K. Flowers

Computer Using Educators—Position Paper On Commercial Software Pricing

The 6502 Resource Magazine
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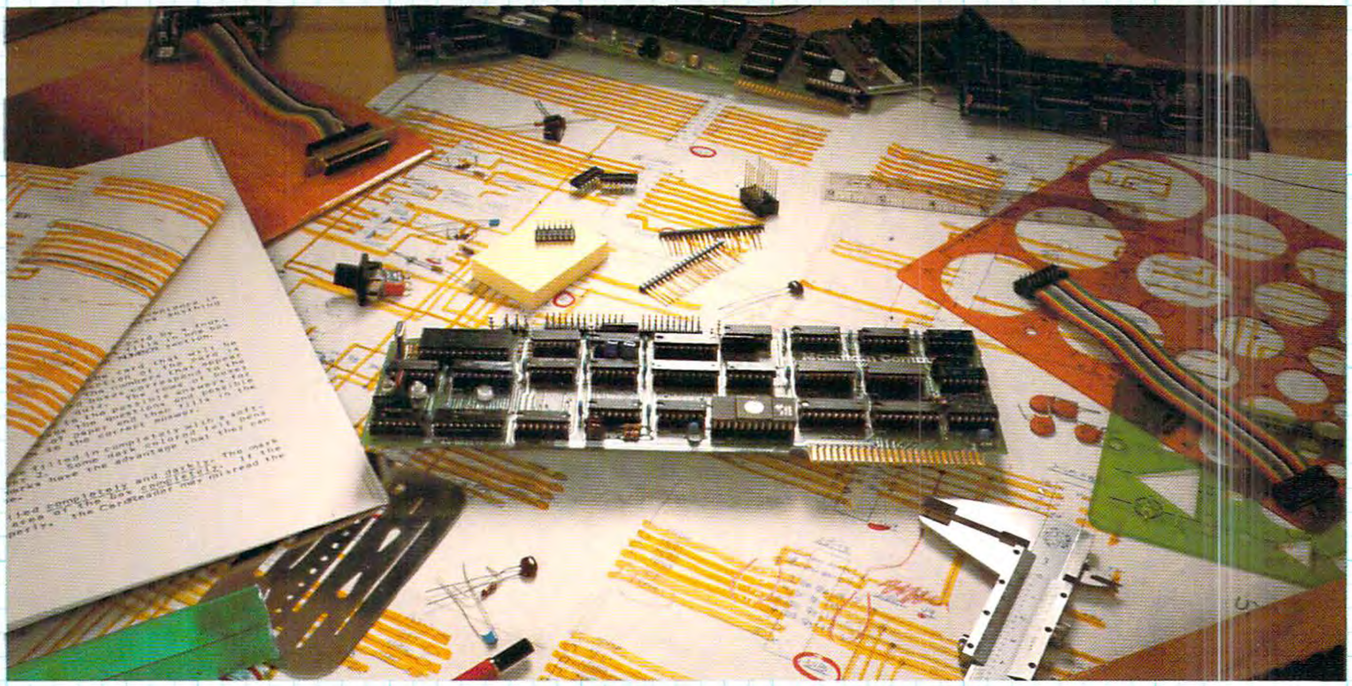

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COMPUTE!

The Editor's notes ...

Robert Lock,
Editor/Publisher

A **COMPUTE!** *first: I'm turning most of my space over to Jim this time for his following article. He didn't write it with the expectation it would show up here, but I think it's import is substantial. We've been discussinng software protection/copying for several issues, and these new products will have a direct impact on existing protection methodology.*

A few pages away, you'll find a position paper from CUE — Computer Using Educators — on software protection. We mentioned possibilities of educational licensing arrangements several issues back, and have had interesting input from educators (we'd welcome more ...). We have yet to hear formally from any software vendors; if you're a seller of software, please read the CUE position paper and RAM/ROMs. Send us some feedback. We'd like to maintain an open forum on the subject for several issues and see if we can converge on some common standards/principles.

One last note ... If you recall Richard Mansfield's excellent article on Machine Language for beginners (March, '81), you'll be pleased to know he is joining our full time staff as Assistant Editor. We're very pleased to have him. RCL

RAM/ROMs— A New Style Of Memory?

Jim Butterfield
Toronto, Canada

Two new commercial products may change the way we use ROM sockets. Both Instant ROM from Greenwich Instruments, England and Soft ROM from Canadian Micro Distributors, Canada are based upon the same principles: RAM that plugs into a ROM socket.

A Trip Down Memory Lane

ROM is read-only memory: its information is permanently burned in, often at the factory. It's marvellous stuff, since it gives your computer its style and intelligence by means of the programs embedded in ROM. When you power up, the programs are in place instantly; they are fixed in ROM forever.

RAM stands for **R**andom **A**ccess **M**emory, but it would be better named Read and Write memory. This is where you store information that is created after power on: programs and the data that they use. RAM memory can be easily changed, but when you turn the computer off, RAM loses its information. This type of amnesia is a characteristic of "volatile" memory; information evaporates when the power goes.

Some picky people like to say that ROM isn't memory at all. The way they see it, if you can't store information there, it can't be memory. Most of us like to think of it as a memory whose information was pre-stored by the manufacturer or supplier. It can't learn anything new, but it won't forget anything.

Empty Sockets In The Old Corral...

