is by an elapsed time indicator, and three levels of play are provided.

ALPHA FIGHTER (Atari only) — **Price: $14.95 Cassette/$18.95 Diskette**
Two excellent graphics and action programs in one! ALPHA FIGHTER requires you to destroy the alien starships passing through your sector of the galaxy. ALPHA BASE is in the path of an alien UFO invasion; let five UFO's get by and the game ends. Both games require the joystick and get progressively more difficult the higher you score! ALPHA FIGHTER will run on 16K systems.

INTRUDER ALERT (Atari only) — **Price: $16.95 Cassette/$20.95 Diskette**
This is a fast paced graphics game which places you in the middle of the "Dreadstar" having just stolen its plans. The droids have been alerted and are directed to destroy you at all costs. You must find and enter your ship to escape with the plans. Five levels of difficulty are provided. INTRUDER ALERT requires a joystick and will run on 16K systems.

GIANT SLALOM (Atari only) — **Price: $14.95 Cassette/$18.95 Diskette**
This real-time action game is guaranteed addictive! Use the joystick to control your path through slalom courses consisting of both open and closed gates. Choose from different levels of difficulty, race against other players or simply take practice runs against the clock. GIANT SLALOM will run on 16K systems.

TRIPLE BLOCKADE (Atari only) — **Price: $14.95 Cassette/$18.95 Diskette**
TRIPLE BLOCKADE is a two-to-three player graphics and sound action game. It is based on the classic video arcade game which millions have enjoyed. Using the Atari joysticks, the object is to direct your blockading line around the screen without running into your opponent(s). Although the concept is simple, the combined graphics and sound effect lead to "high anxiety".

GAMES PACK I (Available for all computers) — **Price: $10.95 Cassette/$14.95 Diskette**
GAMES PACK I contains the classic computer games of BLACKJACK, LUNAR LANDER, CRAPS, HORSERACE, SWITCH and more. These games have been combined into one large program for ease in loading. They are individually accessed by a convenient menu. This collection is worth the price just for the DYNACOMP version of BLACKJACK.

GAMES PACK II (Available for all computers) — **Price: $10.95 Cassette/$14.95 Diskette**
GAMES PACK II includes the games CRAZY EIGHTS, JOTTO, ACEY-DUCEY, LIFE, WUMPUS and others. As with GAMES PACK I, all the games are loaded as one program and are called from a menu. You will particularly enjoy DYNACOMP's version of CRAZY EIGHTS.

Why pay $7.95 or more per program when you can buy a DYNACOMP collection for just $10.95?

MOON PROBE (Atari only) — **Price: $11.95 Cassette/$15.95 Diskette**
This is an extremely challenging "lunar lander" program. The user must drop from orbit to land at a predetermined target on the moon's surface. You control the thrust and orientation of your craft plus direct the rate of descent and approach angle.

ADVENTURE

CRANSTON MANOR ADVENTURE (North Star and CP/M only) — **Price: $21.95 Diskette**
At last! A comprehensive Adventure game for North Star and CP/M systems. CRANSTON MANOR ADVENTURE takes you into mysterious CRANSTON MANOR where you attempt to gather fabulous treasures. Lurking in the manor are wild animals and robots who will not give up the treasures without a fight. The number of rooms is greater and the associated descriptions are much more elaborate than the current popular series of Adventure programs, making this game the top in its class. Play can be stopped at any time and the status stored on diskette.

ABOUT DYNACOMP

DYNACOMP is a leading distributor of small system software with sales spanning the world (currently in excess of 40 countries). During the past two years we have greatly enlarged the DYNACOMP product line, but have maintained and improved our high level of quality and customer support. The achievement in quality is apparent from our many repeat customers and the software reviews in such publications as COMPUTRONICS, 80 Software Critique and A.N.A.L.O.G. Our customer support is as close as your phone. It is always friendly. The staff is highly trained and always willing to discuss products or give advice.

**ATARI, PET, TRS-80, NORTHSTAR, CP/M and IBM are registered tradenames and/or trademarks.* ***TRS-80 diskettes are not supplied with DOS or BASIC.*

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BUSINESS and UTILITIES

SPELLGUARD™ (CP/M only) — **Price: $269.95 Disk**
SPELLGUARD is a revolutionary new product which increases the value of your current word processing system (WORDSTAR, MAGIC WAND, ELECTRIC PENCIL, TEXTED EDITOR II and others). Written entirely in assembly language, SPELLGUARD™ rapidly assists the user in eliminating spelling and typographical errors by comparing each word of the text against a dictionary (expandable) of over 20,000 of the most common English words. Words appearing in the text but not found in the dictionary are "flagged" for easy identification and correction. Most administrative staff familiar with word processing equipment will be able to use SPELLGUARD™ in only a few minutes.

MAIL LIST 2.2 (Apple, Atari and North Star diskette only) — **Price: $34.95**
This program is unmatched in its ability to store a maximum number of addresses on one diskette (minimum of 1100 per diskette, more than 2200 for "double density" systems!). Its many features include alphabetic and zip code sorting, label printing, merging of files and a unique keyword seeking routine which retrieves entries by a virtually limitless selection of user defined codes. Mail List 2.2 will even find and delete duplicate entries. A very valuable program!

FORM LETTER SYSTEM (FLS) (Apple and North Star diskette only) — **Price: $21.95**
Use FLS to create and edit form letters and address lists. Form letters are produced by automatically inserting each address into a predetermined portion of your letter. FLS is completely compatible with MAIL LIST 2.2, which may be used to manage your address files.

FLS and MAIL LIST 2.2 are available as a combined package for $49.95.

SORTIT (North Star only) — **Price: $29.95 Diskette**
SORTIT is a general purpose sort program written in 8080 assembly language. This program will sort sequential data files generated by NORTH STAR BASIC. Primary and optional secondary keys may be numeric or one to nine character strings. SORTIT is easily used with files generated by DYNACOMP's MAIL LIST program and is very versatile in its capabilities for all other BASIC data file sorting.

PERSONAL FINANCE SYSTEM (Atari and North Star only) — **Price: $34.95 Diskette**
PFS is a single diskette, menu-oriented system composed of ten different programs. Besides recording your expenses and tax deductible items, PFS will sort and summarize expenses by payee, and display information on expenditures by any of 26 user defined codes by month or by payee. PFS will even produce monthly bar graphs of your expenses by category! This powerful package requires only one disk drive, minimal memory (24K Atari, 32K North Star) and will store up to 600 records per disk (and over 1000 records per disk by making a few simple changes to the programs). You can record checks plus cash expenses so that you can finally see where your money goes and eliminate guesswork and tedious hand calculations.

FAMILY BUDGET (Apple only) — **Price: $34.95 Diskette**
The FAMILY BUDGET is a very convenient financial record-keeping program. You will be able to keep track of cash and credit expenditures as well as income on a daily basis. You can record tax deductible items and charitable donations. The FAMILY BUDGET also provides a continuous record of all credit transactions. You can make daily cash and charge entries to any of 21 different expense accounts as well as to 5 payroll and tax accounts. Data is easily retrieved giving the user complete control over an otherwise complicated (and unorganized!) subject.

THE COMMUNICATOR (Atari only) — **Price: $49.95 Diskette**
This software package contains a menu-driven collection of programs for facilitating efficient two-way communications through a full duplex modem (required for use). In one mode of operation you may connect to a data service (e.g., The SOURCE or MicroNet) and quickly load data such as stock quotations onto your diskette for later viewing. This greatly reduces "connect time" and thus the service charge. You may also record the complete contents of a communications session. Additionally, programs written in BASIC, FORTRAN, etc. may be built off-line using the support text editor and later "uploaded" to another computer, making the Atari a *very* smart terminal. Even Atari BASIC programs may be uploaded. Further, a command file may be built off-line and used later as controlling input for a time-share system. That is, you can set up your sequence of time-share commands and programs, and the Atari will transmit them as needed; batch processing. All this adds up to saving both connect time and your time.

DYNACOMP also supplies THE COMMUNICATOR with an Atari 830 modem for a combined price of $219.95. The modem is available separately for $189.95.

TEXT EDITOR II (CP/M) — **Price: $29.95 Diskette/$33.45 Disk**
This is the second release version of DYNACOMP's popular TEXT EDITOR I and contains many new features. With TEXT EDITOR II you may build text files in chunks and assemble them for later display. Blocks of text may be appended, inserted or deleted. Files may be saved on disk/diskette in right justified/centered format to be later printed by either TEXT EDITOR II or the CP/M ED facility. Futher, ASCII CP/M files (including BASIC and assembly language programs) may be read by the editor and processed. In fact, text files can be built using ED and later formatted using TEXT EDITOR II. All in all, TEXT EDITOR II is an inexpensive, easy to use, but very flexible editing system.

DFILE (North Star only) — **Price: $19.95**
This handy program allows North Star users to maintain a specialized data base of all files and programs in the stack of disks which invariably accumulates. DFILE is easy to set up and use. It will organize your disks to provide efficient locating of the desired file or program.

FINDIT (North Star only) — **Price: $19.95**
This is a three-in-one program which maintains information accessible by keywords of three types: Personal (eg: last name), Commercial (eg: plumbers) and Reference (eg: magazine articles, record albums, etc). In addition to keyword searches, there are birthday, anniversary and appointment searches for the personal records and appointment searches for the commercial records. Each record are accessed by a single keyword or by cross-referencing two or three keywords.

GRAFIX (TRS-80 only) — **Price: $14.95 Cassette/$18.95 Diskette**
This unique program allows you to easily create graphics directly from the keyboard. You "draw" your figure using the program's extensive cursor controls. Once the figure is made, it is automatically appended to your BASIC program as a string variable. Draw a "happy face", call it H$ and then print it from your program using PRINT H$! This is a very easy way to create and save graphics.

EDUCATION

HODGE PODGE (Apple only, 48K Applesoft or Integer BASIC) — **Price: $19.95 Cassette/$23.95 Diskette**
Let HODGE PODGE be your child's baby sitter. Pressing any key on your Apple will result in a different and intriguing "happening" related to the letter or number of the chosen key. The program's graphics, color and sound are a delight for children from ages 1½ to 9. HODGE PODGE is a non-intimidating teaching device which brings a new dimension to the use of computers in education.

TEACHER'S PET I (Available for all computers) — **Price: $11.95 Cassette/$15.95 Diskette**
This is the first of DYNACOMP's educational packages. Primarily intended for pre-school to grade 3, TEACHER'S PET provides the young student with counting practice, letter-word recognition and three levels of math skill exercises.

MORSE CODE TRAINER (TRS-80 only) — **Price: $12.95 Cassette/$16.95 Diskette**
MORSE CODE TRAINER is designed to develop and improve your speed and accuracy in deciphering Morse Code. As such, MCT is an ideal software package for FCC test practice. The code sound is obtained through the earphone jack of any standard cassette recorder. You may choose the pitch of the tones as well as the word rate. Also, various modes of operation are available including number, punctuation and alphabet tests, as well as the keying of your own message. A very effective way to learn code!

MISCELLANEOUS

CRYSTALS (Atari only) — **Price: $ 9.95 Cassette/$13.95 Diskette**
A unique algorithm randomly produces fascinating graphics displays accompanied with tones which vary as the patterns are built. No two patterns are the same, and the combined effect of the sound and graphics are mesmerizing. CRYSTALS has been used in local stores to demonstrate the sound and color features of the Atari.

NORTH STAR SOFTWARE EXCHANGE (NSSE) LIBRARY
DYNACOMP now distributes the 23 volume NSSE library. These diskettes each contain many programs and offer an outstanding value for the purchase price. They should be part of every North Star user's collection. Call or write DYNACOMP for details regarding the contents of the NSSE collection.

Price: $9.95 each/$7.95 each (4 or more)
The complete collection may be purchased for $149.95

AVAILABILITY

DYNACOMP software is supplied with complete documentation containing clear explanations and examples. Unless otherwise specified, all programs will run within 16K program memory space (ATARI requires 24K). Except where noted, programs are available on ATARI, PET, TRS-80 (Level II) and Apple (Applesoft) cassette and diskette as well as North Star single density (double density compatible) diskette. Additionally, most programs can be obtained on standard (IBM format) 8" CP/M floppy disks for systems running under MBASIC.

STATISTICS and ENGINEERING

DIGITAL FILTER (Available for all computers) — **Price: $29.95 Cassette/$33.95 Diskette**
DIGITAL FILTER is a comprehensive data processing program which permits the user to design his own filter function or choose from a menu of filter forms. The filter forms are subsequently converted into non-recursive convolution coefficients which permit rapid data processing. In the explicit design mode the shape of the frequency transfer function is specified by directly entering points along the desired filter curve. In the menu mode, ideal low pass, high pass and bandpass filters may be approximated to varying degrees according to the number of points used in the calculation. These filters may optionally also be smoothed with a Hanning function. In addition, multi-stage Butterworth filters may be selected. Features of DIGITAL FILTER include plotting of the data before and after filtering, as well as display of the chosen filter functions. Also included are convenient data storage, retrieval and editing procedures.

DATA SMOOTHER (Not available for Atari) — **Price: $14.95 Cassette/$18.95 Diskette**
This special data smoothing program may be used to rapidly derive useful information from noisy business and engineering data which are equally spaced. The software features choice in degree and range of fit, as well as smoothed first and second derivative calculation. Also included is automatic plotting of the input data and smoothed results.

FOURIER ANALYZER (Available for all computers) — **Price: $16.95 Cassette/$20.95 Diskette**
Use this program to examine the frequency spectra of limited duration signals. The program features automatic scaling and plotting of the input data and results. Practical applications include the analysis of complicated patterns in such fields as electronics, communications and business.

TFA (Transfer Function Analyzer) — **Price: $19.95 Cassette/$23.95 Diskette**
This is a special software package which may be used to evaluate the transfer functions of systems such as hi-fi amplifiers and filters by examining their response to pulsed inputs. TFA is a major modification of FOURIER ANALYZER and contains an engineering-oriented decibel versus log-frequency plot as well as data editing features. Whereas FOURIER ANALYZER is designed for educational and scientific use, TFA is an engineering tool. Available for all computers.

HARMONIC ANALYZER (Available for all computers) — **Price: $24.95 Cassette/$28.95 Diskette**
HARMONIC ANALYZER was designed for the spectrum analysis of repetitive waveforms. Features include data file generation, editing and storage/retrieval as well as data and spectrum plotting. One particularly unique facility is that the input data need not be equally spaced or in order. The original data is sorted and a cubic spline interpolation is used to create the data file required by the FFT algorithm.

FOURIER ANALYZER, TFA and HARMONIC ANALYZER may be purchased together for a combined price of $49.95 (three cassettes) and $59.95 (three diskettes).

REGRESSION I (Available for all computers) — **Price: $19.95 Cassette/$23.95 Diskette**
REGRESSION I is a unique and exceptionally versatile one-dimensional least squares "polynomial" curve fitting program. Features include very high accuracy; an automatic degree determination option; an extensive internal library of fitting functions; data editing; automatic data and curve plotting; a statistical analysis (eg: standard deviation, correlation coefficient, etc.) and much more. In addition, new fits may be tried without reentering the data. REGRESSION I is certainly the cornerstone program in any data analysis software library.

REGRESSION II (PARAFIT) (Available for all computers) — **Price: $19.95 Cassette/$23.95 Diskette**
PARAFIT is designed to handle those cases in which the parameters are imbedded (possibly nonlinearly) in the fitting function. The user simply inserts the functional form, including the parameters (A(1), A(2), etc.) as one or more BASIC statement lines. Data and results may be manipulated and plotted as with REGRESSION 1. Use REGRESSION I for polynomial fitting, and PARAFIT for those complicated functions.

MULTILINEAR REGRESSION (MLR) (Available for all computers) — **Price: $24.95 Cassette/$28.95 Diskette**
MLR is a professional software package for analyzing data sets containing two or more linearly independent variables. Besides performing the basic regression calculation, this program also provides easy to use data entry, storage, retrieval and editing functions. In addition, the user may interrogate the solution by supplying values for the independent variables. The number of variables and data size is limited only by the available memory.

REGRESSION I, II and MULTILINEAR REGRESSION may be purchased together for $51.95 (three cassettes) or $63.95 (three diskettes).

ANOVA (Available for all computers) — **Price: $39.95 Cassette/$43.95 Diskette**
In the past the ANOVA (analysis of variance) procedure has been limited to the large mainframe computers. Now DYNACOMP has brought the power of this method to small systems. For those conversant with ANOVA, the DYNACOMP software package includes the 1-way, 2-way and N-way procedures. Also provided are the Yates 2^{K-P} factorial designs. For those unfamiliar with ANOVA, do not worry. The accompanying documentation was written in a tutorial fashion (by a professor in the subject) and serves as an excellent introduction to the subject. Accompanying ANOVA is a support program for building the data base. Included are several convenient features including data editing, deleting and appending.

BASIC SCIENTIFIC SUBROUTINES, Volume I (Not available for Atari)
DYNACOMP is the exclusive distributor for the software keyed to the popular text *BASIC Scientific Subroutines, Volume I* by F. Ruckdeschel (see the BYTE/McGraw-Hill advertisement in BYTE magazine, January 1981). These subroutines have been assembled according to chapter. Included with each collection is a menu program which selects and demonstrates each subroutine.

Collection #1: Chapters 2 and 3: Data and function plotting, complex variables
Collection #2: Chapter 4: Matrix and vector operations
Collection #3: Chapters 5 and 6: Random number generators, series approximations
Price per collection: $14.95 Cassette/$18.95 Diskette

All three collections are available for $39.95 (three cassettes) and $49.95 (three diskettes).
Because the text is a vital part of the documentation, *BASIC Scientific Subroutines, Volume I* is available from DYNACOMP for $19.95 plus 75¢ postage and handling.

ROOTS (Available for all computers) — **Price $10.95 Cassette/$14.95 Diskette**
In a nutshell, ROOTS simultaneously determines all the zeroes of a polynomial having real coefficients. There is no limit on the degree of the polynomial, and because the procedure is iterative, the accuracy is generally very good. No initial guesses are required as input, and the calculated roots are substituted back into the polynomial and the residuals displayed.

ACTIVE CIRCUIT ANALYSIS (ACAP) (48K Apple only) — **Price: $25.95/$29.95 Diskette**
ACAP is the analog circuit designer's answer to LOGIC SIMULATOR. With ACAP you may analyze the response of an active or passive component circuit (e.g., a transistor amplifier, band pass filter, etc.). The circuit may be probed at equal steps in frequency, and the resulting complex (i.e., real and imaginary) voltages at each component juncture examined. By plotting the magnitude of these voltages, the frequency response of a filter or amplifier may be completely determined with respect to both amplitude and phase. In addition, ACAP prints a statistical analysis of the range of voltage responses which result from tolerance variations in the components.

ACAP is easy to learn and use. Simply describe the circuit in terms of the elements and their placement, and execute. Circuit descriptions may be saved onto cassette or diskette to be recalled at a later time for execution or editing. ACAP should be part of every circuit designer's program library.

LOGIC SIMULATOR (Apple only; 48K RAM) — **Price: $24.95 Cassette/$28.95 Diskette**
With LOGIC SIMULATOR you may easily test your complicated digital logic design with respect to given set of inputs to determine how well the circuit will operate. The elements which may be simulated include multiple input AND, OR, NOR, EXOR, EXNOR and NAND gates, as well as inverters, J-K and D flip-flops, and one-shots. The response of the system is available every clock cycle. Inputs may be clocked in with varying clock cycle lengths/displacements and delays may be introduced to probe for glitches and race conditions. At the user's option, a timing diagram for any given set of nodes may be plotted using HIRES graphics. Save your breadboarding until the circuit is checked by LOGIC SIMULATOR.

LOGIC DESIGNER (North Star and CP/M only) — **Price: $34.95 Diskette**
LOGIC DESIGNER is an exceptional Computer Aided Design (CAD) program. With it you may convert a large and complicated digitial truth table (the functional specification) into an optimized Boolean logic equation. This equation may then be *easily* converted into a circuit design using either NAND or AND/OR gates. Operationally, LOGIC DESIGNER is composed of a BASIC program which calls in a machine language routine to reduce execution time. Example: For a 7 variable by 127 line table, the processing time is only two minutes. LOGIC DESIGNER is clearly a fast and powerful tool for building digital circuitry.

ORDERING INFORMATION

All orders are processed and shipped within 48 hours. Please enclose payment with order and include the appropriate computer information. If paying by VISA or Master Card, include all numbers on card.

Shipping and Handling Charges
Within North America: Add $1.50
Outside North America: Add 10% (Air Mail)

Delivery
All orders (excluding books) are sent First Class.

Quantity Discounts
Deduct 10% when ordering 3 or more programs. Dealer discount schedules are available upon request.

8" CP/M Disks
Add $2.50 to the listed diskette price for each 8" floppy disk (IBM soft sectored CP/M format). Programs run under Microsoft MBASIC or BASIC-80.

5¼" CP/M Disks
All software available on 8" CP/M disks is also available on 5¼" disks, North Star format.

Ask for **DYNACOMP** programs at your local software dealer. Write for detailed descriptions of these and other programs from **DYNACOMP**.

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Guest Commentary:

Computer Assisted Instruction-Worth The Effort?

Fred Keplinger
Los Gatos, CA

Let me answer that question with an unequivocal yes! I am a French teacher who has been experimenting with computers in the high school classroom for two years now. I am quite excited about the use of computers for private drill work, *individual tutoring* if you will.

Two years ago our administration purchased one 8K PET with the hope that it might lead to experimentation. Having long felt that computers might be of great aid in individualizing instruction, I appropriated the PET, took it home over the summer, and gradually learned to program it. This was my first experience with computers, but I did manage to make some programs for use in French and Spanish.

