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COMPUTE!

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Issue 19
Vol. 3, No. 12
63379

The Journal For Progressive Computing™

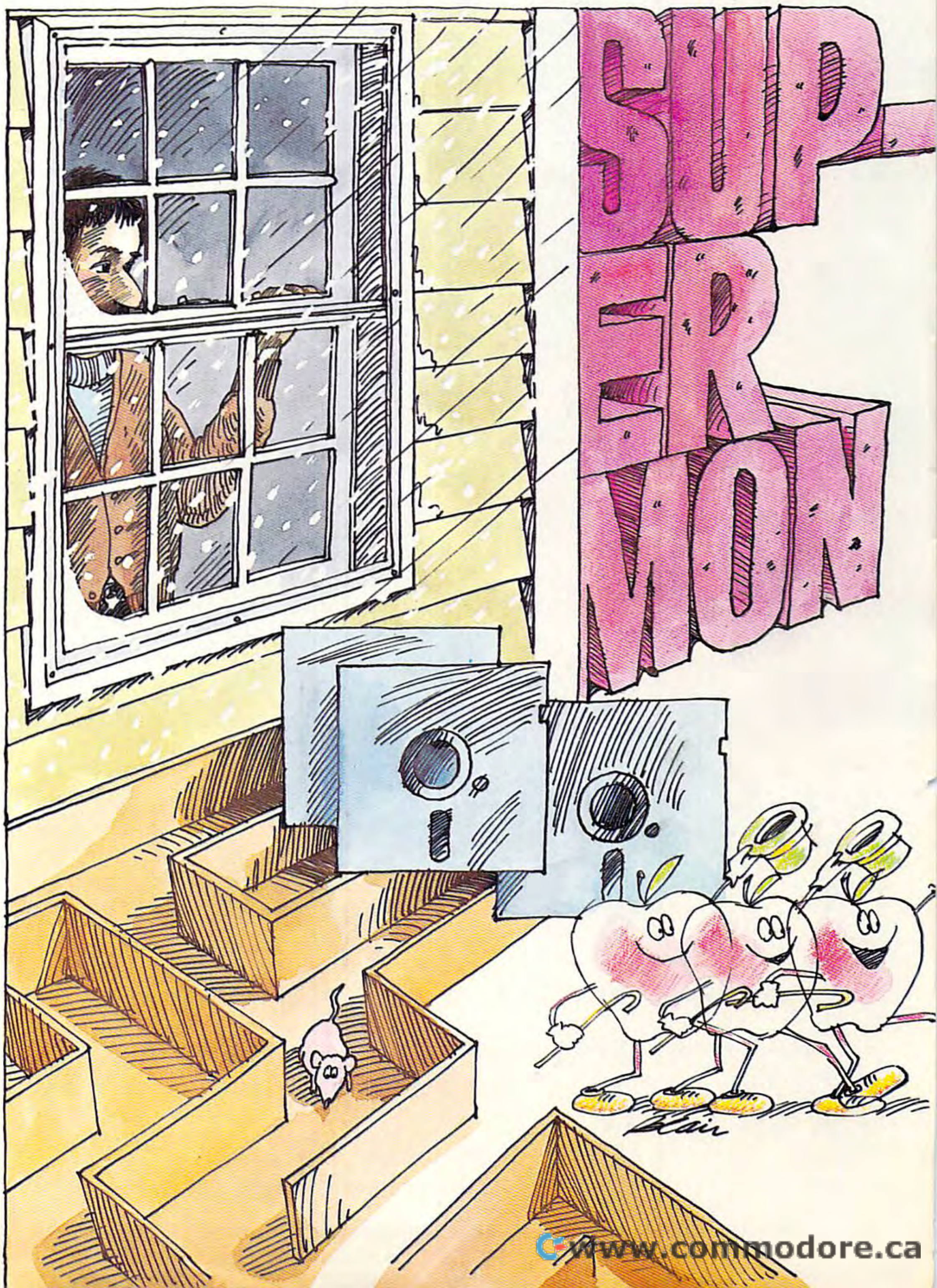
Window Analysis:
A Home Heating/Cooling Application Program

Supermon
Machine Language Monitor For CBM/PET Computers

INSIGHT: Atari
Part II Of The Mysteries Of I/O

Animating Applesoft Graphics

Maze Maker:
A Maze Generator For Game Applications



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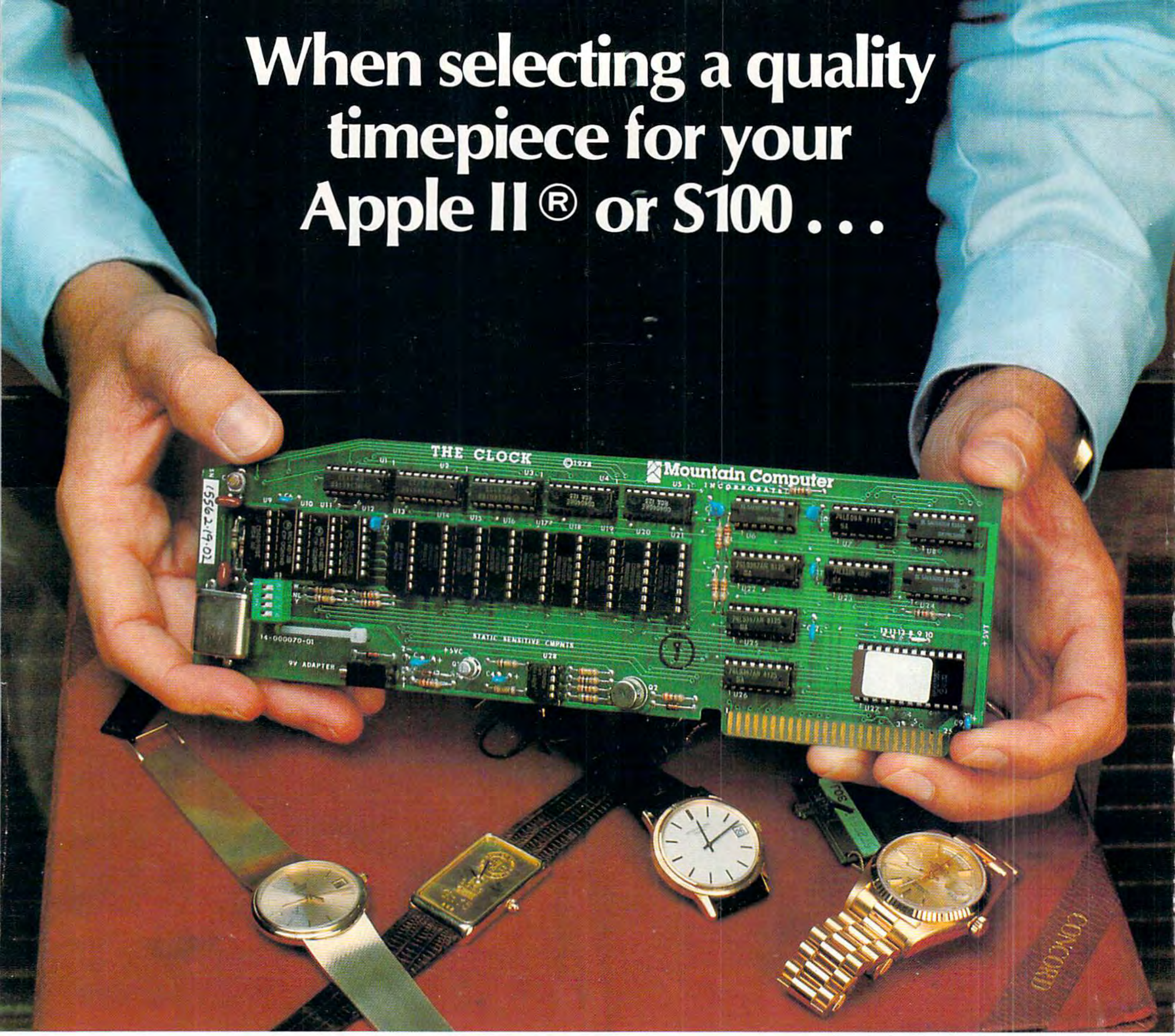

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The Editor's notes...

Robert Lock, Publisher/Editor

The Price Wars

We've recently been hearing increasingly interesting rumors regarding the problems/solutions of "conflict" between mail order houses and "store-front" dealers. We've discussed the matter before on these pages and, without taking sides, the situation is simply this.

Retail outlets, with higher operating expenses, potentially greater overhead, customer service and training in varying degrees, and so on, tend to lean mainly in the direction of "Manufacturer's Suggested List Price."

Many mail order houses, on the other hand, with perhaps less expectation of personnel intensive support, training, and so on (plus potentially far greater volume) tend to discount.

This has been the nature of retailing in the industry for a long time with the lines of argument frequently becoming rather heated. Some stores, for example, refuse to carry magazines, feeling that there's truth, we suppose, in the age old adage: see no evil, buy no evil. For our part, we understand perfectly why a retail store would be completely frustrated by a customer who makes three or four visits to explore hardware and then buys direct, at lower cost, from a mail order house.

The Competition Increases (Decreases?)

Now we hear that Apple is seeking to squelch some of their mail order discounters, a move we would venture is calculated to, among other things, increase dealer loyalty in the face of the recent
IBM entry.

Now the interesting part of this analysis is that Apple sells direct to dealers, while Atari has set up regional distributors. In the past, the discount mail order business could be classified as a fair fight, in the sense that dealers were venturing volume against home town support, etc., etc. Pricing, to them, was roughly similar.

Now, however, we're hearing that a "third" level is being added to the fray: essentially distributor supported and sponsored mail-order houses who, because they have better initial profit margins, can have the best of both worlds. They sell to dealers, both store-front and mail order, plus sell to the end-user through their own mail-order house. Naturally enough, their discount pricing can be more than competitive.

Where Does It Go From Here?

We would guess that time will bring changes in the basic methods of distribution, with the needs and demands of the consumer for fair pricing and support balancing with the needs and demands of the dealers for reasonable profit margins and competitive business practices. We'd like to hear from end users, dealers, and others involved in the distribution process for your comments and suggestions.

Home Applications

Can you really use this machine for some practical applications at home? We certainly think so, and our recent requests for such articles has been well received by you reader/users. This issue presents "Window Analysis." In two versions, one for Microsoft BASIC and one for Atari BASIC, you'll be able to explore how efficiently your house is using solar power to cut heating/cooling costs. Using several vari-

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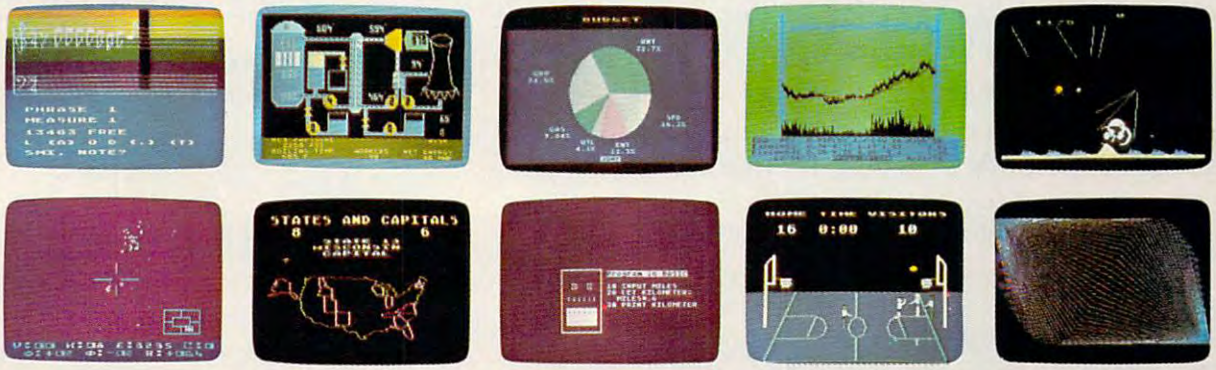

3.7 million reasons why the ATARI Personal Computer is something to see.
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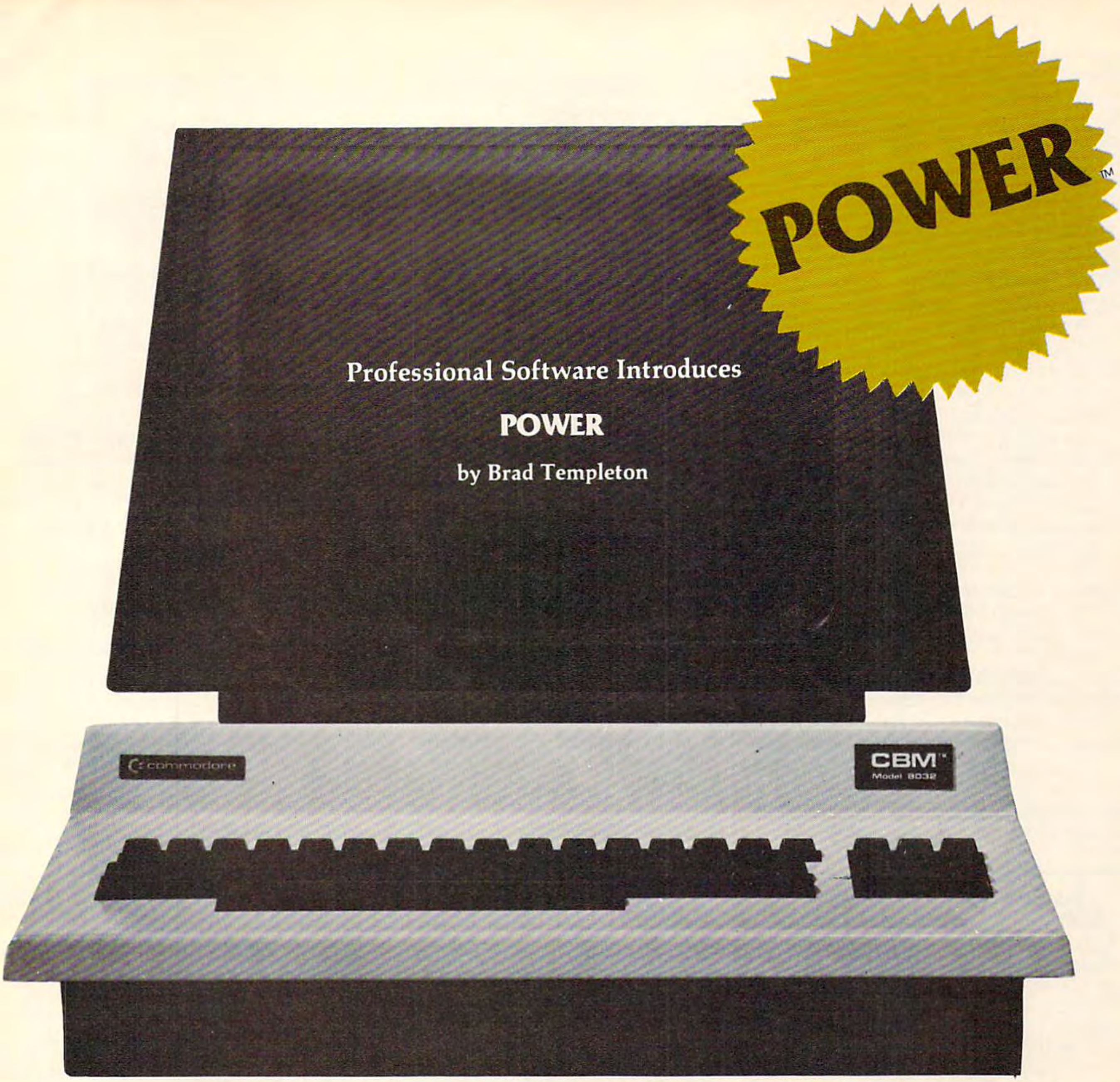
ables, you can decide how to optimize the benefits of free sunlight by making computer-assisted changes; shades, awnings, shrubs, etc.

If you've developed an interesting, useful home or small business application such as this, please write it up and send it in. Where possible, we'll "homogenize" it in-house (we developed the Atari BASIC version here), and present it for all readers to enjoy. If you take an application in **COMPUTE!**, such as "Maze Maker" in this issue, and develop an interesting game around it, we'd like to see that too.

Trade Shows And More Trade Shows

We mentioned in last issue's editorial that more regional/local dealers and distributors were in evidence at the last Boston Show, and fewer manufacturers. This pattern repeated itself at the recent show in San Francisco. With our industry generating new trade shows faster than new computers these days, I suspect we'll see this quickly become the norm. Manufacturers and principals will attend a few shows each year; local distributors and dealers will handle the rest. ©



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Associate Editors

Jim Butterfield, Toronto, Canada
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Contributing Editors

Marvin DeJong, Dept. of Mathematics -Physics, The School of the Ozarks Pt. Lookout, MD 65726
Eric Rehnke, 1067 Jadestone Lane, Corona, CA 91720
David Thornburg, P.O. Box 1317, Los Altos, CA 94022
Bill Wilkinson, Optimized Systems Software, 10379-C Lansdale, Ave. Cupertino, CA 95014
Gene Zumchak, 1700 Niagara St., Buffalo, NY 14207

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By John Harris from On-Line
If you like the PAC-MAN arcade game, you'll love JAW BREAKER! Guide your chompers through a candystore maze, eating "wife-savers" as you go. You are pursued by variously colored "smilies," determined to knock your teeth out. If you eat a jawbreaker, the "smilies" turn to blue "frownies," and you try to eat them! Sound familiar? It's one of the best uses of Atari graphics and sound we've seen yet -- you'll love it!

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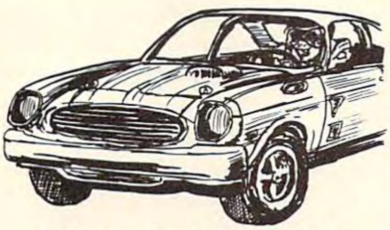

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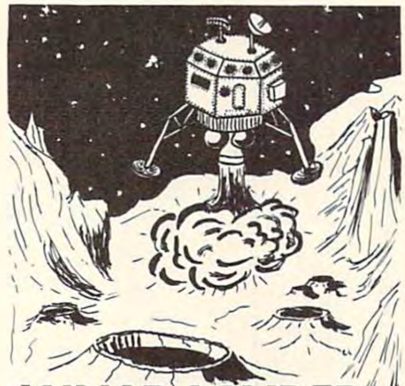

LUNAR LANDER

By Wall, Moncrief & Jessee from A.I.
Grab your joystick and sweat out the touchdown of your LEM. This fascinating and challenging game makes good use of Atari's player/missile graphics, color, and four-voice sound.

Choose from four lunar landscapes, with many choices for landing sites. Select a more difficult site and get more points -- if you can land successfully. You have complete control of your LEM via main engines and small side thrusters, and five successful landings are heralded with a flag raising ceremony. Great fun!

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Ask The Readers

Robert Lock, Richard Mansfield
And Readers

This is *your* column — readers ask the questions and other readers answer. Please address any questions or answers to: Ask the Readers, **COMPUTE!**, P.O. Box 5406, Greensboro, NC 27403.

"I have a suggestion for contributors with programs:

When listing programs it would be exceedingly helpful if lines were numbered in regular increments. Since most of us have Tool Kits it would save considerable time if we who enter our own programs would not have to check that a number 182 or 287 didn't suddenly sneak in after a regular sequence of 10,20,30,40 etc.

[Not using] regularly incremented line numbers negates the value of the Tool Kit's AUTO feature. As an example, recently I was so intent on making sure the entries were correctly typed in that I overlooked checking the numbers. When I was on line 620 the program listing was about 560.

How frustrating!!!!" Edmund N. Ricchezza

We couldn't agree more. **COMPUTE!** has recently published "dynamic keyboard" methods for Atari and Microsoft BASICs (which can be used to generate automatic line numbering during program entry) and a number of software products also provide for it. When generating listings here we are often tempted to renumber programs which arrive with irregular line numbering, but frequently this is impossible because the author has referred to various program lines in his article. Please save everyone time, though, and renumber your programs as Mr. Ricchezza suggests before sending them in to **COMPUTE!**.

"Some of your readers may be interested to know about a 'bug' in a Pet/CBM program called "BASIC AID". Suppose we have this very simple program:

```
1 GOTO 2
2 END
```

If we use the machine language monitor to examine the content of memory beginning at $0401 we will find that the line is as in (a) below. The 04 08 is the link to the next line, the 01 00 is the line number, 89 is the keyword for GOTO, 32 is ASCII 2 and $00 indicates the end of the line.

If we invoke BASIC AID and (re)NUMBER 1,1 and re-examine memory we will find the program looks like line (b) below. Notice that we have picked up a garbage byte after the ASCII 2. If we NUMBER 1,1 again we will find the program content is as in line (c). Note that we have picked up an additional garbage byte. Each time the NUMBER routine is invoked a new garbage byte will be added.

```
(a) 04 08 01 00 89 32 00
(b) 04 09 01 00 89 32 02 00
(c) 04 0A 01 00 89 32 32 02 02 00
```

Consider the following program line:

```
3 ONX GOTO 4, 5, 6, 7
```

The first time the NUMBER routine is used on this program line each of the four line numbers will pick up a garbage byte. However, the second time the NUMBER routine is invoked only the first line number will pick up an additional garbage byte and subsequent line numbers will be left as is.

As a result of this problem the NUMBER routine cannot reliably be used in the BASIC AID program. In particular I have discovered that the "ON-GOTO" statement will tend to bomb in long programs after use of the (re)NUMBER routine." Hal W. Hardenbergh

---

"One day I was programming and I tried to make a variable called COMBAT [on the Atari]. I got an error and after a little deduction I found a command called COM which has something to do with DIMensioning variables, but there is no explanation of it in the Manual. Does anyone know what COM is?" Jeffrey Naiman

COM is, as far as we know, identical to DIM. DIM A$ (30) is the same as COM A$ (30). We do not know why Atari BASIC contains this "extra."

"Does anyone have or know where data is available on the Apple I? Both program data and interface data. We have the monitor listing, but the code seems odd."
Frank Anderson

"A recent article in **COMPUTE!** *#16 began by alluding to the 'hundreds of free systems in operation across the country' (STP-488 A Smart Terminal Program,* et cetera*; P. 108). I assume that the author was referring to information services that one can enter in order to get different kinds of information stored in those systems. If you have a list, complete or partial, of such services, or if you can refer me to a source where I can obtain such information, I would be most appreciative."*
George Liskow

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"Were it not for **COMPUTE!** *it is quite possible that I would not have chosen the Atari in the first place, or having done so, that I would not have kept it.* **COMPUTE!**, *for a novice like me, who does not have time to be a hobbyist, is without peer the finest computer magazine I have encountered; and it appears to be getting better. I anxiously await its arrival every month.*

I am considering upgrading my Atari 800 with more memory and a disk drive. While canned programs are very nearly all written for the 810 disk drive, the 815 double density/double disk is attractive because of its capacity. The questions are these: will the 810 and 815 disk drives work together in a system? Will the canned programs (Visicalc, wordprocessing, etc.) operate with an 815 disk drive?" John Thrash

You are clearly a man of taste and acute judgment. We cannot recommend the 815. Atari has cancelled its production. Because it is double-density, the disk operating system would need to be different from the 810 and having them work together would be very difficult indeed. Although we're sure Atari will continue to support the 815, the cancellation would raise a question in our minds regarding continued support by outside software houses.

*"I'm having problems with John H. Palevich's SHOOT Program [***COMPUTE! ***#16]. The* BOOT TAPE MAKER *(Program 1) works fine, all those DATA statements check out okay and it beeps twice, I press RETURN and CSAVE a copy of the* BOOT TAPE.

Now here's where the problem comes in. When I remove the ROM cartridge, rewind the tape to the beginning of the BOOT TAPE, *press "PLAY" on the 410, press down on the START button (what's this for?) and turn the 800 back on, I* don't *get that BEEP that John says I should (in his article). I really want to see this program work, so I can try something of my own, but I'm stuck with joystick in hand and fire button poised.*

Anyone know what I'm doing wrong, or having the same problems, or is my Atari 800 down with something?" Fred Corsale

You first turn power off and remove the cartridge. Then hold down the START button *while* turning on the computer. Press PLAY and hit RETURN. This complex and lengthy program is worth the effort, but, because it was so complex, many beginners had difficulty. The BASIC program (before the DATA statements) must be typed in *exactly* as it appears. For further suggestions, see last month's **COMPUTE!**, "Typing in SHOOT," an article written to aid those who might experience difficulties. ©

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PET/CBM	11.33	11.0	1.5	2.33
Apple	4.0	6.0	3.58	3.17
OSI	2.0	4.0	.5	.5

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Computers And Society

David D. Thornburg
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The Personal Computer As A Tool For Creative Expression ...

While machines are probably incapable of what we would call creative thought or invention, there is no question in my mind that the personal computer will become the next major tool for creative expression. In fact, the micro has already become invaluable to many artists whose medium is the written word. The ability of word processing software to simplify the capture and subsequent manipulation of words is of exceptional benefit to many writers, be they poets, essayists, or novelists. Of course, the word processor was not created for this audience — it was created for business users. It is the similarities of the text manipulation needs of both these audiences which has allowed this one tool to be so versatile.

In looking at other fields of expression, the artist is not so fortunate. Software packages for music and graphics are in their infancy. Nonetheless, it is clear that the development of additional software tools can expand the personal computer from a word processor into an *idea processor*. There is no intrinsic reason why small computers can't provide the means for capturing and editing musical or graphical ideas with any less facility than for "words."

In addition to its role as an idea capturing device, the personal computer is fast becoming an appropriate medium through which artistic ideas can be expressed. The temptation of many people working in this area is to try to make the computer emulate existing media. I think that this is a mistake. The computer should be thought of as a *new* medium which is as different from other media as the pencil is from oil paints.

Most of the computer generated music I have heard on micros has attempted to copy the sounds of existing instruments. I would guess that, given the choice, most of us would be less impressed by hearing a computer synthesis of Bach's *Toccata and Fugue in D Minor* than we would by hearing this same piece performed on a 6700 pipe Ruffatti organ (for a superb example of the latter, I recommend the direct to disk recording Virgil Fox made for Crystal Clear Records). There is no way that any synthesized sound can accurately model the depth and richness of even the most modest pipe organ.

A New Class Of Instrument

This doesn't mean that composers and musicians should avoid computers — only that they should consider the computer to be a new and different tool for musical expression — a new class of instrument which can double as a composition tool.

Even if the computer had no capabilities to assist in the synthesis of sounds, imagine the tremendous benefit which would come from the existence of a well written music editor. If you have ever composed music, you have undoubtedly noticed the tremendous expenditure of effort required to capture your melody on paper. A well written music editor might let you play at a special keyboard. As you played, each note and duration would be stored in a file for later editing. After the basic melody has been captured, you would then be able to "clean up" the musical score, align chords, repeat melodic phrases, perform transpositions, inversions, etc. The existence of such an editing tool would benefit existing composers as well as those performers who want to create new compositions on their own.

... the development of additional software tools can expand the personal computer from a word processor into an idea processor.

I find it quite heartening, in my ramblings around various college campuses, to see Apples and other personal computers located in music departments. The work, so far, is most crude, but at least some people recognize the potential hidden in these machines.