Many computers such as the PET/CBM have empty sockets intended for future ROM expansion. You may plug in a wide variety of ROMs, many of which are commercial products: Toolkit, Command-O, Visicalc, WordPro and many others. Some of these ROM chips contain the complete system; others contain supporting subroutines and the rest of the system will reside in RAM. A few chips are purely cosmetic: the main program in RAM checks to ensure the ROM is in place but doesn't use it in any functional way.

In addition to commercial products, users are generating their own ROM systems. A special type of ROM called an EPROM can be written by the user using inexpensive equipment; if the user changes his mind or finds a bug in his program, he can erase the chip and re-write it. User clubs have generated their own club ROM systems in this manner.

And now the new products, which I'll dub RAM/ROM, allow ROM systems to be emulated with no special equipment. A user can plug this device into a ROM socket, store information into it, and proceed as if he had a ROM in place.

Program Protection: ROM Rations?

These developments have generated concern on the part of software houses. In the past, they have relied on ROM chips to protect their programs against theft. Now this protection is lessened: EPROMs are not difficult to write, and RAM/ROMs make it a simple job to create a simulated ROM.

Although one must sympathize with these concerns, it's probably high time that ROM protection systems were retired. There are few enough sockets available on a processor board, and the user is often faced with having to permanently give up a socket to one of several software packages; he must choose one and reject all the others ... it's

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impractical to keep switching ROMs in and out of the processor board. Even ROM switches which allow the user to select one of several ROMs eventually reach their limits. Several dozen proprietary programs fighting each other for occupancy of a very few sockets won't lead to a healthy and prosperous software industry. There must be a better way: one that doesn't limit the user.

So while the software houses may groan at the loss of one of their favored protection mechanisms, they may find that in the long run they are being encouraged to use a sounder mechanism. My own biased opinion is that there's no better protection than sound documentation, a good warranty system and continuing customer support.

The user, in turn, is likely to welcome the opportunity to acquire much more software without congesting his machine. He will also be enabled to roll his own software, and to adapt commercial ROMs to his own specific needs.

When would you use "regular" memory for your programs, and when would you put them into ROM space? In general, RAM/ROM systems will tend to hold semi-permanent machine language programs; programs that support or supplement Basic or that aid a separate process such as communications input/output. Basic isn't likely to go up there. Temporary machine language programs will use Basic memory so that they will be replaced when the next program is loaded.

The Commercial Boards

It's worth mentioning that fitting RAM into ROM space isn't an entirely new concept. MTU's Visible Memory, for example, fits into PET's ROM memory space, and can be used as RAM/ROM. The two products discussed here are novel in that they plug directly into the ROM socket.

The units described fit the 2532 type socket which provides 4K of memory on the PET. Other units or strappings are available to match various socket configurations.

ROM sockets don't have the proper pin connections to allow memory to be written ... after all, a ROM is intended only for reading. To overcome this, both products are furnished with mechanisms that allow the computer's "write line" to be accessed.

Instant ROM

Instant ROM is produced by Greenwich Instruments Ltd., 22 Bardsley Lane, Greenwich, London, England SE10 9RF. Price in the UK is 57 pounds.

The device is nicely packaged in an enclosure and very compact. It's not hard to imagine carrying one of these around in your pocket. In fact, there's a carrier provided to allow you to do this.

The striking thing about Instant ROM is that it's non-volatile: the memory contents are not destroyed when you turn the power off! How is this posible? The unit contains its own tiny batteries. When external power is lost the batteries take over, and they can keep the ultra low current CMOS memory going for up to three months. When you turn on your computer again, the batteries will be recharged; as little as one hour's use per week will keep the batteries fully charged.

The non-volatility makes Instant ROM a useful device in a wide variety of applications. You don't need to reload memory every time you power up your computer. It's even possible to rewrite your computer's operating system to run to your own specifications. Would you like to see your computer start up with a message like THE JOE DOAKES PERSONAL BASIC SYSTEM? You can do it by replacing the system ROM with an Instant ROM.

The computer's "write line" is picked up on a wire-wrap connector mounted on one side of the package. A special connector is furnished for the PET. If memory is "permanent" and not subject to change, this connector need not be fitted.

Soft ROM

Soft ROM is distributed by Canadian Micro Distributors Ltd., 365 Main Street, Milton, Ontario L9T 1P7, Canada. Price is $129.

The device is a circuit board with a set of ROM pins attached to one edge. The board plugs in vertically. Soft ROM contains A ROM socket on the board; the user can plug in a ROM here and then select whether he wants to use the on-board ROM or the RAM/ROM.