During the school year 1979-80, we acquired three more PET's — through donations from the community. I used these four machines for review work with my fifth year French students as well as for remedial work with my first year students. I required all beginning students whose progress was not satisfactory to meet with me after school to work with the computer drills. They had to do this until a minimum proficiency was attained. The success of this effort was much greater than I anticipated. For the first time in my twenty-four years of teaching French I had no students with grades of F or D at the end of the first semester.

In the meantime, our Principal and district Superintendent began searching for funds to build a computer laboratory. Generous local citizens and service clubs donated enough money to provide a laboratory equipped with fifteen PET's, two printers, and two disk drives. The school has used general fund money to pay for only one machine.

It is obvious that our program is off to a good start because of generous, enthusiastic local support. But what else is necessary? Let me make some observations. Speaking as one who has dealt with commercial software for the past twenty-two years (I have long been involved with oral-aural language labs and the writing of materials for them), I feel strongly that no adequate commercial software will ever be developed for school use — the students are just too different to allow for a mass market approach. Therefore a good CAI program will exist only when there are teachers throughout the school who are willing to learn enough programming to make their own drills. This is not difficult to accomplish.

Last summer I presented a crash course in programming in BASIC to our Foreign Language Department. The result is that we now have computers that speak French, Spanish, Italian, and Latin. I also offered an after school course to a number of teachers from several departments, as well as to some administrators and members of the clerical staff. We are well on the way to developing our own library of appropriate software.

If CAI is to succeed, another factor is most necessary. Students must have access to the computers. Obvious? Yes, but too often overlooked. We chose the PET computer because it is an integrated unit that is easily mounted on a small cart. It is quite easy to wheel our machines to wherever they are needed, whenever they are needed. I have also trained P.T.A. aides to operate the computers in the lab so that teachers may send students there for supervised drill whenever it is needed.

CAI is not a fad, an instructional gimmick. It is a technique that helps a student study and develop mastery of any material that requires repetition. I find it to be a very exciting technique. ©

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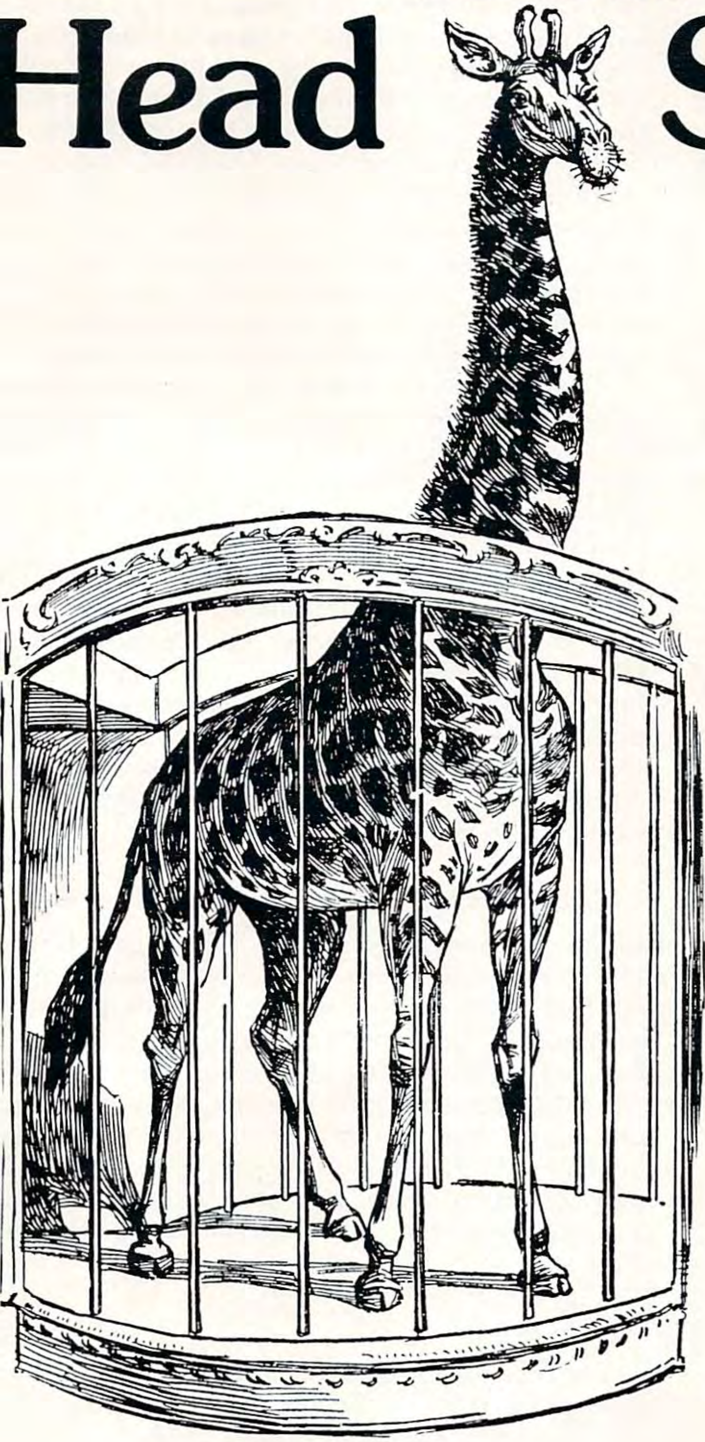

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Wolves, Caribou, And Other Problems

Marvin L. De Jong
Department of Mathematics-Physics
The School of the Ozarks
Pt. Lookout, MO

For a moment let us postpone the problem of wolves and caribou, which is only a specific example of a large class of problems that may be studied with mathematics and a computer. A *mathematical model* attempts to describe a complex social, biological, or physical system using mathematical techniques, with the hope that new insights into the behavior of the system will result. Attempts are made to project the behavior of the system into the future. Perhaps the most popular example of a mathematical model is the now old-fashioned lunar lander game. A good lunar lander game will simulate the *actual* conditions involved in a landing, using Newton's Universal Law of Gravitation and Newton's second law of motion to provide the necessary differential equations. These equations are solved by the computer while the operator controls such parameters as the "burn rate," or thrust. Fortunately, the crash that most of us experience is not actual.

Constructing a mathematical model of a system is not only entertaining and challenging — it may be genuinely useful. Some very useful models have been constructed that project population growth, availability of natural resources, and the growing economic distance between various groups of people on this planet. One of the most pressing needs is a model of the atmosphere of our planet that will allow long-range weather forecasting. In fact, such a model may be crucial if agriculture is going to supply enough food for the world. The vast amount of data needed for this project will require the use of many large and fast computers.

The goal of this article is more modest. It will describe a simple biological system involving predators, the wolves, and prey, the caribou. The credit for the original work on this subject belongs to Alfred Lotka and Vito Volterra whose names have become attached to the Lotka-Volterra Predator-Prey Equations. Lotka's concern was with a herbivorous animal population that preyed upon a plant population. Obviously, their ideas can be extended to a large number of complex biological and social problems because the highest form of life on this planet is a predator.

To begin, we will simplify the problem by making some assumptions about the wolves and the caribou. Suppose the caribou have an *unlimited* supply of mosses and grasses on their home ground, the tundra. Suppose that the wolves prey on caribou with no alternative food supply. In other words, if the caribou are scarce, the wolf population will decline because of starvation. Obviously these assumptions are not completely true, but they will allow us to get started on the problem of how the two populations, wolves and caribou, interact. Complexities in the problem can be introduced later. Besides, our choice of wolves and caribou was intended to be more graphic than accurate.

To find out where you are, you need to know where you started, how fast you have traveled, and for how long. Likewise, to know the current caribou population, you must know what the caribou population was at a previous time, the *rate of change* of the caribou population, and the time interval. For the moment, we will be concerned with the rate of change of the caribou population with respect to time. Just as speed (miles per hour) is the rate of change of distance with respect to time, we are interested in the rate of change (caribou per day) of the caribou population.

Let x be the number of caribou that are alive at any time t. The rate of change of the number of caribou with time is symbolized by:

$$\frac{dx}{dt} = \text{change in the number of caribou per unit time} \quad (1)$$

Do not let the strange looking symbol disturb you. It is no different than any other rate, such as miles per hour or gallons per minute. If dx/dt is positive, the number of caribou is increasing, while, if dx/dt is negative, the number of caribou is decreasing.

What determines dx/dt? Any population (people, rabbits, bacteria) with an unlimited food supply increases at a rate that is proportional to itself. The more rabbits you have, the more baby rabbits you get. Thus, one term in the equation for dx/dt is Ax. That is,

$$\frac{dx}{dt} = Ax \quad (2)$$

where A is some number that depends on many biological factors. These factors include the number of calves a caribou mother bears, at what age she starts bearing caribou babies, the natural death rate of caribou in the absence of predators, and many others.

This brings us to the effect of the wolves on the caribou. Let y be the number of wolves that are alive at any time. The quantity xy is the product of the number of caribou and the number of wolves. If we were to identify each of the caribou and each of the wolves, the product xy would give us the number of possible caribou-wolf encounters. Clearly, the negative component of dx/dt is related

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```
 10 VISMEM: CLEAR
 20 P=160: Q=100
 30 XP=144: XR=1.5*3.1415927
 40 YP=56: YR=1: ZP=64
 50 XF=XR/XP: YF=YP/YR: ZF=XR/ZP
 60 FOR ZI=-Q TO Q-1
 70 IF ZI<-ZP OR ZI>ZP GOTO 150
 80 ZT=ZI*XP/ZP: ZZ=ZI
 90 XL=INT(.5+SQR(XP*XP-ZT*ZT))
100 FOR XI=-XL TO XL
110 XT=SQR(XI*XI+ZT*ZT)*XF: XX=XI
120 YY=(SIN(XT)+.4*SIN(3*XT))*YF
130 GOSUB 170
140 NEXT XI
150 NEXT ZI
160 STOP
170 X1=XX+ZZ+P
180 Y1=YY-ZZ+Q
190 GMODE 1: MOVE X1,Y1: WRPIX
200 IF Y1=0 GOTO 220
210 GMODE 2: LINE X1,Y1-1,X1,0
220 RETURN
```

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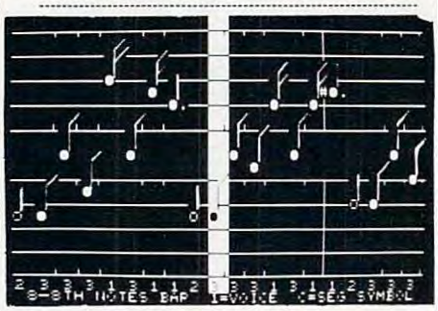

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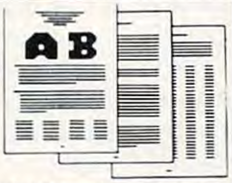

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to the number of caribou-wolf encounters. However, not every encounter leads to a caribou death; the wolf may not be hungry. Thus, the negative component of dx/dt is -Bxy where B is a number that represents the fraction of caribou-wolf encounters in a given period of time that lead to a caribou death. Thus, the final expression for the rate of change of caribou per unit time is:

$$\frac{dx}{dt} = Ax - Bxy \qquad (3)$$

Turning next to the wolves, we must find their rate of change with respect to time; that is, dy/dt, the change in the number of wolves per unit time. The "xy" term in Equation 3 is "bad" for caribou, but good for wolves because it represents more caribou eaten. In general, we can say that what is bad for caribou is good for wolves, and write:

$$\frac{dy}{dt} = Cxy - Dy \qquad (4)$$

where C and D are numbers that depend on a large number of biological factors. Equation 4 shows that, for predators with a limited food supply, an excess of predators (the "Dy" term in Equation 4) can have a detrimental effect on the number of predators.

Before continuing, let me point out the more or less obvious fact that I am not a biologist and I do not pretend to be able to determine the constants A, B, C, and D from biological data. Also, the purpose of this paper is not to reflect in any negative way on the wolf. As a predator he is probably far less harmful than human beings.

Meanwhile, back on the tundra, we would like to find how the number of caribou, *x*, and the number of wolves, *y*, vary with time. This problem will be solved in the same way you would calculate a simple rate problem, such as driving a car. If you are presently 50 miles from home, and you travel for an additional three hours at 55 miles per hour, then you will be 215 miles from home. 215 = 50 + 55*3.

In the same way, the number of caribou at time t is equal to the number of caribou at a time t_o (earlier) plus the rate of change of caribou times the time elapsed between t and t_0. In equation form:

$$x(t) = x(t_o) + \frac{dx}{dt}(t-t_o) \qquad (5)$$

Note the similarity between this statement, Equation (5), and the example in the preceding paragraph. A similar equation may be written for the wolves:

$$y(t) = y(t_o) + \frac{dy}{dt}(t-t_o) \qquad (6)$$

Our calculation proceeds in very small steps because both dx/dt and dy/dt change with x and y. We begin with some initial population, say x_o and y_o. We calculate dx/dt and dy/dt at these two values of x_o and y_o. Next, multiply by the small time interval between t and t_o, and add the results to x_o and y_o as in Equations 5 and 6. Repeating the process over and over again produces a table of values for *x* and *y* at various times *t*, subsequent to our starting time.

Before giving a BASIC program to predict the number of caribou and the number of wolves, we note that a stable condition does exist in which the number of wolves and the number of caribou are constant. If x_o and y_o are the beginning values for the number of caribou and the number of wolves respectively, and if:

$$x_o = \frac{D}{C}, \qquad y_o = \frac{A}{B} \qquad (7)$$

then both dx/dt and dy/dt are zero, and there will be no change in either population.

For purposes of illustration, we chose A = 2, B = .01, C = .01, and D = 8. With these choices for the constants, a choice of $x_o = 800$ caribou and $y_o = 200$ wolves gives a stable population for both species. These constants and initial animal populations do not have their foundation in biological reality; they merely serve to illustrate situations and trends that can occur in predator-prey relationships. Perhaps a much smaller population of wolves can *actually* control a much larger population of caribou, but for our purposes it is nice to keep the numbers of each population in a range so they can both be plotted on the same graph. Nature is rarely that accomodating. The program in Listing 1 can be used to see how the number of caribou and the number of wolves change with time, depending on the initial values chosen for x_o and y_o.

Before describing some of the results, let us examine the details of the program. The first four statements should be obvious. Statement 50 simply prints the current value of the time, the caribou population *x*, and the wolf population *y*. Note that the print statement "dresses up" the output values of *t* and rounds *x* and *y* to the nearest whole number. The data are much simpler to read when placed in this form. Statements 60 and 70 calculate the rates of change of the caribou and wolf populations. They correspond to Equations 3 and 4. Statements 80 and 90 are BASIC equivalents of Equations 5 and 6. Note that our time interval is 0.005 (the units are arbitrary; if you wish, you may think of the units as decades). Statement 100 updates the time each time around the loop. Since there are numerous calculations, we chose not to print all of the results. Statement 110 selects values of $t = 0, .1, .2, ..., 1.0, 1.1, ...$ for printing the current population data, skipping intermediate values of *t*.

Listing 1.

A BASIC program to solve the Lotka-Volterra predator-prey equations.

```
10 PRINT "INPUT THE STARTING POPULATIONS
   OF CARIBOU AND WOLVES."
20 INPUT X,Y
30 PRINT "INPUT THE CONSTANTS A, B, C, AND D
   FOR THIS PROBLEM."
```

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```
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 !"#$%&'()*+,-./0123456789:;<=>?
@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_
`abcdefghijklmnopqrstuvwxyz{|}~
```

BAUDOT Character Set: *A B C D E F G H I J K L M N O P Q R S T U V W X Y Z - ? : • 3 $ # ( ) . , 9 0 1 4 ! 5 7 ; 2 / 6 8* • **Cursor Modes:** *Home, Backspace, Horizontal Tab, Line Feed, Vertical Tab, Carriage Return. Two special cursor sequences are provided for absolute and relative X-Y cursor addressing* • **Cursor Control:** *Erase, End of Line, Erase of Screen, Form Feed, Delete* • **Monitor Operation:** *50 or 60Hz (jumper selectable.*

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NINE	AMPERE	FLOW	MILE	SET
TEN	AND	FUEL	MILLI	SPACE
ELEVEN	AT	GALLON	MINUS	SPEED
TWELVE	CANCEL	GO	MINUTE	STAR
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```
 40 INPUT A, B, C, D
 50 PRINT INT(10*T+.001)/10; INT(X+0.5); INT(Y+0.5)
 60 XP=A*X–B*X*Y
 70 YP=C*X*Y–P*Y
 80 X=X+XP*0.005
 90 Y=Y+YP*0.005
100 T=T+0.005
110 IF ABS(10*T–INT(10*(T+.00001)))<0.00001 THEN 50
120 GO TO 60
140 END
```

Table 1. A sample run of the program in Listing 1.