If music editing and performance are appropriate domains for the personal computer, then these machines are even more appropriate tools for the graphic artist. The resolution and color capabilities of the Atari and Apple computers are

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extremely poor when compared to lower-cost, familiar tools, such as watercolors or oil paints. But, as with music, it is a mistake to think of the computer as a replacement for existing media. The computer will no more displace the canvas than the pencil replaced the charcoal stick. The artist who uses the computer will be creating works of art which are not expressable in other media. Graphic tools such as realtime animation, dynamic hue or luminance variation, or responsiveness to the viewer, are just not available through media like water colors. Provided that the user interface is appropriate, the artist is able to do any of these things with a computer as inexpensive as the Atari 400.

In order for the personal computer to be useful to the graphic artist, the interface between artist and machine needs to be most carefully crafted. In addition to input devices such as graphics tablets and output devices such as color bit-map printers, the artist needs a graphic idea-capturing and editing tool which does not interfere with the flow of creative expression. Normally, one associates human interaction with a computer keyboard with "left-brained," linear, analytical thinking. The creative flow of ideas, on the other hand, is generated by "right-brained" thought patterns. Somehow, the software through which the artist communicates with the computer must be designed to keep the artist in a creative frame of mind. This will probably make useful graphic editors harder to create than the programs which presently facilitate the generation of "business" graphics (pie charts, bar braphs, etc.).

The Graphics Gathering

It is my pleasure to be part of an informal group, centered around Stanford University, called the Graphics Gathering. This group assembles every month or so to exchange ideas and to show films, slides, or "live" demonstrations of art which has been created with the assistance of technology — primarily computer technology. The most exciting aspect of this group is that artists who are interested in technology converse freely with computer professionals who are interested in graphics. The exchange of ideas benefits everyone.

I recently gave a presentation on Turtle Geometry to this group. (The interested reader is encouraged to explore the "Friends of the Turtle" column which will be a regular feature in **COMPUTE!**'s sister publication, *Home and Educational COMPUTING!*). The simple syntax of the graphics commands used in user-friendly languages such as Atari PILOT and TI LOGO convinced some artists that the day would soon arrive when they could use personal computers for their own artistic creations.

There are few impediments to the use of computers by artists. Cost is no longer much of a factor, although a full-blown system can cost as much as you want it to. Still, with an entry fee of $400 or so, motivated artists can start experimenting with this medium. The real limitation is simply the absence of appropriate software. Once high quality, user friendly, and versatile editors are generated, we can expect to see many artists adding the computer to their tools of expression. Within a decade we might expect to see a projection display in every major gallery, with artists opening shows in several cities by sending their works over the telephone lines. Art collectors may start collecting disks!

How and when this happens may depend on you. As someone who uses and is interested in personal computers, you might be in a good position to experiment with the creation of some of the tools needed by artists of all types.

Notes From All Over ...

Judging from the letters and phone calls I have received, the September editorial on Artificial Intelligence was of interest to many of you. To all who took the time to contact me, I extend my sincere thanks. Your comments, both pro and con, were most valuable. In light of your interest in this area, I will devote the next column to a few recently published books on this topic, including *The Mind's I* by Douglas Hofstadter and Daniel Dennett, *Brainstorms* by Daniel Dennett, and *Mind Design,* edited by John Haugeland. Until then, I extend my wishes for a happy holiday season and a most propserous new year. ©

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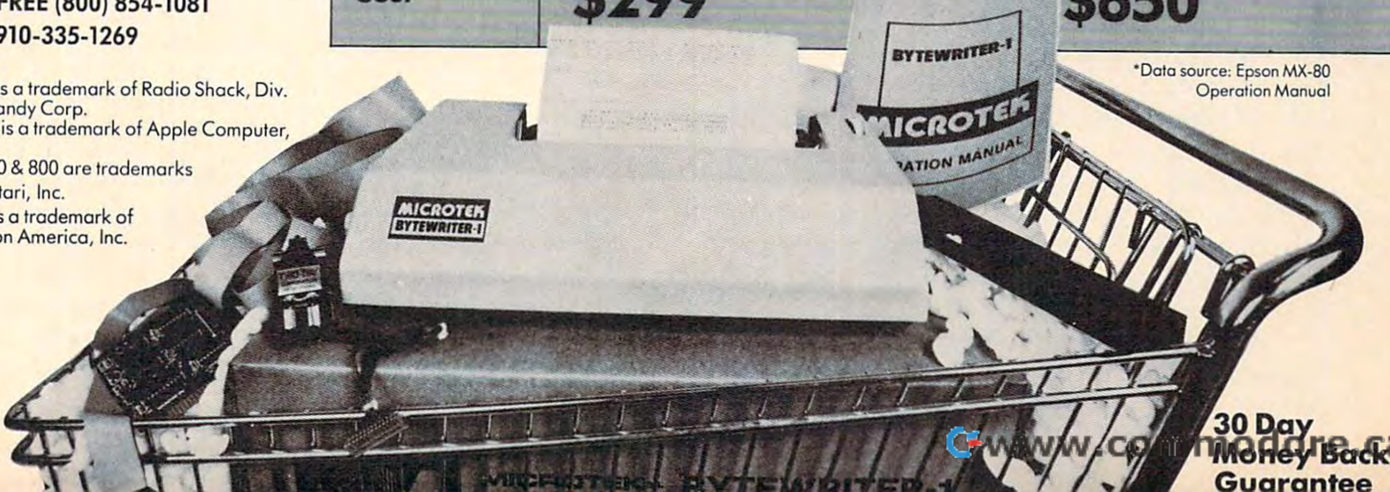

Guest Commentary:

The "World Computer" Revisited

Marvin DeJong
The School Of The Ozarks
Pt. Lookout, MO

This letter is written in connection with the responses I have received to my guest editorial in **COMPUTE!** #14 (page 18). In particular, I am concerned with Mr. Vern L. Mastel's letter in **COMPUTE!** #17 (page 16).

Mr. Mastel implies that my ideas regarding standardization would be the Armageddon of the personal computer industry. The questions he raises and the scenario he depicts are the products of his imagination, not mine.

Let me respond to some of his concerns by pointing out that *standardization* has long been an important factor in the electronics industry as a whole and in the computer industry as well. The IEEE has numerous committees working to standardize various components of the electronics industry, including bus structures, interfaces, and languages.

I can purchase a record from *any* manufacturer (RCA, Columbia, etc.) and put it on *any* turntable or record changer, connected to *any* amplifier, and I will hear music. This is the blessing that results from industry standardization of recording format, speed, and frequency response curves. It is neither "horrifying," nor is it a "nightmare" to operate. (Words in quotes were used by Mr. Mastel.)

Likewise, the industry standards for transmission, reception, and formatting of television pictures have not produced any "monstrous" results. On the contrary, the fact that any TV set (in the United States) can receive any network, all channels, and any local TV station, has been a boon to the industry. My 15-year old black and white set is perfectly compatible with the new color sets. I can purchase a video monitor from any manufacturer and it will work with almost any personal computer as a result of standardization.

Another person who responded to my editorial claimed that the "standard" computer would be restricted to a single microprocessor. Nonsense! The microprocessor and its unique assembly language are completely transparent to anyone who programs in a high-level language. Microsoft has written a BASIC interpreter for almost every microprocessor, it seems. The problem is that *BASIC is not standardized.* There are many different kinds of BASIC. The people who wrote ADA are apparently making efforts to insure that this does not happen to it.

Mr. Mastel implies that we must make a choice between one of the many high-level languages (he included CP/M, which is not a language). I do not think it is an either/or situation. Interpreters are either in ROM or on a disk, and may easily be changed. My idea of a standard computer would be one in which language cards could be plugged in or removed.

It might be well to reiterate my original points. In the context of *educational* uses of the personal computer (an elementary, middle, or high school classroom for example):

1. The cassette recorder is an unacceptable device for storing programs and the industry, including software vendors, should be realistic about its weaknesses.

2. Compatible disk operating systems and *standard* versions of any high-level language would allow software to be easily transported from one machine to another, resulting in reduced software costs and increased incentives for the people who like to write software.

3. *Standardized* graphics commands (with the origin of the coordinate system in the lower left-hand corner where it was for several hundred years before the computer arrived on the scene) would also make transporting a program from one machine to another an easy task. Standardized graphics commands must be built into the interpreter.

4. Standard printer, disk, modem, and plotter interfaces would make assembling a computer system much easier. In a sense this is history, since the RS-232C is already standardized for serial interfaces and Centronics handshaking has become a *de facto* standard for parallel interfaces, while the IEEE-488 bus is used for instrumentation.

My comments were not intended to unveil a poorly disguised communist plot to bring the personal computer industry to an untimely demise. On the contrary, I would like to see the industry become more standardized so that the use of a computer by any elementary school teacher or pupil is simple, inexpensive, trouble-free, educational, and entertaining. ©

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The Beginner's Page

Richard Mansfield
Assistant Editor

Checksum, Terabytes, And Disaster Avoidance

In many ways, your brain is an ideal data storage device. It is in a dust-free case, it can hold an estimated twelve-and-one-half-million terabytes (12,500,000,000,000,000,000 eight-bit bytes. An average microcomputer disk holds about 170 thousand bytes), it self-regulates temperature, and it uses about the same amount of electricity as a twenty watt lightbulb. All in all, an impressive memory.

Until we can manufacture memory devices of this excellence, we will have to follow some rules to make sure that our data and programs are safely stored on tape or disk. Most of our computers rely on memory chips which hold only a few K. The "K" means *kilobyte*, 1,024 bytes. This is not much, really. One kilobyte could hold about 175 English words; less than a double-spaced, typewritten page. To hold this page of **COMPUTE!** we would need about 6K RAM. In an 8K computer, that would leave little space left over for a word processor program to allow corrections, additions, and everything else.

The future of memories looks bright though. 64K on a single chip will be available to us fairly soon — even greater densities, at lower prices, seem inevitable. In fact, there is a possibility that memory cells might actually be *grown*, like mushrooms. Efforts are now underway to create *protein* memory cells. But, for now, we must do without unlimited, inexpensive memory. For now, we compose programs and enter data into a limited RAM and then SAVE what we've created onto cassette tapes or disk drives.

The word SAVE implies a kind of safety, a secure storage. It *can* be secure, but you should observe some precautions. Last month we looked into the management of files. Normally, a file of data is typed into the computer, SAVEd as a file, and then used by a program or programs. The data is kept on a disk or a tape because the computer wipes its RAM memory clean each time power is turned off or each time a new program or set of data comes in.

Backup

Redundancy is an important feature of SAVEing. On your part, this means keeping a backup copy of each program or file. When you write a program (or buy one), the first thing to do is to make a second tape/disk copy of it and put it in a cool place in a dust-free, plastic box. Dirt, smoke, heat or extreme cold, and the oils on fingers are all enemies of magnetic data because both tape and disks are a thin plastic which is easily deformed.

Another danger is vacuum cleaners, TVs, or nearly anything which uses electricity and can generate electric fields. This can remagnetize (erase) tapes and disks. So you cannot safely put a cassette on top of a TV or a refrigerator.

Computers can help us by using their own redundant method of data backup. When a program is sent to a tape machine, some computers record the entire program *twice*. Then, when the program is LOADed back into the computer, the two versions can be compared. The computer then can use the "best" version if there are differences. How does it know which is best?

Data is transferred very fast and many things can degrade it. Often, a *checksum* is used to see if the data made the trip intact. There are various checksum schemes, but here's a simple one. Imagine that we were sending the word *face* to a cassette. The computer would send the numbers 70-65-67-69-271. The letters of the alphabet are each given a code number in computing (the ASCII code). Uppercase A is the number 65, B=66, C=67, D=68, E=69, F=70 and on up. Computers work *only* in numbers. The word *face* means nothing to the computer — it is merely a pattern of numbers. It can print the pattern, alphabetize it (which, to a computer, is merely putting the numbers in *numerical* order), search for it in a paragraph, and all the rest — without ever thinking of the word as anything other than a particular number sequence.

So, it is easy to see why the computer sends 70 65 67 69 271 to the cassette. The number 271 is the sum of the previous numbers. While sending them to the tape, the computer is also adding them up and sending the total at the end. Then, when LOADing, it also adds them up and checks its sum against the one that comes in from the tape. If the sums are not the same, then there was an error in the data transfer. An error of addition is nearly as impossible for a computer as taking a wrong turn would be for a roller coaster. It has been known to happen, but we can be almost certain that it will never happen to you. The computer can be virtually sure that mismatched checksums are the result of bad data on the tape.

This is how it knows which is best of the two versions it recorded on tape. If version one had a bad checksum on the word *face*, but a good checksum on the word *lift* it could keep the word *lift*, but

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wait for the word *face* in the second version. Checksums are done on longer samples than individual words, but the technique is the same.

Computer Wrestling

All of this is an effort, by the computer as well as by the computerist, to protect data. If you make a backup and the computer makes two versions — there are four copies of a program or file. There are two more ways to prevent problems: scratchpad SAVEs and respect for your computer.

When you write your first database program you might want to consider what you are up against. Building a database means typing in lots of records. You do not want to do it twice. Last month we set up a database management system which would permit instant indexing of **COMPUTE!** articles by author or by topic. If you are planning to type hundreds of records (each subject-author-issue number is a record) you don't want to work for hours only to have a fuse blow or someone trip over the computer's electric cord. In a flash, your data is destroyed.

To avoid this, it's a good idea to keep a cassette or disk which is labelled "SCRATCH." It is a temporary scratchpad which is left in the tape or disk drive and SAVEd to every half hour while you rest your fingers.

Finally, the machines themselves, the computers and disk/tape drives, deserve respect. This means gentle treatment. We all know someone who has problems with machines — knobs break off, keyboards malfunction, things jam and fail. They are frustrated by constant "bad luck" with machinery, but, if you watch them make a tape copy, you'll see what's wrong. They move quickly, they force a balky lid down, they *fight* their machinery. To further compound the problem, this same personality type usually avoids instruction manuals. They don't learn that placing electronic devices in direct sunlight, transferring finger oil via disks to drive heads, plugging in peripherals with the power on all invite disaster. We all have our faults, but computer wrestling is an expensive fault. Repairs are slow and expensive. Computer technicians are in short supply.

Transistorized devices are among the most reliable machines man has ever built. A bit of caution and care will keep your data intact and your machine out of the repair shop — until we can buy those disposable terabyte protein box memories for $1. ©

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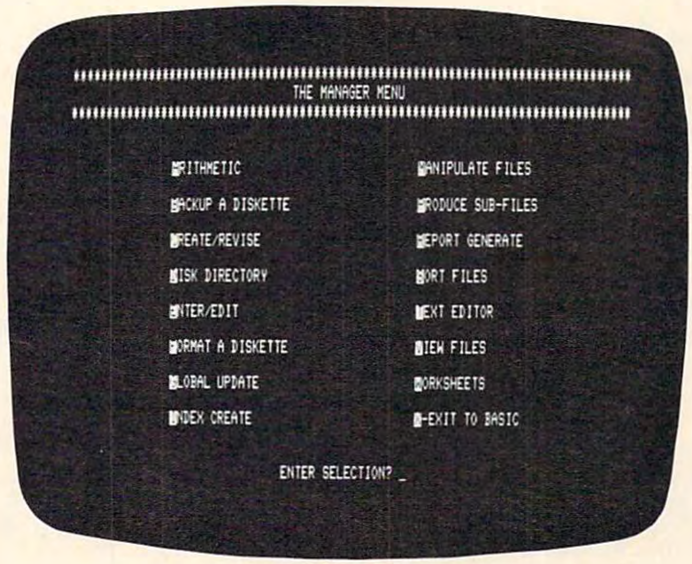

For the Business User

- Uses Menu Options – no programming experience needed.
- Lets you enter data in the form you wish, then lets you recall it using any search criteria.
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Basically Useful BASIC

A Quick-Fix Approach To Calculating Tables

Edward Heite
Camden-Wyoming, DE

Some programs that purport to solve simple problems are, in themselves, too complicated to justify the effort of keying them in. A quickie program should, by definition, be simple and to the point. In my work as an archaeologist, I am often called upon to convert archaic units of measurement to modern units. Old surveys, for example, are expressed in "poles" or "perches", which are 16½ feet long.

To create a quickie conversion table from poles to feet, I wrote this jiffy program:

```
5 OPEN 1,4,Ø
6 PRINT#1,CHR$(147)
1Ø FOR F=1 TO 32Ø
2Ø R=F*16.5
3Ø PRINT#1,F "POLES EQUAL" R " FEET."
4Ø NEXT F
5Ø CLOSE 1
6Ø END
```

Program 1.

```
1 POLES EQUAL  16.5  FEET.
2 POLES EQUAL  33  FEET.
3 POLES EQUAL  49.5  FEET.
4 POLES EQUAL  66  FEET.
5 POLES EQUAL  82.5  FEET.
6 POLES EQUAL  99  FEET.
7 POLES EQUAL  115.5  FEET.
8 POLES EQUAL  132  FEET.
9 POLES EQUAL  148.5  FEET.
1Ø POLES EQUAL  165  FEET.
11 POLES EQUAL  181.5  FEET.
12 POLES EQUAL  198  FEET.
13 POLES EQUAL  214.5  FEET.
```

Figure 1.

My 2022 printer obediently produced a table to convert poles to feet, from one pole to 320, which is a mile. It's a totally unremarkable program; there are no fancy columns, headings, or symbols.

But such fancy programming would have been time-consuming, and would have defeated the initial purpose of providing a quick chart. Since the program is so short, it can be typed for each use, more quickly than it could be loaded from tape.

For those who must frequently calculate conversion tables, a library of quickie programs can be kept on Rolodex cards, ready for instant reference. ©

Window Analysis:
Saving Fuel $$ With Your Computer

David Pitts
Houston, TX

In a typical home, the sunlight transmitted through the windows accounts for 10-14% (ref. 1) of the total air conditioning cost. This can be equal to the savings accrued by installing storm windows or adding attic insulation in some regions of the United States. Furthermore, shielding windows by planting trees or using solar screen, is usually much less expensive than adding insulation or storm windows (especially if one treats only the windows which need shading). The window analysis program described here will allow the homeowner to calculate how much is saved by shading windows in the summer and augmenting the winter heating by allowing sunlight into the home. Also, the program can be used for planning solar collector systems, designing greenhouses, evaluating the merit of adding skylights, or enclosing porches with glass.

As shown in the example run, the user inputs the latitude, the size of the window, the tilt of the window from horizontal, the azimuth [compass directions] that the window faces, and chooses either heating or cooling analysis to be performed. If cooling analysis is desired, the user inputs the capacity (tons) of the cooling system, the current it draws (amps) and the cost of the electricity. If the user chooses heating analysis, he must input the cost of natural gas. Both fuel savings, economic savings and the accrued energy in BTU/sq. ft. are printed by month and season. Because the window azimuth and elevation angle permit any angle window to be analyzed, a variety of applications are possible. In the author's residence, the east-facing windows cause almost $100 in excess cooling cost, whereas the winter gain is about a factor of three smaller. At the low latitude of the author's residence, south-facing windows do not contribute significantly to the heat load in the summer, but are important in reducing heating cost when the sun is lower in the southern sky.

The Calculations

The program was written in Microsoft BASIC on an OSI 4PMF using simple I/O so that the program could be easily converted to other systems. However, lines 372-373 should be replaced for other microprocessors since they provide a flashing cursor on the OSI 4P. The program utilizes eight basic equations which describe the physical amount of sunlight and the angle at which it falls on the window's surface (ref. 2 and 3). The day of the year (DOY) is calculated from the month (M) and the day of month (D) in line 227. The solar declination (DE) is calculated from the day of year in line 350-360. The cosine of the zenith angle of the sun (A1) is calculated in line 440 from the solar declination, the hour angle, and solar elevation angle (AL). The direct solar irradiance is calculated in equation 480 from the apparent solar irradiance at zero air mass (AO), the atmospheric extinction coefficient (BETA) and solar elevation angle (AL). The diffuse irradiance is calculated in line 490 from the tilt of the window (TI) and the direct solar flux (GN). The cosine of the angle between the vector perpendicular to the window and the vector to the sun is calculated in lines 560-570, based on the window tilt (TI), the window azimuth (BI), the sun's azimuth (AZ), and the sun's zenith angle (Z). Finally the total flux transmitted through the window (GL) is calculated in line 600 and summed by month (TT) and by season (SL).

The integration of transmitted energy during a day is accomplished in the FOR loop from line 370 to 712. In this loop, calculations are made during a day for hour angles (HE) of minus 120 degrees (4 AM local solar time) to plus 120 degrees (8 PM local solar time). It is assumed that this calculation is valid for ten days. The integration by month is accomplished between lines 348 and 713 in which three ten-day intervals are calculated per month.

The conversion from energy to utility usage is made assuming that 1100 BTU are produced by each cu. ft. of natural gas and air conditioner run time can be calculated from BTUs by the factor 12,000 BTU/(hr. ton). Kilowatt hours are calculated from volts times amps times time divided by 1000. The program is designed to be used at any latitude (except 0). However, if southern hemisphere calculations are desired, the seasons must be switched in line 225 (the starting month M for heating = 11, and for cooling = 5). Likewise, the length of the heating and cooling seasons must be modified from 152 days (line 715) for printing routine (line 719) should be modified for heating and cooling seasons appropriate for the long season regions. Special transmissionn functions for double glazed glass or solar film may be substituted for the subroutine in lines 2000–2050 as desired.

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BUSINESS and UTILITIES

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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 (1, 2, or 3 up), 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 rel. 2 (Atari, North Star and Apple Diskettes only) — **Price: $34.95**

FORM LETTER SYSTEM (FLS) is the ideal program for creating and editing form letters and address lists. It contains an easy-to-use text editor which produces fully justified text. Special codes are used in the address list to obtain personalized salutations. 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 and sort your address files.

FLS and MAIL LIST 2.2 are available as a combined package for $59.95.

SORTIT (North Star only) — **Price: $29.95 Diskette**

SORTIT is a general purpose sorting 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**

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. 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 are easily retrieved giving the user complete control over an otherwise complicated (and unorganized!) subject.

INTELINK (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.

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 (Atari and North Star diskettes only) — **Price: $19.95**

This handy program allows North Star and Atari disk 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. Reference records are accessed by a single keyword or by cross-referencing two or three keywords.

SHOPPING LIST (Atari only) — **Price: $12.95 Cassette/$16.95 Diskette**

SHOPPING LIST stores information on items you purchase at the supermarket. Before going shopping, it will remind you of all the things you might need, and then display (or optionally print) your shopping list and the total cost. Adding, deleting, changing and storing data is very easy. Runs with 16K.

TAX OPTIMIZER (North Star only) — **Price: $59.95 Diskette**

The TAX OPTIMIZER is an easy-to-use, menu oriented software package which provides a convenient means for analyzing various income tax strategies. The program is designed to provide a quick and easy data entry. Income tax is computed by all tax methods (regular, income averaging, maximum and alternate minimum tax). The user may immediately observe the tax effect of critical financial decisions. TAX OPTIMIZER has been thoroughly field tested in CPA offices and comes complete with the current tax tables in its data files. TAX OPTIMIZER is tax deductible!

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.

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

DYNACOMP CASSETTES

DYNACOMP now offers high quality DYNACOMP brand name C-20 cassettes for computer use. Each cassette is guaranteed to be defect-free.

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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. 5¼" CP/M diskettes are available for North Star and Osborne computer systems.

STATISTICS and ENGINEERING

DIGITAL FILTER (Available for all computers) — **Price: $39.95 Cassette/$43.95 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: $19.95 Cassette/$23.95 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: $19.95 Cassette/$23.95 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 I. 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 (Not available for PET/CBM) — **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, Volumes 1 and 2 (Not available for Atari)

DYNACOMP is the exclusive distributor for the software keyed to the popular texts *BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2* by F. Ruckdeschel (see advertisements in BYTE magazine). These subroutines have been assembled according to chapter. Included with each collection is a menu program which selects and demonstrates each subroutine.

Volume 1

Collection #1: Chapters 2 and 3 - Data and function plotting; complex variables and functions.
Collection #2: Chapter 4 - Extended matrix and vector operations.
Collection #3: Chapters 5 and 6 - Random number generators (Poisson, Gaussian, etc.); 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).

Volume 2

Collection #1: Chapter 1 - Linear, polynomial, multidimensional, parametric least squares.
Collection #2: Chapter 2 - Series approximation techniques (economization, inversion, reversion, shifting, etc.).
Collection #3: Chapter 3 - Functional approximations by iteration and recursion.
Collection #4: Chapter 4 - CORDIC approximations to trigonometric, hyperbolic, exponential and logarithmic functions.
Collection #5: Chapter 5 - Table interpolation, differentiation and integration (Newton, LaGrange, splines).
Collection #6: Chapter 6 - Methods for finding the real roots of functions.
Collection #7: Chapter 7 - Methods for finding the complex roots of functions.
Collection #8: Chapter 8 - Optimization by steepest descent.
Price per collection: $14.95 Cassette/$18.95 Diskette

All eight collections are available for $99.95 (eight cassettes) and $129.95 (eight diskettes).

Because the texts are a vital part of the documentation, *BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2* are available from DYNACOMP:

BASIC SCIENTIFIC SUBROUTINES, Vol 1 (319 pages): $19.95 + 75¢ postage
BASIC SCIENTIFIC SUBROUTINES, Vol 2 (790 pages): $23.95 + $1.50 postage
See reviews in KILOBAUD and Dr. Dobbs.

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1 *Houston Lighting and Power Residential Conservation Services*, copyright 1981, Planenergy Inc., Austin Texas.