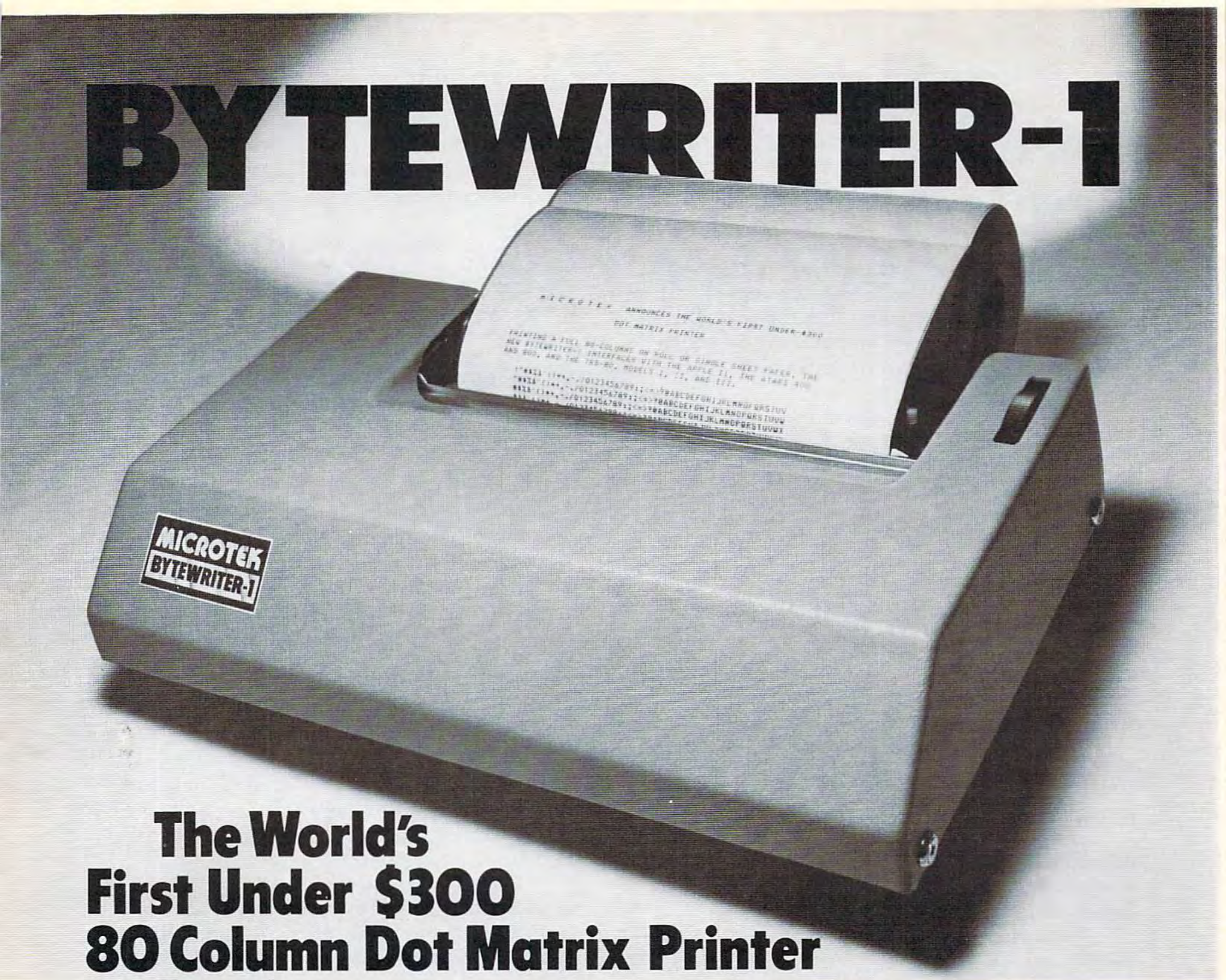
Memory is volatile, so that the user will need to reload the contents of RAM/ROM after power has been off. Soft ROM is suitable for systems which load each package as it's needed.

A connector is provided to pick up the computer's write line. Additionally, a three position switch is provided which extends outside the computer and can be attached to the case. The switch positions are marked: Read/Write; Read Only; Write Only. Read/Write is normal RAM configuration; you can read it or write it. Read Only makes the unit look like true ROM; it cannot be written. Write Only seems puzzling, though: what on earth can you use a Write Only memory for? Answer: it can be used to write into the board even though the computer's write line is not connected; this may be useful in some circumstances.

Summary

It's a new game. Some users will never need RAM/ROMs ... they will plug in the ROMs that they need, if any, and that will be it. Others will appreciate the versatility of the new devices. Each one has its own characteristics and price.

Whether you decide to use one or not, the existence of these new devices will change the way we perceive our computers. We are no longer socket slaves ... these devices will give our programs extra elbow ROM ... ©



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Computers And Society

David D. Thornburg
Los Altos, CA

Every year our neighborhood throws a Fourth of July party, with a pot luck dinner and plenty of entertainment for the kids. Over the years this party has become the *one* annual event at which most of the people in our neighborhood get to visit with each other.

Like many communities in the heart of Silicon Valley, we have a high proportion of residents who either work with or who design computers and computer-based systems. Working for companies like Xerox, Atari, Hewlett Packard, or Lockheed, these people have a solid grasp of the utility, power, *and* limitations of computer technology.

Other residents in our block cover a wide range of professions — contractors, landscape architects, medical doctors, engineers, teachers, *etc.* These people generally have little understanding of the effort needed to make computers do truly useful things.

And it so happens, every Fourth of July, that sometime after dinner, while the kids are getting the fireworks ready, that a doctor (or contractor, or other member of this second group) will say:

"Boy, I don't know about these personal computers. I tried to use one in my business and it was *worthless*. All I use it for now is games — I'm better off keeping my books by hand."

"Just what happened?", one of the "computer" people will ask.

"Well", says the doctor, "I had been reading all this stuff about the microcomputer revolution, and those magazine ads really made an appealing pitch. For a thousand bucks I could buy one of these micros, and I was supposed to be able to write programs which would simplify my business."

"I have a small practice — simple billing procedures, and just a couple of employees — so I figured that what the heck, for a grand or so I could bring my office into the twentieth century. Now I didn't have a whole lot of money to spend, so I went down to the local computer store and picked up a brand new ___________ (fill in with the name of your favorite micro). While I was planning on spending only a thousand bucks, the dealer said that my system was going to be pretty useless without a disk drive and a printer. By the time I got home, I had dropped $3,000 in that place."