```
INPUT THE STARTING POPULATIONS OF CARIBOU
AND WOLVES.
? 1000, 200
INPUT THE CONSTANTS A, B, C, AND D FOR THIS
PROBLEM
?2,  .01 .01, 8
0    1000 200
.1    980 243
.2    921 283
.3    836 307
.4    750 305
.5    682 280
.6    640 244
.7    624 205
.8    631 172
.9    657 147
1     698 130
1.1   753 120
1.2   817 118
1.3   885 124
```

Table 1 shows how the computer prints the results on my AIM 65. The results are best studied by graphing the number of caribou and the number of wolves as a function of time. However, even a brief study of the results in Table 1 can lead to some conclusions. Recall that 800 caribou and 200 wolves give a stable (nature is balanced) population for both caribou and wolves. Try these values in the program. Note that in Table 1 we began with 1000 caribou and 200 wolves, representing an excess of caribou. Perhaps it was a better than average calving year for caribou. In any case, the caribou population begins to decline, while the wolf population increases. The wolves also "benefit" from the excess of caribou. However, at about $t=.3$, the caribou are near their stable level but now there is an excess of wolves. Thus, the caribou population declines below the stable level and the wolf population also declines because there are too few caribou to sustain their numbers. When the wolves have declined below about 200 wolves at $t=.7$, the caribou population begins to climb because there are too few caribou to sustain their numbers. When the wolves have declined below about 200 wolves at $t=.7$, the caribou population begins to climb because there are so few wolves. The decline in the wolf population ends at $t=1.2$ when the caribou population exceeds 800 again. The entire cycle repeats itself over and over again. A graph of these results is shown in Figure 1. Note that the peaks in the wolf population *follow* the peaks in the caribou population. The dips in the wolf population also come at later times than the dips in the caribou population. A slight increase in the peaks and a slight decrease in the dips is observed as time goes on. This is a result of the crudeness of our technique. An actual solution will repeat itself. At least we obtain some idea of what happens when the stable population is disturbed.

Figure 1 suggests some things to try for yourself. What happens when there are too few caribou (less than 800) and too many wolves (more than 200)? What happens when there is an excess of each species? What happens if there are no wolves? No caribou? Suppose that caribou has suddenly become very popular in restaurants, and that the caribou herd is reduced to 80 before we realize that the caribou are almost extinct, and we suddenly quit hunting them (leaving 80 caribou and 200 wolves). What will happen in this case? Try to predict what happens before you run the program.

Equations 3, 4, 5, and 6; the computer program; and the graph of the results make up our mathematical model of the caribou and the wolves. It can be modified by adding additional complexities. What if the supply of grasses on the tundra is limited and there is intraspecific competition? What happens if the caribou sometimes kill wolves?

I would like to acknowledge the inspiration I received from my Numerical Analysis class (Summer 1980). I would also like to acknowledge David A. Smith's book, **INTERFACE: Calculus and the Computer**, (Houghton-Mifflin, Boston, 1976) where I first encountered the predator-prey problem. This book is an excellent source for a large variety of calculus-related problems that can be solved with a computer. Anyone who has had one or more courses in calculus should profit from this book.

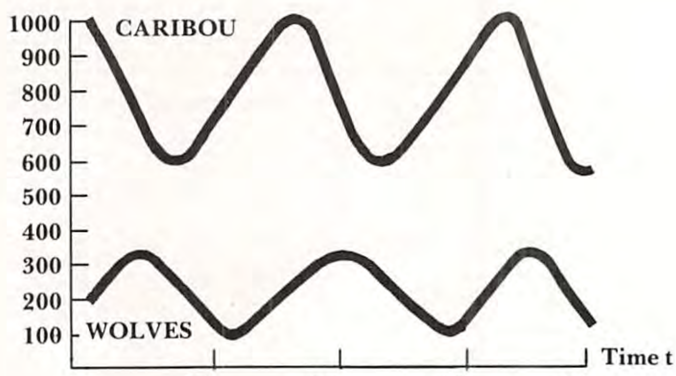

Figure 1. The populations of caribou and wolves as a function of time. Initial populations were $X_o=1000$ caribou and $y_o=200$ wolves.

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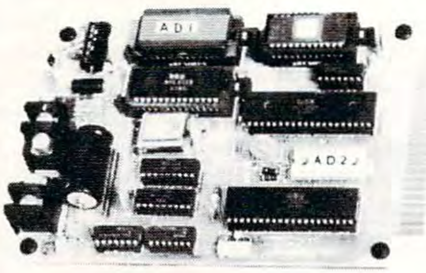

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The combined function of the DA0-7 lines do not allow for easy interfacing to other microprocessors such as the 6502 and 6800 series. One method of interfacing that has been proposed uses a 6820 programmable interface adaptor (PIA) with 8 lines of port A connected to the DA0-7 pins of the sound generator and three of the port B lines for the three bus control pins.

This means of interfacing makes programming the sound chip cumbersome. One needs to simulate the bus waveforms shown in Fig 2. Assuming that one is writing in BASIC, then two POKE commands are needed to set up the 6820 ports as outputs. Then one needs a POKE to send the address of the required internal register to the DA0-7 pins, another POKE to send LATCH ADDRESS to the bus control pins, a third POKE to send BUS INACTIVE, followed by a fourth POKE to send the data to the DA0-7 pins, a fifth POKE to send WRITE DATA to the bus control pins, and a sixth POKE to return the bus control pins to BUS INACTIVE. These last six POKES must be repeated for each of the sixteen internal registers needing input.

Why can one not make the sixteen registers in the sound generator part of the addressable memory of the microprocessor? Then a single POKE to the relevant address would be all that is needed.

The reason that this is not straightforward is that the AY-3-8910 is too slow to respond to the 1uS processor cycle of the 6502/6800 families. Following a falling edge of the 02 clock the minimum time intervals needed are:

delay until the processor address is valid	**300 nS**
AY-3-8910 address set up time	**400 nS**
AY-3-8910 address hold time	**100 nS**
AY-3-8910 data set up time	**50 nS**
AY-3-8910 data pulse width	**500 nS**
AY-3-8910 data hold time	**100 nS**
	1.45uS

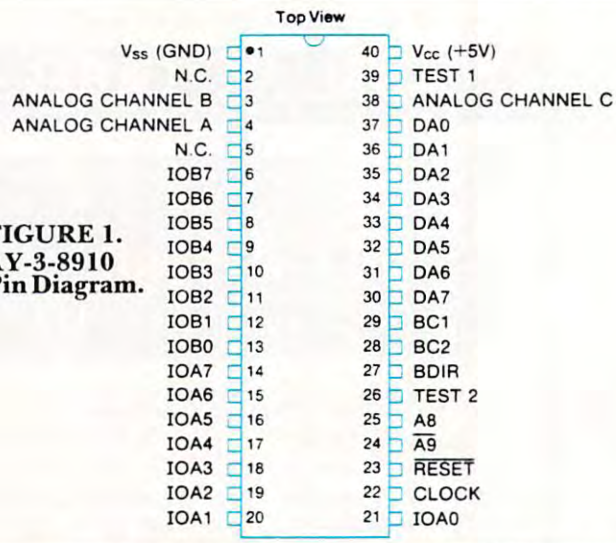

FIGURE 1. AY-3-8910 Pin Diagram.

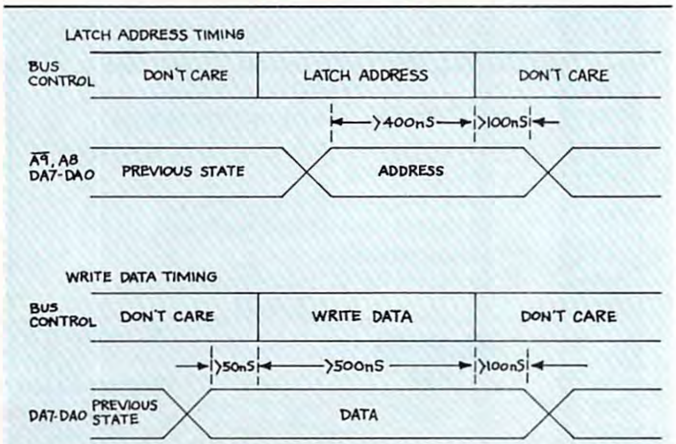

FIGURE 2. Sound Generator Timing (Write Mode).

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The solution is to deliberately spread the writing to the sound chip over two processor cycles. The circuit in Fig. 3 does this. The relevant signal waveforms are shown in Fig. 4. Circuits IC1 and IC2 decode the top eight address lines A15-8 and their outputs feed the additional address select pins A8 and A9 on the sound generator IC8. The quiescent state of IC5 leaves a one on its terminal Q and a zero on Q, the latter enabling the tristate output of IC3 and thereby applying the lower address lines A7-A0 to the combined data/address pins of the sound generator. The first half of the dual monostable IC7 triggers off each falling edge of 02 and produces a 300 nS pulse. The back edge of this pulse triggers the second half generating a delayed 550nS pulse. This latter pulse is applied to pin BDIR of the sound generator, which together with the output Q of IC5 on BC1 (also high during this period) codes LATCH ADDRESS on the bus control pins. The LATCH ADDRESS condition terminates 150nS before the computer address lines A15-A0 change. Only the lowest four address lines A3-A0, of the eight A7-A0 lines, address a register in the sound generator, if the other four lines A7-A4 are not zero, or if A8 and A9 are not 10 respectively then the address is invalid and the sound generator takes no further action.

On the next falling edge of 02 (rising edge of 02), two things happen. The data on the data lines D7-D0 from the microprocessor are latched into IC4, and the low, now on pin D of IC5, is clocked through to the Q terminal. This latter signal enables the tristate output of IC4 at the same time

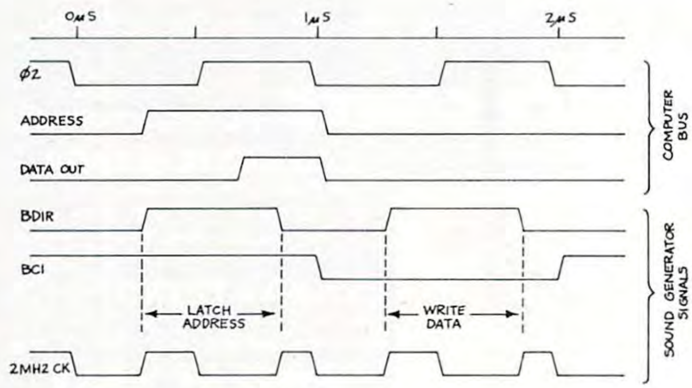
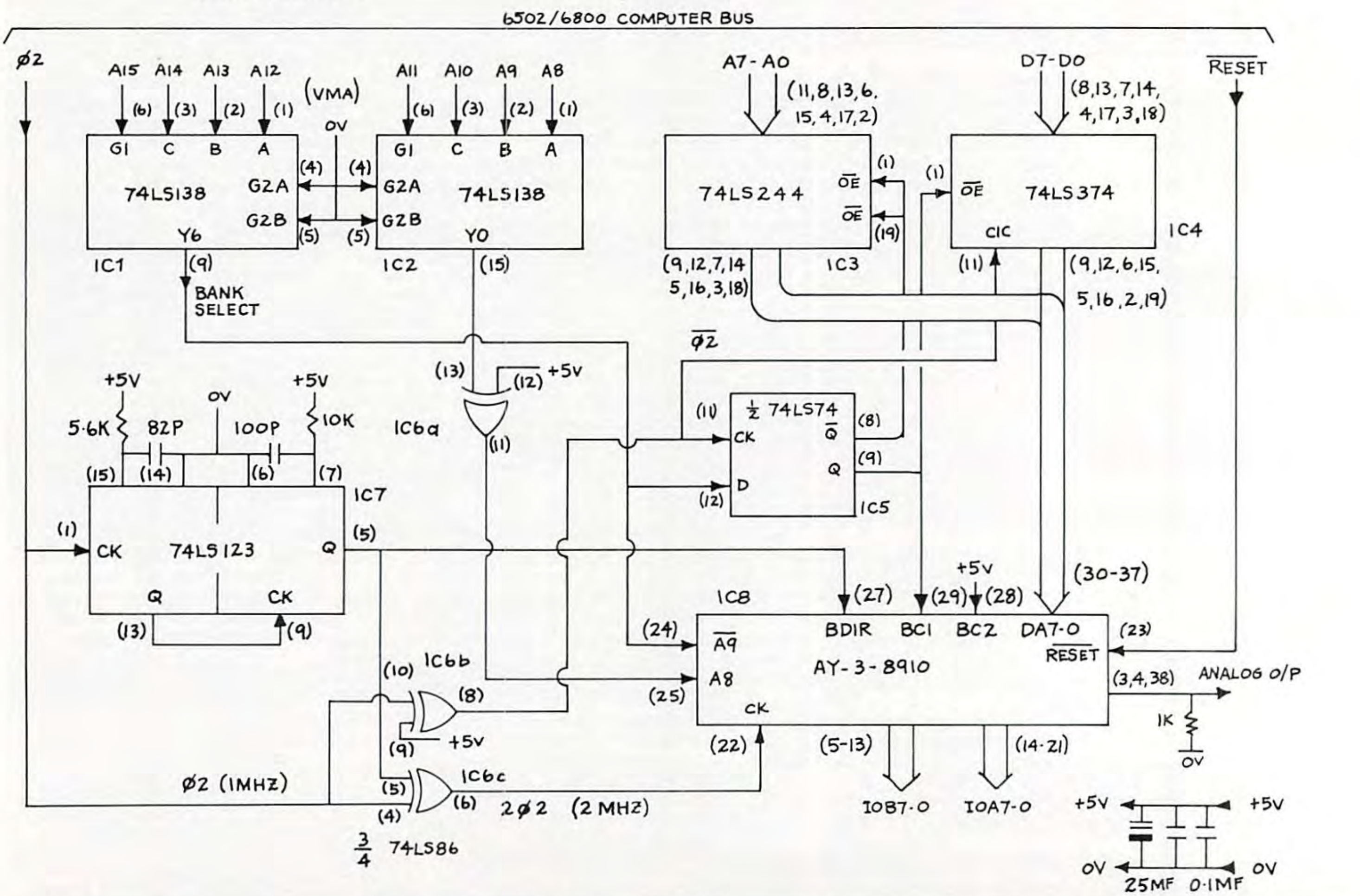


FIGURE 4. Signal Timing.

FIGURE 3. AY-3-8910. Memory Mapped On The 6502/6800 Bus.



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as the output of IC3 is disabled. Data, not address, is now applied to the combined data/address lines of the sound generator IC8. The monostables continue to produce delayed 550nS pulses and, when BDIR is high again, BC1 is now low giving a READ DATA command to the sound generator. Circuit IC6c is an exclusive OR which inverts 02 whenever the monostable output is high. The result is to convert the 1 MHz 02 into a 2MHz clock which is fed to the clock terminal of the sound generator. This 2MHz clock enables the generation of more precise tones at the higher frequencies than a 1MHz clock would allow. (See Table 1.) Circuits IC6a and IC6b are simple inverters and could be replaced by a 74LS04 if the frequency doubling function of IC6a is not required.

I have constructed the circuit for use with a Commodore PET. For this purpose I do not really need IC1, since it duplicates the Bank Select signals which are available on this expansion bus. I have chosen to place the sound generator at memory addresses E800 to E80F, which is in the I/0 area of the PET. Other addresses are possible by choosing different outputs of IC1 and IC2, and possibly the use of the G2 chip select pins. If the circuit is used with the 6800 processor, then VMA should be connected to one of the G2 select pins.

The circuit achieves the objective of permitting POKES directly to the sound generator registers and is only slightly more complex than the use of a 6820 PIA, if one includes the chip select decoding that is also necessary with the PIA. One function that my circuit does not allow is the reading of the register data. To add this feature is not difficult, although it will require a double PEEK: one to strobe in the address, and the second to read the data. There seems little purpose in having a read function. I have yet to use the two output data ports IOA and IOB, but plan them for two D to A converters to provide, additionally, two directly synthesized tone channels.

TABLE 1. Coarse (HI) And Fine (LO) Tuning Register Values Using A 2MHZ Clock.

		--- FREQUENCY (HZ)---			POKE	
NOTE		IDEAL	ACTUAL	ERROR	HI	LO
C	1	32.70	32.71	.0%	14	238
C#	1	34.65	34.65	.0%	14	24
D	1	36.71	36.71	.0%	13	77
D#	1	38.89	38.89	.0%	12	142
E	1	41.20	41.20	.0%	11	218
F	1	43.65	43.66	.0%	11	47
F#	1	46.25	46.24	.0%	10	143
G	1	49.00	49.00	.0%	9	247
G#	1	51.91	51.91	.0%	9	104
A	1	55.00	54.99	.0%	8	225
A#	1	58.27	58.28	.0%	8	97
B	1	61.74	61.73	.0%	7	233
C	2	65.41	65.41	.0%	7	119
C#	2	69.30	69.29	.0%	7	12
		--- FREQUENCY (HZ)---			POKE	
NOTE		IDEAL	ACTUAL	ERROR	HI	LO
D	2	73.42	73.40	.0%	6	167
D#	2	77.78	77.78	.0%	6	71
E	2	82.41	82.40	.0%	5	237
F	2	87.31	87.29	.0%	5	152
F#	2	92.50	92.52	.0%	5	71
G	2	98.00	97.96	.0%	4	252
G#	2	103.83	103.82	.0%	4	180
A	2	110.00	110.04	.0%	4	112
A#	2	116.54	116.50	.0%	4	49
B	2	123.47	123.52	.0%	3	244
C	3	130.81	130.75	.0%	3	188
C#	3	138.59	138.58	.0%	3	134
D	3	146.83	146.89	.0%	3	83
D#	3	155.56	155.47	-.1%	3	36
E	3	164.81	164.91	.1%	2	246
F	3	174.61	174.58	.0%	2	204
F#	3	185.00	184.91	.0%	2	164
G	3	196.00	195.92	.0%	2	126
G#	3	207.65	207.64	.0%	2	90
A	3	220.00	220.07	.0%	2	56
A#	3	233.08	233.21	.1%	2	24
B	3	246.94	247.04	.0%	1	250
C	4	261.63	261.51	.0%	1	222
C#	4	277.18	277.16	.0%	1	195
D	4	293.66	293.43	-.1%	1	170
D#	4	311.13	310.95	-.1%	1	146
E	4	329.63	329.82	.1%	1	123
F	4	349.23	349.16	.0%	1	102
F#	4	369.99	369.82	.0%	1	82
G	4	392.00	391.85	.0%	1	63
G#	4	415.30	415.28	.0%	1	45
A	4	440.00	440.14	.0%	1	28
A#	4	466.16	466.42	.1%	1	12
B	4	493.88	494.07	.0%	0	253
C	5	523.25	523.01	.0%	0	239
C#	5	554.37	555.56	.2%	0	225
D	5	587.33	586.85	-.1%	0	213
D#	5	622.25	621.89	-.1%	0	201
E	5	659.26	657.89	-.2%	0	190
F	5	698.46	698.32	.0%	0	179
F#	5	739.99	739.64	.0%	0	169
G	5	783.99	786.16	.3%	0	159
G#	5	830.61	833.33	.3%	0	150
A	5	880.00	880.28	.0%	0	142
A#	5	932.33	932.84	.1%	0	134
B	5	987.77	984.25	-.4%	0	127
C	6	1046.50	1050.42	.4%	0	119
C#	6	1108.73	1106.19	-.2%	0	113
D	6	1174.66	1179.25	.4%	0	106
D#	6	1244.51	1250.00	.4%	0	100
E	6	1318.51	1315.79	-.2%	0	95
F	6	1396.91	1404.49	.5%	0	89
F#	6	1479.98	1488.10	.5%	0	84
G	6	1567.98	1562.50	-.3%	0	80
G#	6	1661.22	1666.67	.3%	0	75
A	6	1760.00	1760.56	.0%	0	71
A#	6	1864.66	1865.67	.1%	0	67
B	6	1975.53	1984.13	.4%	0	63
C	7	2093.00	2083.33	-.5%	0	60
C#	7	2217.46	2232.14	.7%	0	56
D	7	2349.32	2358.49	.4%	0	53
D#	7	2489.02	2500.00	.4%	0	50
E	7	2637.02	2659.57	.9%	0	47

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F	7	2793.83	2777.78	-.6%	0	45
F#	7	2959.96	2976.19	.5%	0	42
G	7	3135.96	3125.00	-.3%	0	40
G#	7	3322.44	3289.47	-1.0%	0	38
A	7	3520.00	3472.22	-1.4%	0	36
A#	7	3729.31	3676.47	-1.4%	0	34
B	7	3951.07	3906.25	-1.1%	0	32
C	8	4186.01	4166.67	-.5%	0	30
C#	8	4434.92	4464.29	.7%	0	28
D	8	4698.64	4629.63	-1.5%	0	27
D#	8	4978.03	5000.00	.4%	0	25
E	8	5274.04	5208.33	-1.2%	0	24
F	8	5587.65	5681.82	1.7%	0	22
F#	8	5919.91	5952.38	.5%	0	21
G	8	6271.93	6250.00	-.3%	0	20
G#	8	6644.88	6578.95	-1.0%	0	19
A	8	7040.00	6944.44	-1.4%	0	18
A#	8	7458.62	7352.94	-1.4%	0	17
B	8	7902.13	7812.50	-1.1%	0	16

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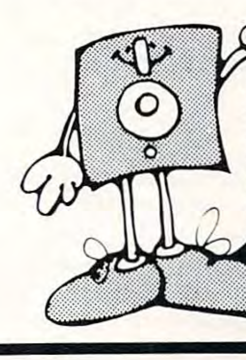

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The Carry Bit-What It Is And How It Works

Eric Brandon
Ontario, Canada

When writing a machine language program, you often make what are called conditional branches. The 6502 makes conditional branches depending on the status of 7 status bits. How to use these bits, what changes their status, exactly what they can tell you: these are the questions that often plague the neophyte machine language programmer. Of the seven, the zero bit and the carry bit are the most used. Since the zero bit is extremely straightforward (when the result of an operation is zero it is set; otherwise it is clear), this article will deal with the carry bit.

The operations that affect the carry bit are:

Operation	Effect On Carry Bit
ADC	Sets carry if result of addition is more than 255 ($FF). Otherwise carry is cleared.
ASL	Bit 7 (MSB) goes into carry bit.
CLC	Clears Carry.
CMP	If byte compared is less than or equal to the contents of the accumulator, carry is set. Otherwise carry is clear.
CPX	Same as CMP, but byte is compared to X register.
CPY	Same as CMP, but byte is compared to Y register.
LSR	Bit 0 (LSB) goes into carry bit.
PLP	Bit 0 of the first byte on the stack goes into carry.
ROL	Same effect as ASL.
ROR	Same effect as LSR.
RTI	Carry restored to what it was before interrupt.
SBC	If the subtrahend (number you are subtracting) is greater than the minuend (number you are subtracting from) the carry bit will be cleared.
SEC	Sets carry.

The tests you can use are:

Test	Meaning
BCC	Branch if carry is clear.
BCS	Branch if carry is set.

The carry bit is most often used with ADC, SBC, and CMP. Because of this I will explain in depth how to use it with these instructions.

ADC means Add With Carry. It operates thus:
accumulator = accumulator + addend + carry

Before adding, the carry bit should always be cleared with the CLC instruction. For example, to add 40 to memory location VALUE, the sequence to use is:

```
LDA     VALUE
CLC
ADC     #40
STA     VALUE
```

When adding numbers of more than 8 bits in length, more than one ADC instruction must be used. Carry should only be cleared before adding the least significant byte. The other bytes will "take care of themselves." For example, to add the number in MSB1 and LSB1 to the number in MSB2 and LSB2 and store the result in VALUE, VALUE + 1, and VALUE + 2 the sequence to be used is:

```
LDA     LSB1
CLC
ADC     LSB2
STA     VALUE+2
LDA     MSB1
ADC     MSB2
STA     VALUE+1
LDA     #0
ADC     #0
STA     VALUE
```

Similar methods can be used for adding numbers of any length. Note that when the decimal mode flag is set, the carry bit will be set when the addition results in a number greater than 99 decimal.

Another frequent carry-related operation is SBC. To understand how carry works with this instruction, we must understand the relationship between the carry bit and an imaginary bit called "borrow." Most books on 6502 machine language programming will tell you that carry is an inverted borrow. What this means is that whenever this imaginary borrow bit would be set, carry is cleared. And, whenever borrow would be cleared, carry is set. SBC works thus:

accumulator = accumulator-subtrahend-borrow

Obviously, borrow must be cleared before subtracting. This is done by *setting* carry. For example, to subract 40 from memory location VALUE, this sequence could be used:

```
LDA     VALUE
SEC
SBC     #40
ST      VALUE
```

As with addition, when adding numbers longer than 8 bits in length, the least significant bits are subtracted first. Carry is set only before the first subtraction.

CMP is an instruction that subtracts the operand from the accumulator without changing either the contents of the accumulator or the operand. So what is it? When it does the subtraction, it adjusts the status bits as if a subtraction had been performed by an SBC.

There is a confusing aspect to interpreting the status bits after a CMP instruction. If the operand is less than or equal to the contents of the accumulator, the carry bit will be set. If the operand is greater than the contents of the accumulator, CMP will clear carry. Armed with this knowledge (and the fact that the zero bit will be set if the bytes were equal) you can test for any relationship between them. In other words:

	Carry	Zero
Operand is greater than accumulator	clear	clear
Operand is equal to accumulator	set	set
Operand is less than accumulator	set	clear

The carry bit can provide you with a wealth of information. Use it to its full advantage and you will find that your machine language programs will become shorter and easier to understand.

6502 Assembly Language Programming, by Lance A. Leventhal, clearly shows what effect each instruction has on the status bits. If you have any questions or problems, read this fine book, or write to me at:

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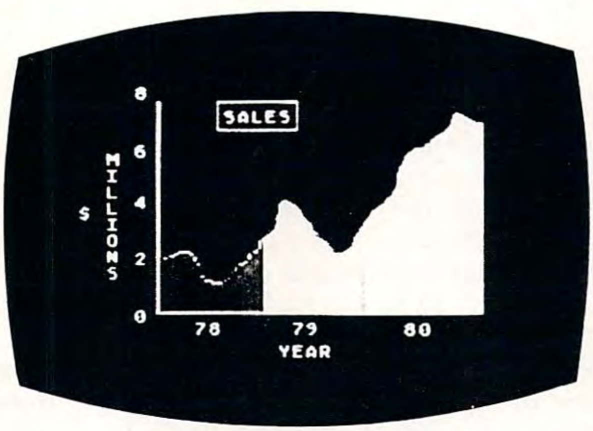

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I. Introduction

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1) a program that converts a decimal number (with a sign and an exponent) to a floating-point binary number (**COMPUTE!** #9)
2) a program that converts a floating-point binary number to a decimal number (**COMPUTE!** #11)
3) a program that multiplies two signed binary floating-point numbers (**COMPUTE!** #12).

In this article we describe a program that divides two floating-point binary numbers. Most of the programming described in this series has been relocatable allowing the user to move the programs or to put them in EPROMs with relative ease. Furthermore, the routines that were used to input and output the numbers can usually be found in a monitor, so that most of the code should be easily adapted to anyone's machine.

II. The Division Routine

Just as the multiplication routine does, the division routine uses three accumulators. The contents of accumulator A (ACCA) is divided *into* the contents of accumulator B (ACCB), and the quotient is stored temporarily in the result accumulator (RES) before the answer is moved back to the accumulator used by the output (floating-point binary to BCD routine) program.

Accumulator A occupies locations with addresses $0000 through $0003 with the most-significant byte in location $0000. The mantissa of the divisor is located in accumulator A. Location $0004 is used as a guard byte, permitting a 34-bit division before rounding the final answer to 32 bits. Thirty-two bits gives an answer that is accurate to approximately nine decimal digits. Accumulator B occupies locations with addresses $0020 through $0023 with a guard byte at location $0024. Accumulator B contains the dividend mantissa. The exponent and sign locations are the same as for the multiplication routine described earlier. The quotient is moved into RES at locations $0010 to $0014 as it is being calculated. When the calculation is finished, the quotient is moved to the accumulator that is used by the floating-point binary to BCD routine to output the answer. The accumulator architecture is exactly the same as for the multiplication routine described in the previous article.

The division algorithm is almost identical to the one you used in elementary school to do long division. Try one of these problems in decimal and then in binary if you want to understand the algorithm. Basically, it proceeds as follows:

1. Set COUNT = 34 = $22 to do a 34 bit division.
2. Calculate DIVIDEN – DIVISOR. If the carry flag is set then the DIVIDEND is greater than the DIVISOR, go to (3). Otherwise go to (4).
3. Replace the DIVIDEND with DIVIDEND – DIVISOR.
4. Shift the CARRY left into the LSB of the QUOTIENT.
5. Shift the new DIVIDEND left. (This is analogous to "bringing down" the next digit.)
6. Decrement COUNT. If COUNT is not zero, go to (2), otherwise go to (7).
7. Normalize and round the quotient.

As in the case of multiplication, the sign of the result is found by forming an exclusive-or with the signs of the divisor and the dividend. Recall from algebra that the exponent of the quotient is found by subtracting the exponent of the divisor from that of the dividend. If the exponent exceeds 127 or is less than -128, the program executes a BRK instruction. It is left to your imagination what you want your BRK routine to do for underflow or overflow. In my case the program simply jumps to the monitor. If the divisor is zero, the program also executes a BRK instruction. If the dividend is zero, the entire division routine is bypassed and the correct answer of zero is placed in the accumulator.

One final important point needs to be made. This division routine uses the same normalize and round instructions that the multiplication routine used. These instructions started at DETOUR ($0C7D) in the previous article and are not repeated here. Thus, you will find a JSR DETOUR instruction just before the routine ends.

In listing 2 you will find a short program to test the division routine. It also makes use of the subroutines published in the previous article in this series. In fact, it differs only in that it jumps to the division subroutine rather than the multiplication subroutine. It duplicates almost exactly Listing 5 in "A Floating Point Multiplication Routine," and you may wish to refer to that article for details.

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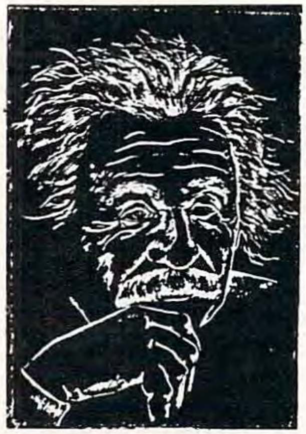
An Intelligent Alternative



TYPRINTER 221

In the research you are doing before purchasing your computer printer, you are probably confused by the various claims, speeds, choices, shapes and prices. Well, we'd like to clear the air a bit and tell you about the most unusual computer-printer around — the TYPRINTER 221.

You see, it's unusual because it is **totally compatible** with **every** computer and word processing program . . . from the largest to the smallest. It's versatile to the point of incredibility . . . We'll discuss the broad advantages and explain the details.

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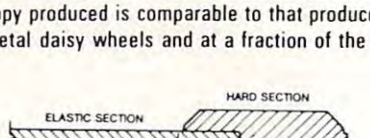
The special daisy wheel supplied is of a unique design consisting of a 100 character carrying radii. Each radii is formed of two distinct types of plastic — an "elastic plastic" for the stalk of the radii, and a comparatively "hard plastic" used to form the character area. This, combined with a very narrow character profile and a special positioner on each of the 100 radii, guarantees a uniform character density. There is near perfect geometric positioning of the character with no character higher or lower than the others. And because of its unique dual material design, micro-vibrations have virtually been eliminated, leaving your final copy clean, clear and smudge free. The copy produced is comparable to that produced by metal daisy wheels and at a fraction of the cost.



THE KEYBOARD

The keyboard has been referred to as a triumph of human engineering - from the way the keys seem to have been custom designed to fit your fingers, to the way the special feature switches have been grouped. A flip of a switch (or under computer control of course) and the printer becomes a foreign language machine. Push a button, and like magic the printer automatically locates and lines up columns of figures, perfectly balanced between the margins. This incredibly fast, extraordinarily quiet electronic keyboard puts more programming power at you fingertips then printers costing five to ten times as much.

THE DISPLAY

The TYPRINTER 221 presents a new dimension in operator/machine communications. In the manual (typewriter) mode, the printer controls and verifies all entries before printing. The display exhibits the last 15 characters of the text, word-by-word, until the end of the line. The operator may control what will be printed before the actual printing takes place. This new found flexibility enables you to make modifications along the entire line and in both directions. This 20 character plasma display has the ability to scroll backwards as well as forwards; will give the operator a visual indication as to which print mode is currently being selected as well as the number of characters remaining before the right margin is reached. The display will also indicate to the operator:

The number of characters available in the memory	What characters will be inserted into an existing text.
When the printer is in an error condition	When the memory for the previous line has been selected.
When a pre programmed form lay out has been selected	A warning message that the end of the page is being approached.
When the printer is operating from the internal memory.	That a hyphenation decision must be made

PRINT MODE

The TYPRINTER 221 will allow you to automatically highlight individual characters, words or complete sentences. Whatever is entered from the keyboard or from the computer, even an existing text file, can be printed in one or more of the five different modes:

- traditional printing;
- underlined characters;
- true bold characters where the horizontal component of the character is increased without disturbing the vertical component;
- characters which are both bold and underlined, and;
- a feature unique among computer printers-printing in reverse — white on black, sort of reverse video on paper.

MULTILINGUAL CAPABILITY

A unique and useful feature of the TYPRINTER 221 is its capability of being able to print in several languages without changing the daisy wheel. In addition to English, every standard daisy wheel has the ability and the necessary characters to print in French, Spanish, Italian and German.

THE FEATURES

Automatic justification of the right margin
The electronics of the TYPRINTER 221 have made right hand justification a simple, automatic operation.

Phrase and format storage
Phrases, dates, addresses, data, etc. that may be stored in your computer's memory may be sent over to the printer and stored in one of the "memory bins" of the printer. This information may then be used by the operator in the manual mode. This can save you hours when trying to get a form "just right."

Automatic centering
The TYPRINTER 221 will not only center any title between the pre-set margins, but will also center over one or more columns, or over any specific point and will even align copy with the right margin independent of the left margin.

Automatic vertical lines
A command from the computer enables an automatic feature which prints vertical lines at any point on the paper.

Automatic tab sequence recall
With the TYPRINTER 221 you may store and recall the most frequently needed margin and tab sequences for applications such as daily correspondence, statistical reports, etc. This guarantees consistent high quality appearance of each document.

Paragraph indent
A computer command instantly sets a temporary margin in order to print one or more indented paragraphs with respect to the right margin.

Automatic decimal point location
No matter how many figures to either the left or right of the decimal point, the TYPRINTER 221 will automatically line up the figures with the decimal point in any position you choose. Statistical printing has never been easier.

Column layout
This feature allows you to obtain automatic and perfect distribution of spaces between columns in respect to the margins. A perfect page balance is assured without the need to carry out calculations or additional operations.

There is a wide variety of options that you can add to TYPRINTER 221.

By now you are probably convinced that **we are sold** on our machine, and we hope you can understand why. In fact, why don't you use these facts to measure against any and/or all the other computer printers on the market.

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Listing 1. The Floating-Point Division Routine.

```
$0000 = ACCA; Most-significant byte of the mantissa in accumulator A.
$0005 = ACCX; Exponent for accumulator A.
$0007 = ACCS; Sign byte for accumulator A.
$0010 = RES;  Most-significant byte of the quotient accumulator.
$0020 = ACCB; Most-significant byte of accumulator B, the dividend.
$0025 = BCCX; Exponent of the dividend.
$0027 = BCCS; Sign of the dividend.
$0A70 A5 00   START   LDA ACCA        Is the divisor zero?
 0A72 D0 01           BNE BR1         No.
 0A74 00              BRK             Yes.
 0A75 A5 20   BR1     LDA ACCB        Is the dividend zero?
 0A77 D0 05           BNE BR2         No.
 0A79 A9 00           LDA #00         Yes. Make the answer zero.
 0A7B 85 01           STA ACCA + 1
 0A7D 60              RTS             Then return.
 0A7E A5 07   BR2     LDA ACCS        Calculate the sign of the quotient.
 0A80 45 27           EOR BCCS
 0A80 45 07           STA ACCS        Return sign to answer location.
 0A84 38              SEC             Now calculate the exponent.
 0A85 A5 25           LDA BCCX
 0A87 E5 05           SBC ACCX        Subtract exponents when dividing.
 0A89 50 01           BVC BR3         Overflow or underflow?
 0A8B 00              BRK             Yes. Go to BRK routine.
 0A8C 85 05   BR3     STA ACCX        No. Put result into answer location.
 0A8E 18              CLC
 0A8F A2 FC           LDX #$FC        Both the mantissa of the divisor and
 0A91 76 04   BR4     ROR ACCA + 4,X  the mantissa of the dividend will now
 0A93 E8              INX             be shifted one bit to the right. It
 0A94 D0 FB           BNE BR4         just makes the division routine easier
 0A96 18              CLC             to write.
 0A97 A2 FC           LDX #$FC
 0A99 76 24   BR5     ROR ACCB + 4,X
 0A9B E8              INX
 0A9C D0 FB           BNE BR5         So far so good. Next we will clear
 0A9E A9 00           LDA #00         the locations to store the answer.
 0AA0 A2 04           LDX #04
 0AA2 95 10   LOOP    STA RES,X
 0AA4 CA              DEX
 0AA5 10 FB           BPL LOOP        Answer locations cleared.
 0AA7 A0 22           LDY #$22        Bit count = $22 = 34. Start division.
 0AA9 38      CIRCLE  SEC
 0AAA A2 04           LDX #04         Start by comparing divisor to dividend.
 0AAC B5 20   BR6     LDA ACCB,X      Is the dividend greater than divisor?
 0AAE F5 00           SBC ACCA,X
 0AB0 CA              DEX
 0AB1 10 F9           BPL BR6
 0AB3 90 0B           BCC BR8         No. Then put a zero in the quotient.
 0AB5 A2 04           LDX #04         Yes. Subtract divisor from dividend
 0AB7 B5 20   BR7     LDA ACCB,X      and use the result as the new
 0AB0 F5 00           SBC ACCA,X      dividend. The carry flag will be
 0ABB 95 20           STA ACCB,X      set after this operation, and it
 0ABD CA              DEX             will be moved into the quotient.
 0ABE 10 F7           BPL BR7
 0AC0 A2 04   BR8     LDX #04         Here is where the carry flag gets
 0AC2 36 10   BR9     ROL RES,X       put into the quotient.
 0AC4 CA              DEX
 0AC5 10 FB           BPL BR9
 0AC7 A2 04           LDX #04         Now rotate the new dividend left.
 0AC0 18              CLC
 0ACA 36 20   BR10    ROL ACCB,X
 0ACC CA      DEX
 0ACD 10 FB           BPL BR10        Mission accomplished.
 0ACF 88              DEY             So decrement the bit counter.
 0AD0 D0 D7           BNE CIRCLE      Then branch back if it's not zero.
 0AD2 A0 00           LDY #00         Actually, you don't need this instruction.
 0AD4 A5 10   BR11    LDA RES         Here we normalize the mantissa and
 0AD6 30 0B           BMI BR13        adjust the exponent for all the shifting
 0AD8 18              CLC             done earlier.
 0AD9 A2 04           LDX #04
```

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0ADB	36	10		BR12	ROL RES,X	
0ADD	CA				DEX	
0ADE	10	FB			BPL BR12	
0AE0	C8				INY	Increment shift counter.
0AE1	D0	F1			BNE BR11	Branch back until mantissa is normalized.
0AE3	84	0B		BR13	STY TEMP	Calculate the exponent adjustment.
0AE5	A9	07			LDA #07	
0AE7	38				SEC	
0AE8	E5	0B			SBC TEMP	
0AEA	18				CLC	
0AEB	65	05			ADC ACCX	
0AED	50	01			BVC BR14	Overflow or Underflow?
0AEF	00				BRK	Yes.
0AF0	85	05		BR14	STA ACCX	Final result into exponent.
0AF2	20	7D	0C		JSR DETOUR	Round and final normalization in
0AF5	60				RTS	multiplication routine.

Listing 2. An Input/Output/Divide Calling Program.

$0050	20	00	0E	AGAIN	JSR INPUT	Call the BCD to Floating-Point Binary Routine.
0053	20	B0	0F		JSR SUB1	Call the subroutine to modify the accumulator.
0C56	20	C0	0F		JSR SUB2	Transfer ACCA to ACCB.
0059	20	00	0E		JSR INPUT	Get the second number (divisor).
005C	20	B0	0F		JSR SUB1	Fix the accumulator again.
005F	20	70	0A		JSR DIVIDE	Divide the first number by the second.
0062	20	00	0B		JSR OUTPUT	Convert the result to BCD and output it.
0065	4C	50	00		JMP AGAIN	Try another pair of numbers.

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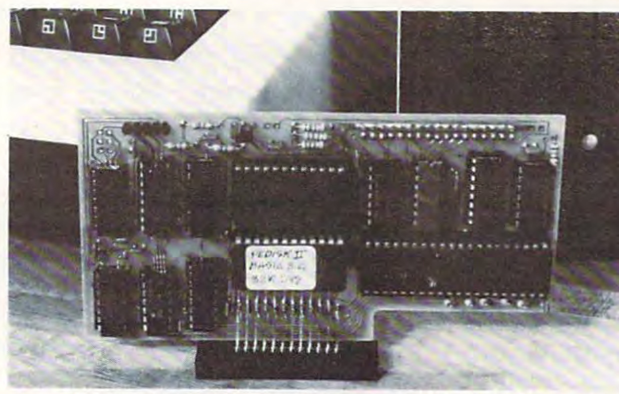

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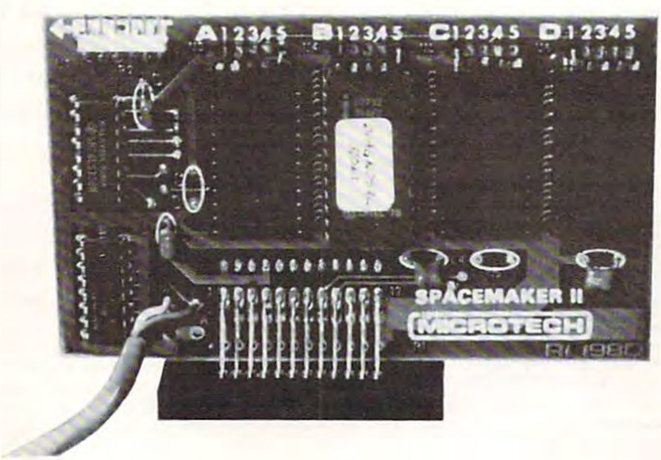

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Part Two:

The Practical Aspects Of Assembly Language Programming

Bruce D. Carbrey,
Raleigh, NC

Editor's Note: Last month, in the first part of this article, the author explored some methods of handling flags. At the end, he discussed setting aside bytes for flags. Here he introduces some additional techniques. To begin with, he proposes a more efficient method of storing and testing flags. RM

If instead you choose $80 to represent true and $00 to represent false, you can use the BIT instruction to test the flag without having to save the A register:

```
BIT   ALFALK  ;TEST THE FLAG
BPL   FOLD1   ;BRANCH IF NO "FOLDING" DESIRED
```

You don't have to save A because the BIT instruction sets the sign flag according to the status of bit 7 of the operand, without altering the accumulator. This saves you 4 bytes in your program, as shown in Listing 3. It also runs faster. You now know two rules to improve efficiency:

Rule 1: Use bit 7 of a byte as a flag.

Rule 2: A flag in memory can be tested without "clobbering" a register by using the BIT instruction.

Now that you know how to test the flag, you will want to be able to set or clear it. This may seem terribly obvious, for example,

```
LDA   #$80
STA   ALFALK  ;ENABLE ALPHA-LOCK MODE
```

sets the flag and,

```
LDA   #$00
STA   ALFALK  ;DISABLE ALPHA-LOCK MODE
```

clears the flag. This method uses one less byte to set the flag and two less bytes to clear the flag! On the

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negative side, it takes two machine cycles longer than the first method to set the flag, but is equally fast for clearing the flag. The shift-method also does not clobber the A register, which may often be useful. Again on the negative side, you could argue that the shift method is not as straightforward as the first method, and also that it leaves the remaining seven bits of the flag "undefined". However, this can also be useful, as I shall now demonstrate.

Suppose at some point in your program you want to *temporarily* allow entry of lower case letters, and then *restore* the previous mode (either alpha-lock or non-alpha-lock, whichever was previously in effect). One method might be:

```
LDA   ALFALK  ;RECALL PRESENT ALPHA-MODE
              STATUS FLAG
PHA           ;SAVE ON STACK
LDA   #0
STA   ALFALK  ;DISABLE ALPHA LOCK TEMPORARILY
...
(code using lower case input...)
...
PLA           ;RECALL ORIGINAL ALPHA-LOCK
              STATUS
STA   ALFALK  ;RESTORE OLD MODE
```

This program segment uses the stack to save and restore the flag status. Now consider this alternative:

```
LSR   ALFALK  ;SAVE OLD MODE, CLEAR ALPHA LOCK
...
(code using lower case input...)
...
ASL   ALFALK  ;RESTORE PREVIOUS ALPHA LOCK
              MODE
...
```

This program segment performs the same function in 6 bytes instead of 13, runs faster, and doesn't clobber the accumulator! It illustrates a simple but powerful fact:

Rule 3: A single byte can be used as an 8-level push-down stack for flags.

Shifting the flag byte right moves the previous status into bit 6; shifting the flag left restores the old flag back into bit 7. This rule has several corolaries which are occasionally useful:

Rule 4: You can test the previous (saved) flag by using a BIT instruction followed by a BVC or BVS instruction.

... programs will have fewer branches, will use less memory, and will run faster ...

Rule 5: You can test both flags (bit 7 and bit 6) with only one BIT instruction.

For example:

```
BIT   FLAG    ;TEST THE FLAG
BMI   NEWSET  ;BRANCH IF PRESENT FLAG IS SET
BVS   OLDSET  ;BRANCH IF PREVIOUS FLAG WAS SET
...
```

Another side effect is:

Rule 6: You can test a flag and restore it to its previous state at the same time by using ASL followed by BCC or BCS.

For example:

```
ASL   ALFALK  ;DISCARD PRESENT, RESTORE OLD
              FLAG
BCS   ISSET   ;BRANCH IF DISCARDED FLAG WAS
              SET
...
```

The same sequence can be used to clear the flag instead if it was initialized to 0 originally and was not used as a stack. All these functions have the advantage of not disturbing any registers (except the PSW). Since they are slightly "tricky", you should document your code with clarifying comments.

As you can see, there's more to the simple little flag than meets the eye! Properly used, flags can greatly simplify and improve your programming. If you try the techniques presented here, I think you will find that your programs will have fewer branches, will use less memory, and will run faster. In next month's installment, we will look at methods for improving machine language loops.

Listing 3: Improved Keyboard Driver With Alpha-Lock Flag Using Bit 7 = 1 = True

```
;
;         SUBROUTINE INCH: KEYBOARD DRIVER FOR ASCII-ENCODED
;         KEYBOARD WITH PARALLEL INTERFACE.
;
;
;         ADDRESSES SHOWN ARE FOR 6530 ON KIM-1 COMPUTER.
;         KEYBOARD DATA LINES TO PORT A BITS 0 TO 6,
```

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```
                ;       NEGATIVE-GOING STROBE TO BIT 7.
                ;
                ;       ON ENTRY: IF ALFALK BIT 7 IS 1, THEN LOWERCASE LETTERS WILL
                ;       BE RETURNED AS THE EQUIVALENT UPPERCASE ALPHA.
                ;       ON RETURN: REGISTER A = ASCII CODE FOR KEY PRESSED;
                ;       X AND Y PRESERVED.
                ;
1700            PAD     =       $1700       ;KIM PORT A DATA REGISTER ON 6530
1701            PADD    =       $1701       ;KIM PORT A DATA DIRECTION REGISTER
                ;
0000                    *=      $1780       ;PROGRAM ORIGIN
                ;
1780 A900       INCH    LDA     #$00
1782 8D0117             STA     PADD        ;SET PORT DIRECTION = INPUTS
1785 AD0017     INCH1   LDA     PAD         ;TEST PORT
1788 30FB               BMI     INCH1       ;WAIT FOR STROBE PULSE
178A 2C0017     INCH2   BIT     PAD
178D 10FB               BPL     INCH2       ;WAIT FOR END OF STROBE
                ;
                ;       IF ALPHA-LOCK FLAG IS SET, FOLD ANY LOWERCASE LETTERS TO
                ;       EQUIVALENT UPPERCASE LETTERS.
                ;
178F 2C9F17     FOLD    BIT     ALFALK      ;TEST "ALPHA LOCK" FLAG
1792 100A               BPL     FOLD1       ;BRANCH IF NO FOLDING DESIRED
1794 C97B               CMP     #$7B        ;LOWER CASE "Z" + 1
1796 B006               BCS     FOLD1       ;BRANCH IF PUNCTUATION
1798 C961               CMP     #$61        ;LOWER CASE "A"
179A 9002               BCC     FOLD1       ;BRANCH IF NOT LOWER CASE ALPHA
179C E920               SBC     #$20        ;ELSE FOLD TO EQUIVALENT UPPERCASE
179E 60         FOLD1   RTS
                ;
                ;       ALPHA LOCK FLAG (DEFAULT = ALLOW LOWER CASE)...
                ;
179F 00         ALFALK  .BYTE   0           ;"ALPHA LOCK" FLAG; NON-0=UPPERCASE ONLY.
                ;
0000                    .END
NO ERROR LINES
```

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Apple Disk Motor Control

William W. Martin
Seven Valleys, PA

The purpose of this article is to demonstrate a method of software motor control operation for the APPLE II DISK system.