2 Yellot, John I.:1974, *Solar Energy Utilization for Heating and Cooling*, NSF 74-41, available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

3 Klem, David C., 1980: Solar Specs, *Microcomputing*, pp. 68-70, 1980.

Program 1. Microsoft Version

```
10 REM **********WINDOW HEATING ANALYSIS**************
30 REM PROGRAM CALCULATES SOLAR RADIATION TRANSMITTED
31 REM THROUGH A WINDOW GIVEN LATITUDE, AZIMUTH AND ZENITH AND
32 REM ANGLE OF WINDOW-DAVID PITTS 16011 STONEHAVEN DR HOUSTON TX 77059
35 REM AL=SOLAR ALTITUDE,HE=HR ANGLE,DE=DECLINATION
36 REMTR=TRANSMISSION,SL=SEASONAL TOTAL BTU/SQ FT,TT = MONTHLY
37 REM TM=TIME(HRS),AO=APPARENT SOLAR IRRADIANCE AT ZERO AIR MASS
38 REM BETA=ATMOSPHERIC EXTINCTION COEFFICIENT
44 FORI=1TO20:PRINT:NEXT
45 PRINTTAB(15);"WINDOW ANALYSIS - SOLAR TRANSMISSION"
46 PRINTTAB(25);"D. E. PITTS"
47 PRINT:PRINT
48 PI=3.14159:P2=PI/2:DIMBETA(12),AO(12)
50 DEFFNRAD(A)=A*PI/180
51 DEFFNASN(B)=ATN(B/(SQR(1-B^2)))
52 DEFFNACS(C)=ATN((SQR(1-C^2))/C)
53 DEFFNDEG(D)=INT((D*180)/PI)
54 DEFFNTRC(E)=INT(E*100)/100
55 DEFFNFUN(F)=F*180/PI
200 INPUT"LATITUDE(DEG)";LAT:L1=LAT:LAT=FNRAD(LAT)
223 PRINT"ANALYSIS DESIRED":PRINT" 1) HEATING":PRINT" 2) COOLING"
225 M=11:INPUTX:D=1:IFX=2THENM=5
226 IFM<3THENDOY=M*31-31+D:GOTO240
227 DOY=INT(M*30.6-32.3+D):REM DAY OF YEAR
240 FORI=1TO12:READAO(I),BETA(I):NEXT
250 INPUT" # SQ FT OF WINDOW FOR EVALUATION";FT:PRINT
260 PRINT:INPUT"WINDOW TILT FROM HORZ, NORMAL=90";TI:T1=TI
261 INPUT"WINDOW AZIMUTH(N=0,S=180), DEG";BI:B1=BI:TI=FNRAD(TI)
262 BI=FNRAD(BI):IFX=1THEN310
263 INPUT"AIRCONDITIONER TONS";T:T=T*12000
264 INPUT"ENTER AMPS OF AIRCONDITIONER, IF NOT KNOWN ENTER 0";SE
265 IFSE<1THENSE=25
267 INPUT"COST FOR ELECTRICITY, CENTS/KWH";C:GOTO335
310 PRINT:INPUT"COST OF NATURAL GAS (CENTS/CU FT)";C
335 PRINT:PRINT:PRINT:PRINTTAB(5);"WINDOW HEATING ANALYSIS BY DIRECT
    SUNLIGHT"
340 PRINTTAB(17);"LATITUDE = ";L1;"DEG"
345 PRINT:PRINT"WINDOW ANGLE ";T1;"DEG";TAB(29);"WINDOW AZ= ";B1;" DEG"
348 PRINT:TT=0:FORJ=1TO3
350 X=FNRAD(DOY-82)*180/182.5:X=23.5*SIN(X):HE=-135
355 M=1:IFDOY>31THENM=INT((DOY+32.3)/30.6)
360 DE=FNRAD(X)
370 FORI=0TO16:AM=4+I:HE=HE+15:AN=FNRAD(HE)
372 IFPEEK(55104)<>95THENPOKE55104,95:GOTO410
373 IFPEEK(55104)=95THENPOKE55104,161:REMCURSOR
410 A1=COS(DE)*COS(AN)*COS(LAT)+SIN(DE)*SIN(LAT)
420 X=FNACS(A1):AL=P2-X
425 IFAL>P2THENAL=AL-PI
440 A2=COS(DE)*SIN(AN)/COS(AL)
441 REM IFA2<-1THENA2=-.9999
```

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```
442 REM IFA2>1THENA2=.9999
445 X=(COS(DE)*COS(AN)-SIN(AN)*COS(LAT))/(COS(AN)*SIN(LAT))
450 AZ=FNASN(A2)+PI:Z=P2-AL:IFX<0THENAZ=PI-AZ
470 IFAL<FNRAD(1)THENGN=0:GOTO490
480 GN=AO(M)/EXP(BETA(M)/SIN(AL))
490 GD=GN*.75*(1+COS(TI))/12
560 A3=COS(Z)*COS(TI)+SIN(Z)*SIN(TI)*COS(AZ)*COS(BI)
570 A3=A3+SIN(Z)*SIN(TI)*SIN(AZ)*SIN(BI)
575 IN=FNACS(A3):IFIN<0THENTR=0:GOTO600
590 GOSUB2000
600 GL=(GN*A3*TR+GD)*10:TT=TT+GL:SL=SL+GL
712 NEXT:DD=DD+10:DOY=DOY+10:IFDOY>365THENDOY=DOY-365
713 NEXT:PRINT"MONTH= ";TAB(9);M;TAB(29);"TOTAL = ";TAB(38);FNTRC(TT);
714 PRINTTAB(48);"BTU/(SQ FT)"
715 GOSUB719:IFDD<152THEN348
717 TT=SL:PRINT"----------------------------------------------------------------------
718 PRINT"ANNUAL SAVINGS!":PRINT:GOSUB719:FORI=1TO1000:NEXT:RUN48
719 IFM>4ANDM<11THEN800
720 P=TT*FT/110000:PRINT"NATURAL GAS SAVED ";FNTRC(P);"      100 CU FT"
730 PRINT"DOLLAR SAVINGS ";FNTRC(P*C)
740 PRINT:PRINT"----------------------------------------------------------------------
750 PRINT:RETURN
800 TM=TT*FT/T:P=220*SE*TM/1000
805 PRINT"POWER EXPENDED ";FNTRC(P);"KWH"
810 PRINT"COOLING COST DUE TO WINDOW";FNTRC(C*P/100);"DOLLARS"
820 PRINT:PRINT"----------------------------------------------------------------------
830 PRINT
1000 RETURN
2000 REM GET TRANSMITTANCE FOR SINGLE GLAZED GLASS
2010 IFIN<.87266THENTR=.87:GOTO2100
2020 IFIN>1.2218THEN2050
2030 CI=(IN-.8726639)*4.5:TR=.16*COS(CI)+.68:GOTO2100
2050 TR=3.0599-1.948*IN:IFTR<0THENTR=0
2100 RETURN
4000 DATA390,.142,385,.144,376,.156,360,.18,350,.196,345,.205,344,.207
4002 DATA351,.201,365,.177,378,.16,387,.149,391,.142
5000 END
```

Program 2. Atari Version

```
10 REM ***WINDOW HEATING ANALYSIS***
30 REM PROGRAM CALCULATES SOLAR
      RADIATION TRANSMITTED
31 REM THROUGH A WINDOW GIVEN LATITUDE,
      AZIMUTH AND ZENITH AND
32 REM ANGLE OF WINDOW-DAVID PITTS
  16011 STONEHAVEN DR HOUSTON TX 77059
35 REM AL=SOLAR ALTITUDE,HE=HR ANGLE,
      DE=DECLINATION
36 REM TR=TRANSMISSION, SL=SEASONAL
      TOTAL BTU/SQ FT, TT=MONTHLY
37 REM TM=TIME(HRS),AO=APPARENT SOLAR
      IRRADIANCE AT ZERO AIR MASS
38 REM BETA=ATMOSPHERIC EXTINCTION
      COEFFICIENT
44 PRINT CHR$(125)
45 ? "WINDOW ANALYSIS - SOLAR TRANSMISSI
ON"
46 POKE 85,14:? "D. E. PITTS"
47 ? :?
48 PI=3.14159:P2=PI/2:DIM BETA(12),AO(12
):RAD
50 FRAD=100
51 FASN=110
52 FACS=120
53 FDEG=130
54 FTRC=140
55 FFUN=150
60 GOTO 200
100 V=V*PI/180:RETURN
```

```
110 V=ATN(V/(SQR(1-V*V))):RETURN
120 V=ATN((SQR(1-V*V))/V):RETURN
130 V=INT((V*180)/PI):RETURN
140 V=INT(V*100)/100:RETURN
150 V=V*180/PI:RETURN
200 PRINT "LATITUDE(DEG)";:INPUT LAT:L1=
LAT:V=LAT:GOSUB FRAD:LAT=V
223 PRINT "ANALYSIS DESIRED":PRINT "1) H
EATING":PRINT "2) COOLING"
225 M=11:INPUT X:D=1:IF X=2 THEN M=5
226 IF M<3 THEN DOY=M*31-31+D:GOTO 240
227 DOY=INT(M*30.6-32.3+D):REM DAY OF YE
AR
240 FOR I=1 TO 12:READ A:AO(I)=A:READ B:
BETA(I)=B:NEXT I
250 PRINT "#SQ FT OF WINDOW FOR EVALUATI
ON";:INPUT FT:?
260 ? :? "WINDOW TILT FROM HORIZ, NORMAL
=90":INPUT TI:T1=TI
261 ? "WINDOW AZIMUTH(N=0,S=180),DEG";:I
NPUT BI:B1=BI:V=TI:GOSUB FRAD:TI=V
262 V=BI:GOSUB FRAD:BI=V:IF X=1 THEN 310

263 ? "AIR CONDITIONER TONS";:INPUT T:T=
T*12000
264 ? "ENTER AMPS OF AIR CONDITIONER":?
"IF NOT KNOW ENTER 0";:INPUT SE
265 IF SE<1 THEN SE=25
267 ? "COST FOR ELECTRICITY, CENTS/KWH";
:INPUT C:GOTO 335
310 ? :? "COST OF NATURAL GAS (CENTS/CU
FT)";:INPUT C
335 ? :? :? :? "WINDOW ANALYSIS BY DIREC
T SUNLIGHT"
340 ? "LATITUDE=";L1;" DEG"
345 ? :? "WINDOW ANGLE ";T1;" DEG   WIND
OW AZ=";B1;" DEG"
348 ? :TT=0:FOR J=1 TO 3
350 V=DOY-82:GOSUB FRAD:X=V*180/182.5:X=
23.5*SIN(X):HE=-135
355 M=1:IF DOY>31 THEN M=INT((DOY+32.3)/
30.6)
360 V=X:GOSUB FRAD:DE=V
370 FOR I=0 TO 16:AM=4+I:HE=HE+15:V=HE:G
OSUB FRAD:AN=V
410 A1=COS(DE)*COS(AN)*COS(LAT)+SIN(DE)*
SIN(LAT)
420 V=A1:GOSUB FACS:X=V:AL=P2-X
425 IF AL>P2 THEN AL=AL-PI
440 A2=COS(DE)*SIN(AN)/COS(AL)
441 REM IF A2<-1 THEN A2=-.9999
442 REM IF A2>1 THEN A2=.9999
445 X=(COS(DE)*COS(AN)-SIN(AN)*COS(LAT))
/(COS(AN)*SIN(LAT))
450 V=A2:GOSUB FASN:AZ=V+PI:Z=P2-AL:IF X
<0 THEN AZ=PI-AZ
470 IF AL<PI/180 THEN GN=0:GOTO 490
480 GN=AO(M)/EXP(BETA(M)/SIN(AL))
490 GD=GN*0.75*(1+COS(TI))/12
560 A3=COS(Z)*COS(TI)+SIN(Z)*SIN(TI)*COS
(AZ)*COS(BI)
570 A3=A3+SIN(Z)*SIN(TI)*SIN(AZ)*SIN(BI)

575 V=A3:GOSUB FACS:IN=V:IF IN<0 THEN TR
=0:GOTO 600
590 GOSUB 2000
600 GL=(GN*A3*TR+GD)*10:TT=TT+GL:SL=SL+G
L
712 NEXT I:DD=DD+10:DOY=DOY+10:IF DOY>36
5 THEN DOY=DOY-365
713 NEXT J:PRINT "MONTH=";M;"  TOTAL=";:
V=TT:GOSUB FTRC:PRINT V;" BTU/(SQ FT)"
715 GOSUB 719:IF DD<152 THEN 348
717 TT=SL:? "--------------------------
----------"

718 ? "ANNUAL SAVINGS!":? :GOSUB 719:FOR
 I=1 TO 1000:NEXT I:CLR :GOTO 48
719 IF M>4 AND M<11 THEN 800
720 P=TT*FT/110000:? "NATURAL GAS SAVED
";:V=P:GOSUB FNTRC:PRINT V;" 100 CU FT"
730 PRINT "DOLLAR SAVINGS ";:V=P*C:GOSUB
 FTRC:PRINT V
740 ? :? "-----------------------------
-------"

750 ? :RETURN
800 TM=TT*FT/T:P=220*SE*TM/1000
805 ? "POWER EXPENDED ";:V=P:GOSUB FTRC:
? V;" KWH"
810 ? "COOLING COST DUE TO WINDOW $";:V=
C*P/100:GOSUB FTRC:? V
820 ? :? "-----------------------------
---------"

830 ?
1000 RETURN
2000 REM GET TRANSMITTANCE FOR SINGLE GL
AZED GLASS
2010 IF IN<0.87266 THEN TR=0.87:GOTO 210
0
2020 IF IN>1.2218 THEN 2050
2030 CI=(IN-0.8726639)*4.5:TR=0.16*COS(C
I)+0.68:GOTO 2100
2050 TR=3.0599-1.948*IN:IF TR<0 THEN TR=
0
2100 RETURN
4000 DATA 390,.142,385,.144,376,.156,360
,.18,350,.196,345,.205,344,.207
4002 DATA 351,.201,365,.177,378,.16,387,
.149,391,.142
5000 END
```

Example Run

```
LATITUDE(DEG)? 30
ANALYSIS DESIRED
 1) HEATING
 2) COOLING
? 2
 # SQ FT OF WINDOW FOR EVALUATION? 70


WINDOW TILT FROM HORZ, NORMAL=90? 90
WINDOW AZIMUTH(N=0,S=180), DEG? 90
AIRCONDITIONER TONS? 4
ENTER AMPS OF AIRCONDITIONER, IF NOT KNOWN ENTER 0? 30
COST FOR ELECTRICITY, CENTS/KWH?     6.55


     WINDOW HEATING ANALYSIS BY DIRECT SUNLIGHT
                 LATITUDE =  30 DEG

WINDOW ANGLE  90 DEG          WINDOW AZ=  90  DEG

MONTH=    5                   TOTAL =   27086.46 BTU/(SQ FT)
POWER EXPENDED  260.7 KWH
COOLING COST DUE TO WINDOW 17.07 DOLLARS
---------------------------------------------------------

MONTH=    6                   TOTAL =   27118.47 BTU/(SQ FT)
POWER EXPENDED  261.01 KWH
COOLING COST DUE TO WINDOW 17.09 DOLLARS
---------------------------------------------------------

MONTH=    7                   TOTAL =   26652.02 BTU/(SQ FT)
POWER EXPENDED  256.52 KWH
COOLING COST DUE TO WINDOW 16.8 DOLLARS
---------------------------------------------------------

MONTH=    8                   TOTAL =   26268.8  BTU/(SQ FT)
POWER EXPENDED  252.83 KWH
COOLING COST DUE TO WINDOW 16.56 DOLLARS
---------------------------------------------------------

MONTH=    9                   TOTAL =   25223.88 BTU/(SQ FT)
POWER EXPENDED  242.77 KWH
COOLING COST DUE TO WINDOW 15.9 DOLLARS
---------------------------------------------------------

MONTH=    10                  TOTAL =   23689.78 BTU/(SQ FT)
POWER EXPENDED  228.01 KWH
COOLING COST DUE TO WINDOW 14.93 DOLLARS
---------------------------------------------------------
---------------------------------------------------------
ANNUAL SAVINGS!

POWER EXPENDED  1501.87 KWH
COOLING COST DUE TO WINDOW 98.37 DOLLARS
---------------------------------------------------------
```

```
LATITUDE(DEG)? 30
ANALYSIS DESIRED
 1) HEATING
 2) COOLING
? 1
 # SQ FT OF WINDOW FOR EVALUATION? 70


WINDOW TILT FROM HORZ, NORMAL=90? 90
WINDOW AZIMUTH(N=0,S=180), DEG? 90

COST OF NATURAL GAS (CENTS/CU FT)? .37

     WINDOW HEATING ANALYSIS BY DIRECT SUNLIGHT
                 LATITUDE =  30 DEG

WINDOW ANGLE  90 DEG          WINDOW AZ=  90  DEG

MONTH=    11                  TOTAL =   19554.29 BTU/(SQ FT)
NATURAL GAS SAVED  12.44       100 CU FT
DOLLAR SAVINGS  4.6
----------------------------------------------------------------

MONTH=    12                  TOTAL =   17299.96 BTU/(SQ FT)
NATURAL GAS SAVED  11      100 CU FT
DOLLAR SAVINGS  4.07
----------------------------------------------------------------

MONTH=    1                   TOTAL =   17660.93 BTU/(SQ FT)
NATURAL GAS SAVED  11.23       100 CU FT
DOLLAR SAVINGS  4.15
----------------------------------------------------------------

MONTH=    2                   TOTAL =   21405.49 BTU/(SQ FT)
NATURAL GAS SAVED  13.62       100 CU FT
DOLLAR SAVINGS  5.04
----------------------------------------------------------------

MONTH=    3                   TOTAL =   25082.35 BTU/(SQ FT)
NATURAL GAS SAVED  15.96       100 CU FT
DOLLAR SAVINGS  5.9
----------------------------------------------------------------

MONTH=    4                   TOTAL =   26858.1  BTU/(SQ FT)
NATURAL GAS SAVED  17.09       100 CU FT
DOLLAR SAVINGS  6.32
----------------------------------------------------------------

------------------------------------------------------------
ANNUAL SAVINGS!

NATURAL GAS SAVED  81.36       100 CU FT
DOLLAR SAVINGS  30.1
----------------------------------------------------------------

LATITUDE(DEG)?
```

©

Subscript Heap Sort

Elizabeth Deal
Malvern, PA

This article describes a one-level-deep, ascending, alphanumeric subscript heap sort. It is written for the PET/CBM computer. It should work on systems that use Microsoft BASIC and permit arrays of character strings (Pet, Apple, OSI, Radio Shack).

Sort vs Subscript Sort

"Subscript sort" may be called *tag* sort, *pointer* sort, *index* sort or whatever you wish. The principle behind this type of ordering is that elements in a list are never moved and are not actually sorted. What gets rearranged into an ascending sequence are the subscripts of the array. The neat thing about this trick is that, as we are sorting records with several fields, we never need to move masses of data around. The corresponding fields are carried with the field that is being sorted. Subsequent to sorting, the access to the elements of the array is through the ordered list of subscripts.

For people with garbage collection problems, there is an additional advantage if they are sorting character strings. Since character strings do not have to move, time-consuming garbage collection during the sort will not need to occur. For further information on that subject consult Jim Butterfield's article in **COMPUTE!** #10, p. 96.

Sorting in BASIC takes considerable time no matter which of many available sorting methods is selected. I like heap sort because its performance is "even" no matter what the order of the original list is and the sorting time is almost linear relative to the list size. The algorithm itself is interesting, fun to study, and efficient on long lists. On short lists (N<25) there is, however, some time penalty as compared to several other sorting methods.

Don't Reinvent The Wheel

If you haven't done so already, you might want to look into a classic on the subject of sorting, merging, and general data management — Knuth, *The Art of Computer Programming*, vol. 3: Sorting and Searching, Addison and Wesley, 1973. The book looks mathematical and forbidding. But the appearance is deceptive, for there are no Greek letters in it and the sentences that look mathematical are, simply, ideas for the lines of a program. The illustrations are clear and the explanations are not at all complicated.

Book in hand, the algorithm is possible to follow if you practice the binary tree logic and the entire process with pencil and paper. It is then possible to modify the program from the book or the one from **COMPUTE!** #2 with some degree of assurance that it will successfully sort by subscripts. This program does just that.

... work on systems that use Microsoft BASIC and permit arrays of character strings ...

Suggestions On Data Management

The demonstration program consists primarily of sorting multifield records. The sort routine sorts field HV. The field type (alpha or numeric) is in HT, number of records to be sorted in H1. The resulting list of subscripts is placed in the SB array, their placement being determined by the comparative numeric or string value of the corresponding elements of the V or V$ array, depending on HT.

When sorting has been finished, in order to use the undisturbed, unsorted list, we ask for V$(f,r) as shown in lines 680-710. To use the list in sorted order we ask for V$(f,SB(r)) as coded in lines 630-661. In plain English, it means to print a value pointed to by the r-th subscript.

The program also contains some suggestions pertaining to general management of data. Take these nonsorting suggestions with a grain of salt. Vary them. These are some of the methods I use, find adequate and which fit most things I do on my PET. It does not mean that your arrangement of data or its parameters has to be like that. These ideas and the following details of the program are given mainly for people who are starting and don't know where to begin.

The program is originally set up (line 760) for NN = 20 estimated number of records and VV = 15 fields per record. You may change those estimates. The actual count of variables (NV) is performed in lines 770-810 while reading in data descriptors contained in the first DATA line. The actual count of records (KN) is done in lines 840-852 while reading in the six records from the remaining DATA lines.

There are two alphabetic and two numeric fields in each of the six records. The field type is stored in array TP. Type is 1 (one) for alpha (A) and 0 (zero) for numbers (N). TP is developed in lines 770-810 using the first DATA line. Since the ASCII collating sequence is irrelevant to sorting unaligned or non-integer or signed numeric values

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BASIC

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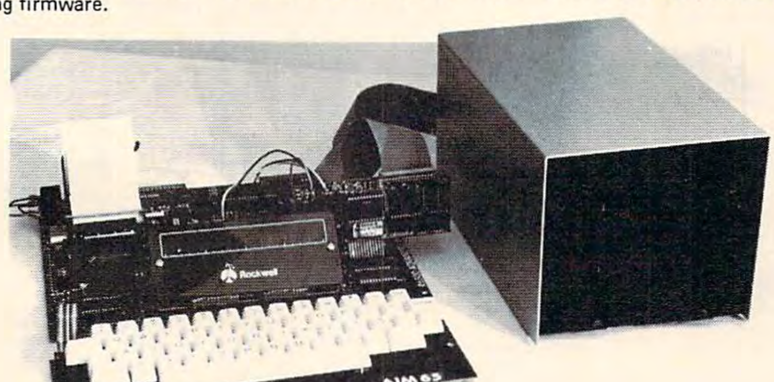
!SAVE — stores a BASIC program file to the disk
!OPEN — forms a sequential or relative data file
!INPUT — reads a data record from a file on the disk
!PRINT — stores a data record to a file on the disk
!CLOSE — ends a sequential or relative data file
!LIST — displays a directory of all files on the disk
!RUN — reads a program file and executes

MONITOR-DOS

D — displays contents of memory or diskette.
G — go to program and execute.
H — help user with listing of all commands.
K — kill a file on the diskette (erase file).
L — read program to the computer memory.
M — memory examine and change monitor.
N — name a file differently (rename).
P — print directory of all files on the disk.
R — return to BASIC mode.
S — save program or data from memory to the disk.
U — utility: format, copy, compress, patch diskette.
X — execute program after loading.



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by John Fluharty **$30**

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by Michael Riley

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For writing text, Paper-Mate has a definable keyboard so you can use either Business or Graphics machines. Shift lock on letters only, or use keyboard shift lock. All keys repeat.

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in character string form, these fields are not used in their string form. The values are placed in a one-dimensional work array V which has been set up in line 840. Should you be short of space for this extra array, you may change the program like this: omit all references to the V array by deleting its DIM in line 840 and lines 591 and 650. In the sort routine change all V(SB(*)) to VAL(V$(HV,SB(*))).

In any case, when HT is set to zero in line 600, the sort routine sorts numbers. This coding is in

Ranking fits in this sorting scheme automatically.

each second line of the subroutines which begin in lines 310, 330 and 350. The main routine (lines 560-711) handles these numbers as character strings, however, so that the output can look tidy while permitting a messy, unaligned input (sometimes useful in files for space-saving reasons).

Two different output methods are used, depending on the type of variable. You'll see different coding for alpha fields (line 640) from that for numeric fields(lines 650-652). The output format is controlled by arrays V1 and V2 which specify the field width. In case of alpha variables, only V1 is required (see the first DATA line where A-12 and A-14 sequences specify alpha fields of 12 and 14 characters to be left-justified by line 530). In case of numbers, both V1 and V2 are needed (see line 450 and N-2-0 and N-4-3 sequences in line 870 which specify right-justified numeric output formats of xxx and xxxx.xxx respectively). The Butterfield formatting procedure from **COMPUTE!** #9 is used for printing numbers in a neat column.

Why not, you may ask, just read the values into a numeric array since that's what has to be used in sorting? There are several reasons. (1) This data might be an example of an existing disk file containing only character strings. (2) This might be a larger task requiring character by character data checking. Hence there is the need for input of character strings. Editing of data is a story outside the scope of this article, but it's a good idea to remember the issue every once in a while. (3) Unless you enjoy looking at unaligned columns of numbers the output ought to be formatted. Here, again, the easiest way is to work with character strings. Again, these are the methods I am comfortable with. Your opinions may differ and lead to a totally different approach.

Ranking

Finally, there exists a short ranking routine within the listing that might be useful to statistics people who would like to use this for nonparametric tests and suspect tied scores. Ranking fits in this sorting scheme automatically. Note that if there are *no* tied values then, by definition, at the end of sort *the subscripts are the ranks*, otherwise an average of ranks is given. Thus the rank routine is needed only when tied values are obvious or suspected. This routine creates an array of ranks (RV) while doing one extra pass through the list in subscript-sorted order. Needless to say, since you get a chance in this demo program to sort on any one of the four variables, the rank values are meaningless in some situations.

Figure 1.