"Next, I spent a couple of weeks trying to write a simple billing program in BASIC. After I saw how much time I was pumping into this project, went out and got a consultant to help me. So far I've paid him as much as I paid for the whole system, and I'm still not happy."

During the recitation of this tale of woe, those of us in the computer industry nod reassuringly, and then try to show our disgruntled friend that his problem is quite common, and that it was avoidable.

The universality of this sad tale has taught me that a business person who buys a computer system without first knowing what he or she is going to do with it could save a lot of grief by flushing the money down the drain instead. And yet, computers are being sold to many thousands of people who have no idea what they are getting into.

... a business person who buys a computer system without first knowing what he or she is going to do with it could save a lot of grief by flushing the money down the toilet instead.

When confronted by a professional who has had this problem, my advice has run along one of two channels. First, subscribe to a local time-sharing service which provides all the needed accounting and bookkeeping programs. Even if it means changing one's bookkeeping practices slightly, there is a lot of merit in using a program which is being used by hundreds of other similar users every week. Since low-cost ($5.00/hour) time sharing services are available in our area, once the "mispurchased" computer is converted to a terminal emulator, we are all set.

The second approach is a bit more time consuming, since it involves looking at a whole bunch of "canned" business programs which are available through local computer dealers. Once again, local changes in record keeping might be needed, but this is a small price to pay for the benefit of having a working computer system.

The third alternative is to recognize that the computer was purchased prematurely and that, perhaps, the business just doesn't warrant a high-tech sledgehammer to drive a thumb tack. In this case, the user should stock up on some good games and enjoy the purchase at home.

I have often wished I had a book to give to my friends who are contemplating the purchase of a micro for small business applications. Until now, I haven't seen anything worth recommending. The books I had all were too technical, or too folksy and full of errors. And still, it is obvious that a non-technical business-oriented book on this topic is genuinely needed.

Fortunately my search is over. It was a most pleasant surprise for me to read the recently published **Business System Buyer's Guide** by Adam Osborne and Steven Cook (Osborne/McGraw Hill, $7.95, paper). This well written book is recommended reading for all small business owners who are contemplating the purchase of a computer system.

The authors make the point that such people are not buying a computer, they are buying a solution to the data keeping and processing problems of their business. Accordingly, the first task Osborne and Cook set out for their readers is to analyze their business practices from the perspective of information flow:

How big are the files to be maintained? What are the file requirements? 30,000 characters? More? Less? What are the input requirements? How many hours a day will the keyboard be used? Will you enter much numeric data? What are the output requirements? Is a printer needed? Is letter quality printing required, or is dot matrix OK? How many pages of printout will be generated per day?

By answering these basic questions, the reader is well on the way to defining his or her system requirements. By performing this task before looking at computer systems, the reader is less likely to be swayed by the kinds of hype which got our doctor friend in so much trouble.

Proceeding through an accurate but simple view of the components which make up a computer system, the authors proceed to show how the answers to the original questions can be used to help select a system. By this time, the reader is in contact with a vendor or two, and has a clear idea of what is available.

The authors encourage readers to look at mini- as well as microcomputers if the business applications are complex enough. The high cost of custom software is mentioned several times, and the reader is encouraged to rely primarily on off-the-shelf packages.

The book is rounded out with a surpirsingly accurate (if somewhat incomplete) list of major software packages and hardware systems to aid the reader in making a selection. My only complaint with their list of computers is that some of the smaller companies with excellent products (such as Exidy) were left out. Beyond that, I think that Osborne products received a little more attention than they might have if the book had been written by someone else. I may be too critical here, however, since the authors' treatment of other computers is quite fair, and their description of the Osborne I computer was quite succinct. Nonetheless, all the other computers mentioned had established themselves in the marketplace well before the book was written. To describe the features of the Osborne computer in a book published before any of these computers had been shipped is, at best, risky business.

All in all, **Business System Buyer's Guide** is an excellent book, and one which I plan on getting to my friends who are contemplating the purchase of a small computer for their business.

Who knows? Maybe *this* Fourth of July we can compare Star Raiders™ scores instead! ©

Brief Review:

The Osborne Microprocessor Handbooks

Jim Butterfield
Toronto, Canada

The **Osborne 4 & 8 Bit Microprocessor Handbook**, together with the **Osborne 16 Bit Microprocessor Handbook**, constitutes a formidable source of information on current microprocessors and support devices.

The books are reference in nature, rather than tutorial. They are handy for quickly looking up some characteristic of the Z80 or the 6809, for example: but they wouldn't be particularly well suited for learning how to program a chip. They contain more than just reference sheets, however. Each chip is described in a narrative style giving its major characteristics.

One of the things I enjoy about Adam Osborne's writing is his willingness to offer opinions along with hard facts. This might seem out of place in a book that is primarily reference in nature; but in fact the editorial comments help place the various chips in better perspective. Users may find their understanding is helped by sentences such as: "When it first appeared, the F8 was discussed as an off-beat product with a strange set of chips and a ridiculous instruction set" ... "All other 8080A manufacturers (other than Intel, Siemens and AMD) are unauthorized ... some differences exist." ... "The TMS 9900 product line has for some time been one of the enigmas of the microprocessor industry." You don't have to agree with these comments, but the fact that they are there will often help the reader to understand how a given chip is accepted in the industry.

These two massive volumes (The 4 & 8 Handbook alone has more than 1200 pages) are offshoots of the popular Osborne series, **An Introduction to Microcomputers**, and are intended to replace Volume 2 — **Some Real Microprocessors**. They haven't completely broken away from their former series membership. There are numerous references to Volume 1 and Volume 3 which might puzzle the reader who has bought the Handbooks as separate volumes. In particular, there are references to a hypothetical microcomputer; this turns out to be from Chapter 7 of Volume 1 of the Introduction series, entitled, "An Instruction Set".