The original reason for adoption of this performance patch was to decrease the time required to load the data file for a TEXT EDITOR I normally use at work. This design can be used anytime maximum performance is desired. The improvement seen for the demonstration program is about 20 percent, but may be greater for TEXT FILES, especially when time is taken to process the data as it is input from the disk.

This performance patch stops the APPLE DOS from turning off the disk motor as normally done during a disk operation. This function can now be controlled by the user with a definite performance improvement without modifying the normal DOS skew parameters.

EXAMPLE: First, since we will be changing the instructions of the DOS, please use a scratch disk in case we destroy it.

Now, please perform these steps in the following order, from the immediate mode.

VERIFY ORIGINAL DATA..

1.'PRINT PEEK (-16834)' - DOS VERSION 3.2 or 3.2.1
OR
'PRINT PEEK (-16819)' - DOS VERSION 3.3
THE VALUE RETURNED SHOULD BE: 189
TO SET DOS PATCH..

2. 'POKE -16834,96' - DOS VERSION 3.2 OR 3.2.1
OR
'POKE -16819,96' - DOS VERSION 3.3

3. NOW TYPE 'CATALOG'

Notice that the disk is still spinning after completion of the 'CATALOG'.

4. TYPE 'CATALOG' AGAIN

Notice how the 'CATALOG' function is performed faster since the motor is already up to speed. Repeat step four to test this again.

TO RESTORE TO NORMAL..

5. 'POKE' -16834,189' - DOS VERSION 3.2 OR 3.2.1
OR
'POKE -16819,189' - DOS VERSION 3.3

This will restore the DOS back to its original value.

6. 'POKE -16152,0' - ALL DOS VERSIONS

This will turn the motor off.

NOTE: 'POKE -16151,0' - TURN DISK MOTOR ON
'POKE -16152,0' - TURN DISK MOTOR OFF

This same method can be used under program control to obtain the same results.

The Demo Program

After entering the program and verifying that it is correct, insert your scratch disk. Type RUN and observe how the DISK motor stops while loading normally, but continues to spin while loading the "TEST" file with the patch set.

Program Description

Lines 100–150 — These lines print the header, change the text window setting, and send the DOS command 'MON I,O,C'. There is a centering routine used here by setting 0$ to the desired output and then executing a GOSUB 970.

Lines 160–179 — This sets up the variable 'D' to a value (200 in this example) that is used to simulate a short delay which would normally be encountered if the input data is processed while being input.

Lines 180–310 — This section establishes the dummy T$ as 'ABCDEFGHIJKLMMNOPQRSTUVWXYZ' and stores it to the scratch disk 100 times.

Lines 320–500 — The 100 T-strings are now read back from file 'TEST' under the normal DOS. Notice how the motor turns on and off while reading the 'TEST' file. Each time the motor starts up again, some time is wasted while waiting for the disk to come to the proper speed.

Lines 510–760 — The 100 T-strings are again read back, but this time using our disk motor patch. Notice that with the patch, the disk motor no longer stops and always maintains proper speed. Besides the time improvement, it is probably a little easier on the APPLE power supply by reducing the on/off cycle for the motor.

NOTE: Line 590–610 — The ONERR GOTO at line 610 is necessary when using this patch because, without it, if a disk error is encountered, the pro-

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gram would break without restoring the original values and turning off the motor. Notice that the ONERR GOTO routine at line 950 insures that the original will be restored due to a disk error of some type.

Assembly Language Notes

What this routine does is replace an LDA ,X instruction that normally stops the disk motor with an RTS instruction. This tricks the DOS into thinking that it turned off the motor.

NOTE: I wish to give special thanks to Mr. E. L. Didion for the information to make this program possible.

```
100  REM   MOTOR CONTROL DEMO BY BILL MARTIN
110 :
120  TEXT : HOME : PRINT :O$ = "DOS MOTOR CONTROL DEMO": GOSUB 97
     0: PRINT :O$ = "BY BILL MARTIN": GOSUB 970
130 O$ = "--------------------------------------": GOSUB 970: POKE
     34,5: HOME
140 D$ =  CHR$ (4): PRINT D$;"MON I,O,C"
150 :
160 D = 200: REM     VARIABLE 'D' IS LOOP DELAY TO SIMULATE INPUT
     DATA PROCESSING
170 :
180 T$ = "ABCDEFGHIJKLMNOPQRSTUVWXYZ"
190  REM    SAVE T$ 100 TIMES
200 :
210  HOME : PRINT "PRESS A KEY TO SAVE 'TEST' FILE..";: CALL  - 7
     56: PRINT : HOME
220 O$ = "SAVING 'TEST' FILE": GOSUB 970:O$ = "-------------------
     ------------------": GOSUB 970: POKE 34,8: HOME
230 :
240  PRINT D$;"OPEN TEST"
250  PRINT D$;"DELETE TEST"
260  PRINT
270  PRINT D$;"OPEN TEST"
280  PRINT D$;"WRITE TEST"
290  FOR N = 1 TO 100: PRINT T$: NEXT
300  PRINT D$;"CLOSE"
310 :
320  REM  READ BACK NORMAL
330 :
340  REM  TAKES ABOUT 51 SECONDS
350 :
360  HOME : PRINT "PRESS A KEY TO READ 'TEST' FILE NORMAL";: CALL
      - 756: PRINT : HOME
370  POKE 34,5: HOME :O$ = "READING 'TEST' FILE - NORMAL": GOSUB
     970:O$ = "--------------------------------------": GOSUB 970: POKE
     34,8: HOME
380 :
390  PRINT D$;"OPEN TEST"
400  PRINT D$;"READ TEST"
410  FOR N = 1 TO 100
420  INPUT "";T$
430 :
440  REM  SIMULATE PROCESSING INPUT DATA
450  FOR C = 1 TO D: NEXT C
460 :
470  NEXT N
480  PRINT D$;"CLOSE"
490 :
```

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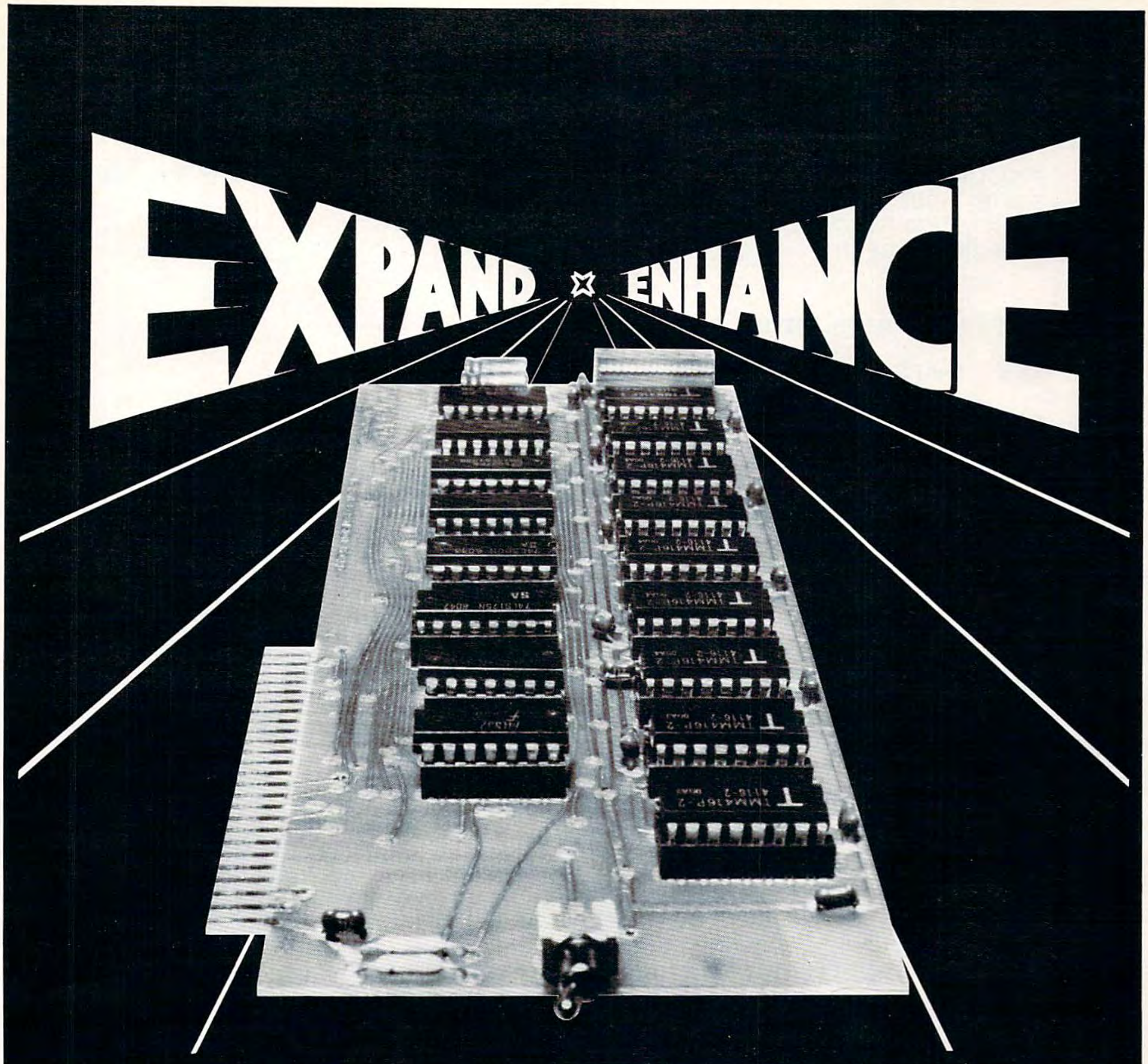

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```
500  PRINT : PRINT "NORMAL READ COMPLETE": PRINT  CHR$ (7): PRINT

510  POKE 34,5: HOME :O$ = "READING 'TEST' FILE - IMPROVED": GOSUB
     970:O$ = "------------------------------------": GOSUB 970: POKE
     34,8: HOME
520  PRINT "PRESS A KEY TO READ WITH MOTOR CONTROL";: CALL  - 756
     : PRINT : PRINT
530 :
540 :
550  REM  READ WITH MOTOR CONTROL
560 :
570  REM  TAKES ONLY 41.5 SECONDS WITH MOTOR PATCH ACTIVE
580 :
590  REM   IMPORTANT TO USE 'ON ERR GOTO' !
600 :
610  ONERR  GOTO 930
620 :
630  GOSUB 820: REM  SET MOTOR CONTROL PATCH
640 :
650  PRINT D$;"OPEN TEST"
660  PRINT D$;"READ TEST"
670  FOR N = 1 TO 100
680  INPUT "";T$
690 :
700  REM  SIMULATE PROCESSING INPUT DATA
710  FOR C = 1 TO D: NEXT C
720 :
730  NEXT N
740  PRINT D$;"CLOSE"
750 :
760  PRINT : PRINT "IMPROVED READ COMPLETE": PRINT  CHR$ (7): PRINT

770  PRINT D$;"DELETE TEST"
780  POKE 216,0: REM  DON'T NEED ONERR GOTO NOW
790  GOSUB 870: REM  RESTORE NORMAL DOS
800  HOME : PRINT "TEST COMPLETE....": TEXT : END
810 :
820  REM  SET MOTOR PATCH HERE
830 :
840  IF  PEEK ( - 16834) = 189 THEN  POKE  - 16834,96: REM  DOS 3
     .2.1 (CHANGE -16834 TO -16819 FOR DOS 3.3)
850  RETURN
860 :
870  REM  RESTORE MOTOR PATCH HERE
880 :
890  IF  PEEK ( - 16834) = 96 THEN  POKE  - 16834,189: REM  RESTO
     RE DOS 3.2.1 ORIGIONAL VALUE (CHANGE -16834 TO -16819 FOR DO
     S 3.3)
900  POKE  - 16152,0: REM  TURN MOTOR OFF
910  RETURN
920 :
930  REM  ON ERR ROUTINE
940 :
950  GOSUB 870: REM  SHOULD RESTORE ORIGIONAL DOS VALUES AND STOP
      MOTOR
960  POKE 216,0: HOME : VTAB 5: PRINT "DISK ERROR": PRINT : PRINT
     "PRESS ANY KEY TO TRY AGAIN.. ";: CALL  - 756: PRINT : GOTO
     550
970  HTAB 20 -  LEN (O$) / 2: PRINT O$: RETURN : REM  CENTERING R
     OUTINE
```

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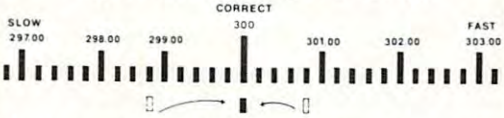

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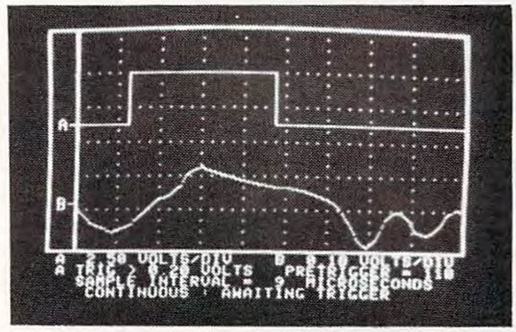

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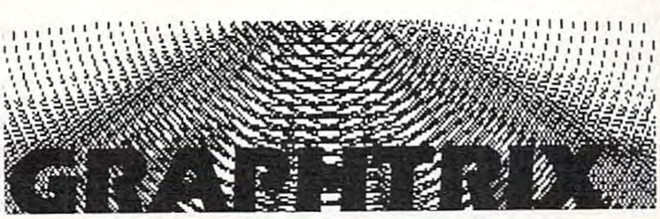

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Interfacing The Apple To 6500 Family Peripherals

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It has been stated previously that 6500 peripheral chips (6522, 6551, etc.) accessed from the Apple II peripheral bus must undergo complete address decoding. This results from the fact that 6500 chips require stable address and chip select lines 180 nanoseconds before the positive edge of the Φ2 clock (1). In this paper, a simple delay circuit allows use of the Apple device select lines to avoid the complexity of full address decoding.

Initially, a test program was written to explore the timing between Φ0 and device select on the Apple II peripheral bus. The test program was as follows:

```
0300 AD   B0   C0   over   LDA slot address
0303 4C   00   03          JMP over
```

This simple program produces continuous low going pulses on the address device select line. Observation via dual channel oscilloscope showed the relationship between Apple peripheral bus lines, device select, and Φ0. Figure 1 illustrates why 6500 family chips have difficulty working with the Apple II peripheral bus using the device select lines. Note that the falling edge of device select corresponds with the rising edge of Φ0. The device select line represents the address decode of the high order address lines that have been logically ANDed with Φ0. For the 6500 family, address lines must be stable 180 nanoseconds before the positive transition of the Φ2 clock line (2). (The Φ2 of 6522 is Φ0 from the Apple II Peripheral Bus.) Figure 1 shows absence of the needed delay. The solution calls for development of circuitry to delay the positive edge of Φ0, making the device select line useful.

A positive edge delay circuit is shown in Figure 2, with a corresponding timing diagram, Figure 3. In the resulting output waveform, the positive edge has been delayed several nanoseconds. The basic concept of the delay circuit centers around the voltage required to trigger a TTL gate. For the 74LS08 AND gate, potentials greater than a threshold of 1.0 volts are considered to be logical "highs." Rationalization for the delay circuit is as follows. When the input goes low, the output of the first AND gate (Pin 3) goes low: the diode is forward biased, discharging the capacitor so that both inputs to the second AND gate are low, resulting in a low output. When the input rises high, the output of the first AND gate goes high to reverse bias the diode. Current is then in the RC network charging the capacitor. The voltage across the capacitor rises until the 1.0V threshold level is reached. At this potential, the second AND gate recognizes the voltage level as a high (Pin 5), changing the state of the output.

The magnitude of the delay can be adjusted by changing the value of the RC time constant. The voltage drop across the capacitor (V_{TTL}) can be expressed by:

$$V_{TTL} = V(1-e^{-t/RC})$$

where: **V - the TTL high (4.0V)**
t - time
RC - resistor and capacitor values.

Rearranging, this equation takes the form:

$$t_{delay} = [-R \, 1N (1-\frac{V_{TTL}}{V})]C$$

where: **t_{delay} - the rising edge delay**
V_{TTL} - threshold voltage 1.0V

Therefore, for a constant resistance R, the amount of delay is proportional to the size of the capacitor (3). For example, for $R = 1.5k\Omega$ and $C = 330pf$, the predicted delay would be 140 nanoseconds, which agrees with that obtained experimentally. The upper limit of the delay results from an RC time constant that will not allow the capacitor to reach the 1.0V threshold during the 1/2 cycle time of ~500 nanoseconds. For $R = .5k\Omega$, the maximum capacitor size is about 2000pf.

Advantages of this circuit are: 1) a TTL level signal results, 2) the falling or trailing edge is unaffected, and 3) inexpensive and simple to incorporate into existing peripheral design.

Implementation of delay circuit utilizing a 6500 family peripheral is shown in Figure 4. A 6522 VIA was chosen to test the applicability of the delay circuit. A simple inspection of memory through the Apple monitor can determine if the 6522 registers are communicating with the Apple. Simple software routines to define data direction, to read and write data to both 8 bit ports, and to set and decrement timers were used to determine that the 6522 was fully functional when using the delay circuit. All features of the 6522 are non-functional with no positive edge delay of Φ0.

Even though all 6500 family chips have not been tested, the authors presume that this delay technique is applicable to all 65XX peripheral devices. This investigation has revealed one excep-

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tion to the Φ0 delay requirement. The 6520 PIA will function properly when connected directly to the Apple Φ0 and device select lines.

In summary, the delay of the positive edge of Φ0 from the Apple peripheral bus results in simpler interfacing with the 6500 family. Eliminating full address decoding utilizes slot independence of peripheral cards that are less expensive and easier to construct.

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3. Diefenderfer, A. James; Principles of Electronic Instrumentation, 2nd Ed. W. B. Sanders; Co. 1979.

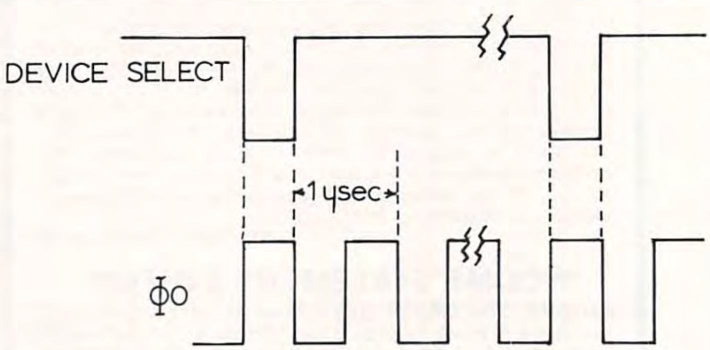


Figure 1.

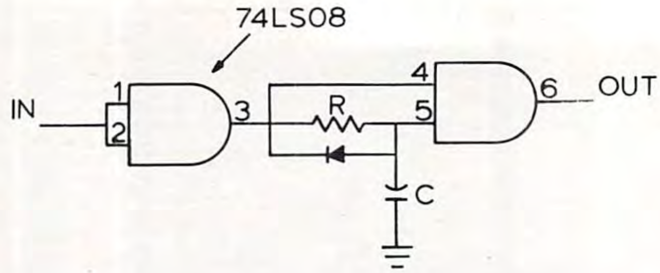


Figure 2.

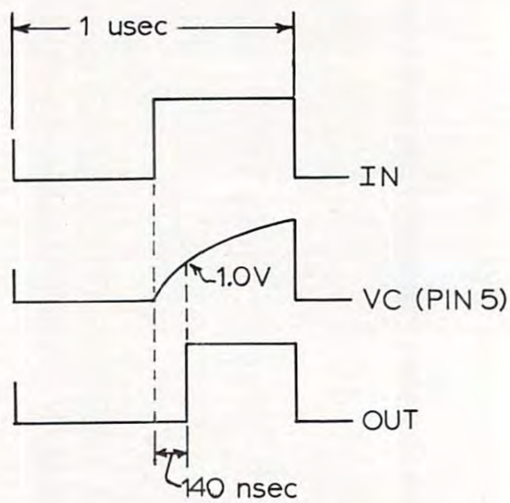


Figure 3.

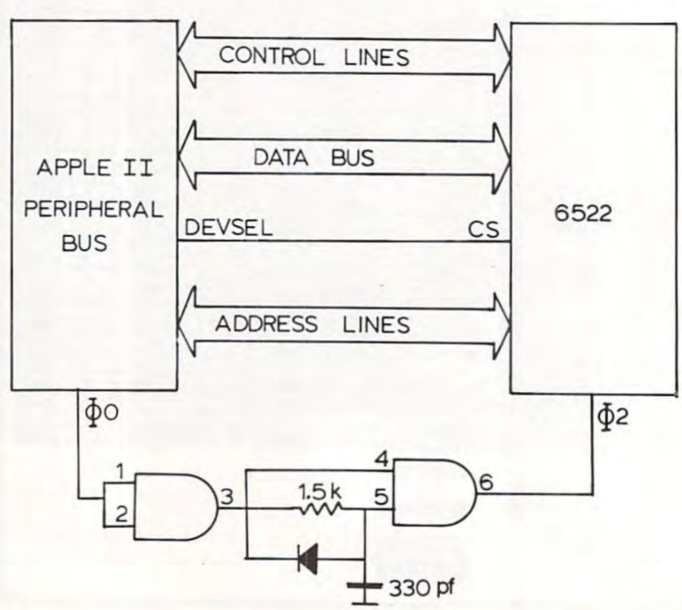
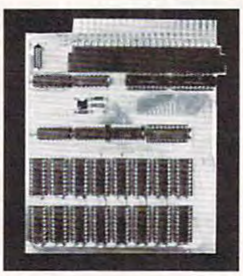


Figure 4.

AIM 65-8K STATIC MEMORY



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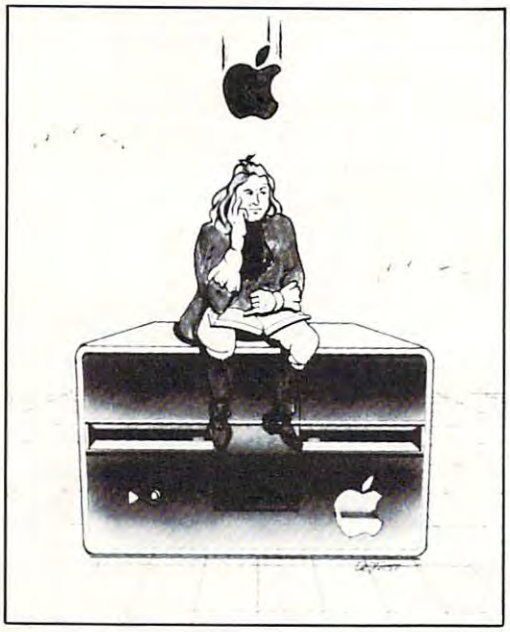

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A Cassette Tape Monitor For The Apple

Jim Lowell
Whitehouse Station, NJ

"Type LOAD; do not press RETURN yet. Remove the plug from the earphone jack of the tape recorder. Press the PLAY button on the recorder and advance the tape until you hear the leader tone. Stop the recorder and replace the plug in the earphone jack. Start the tape, and immediately press RETURN."

The Tape Monitor

To most tape-recorder-based APPLE computer users, the complex instructions above are a source of continued annoyance and frustration. Fortunately, they are also unnecessary.

The tape monitor unit described in this article eliminates the need to remove the plug from the earphone jack and simplifies the tape loading instructions to: "Type LOAD; do not press RETURN yet. Press the PLAY button on the tape recorder. When you hear the leader tone, press RETURN."

For about one hour's work and one-half the cost of a good tape program (about $12.00), you can build a tape monitor unit for your APPLE. To simplify the construction process, I have included a set of templates to locate the required mounting holes and both a schematic diagram (for those of you who are electrically inclined) and a wiring diagram (for those of you who aren't).

Using The Monitor

Use of the monitor unit has several advantages over the remove-the-plug method of tape loading:

- It simplifies the loading procedure.
- It allows the user to listen to the tape as it is loaded.
- It eliminates the need to change the tape recorder volume control setting to avoid disturbing others while listening to the leader tone.
- It reduces the wear and tear on the earphone jack of the recorder and the mini-plug of the computer connecting cable.

To use the monitor for the first time, connect the cord from the *tape in* jack of the APPLE to the mini-jack of the monitor. Then, insert the mini-plug of the monitor into the earphone jack of the tape recorder. Put a tape program into the machine and press PLAY. Adjust the volume control on the monitor (don't change the setting on the recorder yet) until it is at the desired level. Now, rewind the

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tape and go through the following loading steps:

- Type LOAD without hitting return.
- Start the tape.
- When you hear the leader tone, hit RETURN.
- When the cursor re-appears, rewind the tape.

If the tape fails to load properly, the problem could be that the speaker in the monitor is drawing some of the required signal away from the computer (this has never been a problem with my Panasonic recorder — I load most tapes at a volume setting of "4"). If the problem occurs, however, turn the recorder volume up a notch or two — that should fix it.

Building The Monitor

The parts list below uses mostly Radio Shack components because they are widely available; any comparable parts will do.

Here are my suggested steps for building the monitor.

1. Using the templates, locate and drill all holes in both the top and case.

2. Fasten all the proper parts to the top of the project case (i.e. everything but the mini-jack, mini-plug, control knob, and cord). Be sure you mount the speaker cloth over the right hole before mounting the speaker.

3. Connect these parts together as per the schematic or wiring diagrams (using single-conductor copper wire). The wires coming from the switch and volume control to the mini-jack should be about eight inches long. This is to allow the top of the project case to be easily removed if necessary. Don't connect the wires to the mini-jack yet.

4. Put the rubber grommet in the proper hole in the side of the project case (the one where the cord will go).

5. Connect the mini-plug to about one foot of shielded cable (the shield goes to the "ring" terminal of the plug), and thread the other end of the cable (with the shield and conductor already stripped and tinned) through the grommet into the case.

6. Twist the shield of the cord and the end of the wire from the volume control together, and solder them to the "ring" terminal of the mini-jack.

7. Twist the conductor of the cord and the end of the wire coming from the switch together and solder them to the "tip" terminal of the mini-jack.

8. Fasten the mini-jack in position in its hole in the side of the case.

9. Screw on the top of the case, put the control knob onto the volume control post and you're done.

I've tried to supply all the necessary instructions to make building the tape monitor an easy evening's project. If, however, you encounter any problems, drop me a line at the address below:

Jim Lowell
P.O. Box 364
Whitehouse Station, NJ 08889

PARTS LIST

COMPONENT	PART#
1. Project case (4-3/4" x 2-1/2" x 1-2/5")	270-222
2. 2" speaker (8 ohm)	40-245
3. Mini-switch	275-662
4. Mini-volume control (5K ohm)	271-214
5. Control knob	274-415
6. Mini-jack	274-296
7. Mini-plug (shielded)	274-288
8. 1½ feet of single-conductor shielded cable.	
9. 1½ feet of single conductor copper wire.	
10. 1¼ inch piece of speaker cloth (or loose-weave fabric).	
11. A rubber grommet to fit a ¼-inch hole.	

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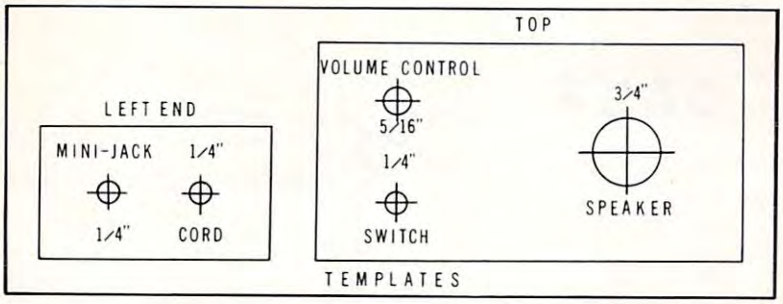

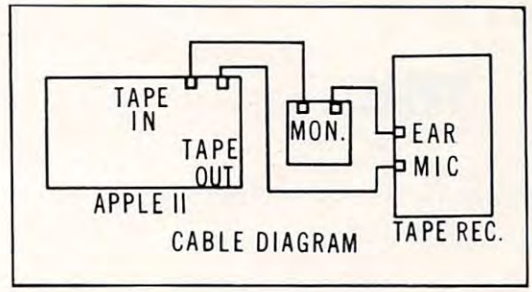

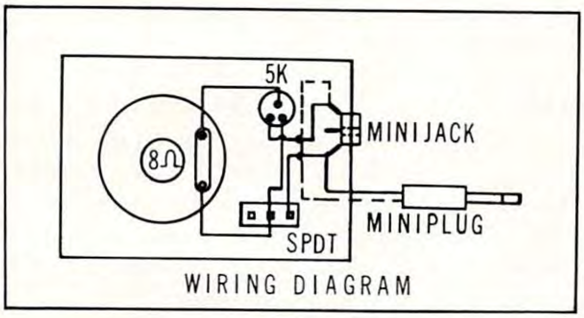

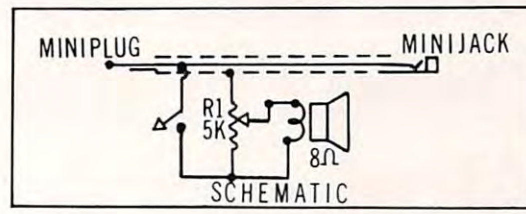

Diskette Sector Space In A Greeting Program

R. R. Hiatt
St. Catherines, Canada

Most Apple users include the system command CATALOG in their greeting program so that when the DOS is booted, the diskette's contents are automatically listed. CATALOG, of course, displays the number of sectors used for each file as well as the file name. What it does not report is the total number of used sectors, or the remaining number unused. To find out this rather useful information, the user must sum the individual numbers and subtract from 403. It's a small chore, but annoying, particularly as the computer should be doing the arithmetic, not the user.

There are two problems: The first, that the numbers are non-resident (except in the screen memory area) is easily solved by PEEKing them out. My program does this, and works quite well as long as the diskette holds fewer than 24 files. It will always sum and report for the last 23 files, but that can be misleading. Consequently, I restrict myself to 23 files per diskette.

The real problem lies in the construction of the CATALOG routine itself. The output is paged, but control is not returned to the program until the entire contents have been screened. Thus, the program stands by helplessly as the numbers it's supposed to PEEK scroll upwards, off the screen, and into oblivion.

It would be an easy matter to amend CATALOG if one knew where it was. But searching the 12K bytes of disassembled DOS 3.2 in the hope of recognizing the routine seems more work than it's worth. Until some thoughtful person publishes a DOS map, I'll be content with my present, admittedly imperfect, but useful, program.

```
10  REM GREETING W CATALOG & ADD
20  REM SECTOR ADD FOR 23 FILES OR FEWER
30  REM CATALOG MUST FINISH BEFORE ADD
WILL START
40  PRINT "SLAVE DISK INIT ON 48K APPLE"
50  PRINT "BY R. HIATT, 12/1/80"
60 D$ = CHR$(4)
70 S = 128:D = S + 48
80  FOR I = 1 TO 2000: NEXT I: HOME
90  PRINT D$;"CATALOG"
100 T = 0:CT = 0
110  FOR BASE = 1024 TO 1104 STEP 40
120  FOR J = 0 TO 7
130 ROW = BASE + J * S
140 T1 = T
150  FOR COL = 3 TO 5
160 A = PEEK (ROW + COL) - D
170  IF A < 0 OR A > 9 THEN 190
180 T = T + A * 10 ^ (5 - COL)
190  NEXT COL: IF T > T1 THEN CT = CT + 1
200  NEXT J: NEXT BASE
210  PRINT : PRINT "SECTORS USED TOTAL
";T
220  PRINT : PRINT "UNUSED SECTORS =
";403-T
230  PRINT "NUMBER OF FILES = ";CT
240 END
```

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Cleveland Heights, OH

Editor's Note: Many Atari users have been waiting for this. For years, one of the most useful programming techniques for the PET involved "dynamic keyboard" programming. This technique permits the machine to automatically "press" its own RETURN key and, in effect, program itself. This permitted automatic line-numbering, block deletion, DATA statements automatically generated, etc.

In this article, Mr. Frumker opens this important door for Atari programmers. Note that POKE 842,13 puts Atari into "RETURN-key mode." The cursor can be made to travel over a GOTO, sending it to a line containing POKE 842,13, to halt the "dynamic" mode. In the program below, text and background are set to identical colors, hiding the action. There is much to experiment with here. When you design a new utility using "dynamic keyboard," send it in to **COMPUTE!**. *—RTM*

One of the very nice features of Atari Basic is the ability to RESTORE to a specific line number of DATA. You can even RESTORE to a variable where that variable represents a line number of DATA. This opens up some nice possibilities. For example, you can generate random line numbers for random testing. In addition, if one of the items in a DATA line is a repetition of the line number, then that can be stored and retrieved later.

I used these possibilities in a homework practice program for my daughters. They often get lists of words in school whose meanings have to be memorized. That led to the following program where they can be randomly tested on the words (in this case, prefixes). When an error is made, the line number is saved in an array, so at the end those words and definitions that need more study can be RESTOREd and printed out.

Along the way, the program evolved into allowing my daughters to enter new lists of practice words themselves. In order to make this process as easy as possible, all of the old words (DATA lines) had to be cleared out of memory, in case the second list was shorter than the first. The method used to clear out the old DATA can instead be used in a program to update existing data, or save new variable values, or whatever else you would like that can be expressed as a legal line. This method will be discussed at lines 2100 – 2150.

I've allowed for 100 lines of practice space, although that many are seldom used. In the program that follows, only lines 1 through 10 are used, as an example. The format is: line number DATA repetition of the line number, question, answer. There are often two definitions for a word, so I've allowed for two answers (B$ for the first, and C$, if needed, for the second). Also, if a word is difficult and needs extra practice, it can be repeated (as I have done on lines 8 and 9) to increase its random frequency of occurence.

The Program

Lines

0 – Line 2000 is the introductory part of the program. It returns to line 110.

110 – The OPEN to screen editor here makes it possible to have INPUT without a ? prompt (by using INPUT #1; var). It also clears the screen when first OPENed, so I put it here where I wanted a screen clear anyway.

120 – CTRL M (44 times). This string is the underlining for the correct definitions. If, instead, you used a for-next loop for underlining, you would see it underline from left to right, which is distracting.

125-150 – The TRAP is set for the expected out of data error. All of the DATA items are read, and then the TRAP is sprung. At this point, P has the line number of the highest DATA line. Let TOTAL=P and use TOTAL in line 160 to set the random number limit. By doing all of this, my daughters don't have to go into the program to change the RND size.

135 – If C$ is a number (that is, less than ASC 65), then there is only one answer, and C$ is ignored.

160-170 – Here is where we RESTORE to random DATA lines, thanks to Atari Basic.

171-177 – This avoids an out of data error if the last DATA line has only one answer. As you see, TRAPs can be used for much more than just avoiding an error crash.

220 – Aha! The "missing" TAB in Atari BASIC really does exist! It's just called POKE 85, avar instead. Memory location 85 is the current cursor column, and you can POKE it with anything that you would use as a TAB argument. Remember that the Atari columns start at 0, but default to 2.

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230 – If I OPENed the screen editor in order to avoid ? prompts, how come I put in my own ? (line 220) for this input? Here I felt that the extra space after the ? helps to visually set off the guessed answer.
270 – P(Q) = P. Remember that P is the repeat of the line number, so that the line number of the DATA on which an error was made is now saved in P(Q). When Q = 16 there is a chance that the list of mistakes will scroll when printed, so I go to that list here, just in case.
360-380 – The POKEs center the answer and U$ underlines it.
540 – I like to use CHR$(125) for a screen clear because it reads correctly on the printer. ESC SHIFT CLEAR prints out as a bracket.
600 – For all of you out there who like green screens ...
630 – FOR R = 1 TO the total number of mistakes.
650 – RESTORE the line number of the line on which an error was made.
730 – I like friendly computers.
745 – The two brackets are ESC CTRL 2. That beeps the internal speaker of the computer.
100-1080 – The flashing CORRECT! subroutine. The POKE 85,15 along with the semicolon holds it all together in the same place on the screen. This way you are not row-dependant, as you are with a POSITION.
2000-2330 – Program introduction and old DATA clearout.
2025 – WARN is a flag to warn that data has been changed. The warning is used in line 740.
2040 – Make the screen printing the same color and brightness as the background, so that it is "invisible." Otherwise, there are lots of distractions on the screen during the DATA clearout.
2050-2070 – How many DATA lines are there to clear out? This is the same kind of count-through as in lines 125–150.
2085 – ERASE is the line number to be "erased."
2090 – While all of this is going on, let's have some musical entertainment.
2100-2150 – The people at the Atari technical information WATS line (800-538-8547) supplied this routine. They have been very helpful, answering all kinds of questions. This routine takes information generated by the program and newly printed on the screen, and enters it into the program as part of the program. The new information must be a complete legal line (new line or changed existing line) including the line number. In this example, on line 2110, the ERASE is where the new line is printed. I have used the routine here with just line numbers in order to erase the old DATA lines. You can enter more than one new line by having more PRINT lines (after 2110 and before 2120). Just be careful to not scroll the screen with too many lines. Possible uses for this routine include updating specific data on existing lines. you might want to do this in a budget program to update expense totals and the projected inflation rate. It is used at lines 2200 to 2360 here to enter the new DATA lines as part of the program. This will work with anything that can be expressed as a complete line (see line 2310). And the result, since it is now part of the program, can be saved.
2200-2360 – The data update routine again. Here it takes INPUTs (lines 2250, 2270, and 2290), organizes them into a legal DATA line at line 2310 (with D incrementing the line number), and then adds this new line to the program.

```
0 DIM A$(20),B$(20),C$(20),U$(44),X$(20)
,Y$(1),P(16):BEEP=3000:GOTO 2000
1 DATA 1,IM____,NOT
2 DATA 2,MIS____,WRONG
3 DATA 3,CON____,WITH,TOGETHER
4 DATA 4,SUB____,UNDER
5 DATA 5,SUPER____,OVER
6 DATA 6,PRE____,BEFORE
7 DATA 7,INTER____,BETWEEN,AMONG
8 DATA 8,EX____,OUT OF
9 DATA 9,EX____,OUT OF
10 DATA 10,TRANS____,ACROSS
110 OPEN #1,4,0,"E:"
115 Q=0:M=0:POKE 752,1
120 U$="
        "
125 TRAP 150
130 READ P,A$,B$,C$
135 IF ASC(C$)<65 THEN RESTORE P+1
140 GOTO 130
150 TOTAL=P
160 X=INT(TOTAL*RND(0)+1)
170 RESTORE X
171 IF X<>TOTAL THEN 180
172 TEST=1:GOTO 174
173 TEST=0:RESTORE X
174 TRAP 173
175 IF TEST=1 THEN READ P,A$,B$,C$
176 IF TEST=0 THEN C$="0":READ P,A$,B$
177 TRAP 40000:GOTO 190
180 READ P,A$,B$,C$
190 B1=LEN(B$):C1=LEN(B$)+LEN(C$)+4
200 ? "          HOMEWORK PRACTICE"
205 ? "          -----------------"
210 ? :? :? :? :? :POKE 752,0
220 POKE 85,17-LEN(A$)/2:? A$;" ? ";
230 INPUT #1;X$
240 POKE 752,1:? :?
250 IF X$=B$ OR X$=C$ THEN GOSUB 1000:GO
TO 500
260 ? "WRONG......TRY AGAIN."
270 M=M+1:Q=Q+1:P(Q)=P:IF Q>15 THEN ? CH
R$(125):GOTO 600
280 ? :? :POKE 752,0
290 POKE 85,17-(LEN(A$)/2):? A$;" ? ";
300 INPUT #1;X$
310 POKE 752,1
320 IF X$=B$ OR X$=C$ THEN GOSUB 1000:GO
TO 500
330 ? :? :? "NOPE..........THE CORRECT A
NSWER IS":? :?
335 IF ASC(C$)<65 THEN 370
340 POKE 85,19-C1/2:? B$;" or ";C$
360 POKE 85,19-C1/2:? U$(1,C1):GOTO 500
370 POKE 85,19-B1/2:? B$
380 POKE 85,19-B1/2:? U$(1,B1)
500 ? :? :? :?
510 ? "  PRESS RETURN FOR ANOTHER PROBLE
M":? "  OR TYPE L FOR A LIST OF MISTAKES
.";
520 INPUT #1;Y$
530 IF Y$<>"" AND Y$<>"L" THEN 510
```

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```
540 ? CHR$(125)
550 IF Y$="L" THEN 600
560 GOTO 160
600 SETCOLOR 1,14,4:SETCOLOR 2,14,0
610 ? "          LIST OF MISTAKES"
615 ? "          ----------------"
620 IF M<1 THEN 700
630 FOR R=1 TO Q
650 RESTORE P(R)
651 IF P(R)<>TOTAL THEN 660
652 TEST=1:GOTO 654
653 TEST=0:RESTORE P(R)
654 TRAP 653
655 IF TEST=1 THEN READ P,A$,B$,C$
656 IF TEST=0 THEN C$="0":READ P,A$,B$
657 TRAP 40000:GOTO 670
660 READ P,A$,B$,C$
670 PRINT A$;
680 IF ASC(C$)<65 THEN ? "......";B$:GOT
O 690
685 ? "...";B$;" or ";C$
690 NEXT R
700 PRINT
710 ? "DO YOU WANT MORE PRACTICE ";:INPU
T Y$
720 IF Y$="Y" THEN FOR R=1 TO 16:P(R)=0:
NEXT R:M=0:Q=0:GRAPHICS 0:POKE 752,1:GOT
O 160
730 ? :? "O.K., GOODBYE FOR NOW."
735 IF WARN=0 THEN GOSUB BEEP:GOTO 750
740 ? :? "YOU ADDED NEW PROBLEMS THIS TI
ME.":? "BE SURE TO CSAVE THIS PROGRAM!"
745 ? "}":FOR TIME=1 TO 10:NEXT TIME:? "
}":FOR TIME=1 TO 400:NEXT TIME
750 FOR TIME=1 TO 400:NEXT TIME
997 GRAPHICS 0:POKE 752,0
998 CLOSE #1
999 END
1000 ? :? :? :GOSUB BEEP
1010 FOR FLASH=1 TO 7
1020 POKE 85,15:? "CORRECT !";
1030 FOR TIME=1 TO 8:NEXT TIME
1040 POKE 85,15:? "CORRECT !";
1050 FOR TIME=1 TO 8:NEXT TIME
1060 NEXT FLASH
1070 POKE 85,15:? "CORRECT !"
1080 RETURN
2000 ? CHR$(125)
2005 POSITION 10,2:? "HOMEWORK PRACTICE
 "
2010 POSITION 9,10:? "DO YOU WANT TO ENT
ER":? "       NEW HOMEWORK PROBLEMS ";:I
NPUT Y$
2015 IF Y$<>"Y" AND Y$<>"N" THEN 2010
2020 IF Y$="N" THEN 110
2025 WARN=1
2030 POKE 752,1:? CHR$(125):POSITION 3,1
1:? "PLEASE WAIT WHILE I GET READY....":
FOR TIME=1 TO 250:NEXT TIME
2040 SETCOLOR 1,9,4:POKE 752,0
2050 TRAP 2085
2060 READ P,A$,B$,C$
2065 IF ASC(C$)<65 THEN RESTORE P+1
2070 GOTO 2060
2085 FOR ERASE=1 TO P
2090 SOUND 0,4*ERASE*RND(1),12,8
2100 ? CHR$(125)
2110 ? "↓";ERASE
2120 ? :? :? "CONT"
2130 POSITION 0,0
2140 POKE 842,13:STOP
2150 POKE 842,12
2160 NEXT ERASE
2200 SOUND 0,0,0,0:? CHR$(125):SETCOLOR
1,9,10:A$="":B$="":C$="":D=0
2210 POKE 752,1:POSITION 8,10:? "O.K., I
'M READY FOR YOUR"
2211 ? "       NEW HOMEWORK PROBLEMS.":F
OR TIME=1 TO 300:NEXT TIME:POKE 752,0
2220 ? CHR$(125):D=D+1:IF D>100 THEN 250
0
2230 IF D>1 THEN POSITION 8,21:? "PRESS
 RETURN IF THE LIST":? "        OF PROBL
EMS IS COMPLETE."
2240 POSITION 14,9:? "PROBLEM #";D:? "
   Please type the QUESTION."
2250 POSITION 14,12:INPUT A$:IF A$="" AN
D D=1 THEN 2200
2255 GOSUB BEEP:IF A$="" THEN 2500
2260 ? CHR$(125):POSITION 14,9:? "PROBLE
M #";D:? "   Now type the ANSWER, plea
se."
2270 POSITION 14,12:INPUT B$:GOSUB BEEP:
IF B$="" THEN 2260
2280 ? CHR$(125):POSITION 6,8:? "PROBLEM
 #";D;" - SECOND ANSWER "
2285 POSITION 6,10:? "If there is no sec
ond ANSWER,":? "        just press RETU
RN."
2290 POSITION 14,13:INPUT C$:GOSUB BEEP
2300 SETCOLOR 1,9,4:? CHR$(125)
2310 ? "↓";D;" DATA ";D;",";A$;",";B$;:I
F C$<>"" THEN ? ",";C$
2320 ? :? :? "CONT"
2330 POSITION 0,0
2340 POKE 842,13:STOP
2350 POKE 842,12
2360 SETCOLOR 1,9,10:GOTO 2220
2500 ? CHR$(125):POKE 752,1:POSITION 4,1
0:? "O.K., I'M READY TO TEST YOU ON":? "
  YOUR NEW HOMEWORK PROBLEMS...."
2510 FOR TIME=1 TO 300:NEXT TIME:A$="":B
$="":C$="":RESTORE :POKE 752,0:GOTO 110
3000 SOUND 0,170*RND(0)+30,10,10:FOR TIM
E=1 TO 20:NEXT TIME:SOUND 0,0,0,0:POKE 7
64,255:RETURN
9999 REM - HOMEWORK PRACTICE
        by BRUCE FRUMKER
```