```
* SORTED ON FIELD 4 *

CHARLOTTE    FARM           74  -93.000
FATHER FOX   VERMONT       100     .003
WILBUR       FARM            1     .488
MOUSE        TOOTLETOWN     84   33.700
TEMPLETON    FARM           98  647.000
TANKER       TOOTLETOWN     84  647.000

* UNSORTED, RANKED ON FIELD 4 *

TANKER         5.5
MOUSE          4.0
FATHER FOX     2.0
CHARLOTTE      1.0
WILBUR         3.0
TEMPLETON      5.5


* SORTED ON FIELD 3 *

WILBUR       FARM            1     .488
CHARLOTTE    FARM           74  -93.000
TANKER       TOOTLETOWN     84  647.000
MOUSE        TOOTLETOWN     84   33.700
TEMPLETON    FARM           98  647.000
FATHER FOX   VERMONT       100     .003

* UNSORTED, RANKED ON FIELD 3 *

TANKER         3.5
MOUSE          3.5
FATHER FOX     6.0
CHARLOTTE      2.0
WILBUR         1.0
TEMPLETON      5.0
```

```
100 REM----------------------------
110 REM SUBSCRIPT HEAP SORT
140 REM ELIZABETH DEAL
150 REM----------------------------
160 GOSUB760:GOSUB560:END
170 REM----------------------------
180 REM SORT SUBSCRIPTS OF FIELD HV
181 REM FIELD TYPE HT (0=N 1=A)
182 REM NUMBER OF RECORDS H1
183 REM PLACE SUBSCRIPTS IN SB ARRA
    Y
190 IFH1<2THENPRINT"NEED 2+":END
200 H2=INT(H1/2)+1:HA=1:HZ=0
210 IFH2>HATHENH2=H2-HA:H8=H2:GOSUB
    310:HR=SB(H2):GOSUB260:GOT
    O210
220 H8=H1:GOSUB310:HR=SB(H1):SB(H1)
    =SB(HA):H1=H1-HA
230 IFH1>=HATHENGOSUB260:GOTO210
240 SB(H3)=HR:RETURN
250 :
260 H4=H2
270 H3=H4:H4=H4+H4:IFH4>H1THENSB(H3
    )=HR:RETURN
280 IFH4<H1THENGOSUB330:IFHLTHENH4=
    H4+HA
290 GOSUB350:IFHGTHENSB(H3)=HR:RETU
    RN
300 SB(H3)=SB(H4):GOTO270
310 IFHTTHENH5$=V$(HV,SB(H8)):RETUR
    N
320 H5=V(SB(H8)):RETURN
330 HL=HZ:IFHTTHENHL=-(V$(HV,SB(H4)
    )<V$(HV,SB(H4+HA))):RETURN
340 HL=-(V(SB(H4))<V(SB(H4+HA))):RE
    TURN
350 HG=HZ:IFHTTHENHG=-(H5$>=V$(HV,S
    B(H4))):RETURN
360 HG=-(H5>=V(SB(H4))):RETURN
370 REM----------------------------
380 REM RANK FROM SUBSCRIPTS
390 RA=1:RB=2:RC=0:FORR1=1TOR3:RS=R
    1:RQ=RC:RF=RC
400 IFV$(RR,SB(R1))=V$(RR,SB(R1+RA)
    )THENRQ=RQ+RA:R1=R1+RA:RF=
    RA:GOTO400
410 FORR2=RSTOR1:RV(SB(R2))=RS+RQ*R
    F/RB:NEXTR2,R1:RETURN
420 REM----------------------------
430 REM 'USING' ARRANGE IN COLUMNS
440 REM J. BUTTERFIELD
450 REM V IS VALUE; V1.V2 PRINTS
460 V4=INT(V*10^V2+.5):REM ROUNDED
470 V$=RIGHT$("          "+STR$(V4),V
    1+V2+1):IFV2<1GOTO500
480 FORV5=V1+2TOV1+V2+1:IFASC(MID$(
    V$,V5))<48THENNEXTV5
490 V6=V5-V1-1:V$=MID$(V$,V6,V1+1)+
    LEFT$(".000000",V6)+MID$(V
    $,V5)
500 IFASC(V$)>47THENV$=LEFT$("*****
    *****",V1+V2+2+(V2=0))
510 RETURN
520 REM----------------------------
530 PRINTLEFT$(VS$+B$,V1);:RETURN
     :REM A
540 GOSUB450:PRINTV$;:RETURN
     :REM N
550 REM----------------------------
560 PRINT:PRINT"SORT FIELD 1 -"NV"O
    R X"
561 INPUTF$:IFF$="X"THENRETURN
570 SI=VAL(F$):IFSI<1ORSI>NVTHENPRI
    NT"???":GOTO560
590 FORI=1TOKN:SB(I)=I:NEXT  :REM I
    NIT SUBSCRIPTS
591 IFTP(SI)=0THENFORI=1TOKN:V(I)=V
    AL(V$(SI,I)):NEXTI  :REM C
    ONVERT V$ TO V
592 :
600 HV=SI:HT=TP(HV):H1=KN:GOSUB190
     :REM SORT
610 RR=SI:R3=KN:GOSUB390
     :REM RANK
611 :
620 PRINT:PRINT"* SORTED ON FIELD"S
    I"*":PRINT
630 FORI=1TOKN
631 FORJ=1TONV:VS$="":V$=""
640 IFTP(J)THENVS$=V$(J,SB(I)):V1=V
    1(J):GOSUB530:GOTO660  :RE
    M A
650 IFJ=SITHENV=V(SB(I)):GOTO652 :R
    EM SORTED N FIELD
651 V=VAL(V$(J,SB(I)))           :R
    EM OTHER N FIELDS
652 V1=V1(J):V2=V2(J):GOSUB540
660 NEXTJ:PRINT
661 NEXTI
662 :
670 PRINT:PRINT"* UNSORTED, RANKED
    ON FIELD"SI"*":PRINT
680 FORI=1TOKN:VS$=""
690 VS$=V$(1,I):V1=V1(1):GOSUB530
     :REM A
```

```
700 V=RV(I):V1=2:V2=1:GOSUB54Ø
     :REM N
71Ø PRINT:NEXTI
711 GOTO56Ø
72Ø REM---------------------------

73Ø REM INITIALIZE
74Ø REM READ DATA DESCRIPTORS FOR O
    UTPUT
75Ø REM READ IN KN RECORDS OF NV FI
    ELDS IN EACH RECORD
76Ø NN=2Ø:KN=Ø:VV=15:NV=Ø:DIM TP(VV
    ):B$="                    "
77Ø READTP$:IFTP$="X"GOTO83Ø
78Ø NV=NV+1
79Ø IFTP$="A"THENTP(NV)=1:READV1(NV
    ):GOTO77Ø
8ØØ IFTP$="N"THENTP(NV)=Ø:READV1(NV
    ),V2(NV):GOTO77Ø
81Ø PRINT"BAD DATA DESCR":LIST87Ø
82Ø :
83Ø DIM V$(NV,NN),SB(NN),RV(NN)
831 FORI=1TONN
84Ø READE$:IFLEFT$(E$,4)="XXXX"THEN
    KN=I-1:DIM V(KN):RETURN
85Ø V$(1,I)=E$
851 IFNV>1THENFORJ=2TONV:READV$(J,I
    ):NEXTJ
852 NEXTI
86Ø :
87Ø DATA A,12, A,14, N,3,Ø, N,4,3,
    X
88Ø :
89Ø DATA TANKER,TOOTLETOWN,84,647
9ØØ DATA MOUSE,TOOTLETOWN,84,33.7
91Ø DATA FATHER FOX,VERMONT,1ØØ,.ØØ
    3
92Ø DATA CHARLOTTE,FARM,74,-93
93Ø DATA WILBUR,FARM,1,.4876
94Ø DATA TEMPLETON,FARM,98,647
95Ø DATAXXXXXXXXXXXXXXXXXXXXXXXXXXX
    XXX
```

Review:

SYZYGY RS-232 Condition Testers

Sanford I. Gossman
San Rafael, CA

S Y Z Y G Y (pronounced "siz-a-gee") is a small, and relatively new, company in Covina California (256 West San Bernardino Road; 91723). They produce a line of RS-232 testing devices which includes two LED devices that monitor the condition of the connections that interface RS-232 devices, or ports. The quality of their products demonstrates what can be done when a manufacturer limits himself to one type of product and does a job right.

S Y Z Y G Y makes two RS-232 line-condition testers. Each are "pocket size," measuring approximately 3x2x½ inches. Each has a male RS-232 connector on one end, and a female connector on the other. Each has eight LED's wired so as to monitor the seven most commonly used signals (pins 2, 3, 4, 5, 6, 8, & 20: TD, RD, RTS, CTS, DSR, DCD, DTR). The eighth LED, labeled "TEST," can be jumpered to any pin not having a light wired to it, so that its status can be monitored.

No Batteries Needed

The devices are powered by the RS-232 signals, so no batteries are required. Current-limiting circuitry assures a constant current over the voltage range permitted by the RS-232 standard, and provides a simple "go, no-go" indication.

The least expensive of the two products is called the "Test Set" and sells for $89. Each of the 25 pins are wired through, and a single 26-pin header provides a means to connect one pin to another.

The "top-of-the-line" model is designated the RS-232 Patch Set. It sells for $111. It is the model I have been using for the past two months.

The difference between the two is that the Patch Set has *none* of the connectors feeding through. Instead, there is a 26-pin header on each end. The unit comes with a generous supply of single and double jumpers. The wires are used to connect the pins manually: either to their corresponding number, or to another pin, or pins, for testing. The advantage of this scheme is that it permits you to easily break the connection of a pin, by merely pulling a jumper. In this way, you can determine what signal is present from each device separately.

Easy Status Checks

I am in the process of writing a series of reviews of RS-232 modems. Most of the equipment represents a new product, and there is no software provided that will permit operation in my equipment environment. So, I have been busy writing software.

The Patch Kit has proven invaluable. With the documentation from some manufacturers being sketchy, at best, it has been imperative for me to know the status of each of several key connections. With the Patch Kit it was easy. Without it I would have been switching a logic probe between pins almost endlessly.

When your installation is complete, either the Test Set or Patch Kit can be left attached.

The ability to segregate signals helped me greatly when I was having difficulty reading a status signal from a modem, through software. Theory said that what I was doing was correct, but I was both baffled and frustrated. Because I was able to determine the status of the problem signal line at "each end" of the connecting cable, the source of the problem was discovered easily.

By disconnecting the corresponding jumper and "reading" the signal as it appeared (both coming from the modem and going to the computer), I was able to discover that portion of a chip inside my computer was inoperative. The condition has previously gone undetected because the line served by the pin had not been used by other equipment previously attached to the port. I'm sure that, had I not had the tester, I would have spent several hours trying to correct what I first believed was a software problem.

First-rate Construction

The construction of the product is "first-rate." Everything is soldered, all edges are smooth, and only high-quality materials are used. The LED's are mounted behind holes in the circuit board that makes up the "chassis" of the device. The holes are silvered on the inside. This treatment enhances the brightness of the glow, and makes it easy to see from virtually any angle.

A placard is conveniently attached to the rear, and provides a wealth of information constantly needed during a configuration or trouble shooting project. A cover retains the jumper wires when the unit is not in use.

The Patch Set has the function of similar products selling for nearly three times as much. Accordingly, it qualified in my book for "best-buy" status.

I recommend that such a device be purchased and used to make a thorough analysis of the status of each pin of each RS-232 device of your system. Then, when a problem develops, you will be able to quickly determine the cause.

When your installation is complete, either the Test Set or Patch Kit can be left attached. Its LED's will give you assurance when you need it and pinpoint a problem if, and when, one develops.

The company also supplies a series of color-coded (sex) adapters, and null-modem configurations, measuring $2\text{x}1\frac{3}{4}\text{x}\frac{1}{2}$ inches. They are priced at $25.00 each. The Anything Cable is a seven foot, 25-conductor, ribbon cable with both a male and female connector on each end. You can do just about "anything" with it, for a cost of $75.00. ©

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Unscramble

Henry Kong
Singapore

The main routine is listed early between lines 80 and 90 for faster execution. These lines select the data randomly and break each word into individual letters. The sorting algorithm rearranges the letters in alphabetical order, providing an "unscramble."

With the main routine securely tucked in, we start the gaming section beginning with line 100. Lines 100 to 120 deal with the questions and responses. Both the number of new words and the total attempts are tallied by the counters Q and C. The counter V keeps score of the correct guesses. Two chances are given in this program before you are out.

The following lines deal with the continuation of the game and/or final result. The final touch is to add in DATA statements. This can be done anywhere, usually at the end of the program. 500 DATA"EAR", "TABLE", "KITCHEN", "MOTHER", "COMPUTER". Since line 80 multiplies the RND by 50, this program needs 50 DATA statements. This can be increased or decreased according to taste. If you have unusually long words such as "misunderstanding" etc. you will need to add:

11 DIMW$(25)

or a (Bad subscript) will interrupt your program.

As it is, the game UNSCRAMBLE works pretty well and provides an enduring challenge for the whole family. It allows you to choose the number of rounds, stop whenever you wish, and gives you a percentage score at the end of the game. The two chances that it allows help you to catch up on your score should you be unsuccessful in your first few attempts.

Adding the last few lines will keep the program running if you want another game (to better your score, perhaps?) or if another player wants to join in.

Program 1. Atari Version

```
10 REM UNSCRAMBLE-ATARI
15 DIM NA$(30),O$(25),W$(25),P$(1),A$(25
)
20 PRINT CHR$(125)
30 PRINT "THE GAME OF"
40 PRINT :PRINT "   ABCELMNRSU"
50 PRINT :FOR X=1 TO 1000:NEXT X
52 PRINT "...UNSCRAMBLE!"
75 PRINT :PRINT "NAME, PLEASE";:INPUT NA
$:GOTO 100
80 R=INT(RND(1)*12)+1:REM CHANGE '12' TO
 NUMBER OF WORDS IN DATA LINES 500-
81 FOR K=1 TO R:READ O$
82 NEXT K:RESTORE
84 LO=LEN(O$):W$=O$
85 FOR LL=2 TO LO:LI=LL-1:P$=W$(LL,LL)
86 IF P$>W$(LI,LI) THEN 90
88 W$(LI+1,LI+1)=W$(LI,LI):LI=LI-1:IF LI
>0 THEN 86
90 W$(LI+1,LI+1)=P$:NEXT LL:RETURN
100 PRINT CHR$(125)
102 Q=Q+1:PRINT "UNSCRAMBLE WORD # ";Q:G
OSUB 80
105 C=C+1:PRINT "ATTEMPT #";C
110 PRINT :PRINT "UNSCRAMBLE THIS WORD..
.":PRINT
114 PRINT W$
120 PRINT "ANSWER";:INPUT A$:IF A$=O$ TH
EN 200
125 PRINT :IF T=1 THEN PRINT "SORRY, THE
 WORD IS":PRINT :PRINT O$:GOTO 300
130 PRINT :PRINT NA$;", ONE LAST TRY":T=
1:GOTO 105
200 FOR X=1 TO 6:PRINT :NEXT X:V=V+1
250 PRINT :PRINT "CONGRATULATIONS, YOU W
IN"
300 PRINT :PRINT "ANOTHER WORD";:INPUT P
$:IF P$="Y" THEN T=0:GOTO 100
310 PRINT CHR$(125)
315 PRINT "OUT OF ";Q;" UNSCRAMBLES"
320 PRINT :PRINT NA$;" HAS ";V;" CORRECT
,"
325 PRINT :PRINT "USING ";C;" ATTEMPTS!"

330 P=INT((V/C)*100)
335 PRINT :PRINT "YOUR SCORE IS ";P
400 PRINT :PRINT "ANOTHER GAME";:INPUT P
$
405 IF P$="N" THEN END
410 V=0:Q=0:C=0:GOTO 20
500 DATA EAR,TABLE,KITCHEN,MOTHER,COMPUT
ER
510 DATA FACE,AUTOMOBILE,RUBBERBAND,DIAM
OND
520 DATA VIBRATE,TENACIOUS,MONSTER,ESCAP
E
```

Program 2. Microsoft Version (PET, Apple, etc.)

```
10 REM UNSCRABBLE
20 FOR X=1 TO 25:NEXT X
30 PRINT "THE GAME OF"
```

```
40 PRINT:PRINT "   ABCELMNRSU"
50 PRINT:FOR X=1 TO 2ØØØ:NEXT X
52 PRINT "...UNSCRAMBLE!"
75 PRINT:INPUT "NAME, PLEASE";NA$:GOT~
   ~O 1ØØ
8Ø R=INT(RND(1)*12)+1:REM CHANGE '12'~
   ~ TO NUMBER OF WORDS IN DATA LINES~
   ~ 5ØØ-
81 FOR K=1 TO R:READ O$
82 NEXT K:RESTORE
84 LO=LEN(O$):FOR LI=1 TO LO:W$(LI)=M~
   ~ID$(O$,LI,1):NEXT LI
85 FOR LL=2 TO LO:LI=LL-1:P$=W$(LL)
86 IF P$>W$(LI) THEN 9Ø
88 W$(LI+1)=W$(LI):LI=LI-1:IF L>Ø THE~
   ~N 86
9Ø W$(LI+1)=P$:NEXT LL:RETURN
1ØØ FOR X=1 TO 25:PRINT:NEXT X
1Ø2 Q=Q+1:PRINT "UNSCRAMBLE WORD # ";~
   ~Q:GOSUB 8Ø
1Ø5 C=C+1:PRINT:PRINT "ATTEMPT # ";C
11Ø PRINT:PRINT "UNSCRAMBLE THIS WORD~
   ~...":PRINT
114 FOR LI=1 TO LO:PRINT W$(LI);:NEXT~
   ~ LI:PRINT:PRINT
12Ø INPUT "ANSWER";A$:IF A$=O$ THEN 2~
   ~ØØ
125 PRINT:IF T=1 THEN PRINT "SORRY, T~
   ~HE WORD IS":PRINT:PRINT O$:GOTO 3~
   ~ØØ
13Ø PRINT:PRINT NA$;", ONE LAST TRY":~
   ~T=1:GOTO 1Ø5
2ØØ FOR X=1 TO 6:PRINT:NEXT X:V=V+1
25Ø PRINT:PRINT "CONGRATULATIONS, YOU~
   ~ WIN"
3ØØ PRINT:INPUT "ANOTHER WORD";Y$:IF ~
   ~LEFT$(Y$,1)="Y" THEN T=Ø:GOTO 1ØØ~
   ~
31Ø FOR X=1 TO 25:PRINT:NEXT X
315 PRINT "OUT OF ";Q;" UNSCRAMBLES"
32Ø PRINT:PRINT NA$;" HAS ";V;" CORRE~
   ~CT,"
325 PRINT:PRINT "USING ";C;" ATTEMPTS~
   ~!"
33Ø P=INT((V/C)*1ØØ)
335 PRINT:PRINT "YOUR SCORE IS ";P
4ØØ PRINT:INPUT "ANOTHER GAME";Y$
4Ø5 IF LEFT$(Y$,1)="N" THEN END
41Ø V=Ø:Q=Ø:C=Ø:GOTO 2Ø
5ØØ DATA "EAR","TABLE","KITCHEN","MOT~
   ~HER","COMPUTER"
51Ø DATA "FACE","AUTOMOBILE","RUBBERB~
   ~AND","DIAMOND"
52Ø DATA "VIBRATE","TENACIOUS","MONST~
   ~ER","ESCAPE"
READY.
```

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Editor's Note: This program (versions here for PET Microsoft and Atari) can be the basis for many excellent games. When you come up with something interesting — send it in to **COMPUTE!** *— RTM*

Maze Generator

Charles Bond
Sunnyvale, CA

Here's a remarkably short algorithm which produces random mazes of any desired size directly on your CRT screen. The program will create mazes on any microcomputer which allows memory mapped graphics. Details are provided for directly applying it to the COMMODORE PET and the Atari 400/800 computers. A typical maze generated by the program is shown in Figure 2.

To understand how it works, refer to the flowchart in Figure 1 and the program listing. The following explanation should clarify the details.

The Background Field

The algorithm operates on a background field which must be generated on the screen prior to line number 200 in Program 1. The field must consist of an odd number of horizontal rows, each containing an odd number of cells: a rectangular array. It's convenient to think of the field as a two dimensional array with the upper left corner having coordinates 'X' = 0 and 'Y' = 0, where 'X' is the horizontal direction and 'Y' is vertical. No coordinates are used to identify absolute locations by the program, but the concept is useful in configuring the field.

Given that the upper left cell of the field has coordinates 0,0 then the terminal coordinates both horizontally and vertically must be even numbers. In addition, the background field must be surrounded on all sides by memory cells whose contents are different from the number used to identify the field. That is, if the field consists of reversed (or inverse video) spaces, then the number corresponding to that character must not be visually adjacent to the field.

This could happen inadvertently if the screen RAM and system ROM have contiguous addresses. A sufficient precaution is to avoid covering the entire screen with field. Leave at least one space at the beginning or end of each line and, in general, leave the uppermost and lowermost lines on the screen blank.

The Maze Generator

The creation of the maze begins by placing a special marker in a suitable starting square. The program here always begins at the square just inside the upper left cell of the previously drawn field. (Note that with our coordinate scheme this would be cell 1,1). Any cell with odd numbered coordinates would work, however, as long as it is internal to the field.

Next, a random direction is chosen by invoking the random number generator in your machine and producing an integer from 0 to 3. This integer, with the aid of a short table, determines a direction and a corresponding cell just two steps away from the current cell. This new cell is examined (PEEKed) to see if it is part of the field. If it is, the direction integer is put there as a marker and the barrier between it and the current cell is erased.

In addition, the pointer to the current cell is moved to point to the new one. This process is repeated until the new cell fails the test; i.e., it is not a field cell. When this happens, the direction vector is rotated 90 degrees and the test is repeated. Thus, the path carved out of the field will continue until a "dead-end" is reached.

A dead-end, incidentally, could occur in as few as five steps. When it does occur, we can make use of the markers which were dropped along the way "Hansel and Gretel" style. These can be checked to determine which direction we came from, so that we can back up and look for untrodden paths. So long as none can be found, the program will back up, one step at a time, erasing the markers as it goes. When a new direction can be taken, the pointer is set off in that direction, and the process continues as before.

Ultimately, the pointer will return to the start, a condition which is detected by the recovery of the special starting (now "ending") marker. This cell is then blanked and the program is done, leaving the pointer as it was at the start.

The Program

Program 1 contains the complete program as implemented on the PET computer, but it is applicable to other machines. The direction table set up in lines 100 and 110 converts an integer to an address offset. In this case (40 column screen), we wish to be able to step two cells to the right, up, left, or down. The memory addresses of these cells differ from that of the current one by 2, –80, –2, and 80, respectively. For computers with 64 column displays, the 80's should be replaced by 128's; for the Atari no change is needed.

Line 120 contains machine-dependent variables. 'SC' is the memory address of the start of screen RAM. For the Atari use the following:

120 WL = 128:HL = 0:SC = PEEK(88) + 256*PEEK(89): A = SC + 43:REM THESE VALUES FOR ATARI

Lines 130-160 establish the background field on the screen. For the PET we chose 23 rows of 39 cells each. The Atari, with default tab settings, will require a slightly smaller field. [*See Program 3 — Ed.*]

The rest of the program draws the maze, as previously explained. Line 310 is simply a convenient stopping point which prevents the screen from scrolling.

It may not be immediately obvious that this algorithm always produces a maze with only one non-trivial path between any two points, or that the maze will always be completely filled, but this can be proved. While the proofs will not be provided here, math buffs may find it interesting that for a maze of any size there will be exactly:

$$\frac{(H-1)(V-1)}{2} - 1 \quad \text{empty cells in the completed maze,}$$

where H is the number of cells in each field row and V is the number of rows.

An interesting feature of this algorithm is that it works equally well in certain types of non-rectangular fields. U-shaped fields or fields with holes in them are quite suitable — as long as certain restrictions are observed. Just make sure that the coordinates of the upper left and lower right cells of any cut out area are pairs of odd numbers. Also, if there is a single row of field cells between any cut out areas and the outside of the original field, it may be removed. See Figure 3.

The Mouse

With slight modifications the Maze Generator can become an artificial "mouse." Programs 2 and 4 show a routine which can be appended to the Maze Generator and which create a mouse which roams the maze endlessly. The mouse adheres to a "left-hand rule" when a choice of directions is possible. That is, when it is confronted with a branch-point, it will move off to the left, if possible. Otherwise it will go forward. When no choice is available it will turn around.

Program 1: Microsoft Version

```
10 REM ******************
20 REM *                *
30 REM * MAZE GENERATOR *
40 REM * ============== *
50 REM *      1981      *
60 REM *                *
70 REM *   BY C. BOND   *
80 REM *                *
90 REM ******************
100 DIM A(3):REM SET UP DIRECTION T
    ABLE
110 A(0)=2:A(1)=-80:A(2)=-2:A(3)=80
    :REM THESE VALUES FOR 40 C
    OLUMN SCREEN
120 WL=160:HL=32:SC=32768:A=SC+81:R
    EM THESE VALUES FOR COMMOD
    ORE PET
130 PRINT "{CLEAR}":REM CLEAR SCREE
    N AND GENERATE MAZE BACKGR
    OUND FIELD
140 FOR I=1 TO 23
150 PRINT "{REV}
                                  "
160 NEXT I
200 REM GENERATE THE MAZE!
210 POKE A,4
220 J=INT(RND(1)*4):X=J
230 B=A+A(J):IF PEEK(B)=WL THEN POK
    E B,J:POKE A+A(J)/2,HL:A=B
    :GOTO 220
240 J=(J+1)*-(J<3):IF J<>X THEN 230

250 J=PEEK(A):POKE A,HL:IF J<4 THEN
     A=A-A(J):GOTO 220
300 REM MAZE IS DONE! WAIT FOR KEYP
    USH
310 GET C$:IF C$="" THEN 310
```

Program 2: Microsoft Version

```
1000 REM MAZE TRAVERSAL ALGORITHM
1010 POKE A,81:J=2
1020 B=A+A(J)/2: IF PEEK(B)=HL THEN
    POKE B,81: POKE A,HL: A=B:
     J=(J+2)+4*(J>1)
1030 J=(J-1)-4*(J=0): GOTO 1020
```

Program 3: Atari Version

```
10 REM ******************
20 REM *                *
30 REM * MAZE GENERATOR *
40 REM * ============== *
50 REM *      1981      *
60 REM *                *
70 REM *   BY C. BOND   *
80 REM *                *
90 REM ******************
100 DIM A(3):REM SET UP DIRECTION TABLE
110 A(0)=2:A(1)=-80:A(2)=-2:A(3)=80:REM
THESE VALUES FOR 40 COLUMN SCREEN
120 WL=128:HL=0:SC=PEEK(88)+256*PEEK(89)
:A=SC+43:REM THESE VALUES FOR ATARI
130 PRINT "{CLEAR}";:POKE 752,1
140 FOR I=1 TO 23
150 PRINT "|
          |"
```

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By Fred Huntington

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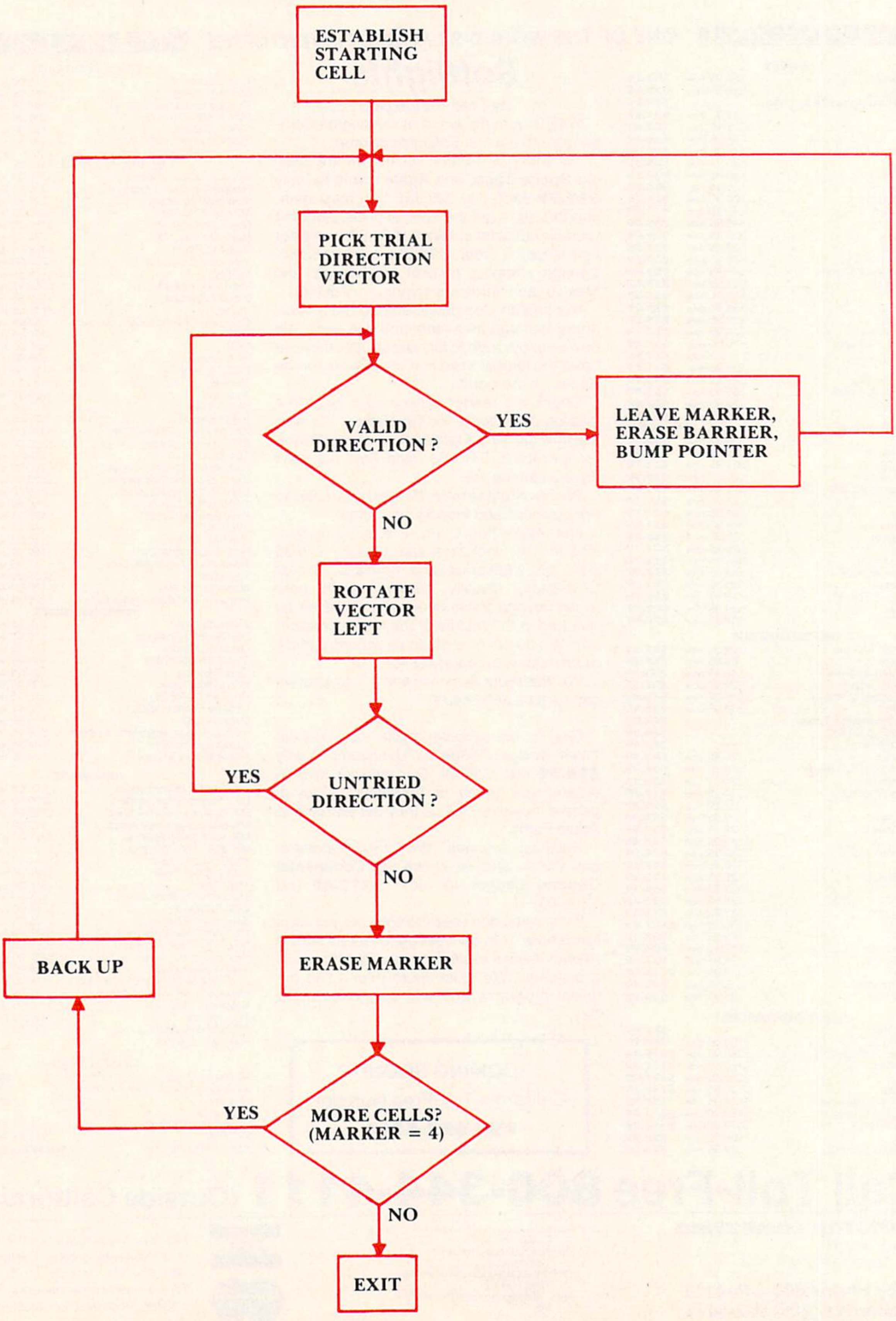
Figure 1. Maze Generator Flow Chart