The problem with the original Volume 2 was its packaging: it was a loose-leaf volume, intended to be kept up to date with periodic update inserts. The logistics of this proved difficult. As a result, we now have two "fixed" volumes — to update them the user will buy newer editions as they appear. I suspect that most of us will find this more familiar, convenient, and portable.

The titles of the two volumes are slightly misleading. 4 & 8 Bit should have been named, "under 16 bits", since the twelve-bit IM6100 is covered. The 16-bit volume also covers the 2900 chip slice (or bit slice) family, which allows you to have however many bits you would like.

A sample program called a "benchmark" is given for all microprocessors. It's quite useful for gaining an understanding of the style of a micro. Although it's not strictly fair to use a single program as a measure of a processor's goodness, users will at least get a feel for the chip. Oddly enough, the authors themselves rather harshly criticize the value of such a program: "Benchmark programs are misleading, irrelevant and worthless ... we will demonstrate the capriciousness of benchmark programs via the following ... ". Gee ... I found it really useful to be able to look at a piece of sample programming.

COMPUTE! readers have a special interest in the 6502, of course, and are likely to use the 6502 material as their own "benchmark" of how good the book is. They may be disappointed. Much of the 6500 introduction describes the chip comparatively: how it relates to the 6800 and Z80. The dazzling speed of the 6502 — one of its main advantages — is ignored; no instruction timings are given. And worst of all, the instruction set is incomplete: the ROR (Rotate Right) instruction is completely missing. The first chips didn't have this instruction; but all 6502s manufactured since 1976 have ROR.

Summary

The Handbooks are a comprehensive pair of books covering a lot of information on a lot of microprocessors. They don't cover all micros: I missed the trusty old 8008, for example. Chip detail is extensive but not exhaustive, as can be seen from the omitted ROR and missing timing information for the 6502. The books contain opinion as well as fact, but I welcome that: it adds perspective.

I can't completely agree with the statement on the back covers: "This is the one source for complete, objective, and accurate information on 4 and 8-bit/16 bit microprocessors." Even so, they are a good set of books. If you are interested in information on a broad range of microprocessors, you'll do well to have these available.

[**Osborne 4 & 8 Bit Microprocessor Handbook/Osborne 16-Bit Microprocessor Handbook**, by Adam Osborne and Gerry Kane; Osborne/McGraw-Hill, 630 Bancroft Way, Berkeley, California] ©

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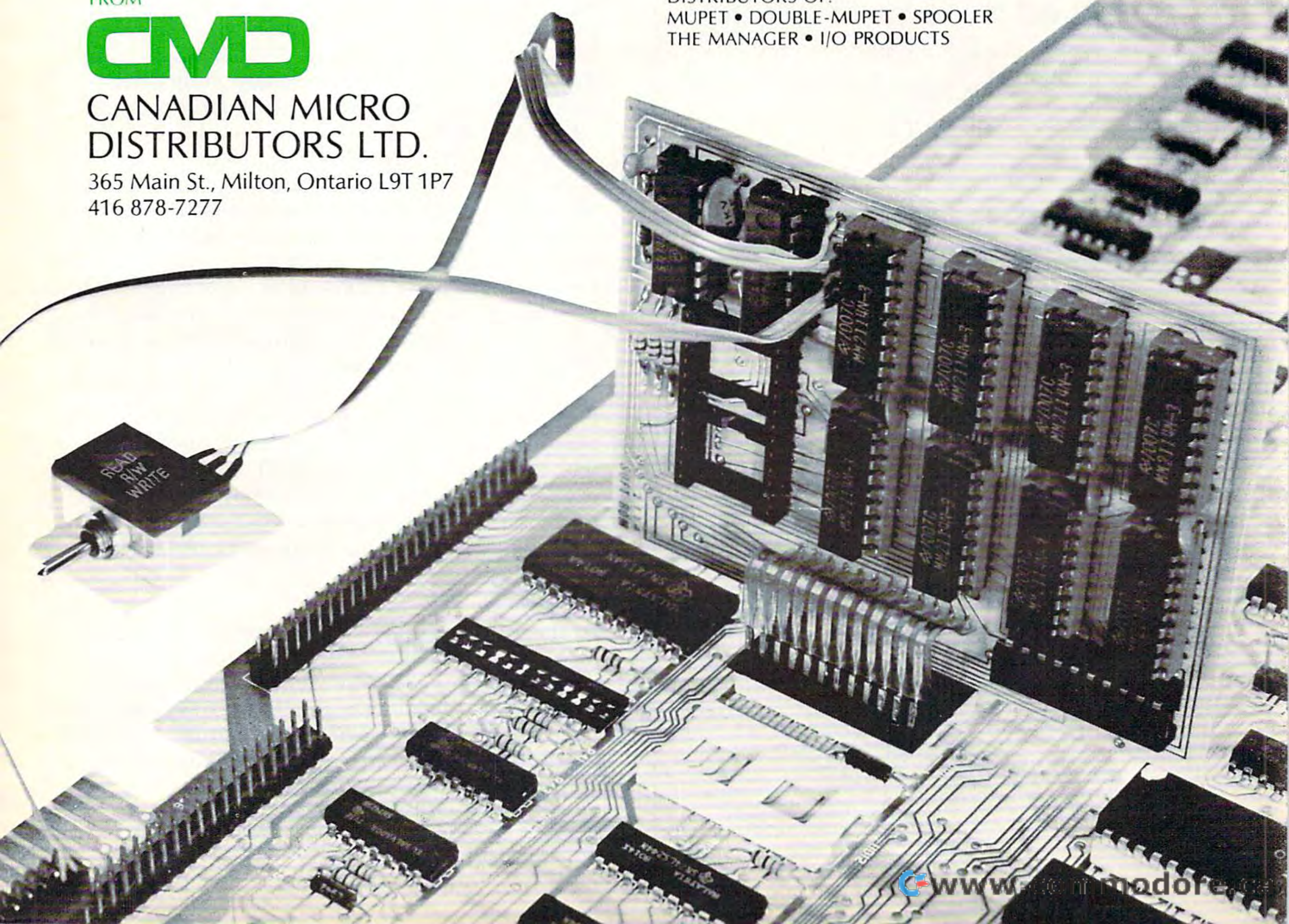