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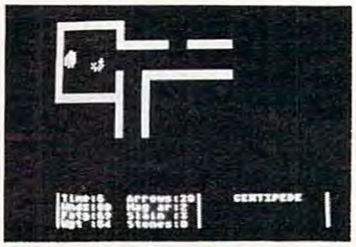

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Easy Reading Of The Atari Joystick

Or, Which Way Is Up?

Edward P. McMahon
Potomac, MD

The ATARI joystick seems to be, at first glance, strangely encoded (Fig. 1) and the most common way of determining which way the stick is pushed in a BASIC program is by coding a series of "IF - THEN - GOTO" statements which test each of the apparently unrelated decimal values which may be in variable STICK. A deeper look at ATARI's scheme reveals the logic of the STICK(I) values and points the way to efficient decoding of a joystick's position.

First, let us label each joystick position with the binary values of each deflection assignment as shown in Figure 2. Second, remember that the implementation of switches such as the trigger (or fire) button on joysticks and paddles uses the value "0" to indicate that the button is pushed and a value "1" to mean that the button is not pushed.

Now, it becomes apparent that the joystick is made from four switches, each of which controls one bit in the STICK(I) value, and is set to "0" by moving the stick in one of the cardinal directions.

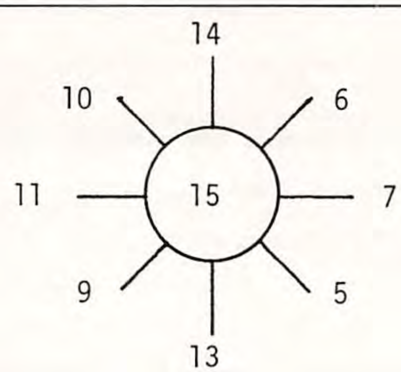

Figure 1.

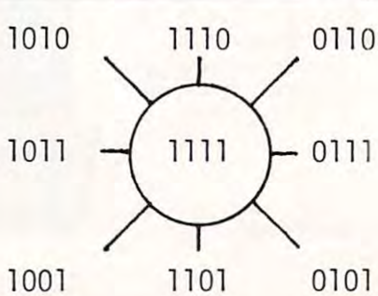

Figure 2.

Assigning bit numbers from right to left (bits 0 to 3) we see that bit 0 controls "forward" or "down", bit 1 controls "back" or "up," bit 2 for "left," and bit 3 for "right." If a control bit is zero, the switch has been pushed in that direction. Diagonal stick movement is encoded by two bits being pushed to zero.

I wanted values for STICK(I) in my programs to be usable in "ON value GOTO" statements, and, for strictly personal preference, wanted a value of "1" to mean that the stick was not deflected. Two values are needed — one for X deflection, one for Y deflection. The BASIC code in Program 1 (lines 10 through 40) produces these values. The rest of the code demonstrates the application of this stick decoding routine.

To be even faster while conforming to my own particular (not peculiar, I hope) conventions, I coded an assembly language routine which is tucked up near the top of page 6 of memory, that memory page thoughtfully left untouched by ATARI for use by us hackers. (Everybody else seems to put their code at the beginning of page 6, so I put this code almost at the end — \$06E4 to \$06FE.)

Note that there are two entry points to the code — one for the X value (\$06E4 or decimal 1764) and one for the Y value (\$06F5 or decimal 1781). This routine can be accessed by a BASIC program from the statements

X = USR (1764, STICK(I))
Y = USR (1781, STICK(I))

for whichever stick you're using (I = 0,1,2 or 3). See Program 1-a.

Program 2 is the assembled code for this routine which can be used to create your own binary program. Program 3 is a BASIC program to POKE the assembly language DATA where it belongs, if you would rather take that approach. Once you enter this code into page 6 of RAM, it should stay there undisturbed by anything but a deliberate write-over by you or a system reinitialization (power off-on).

```
10 P=STICK(0)
20 X=USR(1764,P)
30 Y=USR(1781,P)
50 ON X GOTO 80,60,70
60 ? "LEFT ";:GOTO 80
70 ? "RIGHT ";:GOTO 80
80 ON Y GOTO 110,90,100
90 ? "DOWN":GOTO 10
100 ? "UP":GOTO 10
110 IF X<>1 THEN ? " "
120 GOTO 10
```

Program 1-a.

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Save
Merge
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Printer
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Unlock
Delete
Format Disk
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Quit

Press '<' or '>' to move cursor
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Top Margin
Bottom Margin

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Insert a Character
Delete a Line
Insert a Line
Headers and Footers
Shift Lock and Release
Global and Local Search and Replacement
Underlining and Boldface
Automatic Centering
Horizontal Tabs
Special Print Characters
Split Catalog
Page Numbering up to 65535
Prints up to 255 Copies of Single Text File
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Merge Text Files

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This program also available on the Apple in 40/80 Video (Super'R' Term, Smarterm, Videx, Bit-3). You may use any printer type. The Hays Micromodem II can be used to send files. Can be Reconfigured at any time to use different printer, 80 column board, or standard 40 column video. Much, Much, More!

DEALER INQUIRIES INVITED

COMPUTER BASED SOFTWARE
LJK T.M. ENTERPRISES Inc.

FREE CONTROL PAGE

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(314) 846-6124

*Apple T.M. of Apple Computer Inc., — *T.M. Atari Computer Corporation.

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```
10 P=STICK(0)
20 Q=INT(P/4)
30 X=4-Q
40 Y=4-P+Q*4
50 ON X GOTO 80,60,70
60 ? "LEFT ";:GOTO 80
70 ? "RIGHT ";:GOTO 80
80 ON Y GOTO 110,90,100
90 ? "DOWN":GOTO 10
100 ? "UP":GOTO 10
110 IF X<>1 THEN ? " "
120 GOTO 10
```

Program 1.

```
10 REM POKES STICK READER INTO LOCATIONS $06E4 TO $06FE
20 FOR I= 1764 TO 1790: READ X: POKE I,X: NEXT I :END
30 DATA 104,104,133,213,104,41,12,74,74,73,3,24,105,1
40 DATA 133,212,96,104,104,133,213,104,41,3,76,237,6
```

Program 3.

Poem Writer

Frank Roberts
Ft. Wayne, IN

Want to improve your love life? Enlist your Atari computer to write poems for that "special person." Here is a program designed to help you write Haiku poetry – a Japanese form of short verse having seventeen syllables and, generally, describing some observed natural phenomenon or personal gestalt. Haiku form is traditionally very structured, and the program can be modified to fit such rules, but this one was written just for the fun and love of it. Nevertheless, some remarkable verses can be "composed" with it. This program will turn out enough birthday, anniversary, and Valentine poems for a lifetime – and with no more effort than a few minutes of typing!

The program utilizes the XIO command to delete a temporary disk file upon user termination. LINE 50 opens the temporary file for storage of user input. LINES 600,660 store sector and bite

```
                10 ;
                20 ;INTERPRETS STICK(I) AND RETURNS
                30 ;FOR X: 1=NOTHING
                40 ;       2=LEFT
                50 ;       3=RIGHT
                60 ;FOR Y: 1=NOTHING
                70 ;       2=DOWN  (PUSH STICK)
                80 ;       3=UP    (PULL STICK)
                85 ;
                86 ;  X=USR(1764,STICK(I))
                87 ;  Y=USR(1781,STICK(I))
                90 ;
0000            0100        *=    $06E4
00D4            0110 RESLT  =     $D4
00D5            0115 RESLTH =     $D5
06E4 68         0120 XSTK   PLA               ;THROW AWAY # ARG'S IN STACK
06E5 68         0130        PLA               ;STICK HAS NO HI-ORDER BITS
06E6 85D5       0135        STA   RESLTH      ;STUFF ZERO IN HI-RETURN
06E8 68         0140        PLA               ;THIS IS STICK(I)
06E9 290C       0150        AND   #$0C        ;GET BITS 2 AND 3
06EB 4A         0160        LSR   A           ;SHIFT 'EM LOW
06EC 4A         0170        LSR   A           ; TO BITS 0 AND 1
06ED 4903       0180 FIN    EOR   #$03        ;INVERT BITS
06EF 18         0190        CLC               ;CLEAR CARRY BEFORE ADD
06F0 6901       0200        ADC   #$01        ;ADD 1 SO WE CAN "ON . GOTO .."
06F2 85D4       0210        STA   RESLT       ;PUT ANSWER IN RETURN LOCATION
06F4 60         0220        RTS               ;GO HOME
06F5 68         0230 YSTK   PLA               ;ENTRY FOR Y-STICK, AS ABOVE
06F6 68         0240        PLA               ;NO HI-ORDER DATA
06F7 85D5       0245        STA   RESLTH      ;ZERO HI-ORDER RETURN DATA
06F9 68         0250        PLA               ;THIS IS STICK AGAIN
06FA 2903       0260        AND   #$03        ;GET BITS 0 AND 1
06FC 4CED06     0270        JMP   FIN         ;GOTO CODING
06FF            0280        .END
```

Program 2.

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STARBASE HYPERION™
By Don Ursem

Become absorbed in this intriguing, original space simulation of war in the far future. Use strategy to defend a front line Star Fortress against invasion forces of an alien empire. You create, deploy, and command a fleet of various classes of space ships, while managing limited resources including power generators, shields and probes. Real time responses are sometimes required to take advantage of special tactical opportunities. Use of color, sound, and special graphics add to the enjoyment of this program. At least 24K of RAM is required.

On Cassette — $19.95 On Diskette — $22.95

NAME THAT SONG
By Jerry White

Here is great entertainment for everyone! Two players listen while the Atari starts playing a tune. As soon as a player thinks he knows the name of the song, he presses his assigned key or joystick button. There are two ways to play. The first way requires you to type in the name of the song. Optionally, you can play multiple choice, where the computer asks you to select the title from four possibilities. The standard version requires 24K of RAM (32K on diskette) and has over 150 songs on it. You also get a 16K version that has more than 85 songs. The instructions explain how you can add songs to the program, if you wish. Written in BASIC.

On Cassette — $14.95 On Diskette — $17.95

QS FORTH
By James Albanese

Want to go beyond BASIC? The remarkably efficient FORTH programming language may be just for you. We have taken the popular fig-FORTH model from the FORTH Interest Group and expanded it for use with the Atari Personal Computer. Best of all we have written substantial documentation, packaged in a three ring binder, that includes a tutorial introduction to FORTH and numerous examples. QS FORTH is a disk based system that requires at least 24K of RAM and at least one disk drive. Five modules that may be loaded separately from disk are the fig-FORTH kernel, extensions to standard fig-FORTH, an on-screen editor, an I/O module that accesses Atari's operating system, and a FORTH assembler.

Diskette and Manual — $79.95 Manual Only — $39.95

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numbers of the filed data into arrays SEC and BIT for later random selection. LOOP 700,730 selects sector and bite numbers at random and stores them into arrays A and B. LINES 800,880 choose string data from the file and print user input phrases in groups of four (traditionally, Haiku is a three line poem, and, if desired, this can be accomplished by changing LINE 870 to IF K/3=INT(K/3) THEN LPRINT ;delete LINE 850, and add 790 TRAP 890). LINE 1090 deletes the temporary file without going to DOS.

A word of WARNING! A few weeks ago my wife took a vacation ... well, not being one to enjoy letter-writing, I sent her several pages of Haiku "composed" with my Atari. She has since returned. Now I'm too tired to write more programs. C'est l'amour!

Haiku Poems

By Frank Roberts

Fly away and high
Idly, the ship glides by
I might enjoy tonight's moon
Summer and swimming and smiles
*****

Companions
A baby wren sings his first song
Mellons are ripening
Fly away and high
*****

A voiceless flower speaks
Hidden among the leaves
Companions
Summer and swimming and smiles
*****

Wind
Snow
Hidden in the leaves
Escape!
*****

Do not bother about mountains
Escape!
Summer and swimming and smiles
Where are the flowers
*****

Crickets
Ice and water are forgotten
A voiceless flower speaks
Crickets

Sayanara, Frank-San

```
1 REM **********************************
2 REM
3 REM HAIKU WRITING
4 REM by Frank Roberts
5 REM
6 REM **********************************
7 REM
9 REM
50 DIM A$(100),N$(30),R$(10),A(100),B(100),
   SEC(100),BIT(100)
60 REM
70 GRAPHICS 0:POSITION 5,5
100 PRINT "WHAT IS YOUR NAME, SIR "
110 INPUT N$
115 ? :? :?
120 ? :? "THANK YOU, ";N$
121 ? "DO YOU WANT EXPLANATION ?";
130 INPUT R$
140 IF R$(1,1)="N" THEN 400
150 GRAPHICS 0:POSITION 5,4
200 PRINT "I will help you write Haiku"
201 PRINT "poems.  If you will type in a"
202 PRINT "list of lovely phrases, I will"
203 PRINT "mix them up and put them back"
204 PRINT "together in my own Oriental way."
205 PRINT "  Some of them may not make much"
206 PRINT "sense, but that is probably"
207 PRINT "because language always looses"
208 PRINT "something in translation...."
209 PRINT "RIGHT?  some of them, however,"
210 PRINT "may be quite interesting."
300 ? :? :?
400 ? :? "ARE YOU READY, ";N$;" ";
410 INPUT R$:IF R$(1,1)<>"Y" THEN 400
415 GRAPHICS 0:POSITION 5,5
420 ? "AH......SO.:?"
430 ? :? "HOW MANY POEMS TO YOU WANT (MORE THAN
    3, PLEASE) ";
440 INPUT R
450 P=R*2
460 REM
500 OPEN #1,8,0,"D:HFILE"
570 ? :? "LIST ";P;" LOVELY PHRASES:"
600 FOR K=1 TO P
610 NOTE #1,Y,Z
620 SEC(K)=Y:BIT(K)=Z
630 PRINT K,
640 INPUT A$
650 PRINT #1;A$
660 NEXT K
670 CLOSE #1
675 REM
680 LPRINT CHR$(27);CHR$(14)
681 LPRINT "            HAIKU POEMS"
683 LPRINT CHR$(27);CHR$(15)
684 LPRINT "                              BY ";N$
685 LPRINT :LPRINT :LPRINT
700 FOR K=1 TO P*2
710 X=INT(P*RND(0)+1)
720 A(K)=SEC(X):B(K)=BIT(X)
730 NEXT K
740 REM
760 REM
800 OPEN #1,4,0,"D:HFILE"
810 FOR K=1 TO P*2
820 Y=A(K):Z=B(K)
830 POINT #1,Y,Z
840 INPUT #1,A$
850 IF K/2=INT(K/2) THEN LPRINT " ","    ";
    A$:GOTO 870
860 LPRINT " ",A$:GOTO 880
870 IF K/4=INT(K/4) THEN LPRINT
880 NEXT K
890 CLOSE #1
900 GRAPHICS 0:POSITION 5,5
1000 ? "DO YOU WANT MORE FROM THE SAME PHRASES ";
1010 INPUT R$:IF R$(1,1)="N" THEN 1030
1020 GOTO 700
1030 ? :? "DO YOU WANT TO MAKE NEW PHRASES ";
1040 INPUT R$:IF R$(1,1)="N" THEN 1060
1050 GOTO 430
1060 FOR K=1 TO 5:LPRINT :NEXT K
1061 REM
1062 FOR K=1 TO LEN(N$)
1063 IF N$(K,K)<>" " THEN 1065
1064 N$=N$(1,K-1):GOTO 1066
1065 NEXT K
1066 REM
1070 LPRINT "              SAYANARA, ";N$;"-SAN"
1080 FOR K=1 TO 10:LPRINT :NEXT K
1090 XIO 33,#1,0,0,"D:HFILE"
```

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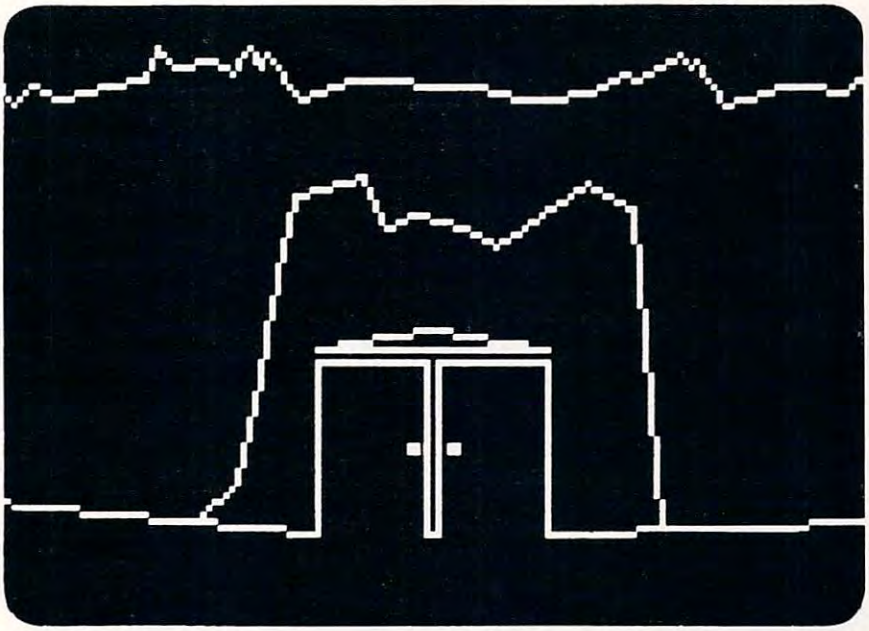
AND NOW BEHOLD THE ENTRANCE TO THE PLACE KNOWN AS DEVIL DWELL!



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CA001 "Atari Epson Screen Dump" is a screen dump program that dumps a screen image (up to GR.7) to the Epson proportionally.

CA003 "Atar-Renum" is a general utility that will renumber any tokenized BASIC program that is co-resident in RAM. Requires only 3565 bytes of RAM.

CA004 "InfoFile" is a program designed to act as an electronic file cabinet. A "dynamic keyboard" moves the user quickly through this menu driven program. This is a "fast" database program. Use it to create, add, delete, edit, print, selectively search, and store your custom files. All files can be secured w/ code.

CA005 "Binary Load Cassette to Disk" is a utility that will take binary load cassette files like SPACE INVADERS (TM) and allow their transfer to disk.

CA006 "Ork Attack" has been renamed previous to release as "DEVIL DWELL." This adventure program is not easily beaten, has good graphics, and an excellent user dialogue.

CA007 Our long awaited "Smart Terminal Emulator Program" has also had a name change. We are very happy to announce that "DOWNLOADER" is now available. This fine piece of software allows you to download information to: Disk, Cassette, or Printer.

SWEDE 1 is a package of four programs (3-D, LUNAR LANDER, ALIEN ATTACK, and SPACE BATTLE) which is meant to be studied as well as enjoyed. It covers mainly the mysterious world of Player/Missile Graphics. By studying the programs you will learn how to smoothly move an object, such as a space capsule, horizontally, vertically, and diagonally. You will also learn how to make the player fire and rotate 360 degrees. Also included are sections on the Cursor, the ESCape key and conversions of other BASICs into Atari BASIC.

COMPUTER AGE SOFTWARE

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Supercube Update

Mike Kinnamon
Perry, OK

Here is an updated version of Steve Steinberg's Supercube program which appeared in **COMPUTE!** #11.

Here is a list of the keys and their functions.

Function	Key
1. Automatic drawing mode	Logo key
2. Change cube color	Spacebar then number
3. Cube size	Insert key
4. Background color	Escape key
5. Background shade	Delete key
6. Clear screen	Clear key
7. Save picture to disk	R key
9. Start and stop erasing cursor	E key