```
160 NEXT I
200 REM GENERATE THE MAZE!
210 POKE A,5
220 J=INT(RND(0)*4):X=J
230 B=A+A(J):IF PEEK(B)=WL THEN POKE B,J
+1:POKE A+A(J)/2,HL:A=B:GOTO 220
240 J=(J+1)*(J<3):IF J<>X THEN 230
250 J=PEEK(A):POKE A,HL:IF J<5 THEN A=A-
A(J-1):GOTO 220
255 IF J=128 THEN STOP
300 REM MAZE IS DONE! WAIT FOR KEYPUSH
310 IF PEEK(764)=255 THEN 310
320 POKE 764,255
```

Program 4: Atari Version

```
1000 REM MAZE TRAVERSAL ALGORITHM
1010 POKE A,84:J=2
1020 B=A+A(J)/2:IF PEEK(B)=HL THEN POKE
B,84:A=B:J=(J+2)-4*(J>1)
1030 J=(J-1)+4*(J=0):GOTO 1020
```

Figure 2.

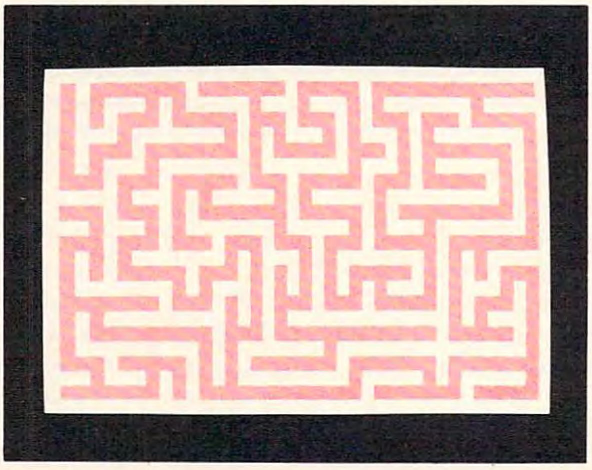
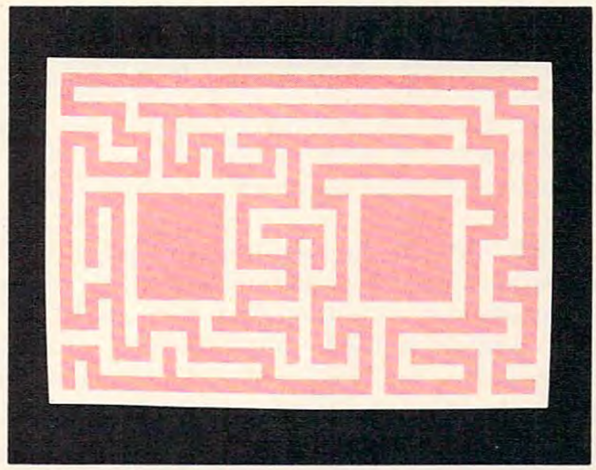


Figure 3.



Part Two:

An Introduction To Binary Numbers

Charles Brannon
Greensboro, NC

This is the second in a series of articles on elementary computer arithmetic. The previous article, Part One, described the binary numbering system, as used on a microcomputer. We will now delve into the use of binary numbers — adding and subtracting.

We'll start with the simplest one first — addition. Besides, you have to know how to add before you can subtract. As you might have realized, binary addition should be rather simple, since you are only adding ones and zeros. The few complications involve the *carry*. Just to refresh you on that, here is a sample base ten addition:

```
  23
+ 51
  ??
```

To add 23 and 51, we add the numbers digit by digit, from right to left. So first we add 3 and 1 to get 4, which we place underneath the digits added. Next we add the 2 and the 5, and place a 7 under those digits to get:

```
  23
+ 51
  74
```

The carry comes in when we add two numbers and get a result too large to fit into a single digit, as in 6 + 8. In this case we have "four, carry the one," thus:

```
  1
   6
+  8
  14
```

Notice that the carried one drops down into the next place in the number. If we were adding 16 and 8, the carry would be added to the 1 in 16, resulting in an answer of 24.

Now all of this is very elementary, but it demonstrates all the necessary actions to add in binary. Here is the "truth table" for addition in binary:

```
0+0= 0
0+1= 1
1+1=10
```

The first three additions are "common sense," but the final one, 1 + 1 = 10 deserves a second look. We know that one plus one equals two, but we're working in binary, so two is expressed as one-zero, or 10. This is also equivalent to "zero, carry the one," since "10" cannot fit in a single digit.

Let's run through a sample addition in binnary:

```
     1111
   00000101     ( 5)
 + 00001011     (11)
   00010000     (16)
  (87654321)
```

1. 1 + 1 = 0, carry the one
2. 0 + 1 = 1, plus carry of 1 gives 0, carry the one
3. 1 + 0 = 1, plus carry of 1 gives 0, carry the one
4. 0 + 1 = 1, plus carry of 1 gives 0, carry the one
5. 0 + 0 = 0, plus carry of 1 gives 1 — no carry!

As always, since we are working with eight-bit bytes, we fill all unused digits with zeros. This is important.

As you can see, a single one can cause a whole string of carries, almost like a chain reaction. It is possible that the carry could be continued past the seventh bit (marked 8 above). Therefore, most microprocessors have a special register, called the *carry bit* to hold and signal this runaway bit. This bit is essential in adding multibyte numbers, which we will cover in Part Three. Let's try another addition.

```
      11
   00011101     (29)
 + 00110010     (50)
   01001111     (79)
  (87654321)
```

This time we have an interesting effect of the carry. In step 5, we get 1 + 1 = 0, carry the one. In step 6, we add 1 + 1 + the carry of 1 to get 1, carry the one (1 + 1 + 1 = 11). The carry comes to rest at step 7. Incidentally, I have numbered the bits from 8 to 1 for convenience. In reality, they are numbered from 7 to 0, the exponents of the powers of two. (Bit $6 = 2^6 = 64$).

You now have the necessary information to add in binary, but in order for it to really "sink in," you will have to practice it until it becomes clear. You can make up your own exercises by randomly stringing a series of ones and zeros together to form two eight-digit numbers. Then add them in binary. To check your answer, convert the addends and the answer into decimal, which you can easily verify.

When you are confident that you can add in binary, you are ready to grasp this section on subtraction. When we perform subtraction in our normal, base ten system, we are really just adding the two numbers. For example, 8 - 5 is equivalent to 8 + (-5). -5 is pronounced "negative five." It is assumed that you are aware of negative numbers, as it is taught as early as sixth grade, but we all can forget, right? All that is necessary is to know that,

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when you add a negative and a positive number, you can get the same result as subtracting the smaller number from the larger number, and giving the answer the sign of the larger number. When you add two negative numbers, the answer is the same as adding the numbers, disregarding their sign (the absolute value), and then giving the sum a negative sign (e.g. (-4) + (-3) = -7). Yet believe it or not, subtraction in binary is even easier than in decimal, as a comparison will show.

First we have to know how a negative number is expressed in binary. Since a binary number is composed of ones and zeros, there is no place for the minus sign. Therefore, the highest bit, bit seven, is used to show that the number is negative. Most microcomputers use a technique called "two's complement" to convert a number into its negative equivalent. If you add numbers using two's complement, the subtraction will be performed automatically. Two's complement has two steps — forming the complement, and adding 1 to it. Numbers properly represented using two's complement are called *signed binary*.

Let's form the signed binary equivalent of -5. Here is the binary equivalent of five: 00000101. To complement it, we turn all the zeros into ones, and all the ones into zeros to get: 11111010. Next we add 1 to it to get:

```
  11111010
+ 00000001
  11111011
```

Positive numbers in signed binary are expressed normally, with the restriction that they must not be greater than 127. If they were, bit seven would be "on," and the number would look as if it were negative. The number 205 in straight binary is 11001101. This is also -51 in signed binary. You can find the value of any negative number in signed binary by running it through the two's complement routine again. You'll get the positive value of the number. Similarly, if you try to make any number larger than 128 negative, it will end up positive. Therefore, in signed binary, the value in the byte must be between -128 and positive 127. Now that we have our background, let's try out our skills.

```
      Subtract: 43-11.          43=001010011

-11=    00001011
        11110100    complement
      + 00000001    plus one
        11110101

      Add 43 and -11:

        1111111
        00101011        43
      + 11110101       -11
        00100000       -32          C:1
```

Notice that the carry was swept out of the byte (C:1). C: represents the imaginary carry register. This carry should be always disregarded in two's complement subtraction. The most wonderful thing about subtraction in binary is that it is seemingly "automatic." But once again, for complete understanding, you must practice subtraction until you feel sure of your comprehension. For this purpose, exercises are once more included at the end of this article.

Next time, we'll learn about *multibyte* numbers and even get into a wee bit of MACHINE LANGUAGE!

Answers to exercises in PART ONE:

1. a) 21 b) 51
c) 60 d) 255

2. a) 00110100 b) 11101010
c) 01000010 d) 00001111

3. The complete chart to sixteen bits:

32768 16384 8192 4096 2048 1024
512 256 128 64 32 16 8 4 2 1

EXERCISES

1. Add:

```
a)   00101011     b)   01000011
   + 00000111        + 00011000

c)   00111000     d)   10011010
   + 10100111        + 00111001
```

2. Convert to binary and add:

a) 20 + 11
b) 18 + 56
c) 29 + 47
d) 32 + 64

3. Complement only:

a) 01010110 b) 01100011

4. Form the two's complement

a) 01111001 b) 10111111

5. Convert into signed binary:

a) -14 d) 108
b) 22 e) -9
c) -134

6. Convert to binary and subtract:

a) 56-18 b) 99-33
c) 58-78 c) -105 -12

7. Why is -56 equal to 200? (Trick question)

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Book Review:

Microprocessors For Measurement And Control

If your business or pleasure is realtime control applications this could be a valuable book for you. Seven realtime control applications are described in complete detail. These include DC motor control, position control, control of temperature, an automatic weighing system, a plotter, a computer controlled saw, and a blending process control system.

Each application is described in great detail, including circuit diagrams, flowcharts, state-transition diagrams, timing diagrams, and a complete discussion of the algorithms. The book is replete with pictures and diagrams. Having studied the examples, readers will be able to think of and design their own control systems. Do not decide against the book simply because your application is not described: there are enough general principles to make the book valuable for anyone working on realtime control of a device by a computer (especially if the device is a robot that will mow lawns and shovel snow).

The book is not written for the novice. Some experience with microcomputers, machine language, binary numbers, and input/output operations is desirable. If you haven't worked with a single-board machine or peeked inside your Apple, PET, or Atari to see what makes it work, then this book is going to be tough sledding. To actually construct the projects described will require electronic test equipment such as an oscilloscope, signal generator, breadboarding equipment, and components.

I liked the book. I liked the idea of describing as application from first principles to the last detail, giving both the theoretical background and the practical implementation of the application. This is because my computer interests gravitate toward interfacing and control. On the other hand, if you are strictly a programmer who is happy with business applications, games, computer aided instruction or number crunching, then this book is out of the mainstream of your current interests.

Of great importance to the 6502 community is the fact that almost half of the book (approximately 155 pages) is devoted to program listings in BASIC, PASCAL, C, and FORTRAN, as well as 8080 assembly and machine language. This half of the book will be almost useless for the great majority of 6502 purists, unless you are familiar with several of these languages, particularly the 8080, Z80, or 8085 instruction set.

The book is characteristic of the generally fine quality of the computer literature published by OSBORNE/McGraw-Hill and, if you are interested in computer control of devices, this book is a good investment.

Reviewed by Marvin L. De Jong: the reviewer is Professor of Physics at The School of the Ozarks, Pt. Lookout, MO 65726. He is the author of the book "Programming and Interfacing the 6502, With Experiments," published by Howard W. Sams & Co., Inc., 4300 West 62nd Street, Indianapolis, Indiana 46268.

David M. Auslander & Paul Sagues
OSBORNE/McGraw-Hill, Berkeley CA
1981
(630 Bancroft Way, Berkeley, CA 94710)

Console Input/Output

Gene Zumchak
Buffalo, NY

Perhaps I'm stepping out of my domain to write an article on a software topic; however, since no "expert" has volunteered an article on the subject, I'd like to say a few words about the very important subject of console input/output.

Input/Output is the interface between the computer and the outside world. Simple input/output consists of switches, relay contacts, indicators, etc. Two other classes of I/O are console I/O and mass storage I/O. The latter would include tape or disk or any other method (usually using magnetic medium) of storing and retrieving large records or files. I'm limiting my discussion here to console I/O.

My experience is mainly with single-board computer types like the KIM, SYM, and AIM, and I will use them as examples, though the principles will apply as well to console systems like APPLE and PET.

A general-purpose computer system is of little value unless a user can communicate with it. This requires two things. First, the computer must have some minimal operating system to permit communication. Second, the computer must be connected to a console device. Traditionally, a computer's primary console device was a teletypewriter. This provides input (keyboard) and output (printer) and sometimes mass I/O in the form of punched paper tape. As a bonus the teletypewriter provides hard copy. More recently, the teletypewriter has been replaced by a CRT, or a CRT substitute, as the console device.

A CRT terminal, like the teletypewriter, is a serial device. It usually has a RS-232C voltage interface however, as opposed to the current loop interface of the TTY. There is, of course, no reason why console input cannot be a parallel keyboard, or the output a parallel or memory mapped display. Most computers with a built-in console device usually treat I/O directly in parallel.

The way that console I/O is treated is a function of the sophistication of the operating system software. At one extreme, some systems permit any devices to serve as console input or console output. At the other end, only a specific device pair can serve as console input and output. The earliest 6502 computer, the KIM, is between these two extremes.

How To Use Non-Serial Devices On KIM

The KIM has two console options: either the built-in keyboard and display or serial teletype format I/O. The choice is made by a jumper on the application

Two other classes of I/O are console I/O and mass storage I/O.

connector. (The KIM actually uses separate programs to treat I/O from the two console options). The user cannot, however, communicate with the operating system with a non-serial I/O device (a parallel video display for example) since the KIM makes no provision for interfacing any non-serial console devices. There are other problems. The tape routines cannot be employed in user programs since they terminate with a jump to the MONITOR instead of an RTS. This is an important point. If you are going to write any kind of routine that might find use elsewhere, write it as a subroutine. Still, the KIM with its monitor is really quite remarkable, considering that it was available within weeks of the 6502 chip itself. The hex keyboard and display, the built-in serial interface, and the built-in tape interface were important innovations.

How does one use a non-serial console device on the KIM? The only choice is to do without the KIM's monitor and replace it with one of your own that can accommodate your console I/O. Since all the KIM monitor does is inspect and change memory, giving it up is not a great loss. For other systems with somewhat more extensive operating systems, replacing the operating system with one of your own is no small project.

SYM Avoids The Problem

The author of the SYM operating system recognized this potential problem and avoided it. This was done by "vectoring" the console I/O. When the SYM is reset, it initializes a block of operating system RAM. Among the locations initialized are an input vector (INVEC) and an output vector (OUTVEC). These occupy three RAM locations each. The first contains the JMP op code, $4C; the next two locations are the low and high address of the specified routine. Thus, JSR INVEC will cause the program to run the routine whose address is found at INVEC, and return to the instruction following the JSR.

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You interact with the MTU-130 through our field proven Channel Oriented Disk Operating System (CODOS) which permits you to easily customize your system. Using CODOS™, any file is transferred from disk to anywhere in memory at a sustained speed of 19.6K bytes/second (not burst speeds!). Files are handled automatically, freeing you to perform at your peak. Auto-execution of "jobs" when power is turned on can turn the MTU-130 into a dedicated-function system. A monitor with 32 commands and 19 utilities is standard. Text or data can be easily transferred to or from other systems on IBM or CP/M* (or others) format disks with our optional DISKEX™ program.

Our standard full screen EDITOR allows you to edit text or program files with rapid positioning anywhere in the file. It edits any file size that fits on the disk (not just in memory) and will edit a file in place or save a backup copy. The concept "what you see on the display is what exists in the file" has been employed which significantly reduces your learning and interacting time. This is a very powerful tool usable by anyone.

If your needs include software development, you will find our optional MOS Technology compatible ASSEMBLER and DISASSEMBLER extremely fast, significantly reducing your development time. For example, a 210K byte source program with 6300 lines and 800 symbols can be assembled in less than 4 minutes. This includes generating the object file and the listing with sorted symbol table and cross reference map on disk. This can be accomplished on a standard 1-drive MTU-130-1S.

If you prefer to program in high level languages, keep in mind that the MTU-130 is RAM-based, not ROM-based, giving you the maximum memory possible for the use with any language. Our version of MICROSOFT BASIC is standard with MTU-130 systems. It allows libraries of commands to be added when needed such as our Virtual (floating point) Graphics. PASCAL and FORTH are planned.

The base standard MTU-130-1S system comes with one single-sided, double-density 8″ floppy disk, a 12″ green phosphor CRT, and MTU-BASIC for $3995. The 3 other models contain 1 or 2 single or double sided drives priced up to $4995 for 2 Megabytes of storage. You can choose an MTU-130 without disk drives, languages or CRT for $2640. 4 Megabyte systems available on request.

We obviously cannot describe fully all of the details of the MTU-130 in this advertisement. If you want to know more about this complete desktop computer, call or write for our complete 28 page descriptive literature. International requests include $5.00 U.S.

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The SYM initializes INVEC and OUTVEC to point to the routines that service the on-board keyboard and display. However, should the serial input bit become active before a key on the keyboard is pressed, the SYM will switch the vectors to point to the serial I/O routines. At any time after reset, the user is free to change either the input or output vectors to point to his own routines. For example, suppose you wished to talk to the SYM using a parallel ASCII keyboard, but wanted to retain the on-board display. You would write a routine to service the ASCII keyboard and put the address of your program in INVEC. Now when the SYM looked for input, it would get it from the ASCII keyboard via INVEC.

The lack of vectoring for console I/O is most evident in the AIM system.

Recently, as an experiment in a course I was giving, I wrote a routine to service an ASCII keyboard, attached to one of the SYM's ports. The ASCII data went to the low-seven bits; the keyboard strobe went to the high, or sign bit. I changed the input vector to point at my program. When I attempted to use the SYM, however, something strange happened. As I entered the monitor command, nothing happened until I hit the carriage return required to execute a command. That is, I did not see my command being entered on the SYM's display. This problem illustrated that there are two distinct kinds of input routine.

In a pure input routine, the program waits for an input, returning with the value (in the accumulator) when the input occurs. The SYM, however, expects an input routine with echo. Such a routine, before returning and giving up the character, causes the character to be sent to the output device. Thus, you are able to see the character as it is entered. Inputs are generally echoed, but there appears to be no agreement as to whether the echoing should take place as part of the input routine, or that the routine calling for the input should echo the character before processing it. Examples of both are common.

If you are writing a routine to service an input device, you should include both styles. Given a pure input routine, INPUT, an input with echo routine is just two instructions:

```
INWITHECHO  JSR INPUT
            JMP OUTPUT ; (OR OUTVEC)
```

Another approach is to write a common input routine for both styles, and have the routine determine whether echo is desired or not with a flag. This is the method used by the SYM for its serial input routine. A RAM location called TECHO determines whether echo is desired. Instead of first inputting a character and then echoing it out, the SYM just causes the output bit to follow the input bit as the input character is being received.

It should be noted that in the INWITHECHO routine above, the OUTPUT routine must not destroy the character being output. This is a very important property that all output routines should have.

When I wrote my operating system for my KIM to accommodate a parallel ASCII keyboard and parallel video display, I did not know about vectoring. I then wrote some action games for the video display which used the video output routine which I had in EPROM. A problem arose when I upgraded my I/O routines. The locations of the video output routine changed and, when I tried to load and run a game, it would bomb since it was pointing to a non-existent output routine. This problem could have been avoided if my operating system used vectored I/O. The game program then, would always point to the output vector. Even if the location of the actual output program changed, the vector could be changed to point to the new output routine. That is, I would not have to make modifications to the game program every time the operating system was changed.

AIM Software: A Curious Mix

The lack of vectoring for console I/O is most evident in the AIM system. The AIM software is a curious mixture of very clever programming and serious oversights. Like the KIM, the AIM has two choices for console input, the built-in keyboard and display/printer, and a serial (TTY or CRT) interface. The choice is made by the slide switch. The switch affects both input and output simultaneously. (It should be understood that the vectors UIN and UOUT on the AIM have to do with mass I/O and do not affect console I/O.) For example, suppose you had a serial video device which you wanted to use for output, but you wished to use the AIM's ASCII style keyboard for input. If you put the switch in the TTY position to get serial output, the AIM would now look for input from the serial channel and you could not use the keyboard. The switch should have been used to initialize the I/O vectors. Then, after the fact, the user could change the input vector, the output vector, or both, to accomodate any special console I/O.

In all fairness, the console output is vectored in a fashion. A vector called DILINKS was included so that output could be echoed to a video display. However, a carriage return appears as $8D and not $0D. A backspace is echoed as a space. Thus, any video device will not be able to respond properly to a backspace or delete. Instead of backing up one, it will go ahead one. The reason for this is that the AIM processes the delete by backing up the display pointer and overwriting the previously written character with a space. Incredibly, the delete is processed in the input routine. An input routine should be responsible for returning characters, period. It should not make value judgements on the characters or play around with output, except for straight echoing.

Although the AIM keyboard resembles that on a CRT, complete with Shift and Control keys, it can be used only as a TTY style (uppercase only) keyboard. While it would not be difficult to write a new input routine to produce lowercase characters and provide for "Caps lock" when appropriate since console input is not vectored, there's no way to tell the AIM that it should use your keyboard routine.

The lack of vectored I/O is evident in the AIM's software listing. In many places in the program, changes were made by jumping to a "patch" area near the end of the listing and then jumping back onto the program. Why didn't the authors just insert the necessary changes and reassemble? Apparently, the I/O addresses from an early version were used when making the BASIC or assembler ROMs, making those addresses inviolate. Thus, changes to the monitor, however necessary, could be made only if they did not affect the addresses of the I/O routines. Had vectors been used, the monitor could be updated and improved at any time, without affecting compatibility with ROMed accessories like BASIC.

Console input/output is an essential element in any general-purpose computer. The ability to customize and personalize a computer system's console will depend upon whether or not console I/O is vectored. Non-vectored console I/O places serious restraints on the system and on the user.

In a later installment, I plan to show how vectored I/O can be taken advantage of to "massage" canned I/O routines and overcome objections to ROMed software accessories. ©

MTU-130: A New 6502 Microcomputer

Micro Technology Unlimited of Raleigh, North Carolina has announced the development of a new "top-of-the-line," general purpose microcomputer. The first production shipments were announced for November for this 6502-based machine which will retail for $3995 (with single-sided disk drive, 500,000 bytes storage). Other packages are offered, which increase disk storage, up to a unit with two double-sided drives, two million bytes, for $4995.

These prices include the MTU-130 computer with 80K RAM, a 12" green phosphor CRT module, the selected floppy drive(s), all necessary cables, the operating system CODOS, an Editor, four-voice, digital, synthesized music, and a demo disk.

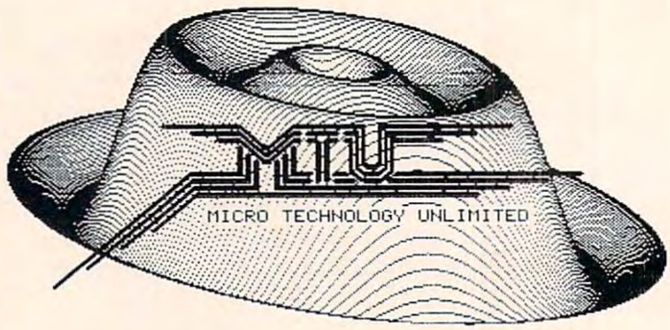
Novel Features

"MTU believes that the user should receive a system powerful enough to perform all necessary functions without having to add memory expansion, graphic expansion, etc...." the designers remarked. The result is a computer which is fully, one might say luxuriously, implemented.

The unit features a 1MHz 6502 with 18 bit addressing for up to 256K clear address space. Three video display operating modes: 1. bit-mapped black and white high resolution graphics 480 wide by 256 high; 2. 25 lines by 80 characters, mixable with graphics; and 3. bit-mapped graphics with four levels of gray in 240 wide by 256 high.

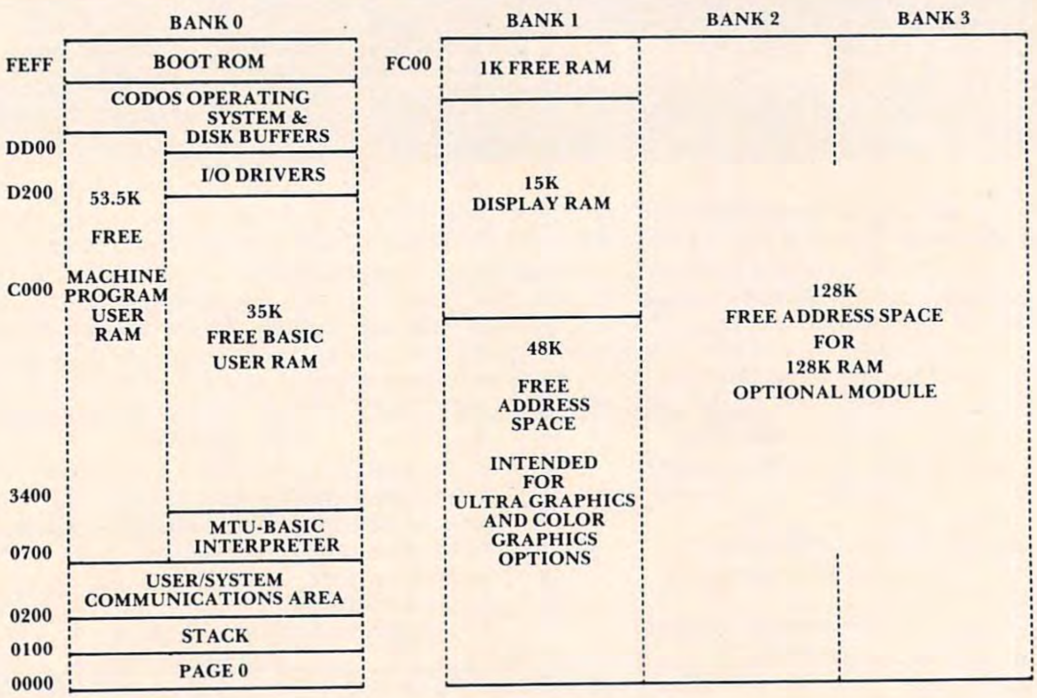
All the software is in RAM permitting easy upgrading or personalizing. It includes a CODOS

Figure 1.



disk operating system, printer drivers (see the high-resolution possible on a definable dot-matrix

Figure 2.



NOTE: I/O addresses occupy 0BE00-0BFFF when enabled under software control.

printer in the photo), two eight-bit parallel ports and one RS-232 serial port with software select of baud rate, an eight-bit D/A port with filter and amp (for speech, sound, and music), and an interface for a 50K Baud, interrupt driven, network option.

Additionally, the MTU-130 contains four EPROM sockets which are software controlled, a high resolution light pen, separate cursor keys, and a bank of eight user-defined function keys.

A unique approach to bank switching — using indirect addressing on the 6502 — allows one 64K section of memory to contain a program while the data resides above in its own 64K zone.

Digitized Sound

The optional MTU-BASIC 1.0 with graphics and disk library extensions is an enhanced Microsoft BASIC. Currently, bank switching is not available to BASIC directly, but the system permits relatively easy user enhancements. Also, when the computer is turned on, it *says*, "MTU model 130. Please enter today's date." The "voice" is entirely digital and sounds remarably human (except that high frequency is muted — the cutoff is around 4 KHz). This provision for digital storage of sound is exciting, but, like high resolution graphics, it is a byte-eater. A two second message uses *16K* on the disk. This space can be reduced, though, and plans are in the works to make the storage more efficient. The manufacturer also expects to provide an optional A/D microphone peripheral which will permit owners to digitize their own messages.

The eight inch floppy drive spins all the time, but the head remains out of contact with the disk until necessary. And it is fast. A 14K high-resolution picture can load to screen in about two seconds. Transfer rate is over 19 thousand bytes per second, sustained.

Future Options

MTU is currently working on additional software for the 130. Expected in early 1982 are FORTH, PASCAL, cassette I/O, PET/Apple BASIC translator utilities, and a word processor. Planned hardware includes a 128K memory expansion board, the A/D microphone system, a high fidelity sound synthesis and analysis package, a network operating system, and a rigid disk controller.

A prototype board for construction of custom circuits and a banker board are available now as options.

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Animating Applesoft Graphics

Leslie M. Grimm
Mt. View, CA

Animating graphics can add a special plus to your BASIC program. A previous article (**COMPUTE!** #14) described how to animate low-resolution graphics in Integer BASIC. A method is described here to do animation of either high-resolution or low-resolution graphics in Applesoft BASIC.

Before beginning, however, a few words comparing the two BASICs for this purpose are in order. Integer BASIC is much faster than Applesoft. This is because the Applesoft interpreter must perform time-consuming manipulations of floating point arithmetic, whereas the Integer BASIC interpreter ignores everything to the right of a decimal point. The effect of all this is that Applesoft graphics routines run about half as fast as Integer routines. This can be crucial in animation.

In general, if the object to be animated is very large (bigger than ¼ of the low-resolution screen area or bigger than about 20 x 20 dots in high-resolution) you will get better results in Integer. However, choice of Applesoft may be a matter of necessity for a variety of reasons. By keeping animated objects small and simple, and observing other speed-increasing tips mentioned below, you can get very nice effects.

Designing The Figure

For the low-resolution example listing below, the figure of a flying bird was chosen. The high-resolution example uses a simple shape (square) for the sake of brevity in this article, but you could modify the bird or make any shape you desire for high-res.

Whatever shape you choose, your first step is to draw the figure in various states of motion. Use graph paper, and number the squares as shown in Figure 1. (This applies to low- or high-res shapes.). Note that, for the flying bird, three different positions simulate the action of flying.

Because the figure will be moving about on the screen, you need to use relocatable coordinates in your plotting routine. Consider the square in the upper-left-hand corner as X=0, Y=0. Then specify all other points relative to that point. For example, a point five squares to the right and three squares down would be called X+5,Y+3.

You should also think about the most economical way to draw the figure. In the case of the bird, you can see that the body is the same for all three drawings. One subroutine was made for it, and another for the wing in its upward position, and still another for the wing in its downward position. To draw the bird with its wing up, the program does a GOSUB to the body routine (at 100) followed by setting hue to 2 (blue) and issuing a GOSUB to the wing-up routine (at 110). Note that the subroutines for wing up and wing down use a variable (hue) for color. This way the same subroutine can be used to draw (hue = 2) or erase (hue = 0) the wing.

In writing the code it is important to keep speed of execution in mind. As much as possible you should put many statements on a single line, separated by colons. Use HLIN and VLIN commands instead of a lot of HPLOTs. Locate your graphics subroutines at low line numbers.

Smooth Animation

The basic technique in animation is to draw the figure at a certain location on the screen, then erase it and redraw it at a new location. (An alternative method is to draw the figure at location one, redraw it at location two, and erase the parts that are left over from location one. If you know that your figure will always move exactly the same number of spaces each time it is redrawn the latter method is preferable. It could work reasonably well without page flipping also, but, because it is not the most general case, it is not demonstrated here.)

For the flying bird, the erase procedure was done with two routines. Line 150 draws the body in color =0 (black), and then hue is set to zero and the appropriate wing routine is used. Note that if you wanted to use a colored background the erase routine could use the color of the background

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rather than zero.

If that were all you did, though, you would probably be disappointed in the results. This is because you would be watching the figure being drawn and erased on the screen. This is distracting and can be avoided by the technique of "flipping pages." Pages can be flipped for either low-resolution or high-resolution graphics, and the methods to do this are described separately below.

The technique for flipping pages is similar for low- and hi-resolution graphics. There are two graphics screen pages for low-resolution graphics (beginning at $400 and $800 respectively) and two screen pages for high-resolution graphics (beginning at $2000 and $4000 respectively). Your program will display one page to the user while erasing and drawing "behind the scenes" on the other page.

In low-resolution graphics it is not possible to draw directly to the second screen page. Drawings can only be placed on screen page two by first making them on page one and then calling a routine in the Apple monitor to move the contents of page one onto page two.

You will need a short assembly language routine to do the move for you. The subroutine beginning at line 10000 pokes this assembly language routine in memory. All you need to do is CALL the routine when you need it.

(A description of how the routine works follows, but you don't need to know how it works to use it. Just skip on to the next paragraph if you wish.) The LDA $C054 at line $C00 causes the Apple to display page one. The lines from $C03 to $C15 specify that the contents of memory locations $400 through $7FF (graphics page one) are to be moved to the region from $800 to $BFF (graphics page two.) Line $C17 sets a counter (Y register) to zero, and the next line does a Jump to SUBRoutine (JSR) at $FE2C — the move routine in the Apple monitor. The move routine transfers the contents of page one to page two very quickly. Line $C1C causes page two to be displayed, and the last line ReTurnS you to your BASIC program.

Bird In Flight

Line 10 sets text mode (in case a previous program had left the machine set to graphics mode) and clears the screen Line 20 POKEs the assembly language routine in via the subroutine beginning at line 10000. Line 40 branches around the graphics subroutines to the start of the animation program. (The graphics subroutines were intentionally placed at low line numbers for speed of execution.)

The animating program first clears the screen (page one), sets initial values for X and Y, and calls the move routine (CALL 3072). The user will now be looking at page two, which is blank. Next, line 1010 draws the figure in its initial position (wing down) behind the scenes on page one. It then calls the move routine. Remember that the move routine displays page one while it is copying page one onto page two, and then flips to page two. The user only sees the finished drawing, first on page one and then on page two. The flip between pages doesn't show.

While that drawing is being displayed the original figure on page one is erased (line 1020). The value for X is changed and the figure is redrawn in a new position (wing up) and a new location (line 1030). Once again the move routine is called to put the new drawing on page two and show it to the viewer.

Line 1040 erases the wing-down bird, moves the bird over and up, and draws just the body. Then it performs the move and flip. In line 1050 the body is erased, and the bird is drawn with wing down in its next location. The move and flip is called again. This process is repeated several times in a FOR ... NEXT loop.

The last lines of the routine restore the display to graphics page one. The cursor is VTABbed to line 21 so that it will be visible when the program ends. The POKEs instruct the computer to locate the next Applesoft program at the normal location ($800). (See below)

In entering and debugging a program that flips pages you may occasionally get "stuck" on page two due to a programming error. When this happens you will hear the beep that accompanies an error message, but no message will show and there will be no cursor. Just type "POKE 16300,0 to restore the display to page one and see your error message.

Relocating

There is one more step required before you can actually run this program. Page two of low-res graphics occupies the same place in memory that your Applesoft program normally occupies. Your only alternative is to relocate your Applesoft program. To do this, before you load your program you must change the values of the "program start" pointers to a new value. This will cause your program to be loaded in at a different place than usual.

The Applesoft program could be relocated to many possible places in memory. In this example it was located at the end of the assembly language subroutine. The assembly language subroutine was placed just above the second low-res graphics page. Alternatively, one could put the assembly language routine at $300 (decimal 768), but since this area is often needed for music routines, it was left free here.

There are several ways to relocate the program. One way is to type the following commands before running your program:

POKE 103,33
POKE 104,12
POKE 3104,0

The first two POKEs place the starting address of the program in memory. The third POKE sets the first byte of the program location to zero, which must be done in order for the Apple to find the program's beginning.

Alternatively, you can write a short program to do the POKEs for you. A sample listing is Program 1.

(A third method, which incorporates the relocating program as a subroutine of the main program, will not be explained here for the sake of brevity.)

Whichever method is used to relocate the program, it is a good idea to restore the pointers to their usual values at the end of your program. The next Applesoft program will then load into the normal area of memory. This is shown at the end of the example program.

Flipping between high-resolution pages is easier than flipping in low-resolution graphics because it is possible to draw directly on either page. Also, it is not necessary to relocate your Applesoft program. However, only very small drawings can be animated in BASIC, due to speed limitations. Program 3 moves a very small, simple shape (square) diagonally across the screen, flipping pages between each move.

Line 10 clears both hi-res pages and sets the screen to full-screen graphics. Full screen is necessary to prevent text "garbage" from appearing at the bottom of screen page two.

The subroutine at line 100 draws or erases the square, depending on the value given to hue. A value of 5 sets the color to orange, and 0 is black. Line 1000 sets up the original values for X and Y, and causes page two to be displayed (POKE–16299,0).

The value POKEd into location 230 determines whether your program draws on hi-res graphics page one or two. To draw on page one this value must be 32 ($20). To draw on page two, set it to 64 ($40). Note that you could also simply specify HGR for page one or HGR2 for page two, but these commands include an implicit "clear screen" which would erase the whole screen and take far too long.

As in the low-res animation process, the program displays only finished drawings to the viewer while it erases and redraws figures on the undisplayed pages. Line 1002 directs the drawing process to page one, but it will not be seen since page two is being displayed.

Again, as in the low-res animation routine, a FOR ... NEXT loop is used. Line 1010 sets the color to orange and the GOSUB 100 draws it on page one. The POKE–16300,0 flips the display to page one when the drawing is finished. To the viewer, the drawing seems to pop onto the screen.

Line 1020 first resets X and Y to the previous location so that the last square on page two can be erased. Location 230 is set to 64 so that drawing will be done on page two. X and Y are then advanced to the new location, color is set to orange again, and the new square is drawn. Finally, the display is flipped back to page two. The viewer sees the square slide to a new location.

Line 1030 sets drawing to occur on page one again, erases the square there, and sets X and Y to the location for the next square. When the NEXT J instruction in Line 1040 is encountered, the program will jump back to line 1010, which will actually draw the square.

Line 2000 restores the display to page one, and ends. One could add the command TEXT before END to restore the viewer to text mode.

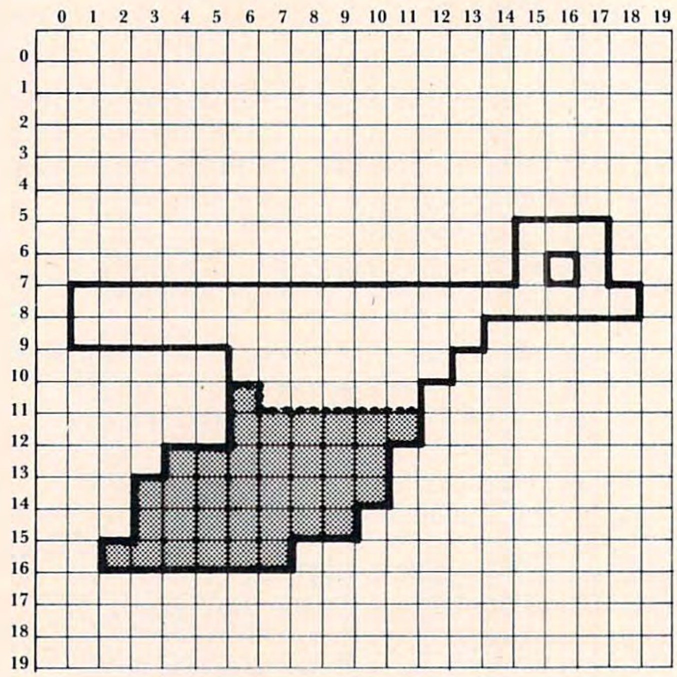
This method for high-resolution animation is not as satisfactory as an assembly language routine would be, but could be useful in many simple applications. Another possibility for a simpler way to use this method would be to have two pictures, (one on each page) showing different positions of the same figure. For example, one could have a Jumping Jack with arms up in one and arms down in the other picture. These could be large, elaborate drawings. By flipping between the two pages (POKE –16299,0, then POKE –16300,0) many times the Jumping Jack would appear to swing its arms up and down. In practice, it would probably be necessary to have a short delay between successive flips for this application.

Many other techniques of animation can be employed, but these methods should provide a starting point for the beginning or intermediate level Applesoft BASIC programmer.

Figure 1. Sketch of flying bird.

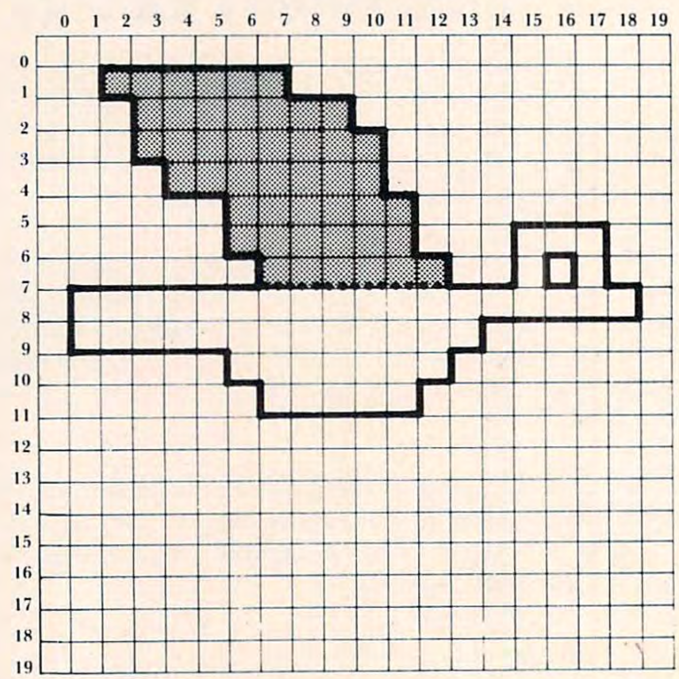
1 wing down 2 body (wing parallel) 3 wing up

Figure 2. Wing down and body.



.... = bottom of body

Figure 3. Wing up and body.



... = top of body

Program 1. (50)

```
5  REM  BIRD LOADER PROGRAM
10  TEXT : HOME : VTAB 10
20  FLASH : HTAB 17: PRINT "LOADING": NORMAL
30  PRINT : PRINT : HTAB 13: PRINT "BIRD IN FLIGHT"
40  POKE 103,33: POKE 104,12: POKE 3104,0: REM  RELOCATES NEXT APPLESOFT
     PROGRAM TO LOAD AT $C20
50 D$ =  CHR$ (4): PRINT D$;"RUN BIRD IN FLIGHT"
```

Program 2. (10010)

```
3  REM  BIRD IN FLIGHT
5  REM   POKE 103,33, POKE 104,12, POKE 3104,0 TO RELOCATE PROGRAM BEFORE
      RUNNING
10  TEXT : HOME
20  GOSUB 10000: REM  POKE IN MOVE AND FLIP ROUTINE
40  GOTO 1000
99  REM  ** GRAPHICS SUBROUTINES **
100  COLOR= 2: HLIN X + 1,X + 18 AT Y + 8: HLIN X + 1,X + 13 AT Y + 9: HLIN
     X + 6,X + 12 AT Y + 10: HLIN X + 7,X + 11 AT Y + 11
102  HLIN X + 15,X + 17 AT Y + 6: HLIN X + 15,X + 17 AT Y + 7: COLOR= 0: PLOT
     X + 16,Y + 7: COLOR= 1: HLIN X + 17,X + 18 AT Y + 8: RETURN : REM BO
     DY
110  COLOR= HUE: HLIN X + 2,X + 7 AT Y + 1: HLIN X + 3,X + 9 AT Y + 2: HLIN
     X + 3,X + 10 AT Y + 3: HLIN X + 4,X + 10 AT Y + 4
112  HLIN X + 6,X + 11 AT Y + 5: HLIN X + 6,X + 11 AT Y + 6: HLIN X + 7,X
      + 12 AT Y + 7: RETURN : REM  WING UP
```

```
120  COLOR= HUE: PLOT X + 6,Y + 11: HLIN X + 6,X + 11 AT Y + 12: HLIN X +
     4,X + 10 AT Y + 13: HLIN X + 3,X + 10 AT Y + 14
122  HLIN X + 3,X + 9 AT Y + 15: HLIN X + 2,X + 7 AT Y + 16: RETURN : REM
     WING DOWN
150  COLOR= 0: HLIN X + 1,X + 18 AT Y + 8: HLIN X + 1,X + 13 AT Y + 9: HLIN
     X + 6,X + 12 AT Y + 10: HLIN X + 7,X + 11 AT Y + 11: HLIN X + 15,X +
     17 AT Y + 6: HLIN X + 15,X + 17 AT Y + 7: HLIN X + 17,X + 18 AT Y +
     8: RETURN : REM ERASE BODY
999  REM  ** ANIMATION DRIVER **
1000  GR : HOME :X = 0:Y = 20: CALL 3072
1010  GOSUB 100:HUE = 2: GOSUB 120: CALL 3072
1020  FOR FLY = 1 TO 4: GOSUB 150:HUE = 0: GOSUB 120:X = X + 2
1030  GOSUB 100:HUE = 2: GOSUB 110: CALL 3072
1040  GOSUB 150:HUE = 0: GOSUB 110:X = X + 1:Y = Y - 1: GOSUB 100: CALL 3
     072
1050  GOSUB 150:X = X + 2:Y = Y - 1: GOSUB 100:HUE = 2: GOSUB 120: CALL 3
     072
1060  NEXT FLY: POKE  - 16300,0
1200  VTAB 21: POKE 103,1: POKE 104,8: POKE 2048,0: END : REM  RESET PROG
     RAM START POINTERS TO NORMAL VALUE
9990  REM  ** ASSEMBLY LANGUAGE ROUTINE
9992  REM  COPIES LO-RES GRAPHICS PAGE ONE
9994  REM  TO PAGE TWO WITH PAGE FLIPPING
9996  REM  LOCATED AT $C00 (3072)
10000  FOR I = 3072 TO 3103: READ CODE: POKE I,CODE: NEXT I: RETURN
10010  DATA   173,84,192,160,0,132,60,169,4,133,61,169,255,133,62,169,7,
     133,63,169,8,133,67,132,66,32,44,254,173,85,192,96
```

Program 3. (2000)

```
5  REM  ANIMATED SQUARE
6  REM  HI-RES ANIMATION DEMO
10  HOME : HGR2 : HGR : POKE  - 16302,0: REM   FULL SCREEN
20  GOTO 1000
99  REM  ** DRAW SQUARE **
100  HCOLOR= HUE: FOR I = Y TO Y + 10: HPLOT X,I TO X + 10,I: NEXT I: RETURN
999  REM  ** ANIMATION DRIVER **
1000 X = 50:Y = 50: POKE  - 16299,0: REM  DISPLAY PAGE TWO
1002  POKE 230,32: REM   DRAW ON PAGE ONE
1005  FOR J = 1 TO 20
1010 HUE = 5: GOSUB 100: POKE  - 16300,0: REM  DISPLAY PAGE ONE
1020 X = X - 2:Y = Y - 2:HUE = 0: POKE 230,64: GOSUB 100:X = X + 4:Y = Y +
     4::HUE = 5: GOSUB 100: POKE  - 16299,0
1030  POKE 230,32:X = X - 2:Y = Y - 2:HUE = 0: GOSUB 100:X = X + 4:Y = Y + 4
1040  NEXT J
1050  POKE  - 16301,0: REM  RESTORE MIXED TEXT AND GRAPHICS MODE
2000  POKE  - 16300,0: VTAB 22: END
```

Program 4. (0C1F) Assembly Language Routine Flip And Move

```
0C00-   AD 54 C0    LDA   $C054
0C03-   A0 00       LDY   #$00
0C05-   84 3C       STY   $3C
0C07-   A9 04       LDA   #$04
0C09-   85 3D       STA   $3D
0C0B-   A9 FF       LDA   #$FF
0C0D-   85 3E       STA   $3E
0C0F-   A9 07       LDA   #$07
0C11-   85 3F       STA   $3F
0C13-   A9 08       LDA   #$08
0C15-   85 43       STA   $43
0C17-   84 42       STY   $42
0C19-   20 2C FE    JSR   $FE2C
0C1C-   AD 55 C0    LDA   $C055
0C1F-   60          RTS
```

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Programming The RESET Key The Easy Way

Richard Cornelius, Wichita, KS

On the Apple Computer the RESET key, to most users, is a magical key that provides an instant means to get out of any program. Usually a person begins to modify the RESET function only after learning machine language. Here is a method of making the RESET key do anything (well, almost anything) that you want it to do on an Apple II Plus, and you don't need *any* knowledge of machine language.

First let's examine what the RESET key does. When the RESET key is pressed the currently running program is interrupted; the screen display is set to text page 1; output to the screen is set to NORMAL; the text window is set to the complete screen; the cursor is moved to the bottom of the page; a beep sounds; accessory I/O is shut down; and then the computer looks in locations 1010 and 1011 in memory to see where it should go next for instructions. When the computer is turned on, the contents of these two locations are automatically set such that when RESET is pressed the computer is returned to immediate mode in BASIC. Changing these locations to make the computer go to different places for instructions involves only POKEs to positions 1010 and 1011 and a CALL-1169.

Where should the computer be sent? Starting at position 768 there is some room that is reserved for short machine language programs, and that is where we shall send it. (Don't worry — you don't need to know any machine language.) POKEs to seven bytes are used to make the RESET key run a BASIC program starting at the *second* line of code. When the first line of the program makes the program jump around the second line, then the second line will *only* be executed when RESET is pressed.

The program will help you understand how the RESET key can be used to execute any BASIC statements that can be put into a program. When the program is RUN, statements 110 through 190 are jumped over so that lines 200 through 260 are the first statements in the program that perform any tasks. These lines fix the RESET key so that the computer will go to line 110 when the RESET key is pressed. The length of the very first statement is critical. As long as it has a three-digit number after the GOTO, the RESET key will operate as desired. Changes in the length of the statement will likely mean that the RESET key will send the computer to some nonsense location. Placing a REM statement (or any other statement) before line 100 will have the same effect. Modifying the DATA statement in line 230 to accommodate changes in the length of that first statement is not difficult, but, unless you understand what to do, you had better not make any changes.

Lines 270 through 310 constitute a dummy BASIC program to show that the program is being RUN. Statements 110 through 190 tell the computer what to do when the RESET key is pressed. Lines 140 through 190 can be changed to make the RESET key do whatever you want it to do. In this example, the program is simply rerun from the beginning, but you can make lines 140-190 do whatever you wish. Lines 120 and 130 should not be changed since they fix up some things that are undone by the short machine language program that is POKEd in, but omit line 130 if you don't have a disk drive. If you should want to "turn off" the changes to the RESET key so that it behaves normally, simply POKE 1010,3: POKE 1011,244: POKE 1012,69 if you have no disk drive or POKE 1010,191: POKE 1011,157: POKE 1012,56 if you do have a disk drive.

For those who don't wish to stray from BASIC, this short program contains all that is needed to make the RESET key do almost anything. Take an existing program and add it starting at line 280 to the program. In lines 140-190, put statements that you wish to be executed when the RESET key is pressed. You can thus program the RESET key in BASIC without knowing any machine language. For those who are interested in straying just a little from BASIC, the final paragraphs explain the details of what is happening.

Positions 1010 and 1011 (hex 3F2 and 3F3) contain the low and high bytes of the location that the RESET key makes the computer jump to after it performs a fixed set of operations. The POKEs in statement 210 change this location from 40383 (hex 9DBF) to 768 (hex 300). Before the computer performs this jump, it looks at the "power-up" byte, position 1012 (hex 3F4), to see whether the value at this location equals an exclusive OR of the value in position 1011 (hex 3F3) with the constant 165. If the values correspond properly, the computer believes that it has *not* just been turned on and it executes a jump to the specified location. If the values do not properly correspond, the computer thinks that it has just been turned on, and it will attempt to reboot the disk if a disk controller card is present. The CALL-1169 in statement 210 properly sets this power-up byte.

The DATA statement in line 230, coupled with the POKE statement in the FOR...NEXT loop in lines 240 through 260, puts a very short machine language program into memory. This program is shown below:

```
0300- A9 0A      LDA  #$0A
0302- 85 67      STA  $67
0304- 4C 66 D5   JMP  $D566
```

The first two statements in this program place the value 10 (hex 0A) into location 103 (hex 67). Position 103 is the low byte (and position 104 is the high byte) of the starting location of the current BASIC program. The first statement in the program is "100 GOTO 200" and occupies 9 bytes: 2 bytes for the location of the next line, 2 bytes for the statement number, 1 byte for the GOTO token, 3 bytes for the digits of the number 200, and 1 byte for a terminating 0. Normally location 103 would contain the value 1, so adding 9 to this value makes the computer think that the BASIC program begins at the second line. To see that this works, enter the BASIC program and then POKE 103,10. If you list the program after this POKE, the list will begin with line 20. POKEing 103 with the value 1 will restore the program to begin with statement 10.

The final line in this machine language program jumps to 54630 (hex D566) where the RUN routine in firmware Applesoft BASIC resides. Since the value in location 103 (hex 67) has been changed, the RUN command executes the BASIC program starting at line 110. Once the program is running, the section that can only be accessed by the RESET key, the value in location 103 is changed back to its standard value so that the RUN command in line 190 will RUN the program starting with the first line of the BASIC program.

Many variations on this general scheme are possible. By making the RESET key RUN statements of BASIC code, changing the RESET key function becomes an easy adaptation to add to any BASIC program.