Computer Using Educators

Position Paper On Commercial Software Pricing Policies

LeRoy Finkel
Menlo Park, CA

I. Problem:

Data on magnetic disks and cassettes are subject to damage from student mishandling and because of machine malfunction. It is essential that teachers have backup copies of disks and cassettes at their school sites so that classroom activity can continue uninterrupted in the event of such data loss.

Recent entrants to the computer software business are charging substantial prices for their programs, but many do not allow copies to be made for backup, or for use by other teachers in the same schools. Some firms allow additional copies to be purchased at a discounted price, while others issue a "license" to make X number of copies, or to use in Y classrooms, or on Z number of computers or terminals. Still other companies allow unlimited copies for classroom use at "the school" or will issue a license to an entire school district. There is no consistency in policies. If the restrictive policies become the accepted standard, they will produce insurmountable difficulties for schools and will inhibit the increased and productive use of computers in education.

These restrictions can lead to either very expensive educational programs, to underutilized computers, to unsold software, or to casually ignored license agreements. Our desire to minimize the occurence of each of these events leads to this position paper. We hope to encourage a dialog between the educational community and software producers.

II. Position:

At the current time, CUE (Computer Using Educators) encourages schools and educators NOT to purchase computer software from commercial sources who prohibit the purchaser from making free backup copies or who fail to provide reasonable arrangements for the use of the software on all computers operated at the school site.

III. Background:

The computer software industry is in its infancy.

Policies are in the making and the legality of software copyrights is being decided in the courts. Large firms, who are new to education or new to computers, are entering the software market. They have made substantial commitments to software development and it is quite natural for these firms to seek to protect their investment.

CUE understands the position of software distributors in this case. We realize that unless proper compensation can be derived from distributing software, this all important source of educational materials could dry up, to the detriment of all.

The early sellers of software warned users not to make copies for resale or profit. A further implied warning was not to impose on the sale of the materials (in other words, don't give away copies to others who might otherwise purchase the items).

CUE proposes a policy based on the school unit...

Then came Personal Software Inc., with their VisiCalc software for Apple computers. Apple VisiCalc contains locks that make it impossible to copy the program. For $150, the buyer gets one non-copyable disk that is guaranteed against defects, but not against machine malfunction, student abuse, etc. (a recent policy change allows original purchasers to buy one backup disk for $30). VisiCalc has tremendous potential as a classroomm management tool for teachers as well as providing a programming-type skill that we can teach to students. But not at $150 per student (Radio Shack VisiCalc does allow copies for personal use but the policy appears to be changing).

We have now spoken to four major companies who are new entrants to the computer software field. Each seems to be "field testing" non-copy policies similar to those used by Personal Software Inc. to see if they can, indeed, sell software to schools with these restrictions. We believe that resistance on the part of educators will inform these companies that while such a policy may be appropriate for industry or home use, it lacks sensitivity for the needs of education.

In a personal or small business environment, there will be only one or two computer stations being used, normally by competent personnel. In a school, however, with many stations per school, there may be hundreds of inexperienced students using the computers each day. The hazards that our computers and disks are exposed to daily far exceed the hazards that an industry installation might receive in a year. Must we be held financially accountable for the malfunction of our computers and our students? Apparently so, said the salesman from one large company new to this segment of

His response to our query was, "If you crack up your brand new car, you can't take it back to the dealer, can you?"

the industry. His response to our query was, "If you crack up your brand new car, you can't take it back to the dealer, can you?". It seems that some of these firms have not given enough thought to the problems that educators have and that the car analogy is not relevant.

IV. Proposed Solution:

The major publishers and software vendors are seeking to gain a fair return on their investment. They are entitled to that. What they fear is that indiscriminate copying will erode this return.

What kind of policy will meet our requirements and at the same time protect their investment and return? What kind of policy will allow teachers to make enough policies to use on multiple computers in one room, OR multiple rooms in one school, OR multiple teachers in the same school, OR multiple schools in the same school district?

What kind of policy will be acceptable and be respected and honored by educators? The solution must be compatible with school financial policies. In most schools, budgets are allocated on a school-by-school basis. Likewise, Federal and State funding is allocated to districts and then reallocated to individual school sites. Therefore, a software licensing policy that allows unlimited copies at the school site-of-purchase may be a fair policy and compatible with existing school purchasing policies.

CUE proposes a policy based on the school unit, or as one software vendor put it, "for use in the same building or physical complex." Any software is "licensed" to that school, to be copied and used by any and all teachers in that one school regardless of the number of computer stations or type of installation. To be fair to smaller schools and to vendors, we further propose a sliding scale based on school enrollment.