```
1 DIM A$(20),B$(20),C$(4),PR$(1),PR1$(80
)
2 SHADE=2
3 HUE=0
4 X=80:Y=40
5 CV=1
6 FX=1
10 GRAPHICS 0:? "          3-D DRAWING
          "
12 ? "     USE JOYSTICK #1 TO PLAY"
14 ? " YOU MAY PLACE A 3-D CUBE ON THE "
:? "SCREEN BY MOVING THE CURSOR TO THE "

16 ? "APPROPRIATE SPOT AND PRESSING THE
":? "RED BUTTON THEREBY CREATING A PLEAS
ANT";:? "DESIGN."
18 ? :? " YOU HAVE SEVERAL OPTIONS TO CH
OOSE":? "FROM:"
20 ? "1.CUBE SIZE-FROM 0 TO ?":? "CHANGE
 THIS BY PRESSING THE INSERT KEY";
22 ? "THEN ANSWER THE SIZE QUESTION WITH
 A":? "NUMBER,AND PRESS RETURN"
23 ? "numbers larger than 10 may not wor
k"
24 ? "2.CUBE COLORS-PRESS THE SPACEBAR T
HEN":? "CHOOSE FROM THE 10 COLORS AND PR
ESS":? "RETURN."
26 ? "3.BACKGROUND COLOR AND SHADE-ESC K
EY":? "CONTROLS COLOR  DELETE KEY CONTRO
LS":? "SHADE."
28 ? "4.CLEAR KEY CLEARS THE SCREEN."
30 TRAP 30:? "ENTER CUBE SIZE NOW";:INPU
T SQ:TRAP 0
40 GRAPHICS 7
45 SETCOLOR 4,0,4
70 GOSUB 600
80 LOCATE X,Y,Z:ZZ=5:IF Z<>2 THEN ZZ=2
81 IF CV/2=INT(CV/2) THEN Z=4
82 IF PEEK(764)=39 THEN FX=FX+1:POKE 764
,255
84 IF FX/2=INT(FX/2) THEN GOSUB 700
85 IF STRIG(0)<>0 THEN GOSUB 500:GOTO 14
0
120 POKE 77,0
130 IF STRIG(0)=0 THEN GOSUB 700
140 GOSUB 1000
150 X=X+XDIF:Y=Y+YDIF
200 IF X>143 THEN X=0:GOTO 300
210 IF Y>78 THEN Y=7:GOTO 300
300 IF X<0 THEN X=143:GOTO 400
310 IF Y<7 THEN Y=78
400 GOTO 80
500 COLOR ZZ:PLOT X,Y
500 COLOR ZZ:PLOT X,Y
501 IF PEEK(764)=55 THEN POKE 764,255:?
"}ENTER NEW DIMENSION FOR CUBE";:INPUT S
Q:? CHR$(253):GOSUB 3000
502 A=PEEK(764):IF A=33 THEN POKE 764,25
5:? CHR$(253):GOSUB 600
503 IF A=54 THEN GRAPHICS 7:SETCOLOR 1,C
,12:SETCOLOR 2,C,6:SETCOLOR 0,C,4:SETCOL
OR 4,HUE,SHADE:POKE 764,255:? CHR$(253):
GOSUB 3000
504 IF A=52 THEN SHADE=SHADE+2:POKE 764,
255:IF SHADE>14 THEN SHADE=0:? CHR$(253)
:GOSUB 3000
504 IF A=52 THEN SHADE=SHADE+2:POKE 764,
255:IF SHADE>14 THEN SHADE=0:? CHR$(253)
:GOSUB 3000
505 IF A=28 THEN GOSUB 2000:POKE 764,255
:HUE=HUE+1:GH=1:IF HUE>15 THEN HUE=0:? C
HR$(253)
506 IF A=62 THEN GOSUB 4000:GOSUB 3000:G
OTO 80
507 IF A=40 THEN GOSUB 5000:GOSUB 3000:C
OLOR 80
508 IF A=42 THEN CV=CV+1:POKE 764,255:?
CHR$(253):GOSUB 3000
509 IF A=10 THEN GOSUB 7000
510 SETCOLOR 4,HUE,SHADE
549 COLOR Z:PLOT X,Y
550 RETURN
600 POKE 764,255:? "}PRESS A NUMBER TO C
HANGE COLORS":? "1-GOLD 2-ORANGE 3-RED 4
-PINK 5-PURPLE":? "6-BLUE 7-GRAY";
601 ? " 8-VIOLET 9-GREEN ":? "0-TURQUOIS
E";
602 IF PEEK(764)=255 THEN 602
603 A=PEEK(764)
604 IF A=31 THEN C=1:GOTO 650
605 IF A=30 THEN C=2:GOTO 650
606 IF A=26 THEN C=3:GOTO 650
607 IF A=24 THEN C=4:GOTO 650
608 IF A=29 THEN C=6:GOTO 650
```

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GRAPHICS EDITOR (refer to MY FIRST ALPHABET.)

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Part I
Cash Flow

This month AVATAR SOFTWARE introduces a totally integrated package for the home.

HOME MANAGER is a series of programs which cover cash flow, budget, time scheduling, filing, inventory and gas consumption. Each program allows you to input up to 200 entries per month as both income and expense, in category names that can be used as is or modified to suit your own needs. All entries are saved on disk. Categories can be viewed on the screen or can be printed.

You don't have to be a computer programmer to use this package! The computer does the work for you. Along the way your choices and inputs are carefully monitored by the program to insure that only the correct data is being used and saved.

Cash Flow, written by Jerry Falkenhan, has been tested for over six months with non-computer oriented people. The result is a nice, clean, smooth-running package that makes using the computer an enjoyable experience with useable, practical applications.

Cash Flow is a total package in itself, and is also a module that fits into the **Home Manager Package.** As these modules become available, they can be purchased and put into the binder indexes already provided for you. You can then tailor our package to your own personal needs.

Cash Flow comes in a handsome, 3-ring binder with documentation.

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```
609 IF A=27 THEN C=7:GOTO 650
610 IF A=51 THEN C=0:GOTO 650
611 IF A=48 THEN C=12:GOTO 650
612 IF A=50 THEN C=10:GOTO 650
613 IF A=53 THEN C=5:GOTO 650
620 POKE 764,255:GOTO 602
625 ? "}"
650 SETCOLOR 1,C,12:SETCOLOR 2,C,6:SETCO
LOR 0,C,4:? "}"
651 GOSUB 3000
670 RETURN
700 REM
701 IF GH=1 THEN GH=0:GOSUB 3000
710 TRAP 1002
720 COLOR 1
730 FOR I=0 TO SQ
740 PLOT X,Y+I:DRAWTO X+SQ,Y+I
750 NEXT I
760 COLOR 2
770 FOR I=1 TO INT(3*SQ)/5
780 PLOT X+I,Y-I:DRAWTO X+I+SQ,Y-I
790 NEXT I
800 COLOR 3
810 FOR I=1 TO INT(3*SQ)/5
820 PLOT X+SQ+I,Y-I:DRAWTO X+SQ+I,Y+SQ-I
+1
830 NEXT I
840 IF STRIG(0)<>0 THEN X=X-1
850 RETURN
1000 WHAT=STICK(0):XDIF=0:YDIF=0
1002 IF FX/2=INT(FX/2) THEN X=INT(RND(0)
*140):Y=INT(RND(0)*70):SQ=INT(RND(0)*20)
:POKE 77,0:GOTO 1200
1100 IF WHAT=15 THEN RETURN
1110 IF WHAT=14 THEN YDIF=-1:RETURN
1120 IF WHAT=13 THEN YDIF=1:RETURN
1130 IF WHAT=11 THEN XDIF=-1:RETURN
1140 IF WHAT=10 THEN XDIF=-1:YDIF=-1:RET
URN
1150 IF WHAT=9 THEN XDIF=-1:YDIF=1:RETUR
N
1160 IF WHAT=7 THEN XDIF=1:RETURN
1170 IF WHAT=6 THEN XDIF=1:YDIF=-1:RETUR
N
1180 IF WHAT=5 THEN XDIF=1:YDIF=1:RETURN

1200 IF RND(0)>0.9 THEN C=RND(0)*15:SETC
OLOR 1,C,12:SETCOLOR 2,C,6:SETCOLOR 0,C,
4:HUE=RND(0)*15:SHADE=RND(0)*15
1201 IF RND(0)>0.95 THEN SQ=44
1202 RETURN
2000 ? "}BACKGROUND HUES ARE:ORANGE ":?
"GRAY-GOLD-ORANGE-RED-PINK-PURPLE":? "BL
UE-LIGHT BLUE-TUROUOISE-GREEN/BLUE"
2002 ? "GREEN-YELLOW/GREEN-ORANGE/GREEN"
;
2004 RETURN
3000 POKE 752,2:POKE 82,0:? "}S-SAVE PIC
 TO DISK R-RETRIEVE PIC":? "DELETE-BCKGN
D SHADE CLEAR-CLEAR SCREEN"
3001 ? "SPACEBAR-CUBE COLORS INSERT-CUBE
 SIZE":? "ESC-BCKGND COLORS E-START/STOP
 ERASE";
3002 RETURN
4000 POKE 764,255:? "}Name of picture to
 save";:INPUT A$:B$="D:":B$(LEN(B$)+1)=A
$:C$=".PIC":B$(LEN(B$)+1)=C$
4001 ? "Insert proper disk and hit any k
ey ":? "It will take about 4 1/2 minutes
 ":GOSUB 6000
4002 OPEN #1,8,0,B$:POKE 559,0:? CHR$(25
3);
4003 FOR YY=0 TO 79:FOR XX=0 TO 159
4004 LOCATE XX,YY,ZZZ:IF ZZZ<>0 THEN PUT
 #1,XX:PUT #1,YY:PUT #1,ZZZ
4005 NEXT XX:NEXT YY:POKE 559,34:CLOSE #
1:FOR XX=1 TO 5:? CHR$(253);:NEXT XX
4006 POKE 764,255:RETURN
5000 POKE 764,255:? "}Name of picture to
 get";:INPUT A$:B$="D:":B$(LEN(B$)+1)=A$
:C$=".PIC":B$(LEN(B$)+1)=C$
5001 TRAP 5006
5002 OPEN #1,4,0,B$:POKE 559,0:? CHR$(25
3);
5003 FOR C=1 TO 2 STEP 0
5004 GET #1,XX:GET #1,YY:GET #1,ZZZ:COLO
R ZZZ:PLOT XX,YY:NEXT C
5006 CLOSE #1:POKE 559,34:POKE 764,255:F
OR XX=1 TO 5:? CHR$(253);:NEXT XX
5008 RETURN
6000 OPEN #1,4,0,"K:":GET #1,R:CLOSE #1:
RETURN
7000 POKE 764,255:LPRINT CHR$(27);CHR$(6
5);CHR$(6)
7001 FOR XX=0 TO 159:FOR YY=79 TO 0 STEP
 -1
7003 A=PEEK(764):IF A=33 THEN XX=159
7004 LOCATE XX,YY,ZZZ
7005 IF ZZZ=0 THEN PR$=" "
7006 IF ZZZ=1 THEN PR$="#"
7007 IF ZZZ=2 THEN PR$="+"
7008 IF ZZZ=3 THEN PR$="*"
7009 IF ZZZ=4 THEN PR$="="
7010 IF ZZZ=5 THEN PR$="%"
7015 PR1$(LEN(PR1$)+1)=PR$
7020 NEXT YY:LPRINT PR1$:PR1$="":NEXT XX

7025 POKE 764,255
7027 LPRINT CHR$(27);CHR$(50);
7028 FOR CG=1 TO 32:LPRINT :NEXT CG
7040 RETURN
```

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Atari Sound Utility

Jimmy Mork
Winger, MN

Have you ever wished you could get sound out of that little speaker hidden somewhere in your Atari? The one that is responsible for the buzz that occurs in the cassette input/output routines. Well, I think I have a routine that just may be able to add those little clicks and buzzes, and create some pretty good sound effects.

First let us try a USR call that will jump right into the middle of one of those routines ... try this:

```
U=USR(61530)
```

Does that sound familiar? If you have problems stopping it, try the SYSTEM RESET key.

What you just USRed to was the routine in the operating system that gives you the buzz in the CLOAD command.

How about that little click you hear when you push the SYSTEM RESET key? That is done in a little simpler way! The RAM location for the speaker is 53279 (D01F). Sound kind of familiar? It is also the location of the console switches. Which means that POKING to this location will activate the speaker, and PEEKing into it will give you console switch status.

The click you hear when you press the SYSTEM RESET can be duplicated as follows:

```
POKE 53279,0
```

So far, the use of the speaker to create sound effects has yielded little value. There is obviously a need to dig deeper. Here is an assembler routine similar to that at ROM location 61530.

```
0100            *=$600
0110  SPKR=  $  D01F
0120            PLA
0130            LDX    #$FF
0140  MAIN      LDA    #$FF
0150            STA    SPKR
0160            LDA    #$00
0170            LDY    #$F0
0180  LOOP1     DEY
0190            BNE    LOOP1
0200            STA    SPKR
0210            LDY    #$F0
0220  LOOP2     DEY
0230            BNE    LOOP2
0240            DEX
0250            BNE    MAIN
0260            RTS
```

To load the assembler routine, type in the following program and RUN it:

```
100 DATA 104, 162, 255, 169, 255, 141, 31, 208, 169,
  0, 160, 240, 136, 208, 253, 141, 31, 208, 160, 240, 136,
  208, 253, 202, 208, 233, 96
110 RESTORE: FOR A=0 TO 26: READ H: POKE
  1536+A,H: NEXT A
```

Now that you have the subroutine loaded into memory do a:

```
U=USR(1536)
```

I suppose by now you are saying, "OK great, but who wants a game that sounds like CLOAD?" If you don't want it to sound like that, all you have to do is simply rearrange the machine language subroutine. There are two variables you can change that will change the pitch of the sound: the "LDY's" that set the number of iterations to loops "LOOP1" and "LOOP2" in the subroutine. Thus, by changing locations 1547 and 1555, you will have changed the pitch.

```
POKE 1547,120
U=USR(1536)
```

If you tryed the two instructions above, you should have heard a higher pitch than the one before. If the sounds are too long for you, all you have to do to change the length is change RAM location 1538 (the LDX). POKEing 1538 to 10 will give you a short chirp.

If you want to do some experimenting with different pitches and lengths, add the next four lines to your program:

```
120 PRINT "LENGTH, PF1, PF2 ";: INPUT
  L,PF1,PF2
130 POKE 1538,L: POKE 1547,PF1: POKE 1555,PF2
140 FOR A:=1 TO 100:NEXT A: REM This line will
  delay the routine to prevent 'key click'/sound
  confusion.
150 U=USR(1536):GOTO 120
```

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Blockade For The Atari

Douglas Pinho
Valley Cottage, NY

Surround (or Blockade) was a popular arcade game in the early days of video games. The format of the game is not complex in itself, but it still is enjoyable and challenging. The object of the game is to build walls to trap the opposing player and force him to collide with: 1) his own walls, 2) the opposing player's walls, 3) the boundaries of the playfield. When this occurs, the player who did not crash receives a point. Upon every collision, the walls of the player who crashed will blink. The screen is then cleared and the game continues.

The first player to reach nine points is the winner. To start the next game just press the fire button. To play, plug joysticks into the middle two joystick ports (sticks 1 and 2).

Program Description And Explanation

Lines 1–2 set up the title display. Line 5 sets up a mixed graphics mode with 1 line of GR. 1 followed by 1 line of GR. 2 and 44 lines of GR. 5. START calculates the address of the display list in memory. This pointer is needed since the location of the display list is dependent upon the amount of memory installed in the Atari. The two POKES then place instructions for the desired graphic modes at the appropriate memory locations. Line 10 initializes the variables X and Y, the starting locations of player 1, and S and T which give the location of player 2. Variables X1 and Y1 and S1 and T1 are the increment or decrement values for plotting the walls on the screen. F is a flag to determine whether there was a simultaneous collision between the two players. H1 and B1 are used to keep score. Line 12 plots the boundaries of the playing field in blue. Poking memory location 87 (current screen mode) with 5 directs the computer to plot in GR. mode 5. This is only needed in a mixed graphics mode. Line 14 goes to a subroutine at line 300 which prints the score in GR. 2 characters. Line 15 checks for the end of the game.

Lines 20–120 contain the main game loop. Lines 25 to 43 check for joystick movement and assign the move variable (X1, Y1, S1, T1), and a value for P and L. One of the nice features of Atari Basic is that you can use a variable as a GOSUB address. This feature is used in line 50 to branch to different subroutines depending upon the value of P (player 1) and L (player 2). Note that in line 23, you must POKE 5 into memory location 87 again because it was changed during subroutine 300 (line 14). Lines 150 to 185 first check for a collision. If there is none, it plots the new block. A collision is found by locating the next position in front of the plotted block and finding its color. If the color is 0 (which is the background default color), it continues and plots the next block. If it is any other color, there is a collision. If the first player has collided, the program branches to line 201 to check for a simultaneous collision by the other player. Flag F is set if a simultaneous collision is found. Lines 210-220 update the score and blink the losing player's walls. Subroutine 300 prints the score at the top of the screen in GR. 2 characters. Subroutine 350 blinks the colors of the colliding player's walls. Lines 400-410 check if you want to start a new game (prints in GR. 1 characters).

If you haven't played "Blockade" before, grab a friend and try it. It requires quick decisions and good strategy. You'll like it.

```
1 GRAPHICS 2+16:SETCOLOR 4,5,5:POSITION
6,5:? #6;"BLOCKADE"
2 FOR D1=1 TO 6:FOR E1=0 TO 89:SOUND 1,E
1,10,10:NEXT E1:NEXT D1:SOUND 1,0,0,0
5 GRAPHICS 5+16:START=PEEK(560)+PEEK(561
)*256+4:POKE START-1,71:POKE START+2,6
10 X=13:Y=23:X1=1:Y1=1:S=66:T=23:S1=-1:T
1=1:P=160:L=170:F=0
12 POKE 87,5:COLOR 3:PLOT 0,3:DRAWTO 0,4
6:DRAWTO 78,46:DRAWTO 78,3:DRAWTO 0,3
14 GOSUB 300
15 IF H1=9 OR B1=9 THEN GOTO 400
20 B=STICK(1):H=STICK(2)
21 SOUND 3,200,10,15
23 POKE 87,5
25 IF B=14 THEN Y1=-1:P=150
27 IF H=14 THEN T1=-1:L=180
30 IF B=13 THEN Y1=1:P=150
32 IF H=13 THEN T1=1:L=180
35 IF B=7 THEN X1=1:P=160
37 IF H=7 THEN S1=1:L=170
40 IF B=11 THEN X1=-1:P=160
43 IF H=11 THEN S1=-1:L=170
44 SOUND 3,150,10,15
50 GOSUB P:GOSUB L
120 GOTO 20
150 Y=Y+Y1:COLOR 1:LOCATE X,Y,Z:IF Z<>0
THEN GOTO 201
155 PLOT X,Y:RETURN
160 X=X+X1:COLOR 1:LOCATE X,Y,Z:IF Z<>0
THEN GOTO 201
165 PLOT X,Y:RETURN
170 S=S+S1:COLOR 2:LOCATE S,T,U:IF U<>0
THEN GOTO 220
175 PLOT S,T:RETURN
180 T=T+T1:COLOR 2:LOCATE S,T,U:IF U<>0
THEN GOTO 220
185 PLOT S,T:RETURN
201 IF L=170 THEN S=S+S1:POSITION S,T:LO
CATE S,T,U:IF U<>0 THEN F=1
202 IF L=180 THEN T=T+T1:POSITION S,T:LO
CATE S,T,U:IF U<>0 THEN F=1
203 GOTO 210
210 SOUND 3,0,0,0:SOUND 1,100,14,14:FOR
W=1 TO 300:NEXT W:B1=B1+1:GOSUB 300:Q1=0
```

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