```
100 GOTO 200
110 REM **HERE IS WHERE THE RESET KEY
        SENDS THE COMPUTER**
120 POKE 103,1
130 CALL 1002
140 HOME
150 VTAB 3
160 PRINT "YOU HAVE PRESSED THE RESET
    KEY."
170 PRINT: PRINT "I WILL NOW RERUN THE
    PROGRAM."
180 FOR PAUSE=1 TO 2000:NEXT
190 RUN
200 REM **MAKE THE RESET KEY GOTO
        SECOND STATEMENT**
210 POKE 1010,0: POKE 1011,3:
    CALL -1169
220 REM -THE ABOVE STATEMENT RESETS
        "JUMP TO" LOCATION FOR RESET
230 DATA 169,10,133,103,76,102,213
240 FOR SPOT = 768 TO 774
250 READ CODE: POKE SPOT,CODE
260 NEXT
270 REM **PLACE BODY OF PROGRAM HERE**
280 HOME
290 VTAB 3
300 PRINT "THE PROGRAM IS NOW RUNNING."
310 GOTO 310
```

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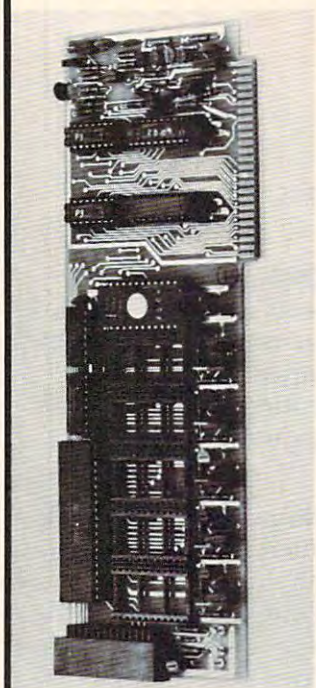


A Simple Printer Interface For The Apple II

Marvin L. DeJong
Dept. of Math-Physics
The School of the Ozarks
Pt. Lookout, MO

In the January 1981 issue (**COMPUTE!** #8) I described a simple circuit that could be used with an Apple II to perform the experiments in my book[1]. The circuit provided one eight-bit output port. These two ports can also be used to interface the Apple II to a parallel port printer.

The Circuit

For the unfortunates who do not have a copy of **COMPUTE!** #8, I have included the circuit diagram of the peripheral I/O card in this article. It is shown in Figure 1. My circuit was wire wrapped on a Vector Electronic #4609 plugboard which fits into the peripheral card connectors on the Apple II. For the purpose of this application, the eight LEDs and the DIP switch (with pull-up resistors) are not needed. They are only used if you wish to use the peripheral I/O board in conjunction with the experiments in my book. You may also wish to experiment with the possibility of omitting the 74LS242 bus transceivers and the associated logic, simplifying the circuit further. This would leave only the 74LS138, an inverter, the two 74LS75s, and the 81LS97. Since only one bit of the input port is used to interface to the printer, you may wish to replace the 81LS97 with a 74LS125. I used the circuit as it is shown in Figure 1, with the DIP switch removed from the socket.

My printer (which was not the one used to make the listings in this article) is a MICROTEK MT-80P which I normally use to interface to one of my TRS-80 machines. It claims to have a "Centronics-compatible interface," so perhaps the circuit and software we describe here may also be used with Centronics printers. The printer has eight data lines and several handshaking lines. The eighth bit is not used by the printer: it uses seven-bit ASCII. So seven bits of the output port on our peripheral I/O card are used to send the character to be printed to the MT-80P printer.

Two handshaking lines are used, DATA STROBE and BUSY. The microcomputer must supply a logic-zero pulse (strobe) of at least one microsecond in duration when the character on the data lines is to be read by the printer. Thus, the DATA STROBE line is controlled by the Apple II peripheral I/O card. In particular, I used bit zero (PA0 in Figure 1) to control the DATA STROBE line, while the seven-bit ASCII character appears on bits one to seven (PA1 - PA7). When the DATA STROBE pulse is sent, the printer responds by bringing the BUSY line to logic one. It stays at logic one until the character is read. This will only take about 40 microseconds unless the buffer is full. The BUSY line will stay high until there is room in the buffer. Thus, the BUSY line is connected to bit seven of the input port on the peripheral I/O card where it may be watched with a BMI instruction. Figure 2 shows the connections to the printer, and Figure 3 illustrates the handshaking sequence.

The Software

The machine language software driver routine is shown in Program 1. It is used with DOS 3.3, but other versions should work equally well. The machine language program consists of two parts. The first part starts with line six in the listing and ends with line 19 (locations \$02C0 – \$02DB). It has two functions:

1. It sets up the Apple II output registers (\$36 – \$37) to point to the printer routine at \$02E0, and it jumps to a DOS routine to fix the DOS output register. (See pages 103-104 in the APPLE II DOS MANUAL.)

2. It loads a form-feed character, \$0C, into the printer and pulses the DATA STROBE line.

The second part of the machine language routine is the actual print routine. It puts an ASCII character on the data lines to the printer and then it pulses the DATA STROBE line, but it does not do this unless the BUSY line is at logic zero, indicating that the printer is not busy. Finally, it jumps the monitor COUT routine that prints the character on the video monitor screen, before returning to the DOS program.

In Program 2 I show a greeting program that is the INITilization program on the slave diskette for our DOS 3.3. It gives the user the chance to call PRINTS, the object code file that is also stored on the slave diskette. This completes the description of the software for this system. Refer to the comments for more details regarding the software.

If you are not running a disk system, then to operate the printer load the machine language programs in Program 1 with a single modification. Replace the JMP DOSSYS instruction with a BRK.

Execute the program from the monitor, starting at \$02C0. You can then either stay in the monitor or return to BASIC with a control B.

Notice that the software is located in page two of memory. If you type in a very long sentence you may wipe out your program, since it is part of the input buffer for the Apple II. Ideally, you would PROM the software. (We should add that the software as shown assumes that the peripheral I/O card is in *slot one* on the Apple II. The software, assuming the peripheral I/O card is in slot one, would be loaded into locations \$C100 upward, *starting with the instructions at \$02E0 in Program 1*.

To initialize the printer you would still want to execute instructions from \$02C8 through \$02D8, with a BRK replacing the JMP DOSSYS at location \$02D9. Thereafter a PR#1 command would produce an active printer, and a PR#0 would disable it. I should add that I have *not* tried to run the system with the program in EPROM, but I think that I understand my Apple II enough to make the instructions just given. I would very much like to hear from someone who might try this approach.

Obviously this interface circuit will work with almost any microcomputer system and any parallel printer. Even the software requires little modification to work with any 6502 based system. The card to mount the components is the most expensive item, \$23.25. Note that the card I used has another edge connector not used to plug into the Apple II, and I used that connector to attach to our printer cable. It accepts a standard 20/40 edge connector, but my printer used a 19/36 edge connector, so I sawed and filed to fit. It has a big price advantage over the usual parallel interfaces found in your catalogs.

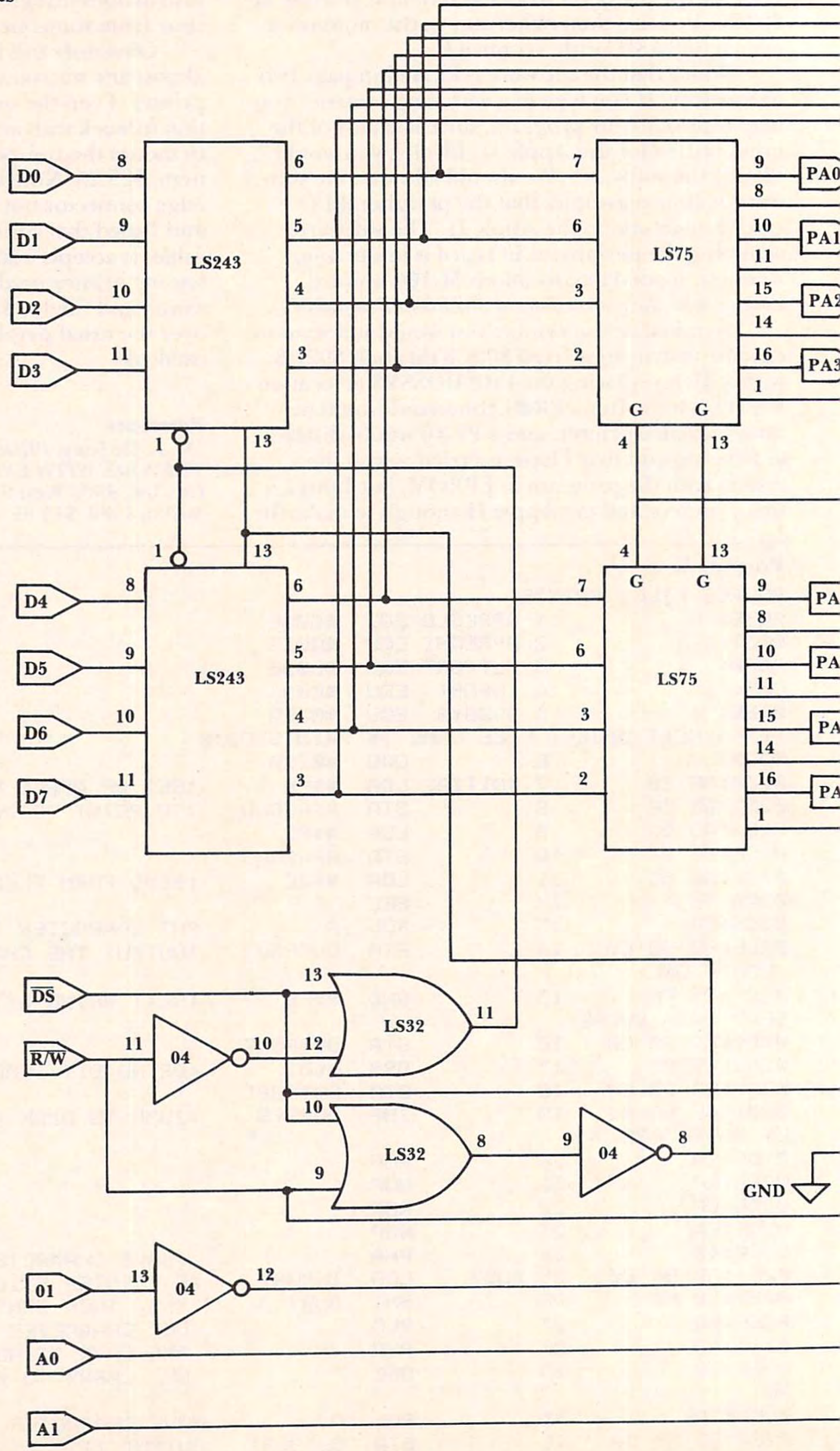
Reference

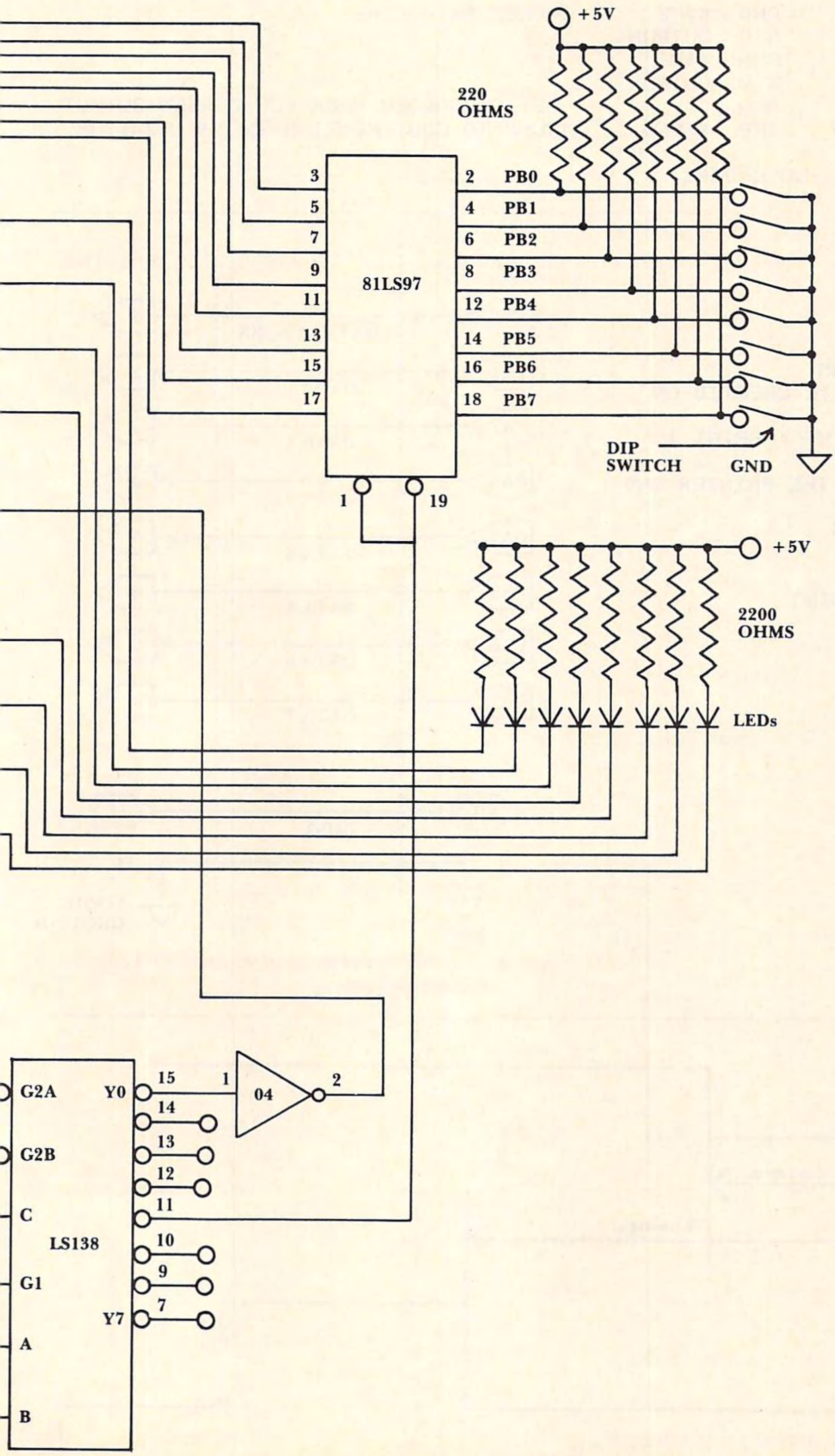
[1]M. L. De Jong, *PROGRAMMING & INTERFACING THE 6502, WITH EXPERIMENTS,* Howard W. Sams & Co., Inc. 4300 West 62nd St., Indianapolis, Indiana 46268, 1980. \$15.95

Program 1.

```
SOURCE FILE: PRINTS
0036:              APREGLO EQU   $0036
0037:              APREGHI EQU   $0037
C090:              OUTPORT EQU   $C090
C094:              INPORT  EQU   $C094
03EA:              DOSSYS  EQU   $03EA
----- NEXT OBJECT FILE NAME IS PRINTS.OBJ0
02C0:                      ORG   $02C0
02C0:A9 E0         INITIAL LDA   #$E0      ;SET UP APPLE OUTPUT REGISTERS
02C2:85 36                 STA   APREGLO   ;TO POINT TO PRINTER ROUTINE
02C4:A9 02                 LDA   #$02
02C6:85 37                 STA   APREGHI
02C8:A9 0C                 LDA   #$0C      ;SEND FORM FEED TO PRINTER
02CA:38                    SEC
02CB:2A                    ROL   A         PUT CHARACTER IN HIGH ORDER 7 BITS
02CC:8D 90 C0              STA   OUTPORT   ;OUTPUT THE CHARACTER WITH BIT ZERO AT
 LOGIC ONE
02CF:29 FE                 AND   #$FE      ;NEXT BRING BIT ZERO TO LOGIC ZERO TO
SEND DATA PULSE
02D1:8D 90 C0              STA   OUTPORT
02D4:09 01                 ORA   #$01      ;BRING BIT ZERO TO LOGIC ONE AGAIN
02D6:8D 90 C0              STA   OUTPORT
02D9:4C EA 03              JMP   DOSSYS    ;JUMP TO DISK ROUTINE TO EXCHANGE OUTP
UT REGISTERS
02DC:EA                    NOP
02DD:EA                    NOP
02DE:EA                    NOP
02DF:EA                    NOP
02E0:48                    PHA              ;SAVE CHARACTER
02E1:AD 94 C0      BUSY    LDA   INPORT    IS PRINTER STILL BUSY?
02E4:30 FB                 BMI   BUSY      ;YES, THEN DONT BOTHER IT
02E6:68                    PLA              GET CHARACTER BACK
02E7:48                    PHA              AND SAVE IT AGAIN
02E8:38                    SEC              SET CARRY TO ROTATE A ONE INTO BIT ZE
RO
02E9:2A                    ROL   A         MOVE CHARACTER UP ONE BIT
02EA:8D 90 C0              STA   OUTPORT   OUTPUT IT
```

Figure 1. Peripheral Card Data bus




+5V
220
OHMS
81LS97
3
5
7
9
11
13
15
17
2 PB0
4 PB1
6 PB2
8 PB3
12 PB4
14 PB5
16 PB6
18 PB7
DIP
SWITCH
GND
1
19
+5V
2200
OHMS
LEDs
G2A
Y0
15
14
13
12
11
10
9
7
Y7
G2B
C
LS138
G1
A
B
1
04
2

```
02ED:29 FE          AND  #$FE      ;PULSE DATA LINE
02EF:8D 90 C0       STA  OUTPORT
02F2:09 01          ORA  #$01
02F4:8D 90 C0       STA  OUTPORT
02F7:68             PLA             GET CHARACTER BACK FOR SCREEN OUTPUT
02F8:4C F0 FD       JMP  $FDF0     ;JUMP TO COUT ROUTINE IN THE MONITOR

*** SUCCESSFUL ASSEMBLY: NO ERRORS
```

Program 2.

```
]LISTLIST
?SYNTAX ERROR
]LIST

5   REM  GREETING PROGRAM
10   PRINT "SLAVE DISKETTE CREATED ON
     32K SYSTEM"
15   PRINT : PRINT : PRINT : PRINT :
     PRINT
21   INPUT "DO YOU WANT THE PRINTER ON?
     (TYPE Y OR N.) ";A$
22   IF A$ = "Y" THEN 30
23   GOTO 50
30 D$ =  CHR$ (4)
40   PRINT D$;"BRUN PRINTS"
50   END
```

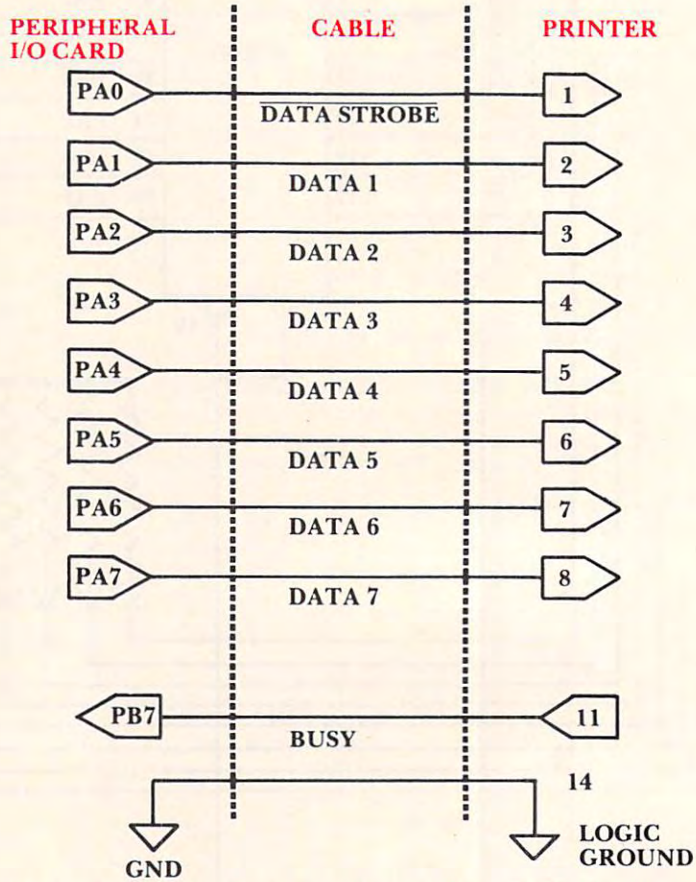


Figure 2. Interface between the peripheral I/O circuit and the printer.

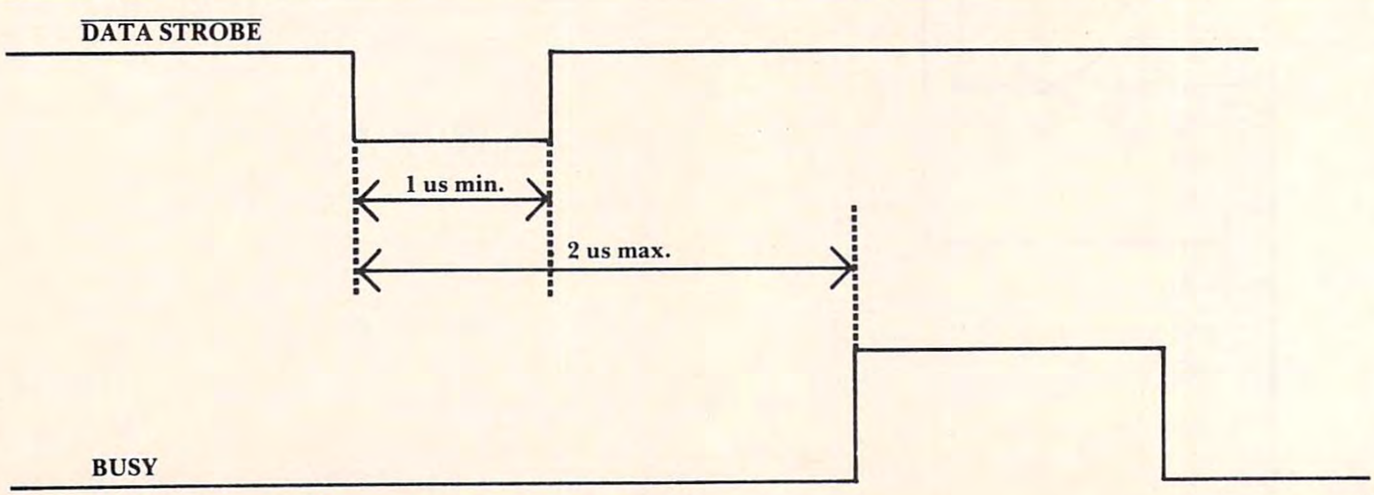


Figure 3. Microcomputer-Printer handshaking sequence.

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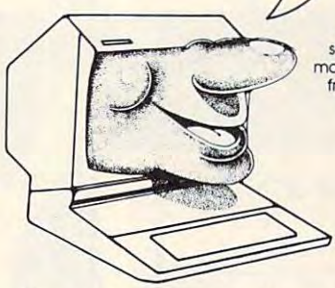

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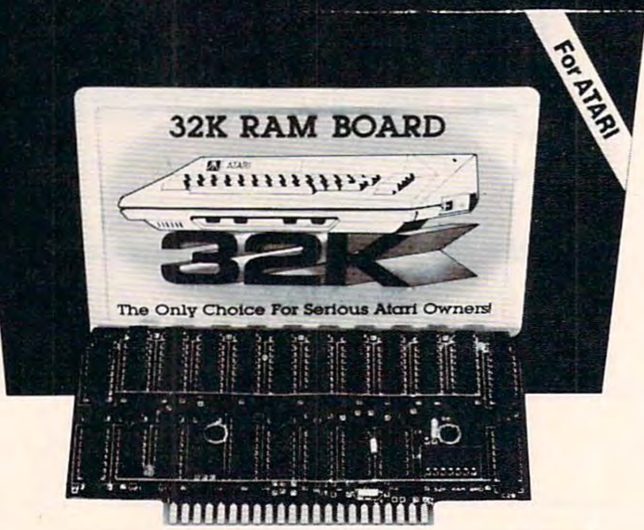

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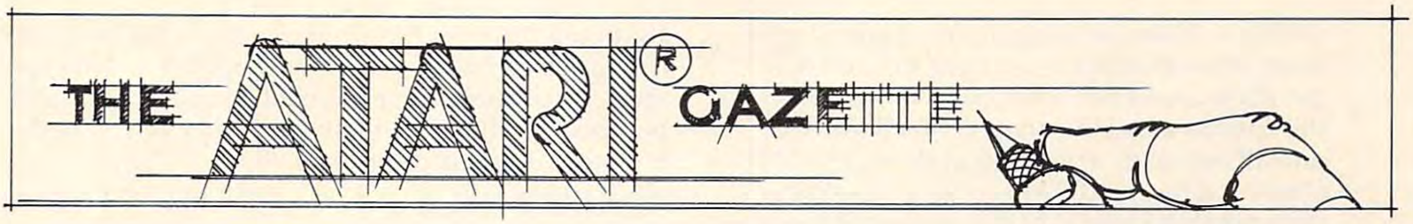

INSIGHT: Atari

Bill Wilkinson
Optimized Systems Software
Cupertino, CA

Last month, we tackled some of the fundamentals of I/O under Atari's OS. This month we will look at the extended disk operations available and will try our hand at writing a useful program in assembly language.

There simply isn't space to repeat the charts given in last month's article, so you will have to open to those pages: we will be referring to them often.

Atari I/O, Part 2: Disk File Manager

Notice that the title of this section is *not* "ATARI DOS." There is a simple reason, which I expounded on before: Atari does not have a DOS. (But please don't tell them I said so; they think they have to call it "DOS," because that's what everybody else calls it.) Atari *has* an "OS"; actually a much more powerful system than what is normally called "DOS" on microcomputers. And please recall from last month that the Atari OS understands *named* devices, such as "P:" and "E:". The Disk File Manager (DFM) is actually simply a device driver for the disk ("D:") device. It was written completely separately from Atari OS and interfaces to OS the same way any other driver does. In fact, there is nothing magic about the DFM. In theory, by the end of next month's article you should know enough about Atari OS and the DFM to implement your own File Manager and to replace the one that Atari supplies you. (*In theory*. In practice, you had better know the principles of disk space allocation, I/O blocking and deblocking, and much more, before tackling such a job.) Even if you aren't quite that ambitious, we hope that this series will give you some "insight" into how such things as BASIC's I/O are implemented.

Extended Disk Operations

We should first note that most of the extended disk operations are documented in the Atari *Basic Reference Manual* in the section about the XIO command. There are two exceptions, NOTE and POINT, which were given special BASIC commands (and we will see why soon). Naturally, the Atari *Disk Operating System II Reference Manual* is pertinent, but it doesn't really give more information about the internal workings of Atari's OS than does the BASIC manual. Before delving into assembly language, let's examine each of the extended disk operations in a little detail:

ERASE, PROTECT, UNPROTECT — Also known as Delete, Lock, and Unlock, these three commands simply provide OS with a channel number (i.e., the X-register contains IOCB number times 16), a command number (ICCOM), and a filename (via ICBAL/ICBAH). When OS passes control to the DFM, an attempt is made to satisfy the request. Note that the filename may include "wild cards," as in "D:*.??S" (which will affect all files on disk drive one which have an 'S' as the last letter of their filename extension).

RENAME — Very similar to ERASE, et al, in usage. The only difference is in the form of the filename. Proper form is:

"Dn:oldname.ext,newname.ext"

Note that the disk device specifier is not and *cannot* be given twice.

NOTE, POINT — Other than OPEN, these are the only commands we have encountered so far (including last month) which use any of the AUXilliary bytes of the IOCB. For these commands, one specifies the channel number and command number and then receives or passes file pointer information via three of the AUX bytes. ICAX3/ICAX4 are used as a conventional 6502 LSB/MSB 16-bit integer: they specify the current (NOTE) or the-to-be-made-current (POINT) sector within an already OPENed disk file. ICAX5 is similarly the current (NOTE) or to-be-made-current (POINT) byte within that sector. These are complex commands to use, but their operation from BASIC is adequately covered in the *Atari DOS II Manual* so it will not be covered here.

OPEN — Open is not truly an extended operation, but for disk I/O we need to know that the DFM allows two additional "modes" beyond the fundamental OS modes (which are 4, 8, and 12 for read, write, and update). If ICAX1 contains a 6 when DFM is called for OPEN, then the disk DIRECTORY is opened (instead of a file) for read-only access. The filename now specifies the file (or files, if wild cards are used) to be listed as part of a directory listing. Note that DFM expects this type of OPEN to be followed by a succession of GETREC (get text line) OS calls (and we present an example of this below). If ICAX1 contains a 9, the specified file is opened as a write-only file, but the file pointer is set to the current end-of-file. Caution: DFM only appends on sector boundaries (normally this is transparent to the user, but *caveat artificer*).

Error Handling

This may not be the best place to introduce this topic, but the information is needed for examples which follow. Space doesn't permit a listing of all the I/O error codes, so we must refer you again to the BASIC and/or DOS II reference manuals. There are four fundamental kinds of errors that can occur with Atari OS:

HARDWARE ERRORS — Such as attempting to read a bad disk, write a read-only disk, etc.

SERIAL BUS ERRORS — Errors which occur when data is transferred between the computer and a peripheral device. Examples include Device Timeout, Device NAK, Framing Error, etc.

DEVICE DRIVER ERRORS — Found by the driver for the given device, as in (for the DFM) File Not Found, File Locked, Invalid Drive Number, etc.

OS ERRORS — Usually fundamental usage problems, such as Bad Channel Number, Bad Command, etc.

On return from any OS call, the Y-register contains the completion code of the requested operation. A code of one (1) indicates "normal status, everything is okay." (I know, why not zero, which is easier to check for? Remember, I said Atari was good, not perfect.) By convention, codes from $02 to $7F (2 through 127 decimal) are presumed to be "warnings." Those from $80 to $FF (128 through 255 decimal) are "hard" errors. These choices facilitate the following assembly language sequence:

```
JSR CIOV    ; call the OS
TYA         ; check completion code
BMI OOPS    ; if $80-$FF, it must be an error
```

In theory, Atari's OS always returns to the user with condition codes set such that the TYA is unnecessary. In practice, that's probably true; but a little paranoia is often conducive to longer life of both humans and their programs.

A Real, Live Example

Believe it or not, you now have all the information you need to do from assembly language any and all I/O done by Atari BASIC and/or BASIC A+ (excepting graphics, but that's coming...hold your breath). In an attempt to make you believe that statement, we will write a program in both BASIC and assembly language.

The BASIC Program

```
100 DIM BUFFER$(40)
200 OPEN #1,6,0,"D:*.*"
300 TRAP 700
400 INPUT #1,BUFFER$
500 PRINT BUFFER$
600 GOTO 400
700 CLOSE #1
```

This program will list all files on disk drive one (D1:) to the screen. This is exactly equivalent to using the "A" option of Atari's menu "DOS" (and then hitting RETURN for the filename) or to using "DIR" from OS/A+. Admittedly, this program is easily improved. For example, replace line 200 with:

```
200 INPUT BUFFER$ : OPEN #1,6,0,BUFFER$
```

and now you can choose to list only some files. You might also wish to send the listing to the printer (change PRINT to LPRINT). However, we will leave such changes as an exercise to the reader and discuss only our simplified version.

Please now refer to the listing in Program 1. Since it follows the scheme of the above BASIC listing, it is almost self-explanatory. A few words are in order, though. The equates at the beginning have been kept to a minimum; I refer you to the "SHOOT" listing in **COMPUTE!** #16 if you want a comprehensive list. (The mnemonics used are not all identical to those in the "SHOOT" listing; those shown are from our standard equates file.)

The program is intended to be called from BASIC via the USR function. However, no check is performed to see if the BASIC program were coded as (for example) PRINT USR(1600,0) instead of just PRINT USR(1600). (Note that 1600 decimal = 640 hex, the starting address.) If you would like to test this program with the BUG debug monitor, you should replace the RTS at the end of the program with a BRK before saying 'G641' (641 to avoid the PLA).

All errors, including an error on the OPEN DIRECTORY call to OS, are treated as end-of-file. A better program would verify the error status and print a message or some such. As an example of a

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minor improvement, at LINE700 one could save the Y-register (status) value in FR0 and zero in FR0 + 1 ($D4 and $D5), thus returning the error code to the calling BASIC program.

Notice that values stored into the IOCB for FILE0 (the console screen output) were stored directly into ICCOM, etc., without an X-register offset. This is perfectly valid, so long as the X-register contains the proper value on calling CIO. In fact, we could have stored the values for FILE1 (the directory) by coding (for example) STA ICCOM + FILE1. Obviously, this technique only works when one uses a constant channel number; but most BASIC programs and many language programs can use predefined channel numbers.

There isn't really much more to say other than, "Try it!" It really does work. And, even if you don't understand the concepts on first reading, actually entering the program and following the program flow and remarks might give you a painless introduction to I/O from assembly language.

The Easiest Way Of Making Room?

With an ATARI 400 or 800, there are many ways and places to find "safe" hunks of memory, places to put assembly language routines, player/missile graphics, character sets, etc. Many of the programs that I have seen involved techniques that I consider risky. For example, moving BASIC's top of memory down requires that one do so only after issuing a GRAPHICS, command for the most memory-consuming graphics mode used in the program.

Other programs use machine language subroutines; but such subroutines must themselves have a place to stay. The best of such routines, however, approach the "official" Atari method. The approved method is normally used (by Atari) to add device drivers to the OS; in fact, the drivers for both DOS and the RS-232 ports follow these rules:

1. Inspect the system LOMEM pointers.

2. Load your routine (or reserve your buffer) at the current LOMEM.

3. Add the size of the memory you used to LOMEM and

4. Store the resultant value back into LOMEM.

If each routine, driver, etc., followed these rules, one could reserve more and more of memory without disturbing any following routine. (In fact, Atari drivers presume that LOMEM will never grow beyond 16K, $4000, or even less; but the principle holds.) Actually, there's a hole in the above method: if the SYSTEM RESET button is pushed, OS goes through and resets all its tables, including the value in LOMEM. A "good" device driver can even take this into account, but we are going to make a few presumptions that are generally valid.

By now, you should realize that all of BASIC's fundamental I/O commands are simply implementations of OS calls. PRINT becomes PUT TEXT RECORD; INPUT becomes GET TEXT RECORD; OPEN and CLOSE are essentially unchanged. In fact, the only BASIC commands that are not obvious clones of their assembly language counterparts are GET and PUT. Suffice it to say that these are actually simply special case implementations of GET BINARY RECORD and PUT BINARY RECORD (commands 7 and 11) where the buffer length is set to one byte.

Next month, we tackle the task of understanding how device drivers work, and we actually write a new and useful one that talks to a device built into *all* Atari machines (but one that Atari didn't provide a driver for). And we haven't forgotten the promise to show how graphics routines (such as PLOT and DRAWTO) are actually I/O routines.

The trick: BASIC always, repeat always, LOADs new programs at what it perceives LOMEM to be! Unfortunately, BASIC keeps its own MEMLOW pointer, which is loaded from LOMEM only on execution of a NEW, not on execution of LOAD or RUN and (significant!!!) not even in the case of SYSTEM reset. However, when there's a will...

```
— ATARI BASIC —
10 LOMEM = 743 : MEMLOW = 128
20 ADDR = PEEK(LOMEM) + 256 * PEEK
   (LOMEM + 1)
30 ADDR = ADDR + SIZE
40 HADDR = INT( ADDR / 256 ) : LADDR = ADDR
   - 256 * HADDR
50 POKE LOMEM,LADDR : POKE LOMEM + 1,
   HADDR
60 POKE MEMLOW,LADDR : POKE MEMLOW + 1,
   HADDR : RUN "D:PROGRAM2"
— BASIC A + —
10 lomem = 743 : memlow = 128
20 addr = dpeek(lomem) : dpoke lomem, addr + size
30 dpoke memlow, addr + size : run "D:PROGRAM2"
```

The above listing is Program A, whose only purpose in life is to set up memory for the real program, Program B. "SIZE" is the amount of memory to be reserved. The program changes both the system and BASIC bottom-of-usable-memory pointers so that either NEW or RUN "..." will recognize the reserved memory. The beginning lines of PROGRAMB follow:

```
— ATARI BASIC —
10 LOMEM = 743 : MEMLOW = 128
20 POKE LOMEM, PEEK(MEMLOW) : POKE
   LOMEM + 1, PEEK(MEMLOW + 1)
— BASIC A + —
10 dpoke 743, dpeek(128)
```

The only reason for these lines in PROGRAMB is in case of SYSTEM RESET. If the user types RUN after the reset, BASIC will copy its MEMLOW (the value which includes the reserved space!) into the system's LOMEM, just so they agree with each other. A caution: I don't know what will happen if you hit SYSTEM RESET as BASIC is in the process of loading PROGRAMB.

As far as I can tell, the only real problem that could occur would be if SYSTEM RESET were followed by a "DOS" command from BASIC. The OS would then get control, thinking that LOMEM had not been changed. In a normal running program environment, though, this is, at worst, unlikely, so this method seems more than adequate.

Columnar Output

A problem inherent in Atari BASIC is that the default tabbing (when using 'PRINT exp,exp') is ten columns while the screen is 38 columns wide. This produces an output something like this:

```
PRINT 1,2,3,4,5,6,7,8,9,10

1         2         3         4
 5         6         7         8
  9         10
```

Not too pretty. POKE 82,0 will change the left margin of the screen to zero (default is column 2), thus producing a 40 column screen and thus making 10 column tabbing an excellent choice. Unfortunately, many TV sets have too much overscan to handle a true 40 column screen. Fortunately, Atari BASIC allows one to change the number of columns used in tabbing via a POKE 201, ‹tabwidth›. But the only factors of 38 are 19 and 2, meaning you can have 19 columns of 2 characters each or 2 columns of 19 characters each. Not much improvement so far.

Consider, though, the table of factors shown in Figure 1. As an example, if we have a screen 36 characters wide, we can have 2,3,4,6,9,12, or 18 columns. And to get a screen 36 characters wide is easy: just POKE 83,37 (presuming that location 82 still contains a 2). So look at the list of factors, choose a screen width of N, and you can use a tab width equal to any factor. NOTE: a tabwidth of two will not print numerics in only two columns.

Finally, consider the flexibility available by judiciously choosing your tabwidth setting:

```
20 POKE 201,4 : PRINT 1,2,
30 POKE 201,7 : PRINT 3,
40 POKE 201,10 : PRINT 4,5
```

Printing various values in a loop with this method can actually produce some quite readable columnar listings.

N	Factors of N
40	2,4,5,8,10,20
39	3,13
38	2,19
37	none
36	2,3,4,6,9,12,18
35	5,7
34	2,17
33	3,11
32	2,4,8,16

Figure 1.

```
0000          1000          .TITLE "DEMONSTRATION FOR DECEMBER COMPUTE"


DEMONSTRATION FOR DECEMBER COMPUTE
SYSTEM EQUATES

0000          1010          .PAGE "SYSTEM EQUATES"
              1020 ;
0342          1030 ICCOM  =     $342      ; 'COMMAND', IN IOCB
0344          1040 ICBADR =     $344      ; 'BUFFER ADDRESS'
0348          1050 ICBLEN =     $348      ; 'BUFFER LENGTH'
034A          1060 ICAUX1 =     $34A      ; 'AUX BYTE 1' (OPEN MODE)
              1070 ;
0003          1080 COPN   =     3         ; 'OPEN' COMMAND VALUE
0005          1090 CGTXTR =     5         ; 'GET TEXT RECORD'
0009          1100 CPTXTR =     9         ; 'PUT TEXT RECORD'
000C          1110 CCLOSE =     12        ; 'CLOSE'
              1120 ;
0006          1130 OPDIR  =     6         ; 'OPEN DIRECTORY' SUB-COMMAND
              1140 ;
E456          1150 CIO    =     $E456     ; WHERE TO CALL ATARI OS
              1160 ;
              1170 ; NOTE: OS/A+ users may omit lines 1010 thru 1160
```

```
                1180 ; if they use .INCLUDE #D:SYSEQU.ASM
                1190 ;
0000            1200 FILE0  =     $00        ; IOCB NUMBER * 16
0010            1210 FILE1  =     $10        ; IOCB NUMBER * 16
00FF            1220 LOW    =     $FF        ; MASK FOR LSB OF ADDR
0100            1230 HIGH   =     $100       ; DIVISOR FOR MSB


DEMONSTRATION FOR DECEMBER COMPUTE
BEGIN ACTUAL PROGRAM
0000            1240        .PAGE "BEGIN ACTUAL PROGRAM"
                1250 ;
                1260 ; HOUSEKEEPING:
                1270 ;
0000            1280        *=    $640       ; PUT ALL THIS IN SAFE PLACE
0640            1290        .OPT OBJ         ; WE DO WANT OBJECT CODE
                1300 ;
                1310 ; This program will list the
                1320 ; directory of disk D1: to the
                1330 ; E: device.
                1340 ;
                1350 ; Throughout, reference is made
                1360 ; to the BASIC demo program
                1370 ; which performs the same
                1380 ; functions.
                1390 ;
                1400 DIR
                1410 ; !!!! CAUTION !!!!
                1420 ; If this routine is to be used
                1430 ; from BASIC, the form MUST be
                1440 ; xxx=USR(addr)  as this routine
                1450 ; makes no check on number of
                1460 ; parameter bytes !!!
                1470 ;
0640 68         1480        PLA              ; PULL OFF # OF BYTES
0641 4C7206     1490        JMP  START
                1500 ;
                1510 ; We jump around the buffer.
                1520 ; Normally, the buffer would
                1530 ; be at the end; but we simulate
                1540 ; the BASIC program as closely
                1550 ; as possible
                1560 ;
                1570 ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
                1580 ;
                1590 ; 100 DIM BUFFER$(40)
                1600 ;
0028            1610 BUFLEN =    40
0644            1620 BUFFER *=   *+BUFLEN   ; RESERVER 40 BYTES OF SPACE
                1630 ;
                1640 ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
                1650 ;
                1660 ; 200 OPEN #1,6,0,"D:*.*"
                1670 ;
066C 44         1680 NAME    .BYTE "D:*.*",0
066D 3A
066E 2A
066F 2E
0670 2A
0671 00
                1690 ;  just a place to put filename
```

7 ATARI PRODUCTS

THE MONKEY WRENCH

The Monkey Wrench is a machine language ROM cartridge which extends the operating capability of the ATARI 800 computer. The Monkey Wrench provides 9 new BASIC commands. They are:

Auto Line Numbering	— Provides new line numbers when entering BASIC program lines.
Delete Line Numbers	— Removes a range of BASIC line numbers.
Renumber	— Renumbers BASIC's line numbers including internal references.
Cursor Exchange	— Allows usage of the cursor keys without holding down the CTRL key.
Change Margins	— Provides the capability to easily change the screen margins.
Memory Test	— Provides the capability to test RAM memory.
Hex Conversion	— Converts a hexidecimal number to a decimal number.
Decimal Conversion	— Converts a decimal number to a hexidecimal number.
Monitor	— Enter the machine language monitor. In addition to the BASIC commands, the Monkey Wrench also contains a machine language monitor with 15 commands used to interact with the powerful features of the 6502 microprocessor

Cartridge and Manual – $49.95

TYPING EXERCISE FOR ATARI

Typing Exercise is a great educational program for those who wish to improve their typing skills. Typing Exercise consits of two programs. TYPING 1 contains 13 typing drills; 9 drills progress thru alphabet and 4 thru numerics. TYPING 2 is a timed typing test. Time and words per minute are calculated for you. 810 Diskette – $12.95

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MAE contains the most powerful 6502 assembler and test editor currently on the market. If you are looking for a professional development tool that can greatly increase the productivity of your programming staff, then MAE may be the answer. The following are just some of MAE's features – Write for detailed spec sheet:

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- Contains a machine language monitor with numerous commands for debugging machine code.
- 38 error codes, 27 commands, 26 pseudo ops, and 5 conditional assembly operators.
- Contains a word processor, example files, and learning aid.
- Requires at least 32K of memory.
- All commands oriented for disk operation with ATARI 810 disk drive.
- Macro, Conditional Assembly, and Interactive Asembly capability.
- Sorted Symbol Table.
- Optionally creates executable object code in memory or relocatable object code on disk.
- 50 page manual. 810 Diskette and Manual – $169.95 (requires license agreement)

MACRO ASSEMBLER AND TEXT EDITOR (ASSM/TED)

ASSM/TED is a high powered Macro assembler and text editor for use with ATARI 800 computers with at least 40K of memory.

- Written entirely in Machine Language – Not in Basic like some we know of. Thus you get very fast and accurate assemblies.
- 36 Error Codes, 26 Commands, 22 Pseudo ops.
- Macro and Conditional Assembly Capability.
- Input/Output of source files to cassette deck.
- Multiple source files on cassette may be assembled.
- Built-in machine language monitor. . . . . Cassette and Manual – $49.95

810 Diskette and Manual – $53.95

MACHINE LANGUAGE MONITOR FOR ATARI

The Machine Language Monitor for ATARI provides 21 commands which allows the user the ability to interact with the 6502 microprocessor. It is compatible with ATARI BASIC and (once loaded) is ready for your use at anytime. The monitor comes on cassette or on diskette for the ATARI 810 disk. Cassette version – $24.95 Diskette version – $29.95

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#2: HORIZONTAL/VERTICAL SCROLLING — The information you put on the screen, either graphics or text, can be moved up, down or sideways. This can make for some nice effects. You could move only the text on the bottom half of the screen or perhaps create a map and then move smoothly over it by using the joystick.

#3: PAGE FLIPPING — Normally you have to redraw the screen every time you change the picture or text. Now you can learn how to have the computer draw the next page you want to see while you are still looking at the previous page, then flip to it instantly. You won't see it being drawn, so a complicated picture can seem to just appear. Depending on your memory size and how complicated the picture, you could flip between many pages, thus allowing animation or other special effects with your text.

#4: BASICS OF ANIMATION — Shows you how to animate simple shapes using the PRINT and PLOT commands, and also has a nice little PLAYER/MISSILE Graphics demo to learn. This would be an excellent way to start making your programs come alive on the screen.

#5: PLAYER MISSILE GRAPHICS — This complex subject will be demonstrated by starting with simple examples, and building up to a complete game and also an animated business chart on multiple pages! As always, the computer does most of the calculations. Ready Nov. 1981. Requires 32 k disk or tape and costs 29.95 (extensive manual included)

Tricky Tutorials (except #5) require 16k memory for cassette orders and 24k for disk. The price is $14.95 each. You may order 1,2,3, & 4 for $49.95!

MASTER MEMORY MAP(tm) — is really the key to using the ATARI's capabilities. We start out by explaining how to PEEK and POKE values into memory so that even new programmers can use this. Then, we give you over 15 pages of the memory locations that are the most useful. The information is condensed from both the ATARI's Operating System Manual and various articles and programs. It is, of course, useful even for experienced programmers as a reference. Also, we highly suggest that dealers offer this Memory Map to customers who request to be told how to use the power of the machine. We guarantee it will answer many of the questions you have about the machine. **$5.95**

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* * * * * * * * * * * * * *

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```
DEMONSTRATION FOR DECEMBER COMPUTE
BEGIN ACTUAL PROGRAM

             1700 ;
             1710 START
             1720 ;  begin actual program
             1730 ;
0672 A210    1740        LDX  #FILE1
0674 A903    1750        LDA  #COPN      ; THE OPEN COMMAND
0676 9D4203  1760        STA  ICCOM,X    ; IS SET UP
0679 A906    1770        LDA  #OPDIR     ; MODE 6, DIR OPEN
067B 9D4A03  1780        STA  ICAUX1,X   ; THUS THE MODE
067E A96C    1790        LDA  #NAME&LOW
0680 9D4403  1800        STA  ICBADR,X   ; LSB OF ADDR
0683 A906    1810        LDA  #NAME/HIGH ; AND MSB OF ADDR
0685 9D4503  1820        STA  ICBADR+1,X ; ...OF FLNM
0688 2056E4  1830        JSR  CIO        ; CALL ATARI OS
068B 98      1840        TYA             ; CHECK STATUS
068C 3035    1850        BMI  LINE700    ; HUH??
             1860 ;
             1870 ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
             1880 ;
             1890 ; 300 TRAP 700
             1900 ;  SEE THE 'BMI' JUST ABOVE
             1910 ;
             1920 ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
             1930 ;
             1940 ; 400 INPUT #1,BUFFER$
             1950 ;
             1960 LINE400
068E A210    1970        LDX  #FILE1
0690 A905    1980        LDA  #CGTXTR
0692 9D4203  1990        STA  ICCOM,X    ; 'INPUT' A LINE
0695 A944    2000        LDA  #BUFFER&LOW
0697 9D4403  2010        STA  ICBADR,X   ; LSB OF ADDR
069A 8D4403  2020        STA  ICBADR     ; OF WHERE LINE GOES
069D A906    2030        LDA  #BUFFER/HIGH
069F 9D4503  2040        STA  ICBADR+1,X ; AND MSB
06A2 8D4503  2050        STA  ICBADR+1   ; (WE ALSO SET UP ADDR FOR FILE #0)
06A5 A928    2060        LDA  #BUFLEN
06A7 9D4803  2070        STA  ICBLEN,X   ; BUFFER LEN
06AA 8D4803  2080        STA  ICBLEN     ; IS MAX WE USE
06AD 2056E4  2090        JSR  CIO        ; AND GO GET A LINE
06B0 98      2100        TYA
06B1 3010    2110        BMI  LINE700    ; "TRAP 700"
             2120 ;
             2130 ;;;;;;;;;;;;;;;;;;;;;;;;;;;
             2140 ;
             2150 ; 500 PRINT BUFFER$
             2160 ;
             2170 ; note that PRINT automatically
             2180 ; uses file #0, so we will do
             2190 ; so also !!
             2200 ;
             2210 ; also note that we saved a few

DEMONSTRATION FOR DECEMBER COMPUTE
BEGIN ACTUAL PROGRAM

             2220 ; bytes by setting up the buffer
             2230 ; address and length in 'LINE400'
             2240 ;
```

```
06B3 A909   2250        LDA  #CPTXTR
06B5 8D4203 2260        STA  ICCOM      ; PUT A LINE IS CMD
06B8 A200   2270        LDX  #FILE0     ; THE CONSOLE IS #0
06BA 2056E4 2280        JSR  CIO        ; TO THE I/O
06BD 98     2290        TYA
06BE 3003   2300        BMI  LINE700    ; OOPS?? HOW ???
            2310 ;
            2320 ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
            2330 ;
            2340 ; 600 GOTO 400
            2350 ;
06C0 4C8E06 2360        JMP  LINE400    ; SELF EXPLANATORY
            2370 ;
            2380 ;
            2390 ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
            2400 ;
            2410 ; 700 CLOSE #1
            2420 ;
            2430 LINE700
06C3 A210   2440        LDX  #FILE1
06C5 A90C   2450        LDA  #CCLOSE
06C7 9D4203 2460        STA  ICCOM,X    ; COMMAND IS 'CLOSE'
06CA 2056E4 2470        JSR  CIO        ; GO CLOSE THE FILE
06CD 60     2480        RTS             ; END OF ROUTINE
            2490 ;
            2500 ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
            2510 ;
06CE        2520        .END
```

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Discovering Atari's "Hidden" Graphics

Gregory L. Kopp
Indianapolis, IN

If you were a stumbling, beginning BASIC programmer like I was, you probably tried to enter a few "improper" graphics commands which resulted in curious and unexpected displays on your television screen. Before I understood the function and proper use of POKE 756 (which allows one to display Atari lower case letters and special graphics characters in text modes 1 and 2, I stubbornly tried to put CONTROL characters on-screen *without* the requisite POKE, which produced only seemingly random keyboard characters and frustration instead.

Much later, the thought nevertheless occurred to me that I might have actually accidently discovered some "hidden" (or at least undocumented) graphics capability of my Atari. In the experimental binge to which owners of microcomputers are sometimes given, I used the PRINT #6; command to enter each keyboard character while pressing CTRL at the same time. Discovery! Although the Atari special graphics characters appeared in the PRINT #6; statement, the actual screen display consisted of *keyboard* characters, but *not* the characters for the keys I entered.

Dutifully noting the results (first chart below), I pondered the apparent micro-fluke, these "hidden" characters, then asked myself the inevitable scientific question: "So what?" Two uses came fairly quickly to mind — the first purely cosmetic, the second functional.

```
10 GR. 2+16
20 X=0
30 FOR L=1 TO 50
40 RC=INT(15*RND(0)):RS=(255*RND(0))
50 SETCOLOR 0,RC,6
60 SOUND 0,RS,10,4
70 POSITION 5,4
80 PRINT #6; "1⌐[1][⌐]" (use CTRL=Q)
90 FOR W=1 TO 25:NEXT W
100 X=X+1:IF X=4 THEN X=0
110 NEXT L
120 SOUND 0,0,0,0
130 GR. 2+16
140 POSITION 5,4
150 PRINT #6; "1⌐[1][⌐]"
160 FOR W=1 TO 500:NEXT W
170 POSITION 2,7
180 PRINT #6; "HIDDEN GRAPHICS!"
190 FOR W=1 TO 1000:NEXT W
```

If one could change these hidden characters from "default green" to other colors, one could

... one may use "hidden graphics" to redefine the number set ...

eliminate the irksome problem encountered in modes 1 and 2 of having punctuation and numbers displayed in different colors than the text lettering. The INVERSE key! Sure enough, PRINTing the graphics characters in inverse changed my hidden green characters to red. Now I could choose from normal character (yellow), inverse normal (blue), CTRL character (green) and inverse CTRL (red). Experimenting further, I discovered one could achieve *any* Atari color by use of a SETCOLOR 0 to 3 or POKE 709 to 711 command to change each respective character. No more would I have to sheepishly explain to those not-of-the-computer-persuasion why my apostrophe or my "1" was blue while my text was red!

So much for cosmetics. If you are not bothered by the inconsistent color text problem, then use the last two paragraphs as speed-reading exercises. However, if you have purchased software such as Iridis 2 or Datasoft's Character Generator, you may already have thought of the second application, Instead of redefining one's lower case (and thereby "losing" it) to achieve new characters, one may use "hidden graphics" to redefine the number set, selected punctuation marks, or arithmetic signs. While this could be done normally, using "hidden graphics" allows one to display numbers, punctuation, or signs in *four* colors instead of only two! (If you have not run the above program yet, try it. Then try to produce four different color 1's the conventional way.)

A Second Approach

Now enter and run the following program:

```
10 X=0: Y=0: Z=65
20 GR. 2+16
30 FOR AZ=0 TO 25
40 SOUND 0,255-AZ*10, AZ+8,8
50 COLOR Z
60 PLOT X,Y:IF X=18 THEN X=0: Y=Y+1
```