As an organization, CUE will work to insure that educators are informed of the importance of copyrights and licensing, and we will strongly urge our colleagues to respect and abide by such agreements. ©

Mapping And Modifying Unknown Machine Language

WordPro 4

Editor's Note: Although this article specifically deals with Professional Software's WordPro 4™, the material as presented is useful to any reader interested in learning more about machine language.

Richard Mansfield
Philipsburg, PA

At one time or another, all machine language programmers will face the challenge of modifying a large, undocumented program. If the program is your own, if you have documented the routines and major variables, the problems are relatively minor. But if you buy WordPro 4 Plus and want to run a Centronics printer with it — the challenge is severe. WordPro 4 Plus contains roughly 21,000 bytes of machine language code. And nothing but your wits and patience will help you unlock its secrets.

Experienced machine language programmers will forgive me if I seem to over-explain things. Without sufficient detail, however, articles such as this are useless to the majority of computer enthusiasts and contribute nothing to an understanding of machine language programming. For this reason, I will discuss techniques which I have found generally useful in analyzing unknown code and then explain some of the details of WordPro 4 Plus and how they can be used to customize the program for particular hardware and wordprocessing needs.

The Mountain Of Mystery Code

For several years I have been intrigued (and in awe) of the maps and lists provided by Jim Butterfield of BASIC machine language code. And, while I have written a good amount of machine language, the task of trying to untangle someone else's massive program seemed filled with pitfalls. I was happy to let Butterfield work his magic. Then things changed. I had to tackle a mountain of unknown WordPro 4 Plus code. I do consultant work for Maines Data Service in Pennsylvania and they wanted to put WordPro 4 Plus to work on a Centronics 737. The program is designed to work with NEC, Diablo, CBM, and other printers, but not Centronics.

For letter-quality printing, the Centronics uses a character set called "proportional" which looks very like typewriting. Each time the printer is powered up, it must receive two numbers from the computer — 27 and 17 — which alert it to use the proportional mode until further notice. The 27 is a special number (ESC, literally "escape" — meaning "take notice, something unusual follows") and it generally preceeds special printer codes. The 17 is notification that the printing style is to be proportional. WordPro 4 Plus will not send these numbers to the printer. The program was not written with any provision for Centronics.

It is possible, by defining special characters within a text, to send such numbers from within WordPro 4 to a printer. But this is unnecessarily complicated and needs to be remembered each session. Clearly, it would be desirable were the program to send the code automatically. Computers, as one of their primary advantages, automate. And, more important, the less complicated a program is to operate, the easier it is to demonstrate and to sell to businessmen. During demonstrations, you do not want to be typing in special symbols and odd codes just to get the printer set up. This has a chilling effect on prospective buyers.

techniques ... generally useful in analyzing unknown code ...

And WordPro 4's initialization sequence asks several questions such as the disk device number, printer number, ASCII? etc., all of which could be programmed in to save time and to customize the program for a specific hardware configuration. Finally, the underlining routine within WordPro 4 does not work correctly with Centronics. That should be fixed too. The machine language code will have to be mapped and studied. Unlike BASIC, which is essentially *lineal*, machine language does not proceed clearly from one job to the next. Rather, it is comprised of hundreds of interwoven, nested, and sometimes self-modifying routines. In BASIC, a main loop is fairly obvious (FOR ....NEXT or something similar), but in machine language, the main loop might be several dozen JSR statements of obscure purpose.

What to do? Like many machine language programs, WordPro 4 starts off with a little touch of BASIC on the theory that typing RUN is simpler than SYS 1037. If you load, then list WordPro 4, you will see 10 SYS 1037 on the screen. This means that the program proper begins at 1037. It starts there to make room for that BASIC line. Since the first thing we want to do is to send our code characters to the printer, we can just squeeze in the following without disturbing the body of WordPro 4:

```
1OPEN4,4:SYS864
```

This allows us to easily open the correct I/0 (in/out) channel to the printer (and I/0 is the most

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See your nearest Commodore dealer for a demonstration of this outstanding business software system.

CMS Software Systems

5115 MENEFEE DRIVE • DALLAS, TX 75227 • 214-381-0690 tricky, most complex aspect of machine language programming). So, we don't bother doing it in machine language. We let BASIC do it for us. The very first thing that WordPro 4 does will be to jump to a vacant area of lower RAM (cells 860-1017) and perform what's in a little program that sends the proper numbers to the printer and then jumps back up to the start of WordPro 4 as if nothing had happened.

```
0360 LDX #$04
0362 JSR $FFC9
0365 LDA #$1B
0367 JSR $FFD2
036A LDA #$11
036C JSR $FFD2
036F JSR $FFE7
0372 JSR $FFCC
0375 JMP $17CC
```

This routine first puts the peripheral device number into register X. The printer is usually #4 and the next command (JSR FFC9) wants to have that device number in the X register. This JSR sets up the proper channels so that the computer will correctly talk to an external device. In this case, preparations will be made to send something to the printer.

Then we load the A register (the accumulator) with 1B which is the hex equivalent of 27. And we send that number to the printer along the already arranged channels. JSR FFD2 is an extremely common routine in machine language in Commodore computers. It sends a byte, usually to the screen, which has been placed in the accumulator. Next we put an 11 (17 decimal) in and again send it to the printer. Now our Centronics knows (it has a memory and some intelligence) that it will be printing in the proportional mode.

The next two JSRs (jump to subroutine) are into CBM BASIC also. We save a great deal of time by using routines already in ROM BASIC for these tasks. FFE7 aborts (cancels) all the channels set up previously. In this case, it cleans up the output to the printer so that no additional bytes can sneak in after the 27 and 17. If they did, they would be the first thing printed later on since they would remain first in line on the printer's buffer (holding area). Writing to a Mr. O'Connor, we might then see:

?,#Dear Mr. O'Connor:

The first three characters went into the printer without our realizing it. After this, we JSR to FFCC which restores the default (the conditions that the computer sets up when power is turned on) values for the output channels. With the default conditions reestablished, anything sent to FFD2 would print to the screen which is what the computer expects unless it deliberately changes the output status.

Finally, we jump directly into the WordPro 4 machine language code. This is where WordPro 4 initializes *its* default status and makes other necessary preparations. How did we know to jump to address 17cc (6092 decimal)? When we first examined WordPro 4, we noticed that its BASIC consisted of 10 SYS 1037. So, we looked at this address with our monitor and it was a jump to 17cc. Since we were merely adding some printer-specific code, we substituted a jump to 0360 *before* any WordPro 4 activities and then, at the conclusion of our tasks, we simply jumped up to where WordPro 4 wanted to go in the first place.

In this case, we did not need to worry about saving registers because nothing had happened yet in WordPro 4's world. Usually, however, care must be taken when jumping out of the middle of a machine language program. There are three registers (temporary data storage cells) in the 6502 CPU (central processing unit). Each is important and can contain necessary information. If you write your own routine (or access a part of BASIC) you will probably cause changes in one or more of these registers. Then, when you return to the host program, it will find the registers changed. This leads to unpredictable mixups. To be on the safe side, it is best to set aside a few bytes of your lower RAM area and when you enter your parasite routine, the first thing done is to save the X, Y, and A register values. In addition, it does not hurt to PHP which saves the status of processor flags (indicators that the last performed task resulted in a zero, or an overflow, or a negative, etc.) — they can be important to the host program as well.

These saves are then reloaded back into their registers (PLP restores the processor status flags) just before returning to the host program. In some cases this is not essential, but it is not hard to do and can save hours of bug hunting later.

Simplifying The Task

It was not so very hard to do these things because the program has not yet taken control of the computer. A number of programs leave you some room to do similar initializing before jumping to their start-up procedures. After the program takes hold, on the other hand, things get rougher.

Visicalc, WordPro 4, and other popular machine language programs do take control of the computer. The STOP key is blocked. Once you're in the program, you follow their rules. A provision is usually made for exiting to BASIC (in WordPro 4 you type ESC, Shift, Q), but you also wipe out the program itself. So, to modify the program, the first thing to do is to determine where it is inputting your keyboard responses. Then, before it analyzes the meaning of what you type in, you can jump down to lower RAM again where another of your parasite routines awaits. You could then make Q mean anything you want it to. If some other letter were typed, the parasite throws program control back up to the host. This allows the addition of personalized features and commands to programs.

Before going into the details of adding features to WordPro 4, it is worth noting that WordPro 4 is more than a program. Like Visicalc and some few others, it is a *language.* The bulk of ROM — BASIC and the operation systems, tape and machine language monitor, part of DOS (disk operating system), interrupt, screen, and keyboard control, and initialization — all of this uses up about the same space (in ROM) as WordPro 4 uses up (in its RAM and a crypto-ROM chip). In effect, when you RUN WordPro 4, it is to the computer what BASIC is. It has a set of commands and rules like BASIC. WordPro 4 might well be thought of as a wordprocessing language which temporarily dedicates the computer to writing jobs. BASIC is a language which develops computer programs. Visicalc, too, is a language. It models arithmetic relationships and is, in essence, an econometrics system simplified.

But back to our effort to examine WordPro 4. In the way that Toolkit adds new commands to BASIC and Supermon adds new features to the machine language monitor, we want to be able to break into the control loop of WordPro 4 and add a command or two. Commodore has thoughtfully provided us with an easy way to amplify the machine language monitor. Addresses 03FA and B can be poked with the address of a parasite routine. The machine language monitor, in the course of its activities, will go first to the address in this vector (target). Usually, the vector points right back to the monitor, but you can change that. As of now, though, no published software no matter how expensive, provides user extension vectors. You have to break in yourself. And, first, you have to find out where, in the jumble of twenty thousand bytes, this breakpoint is. And the stop key does not work.

Breaking Into Unknown Code

Doubtless there are other ways, but here are some techniques which I have found to be helpful in mapping machine language. The first one might be called ASCII Hunting. This is a two-step process.

Most programs will need to print messages (prompts, error listings, etc.) to the screen. And these messages are usually stored as a table (stored together) and separated from each other by a 0 which signals the end of any particular message.

A common way to print a canned message to the screen in machine language is:

```
     LDY #$00
2001 LDA $0730,Y    LOOP START
     BEQ $2010
     JSR $FFD2
     INY
     JMP $2001    END LOOP
2010 (continues with something else)
```

What is happening here is that the Y register is loaded with a zero (so it can be used as an increasing

counter to point to each letter of the message in turn). Then (at address 2001) we load the A register with whatever appears in the address $0730 *plus* the value of Y (so, the first time through this loop, it will load the letter found at address $0730 itself). The BEQ means Branch if EQual. In BASIC it would be: IF A=0 THEN GOTO (2010). So, if the A register ever gets a zero loaded into it, it will end the printout and jump to $2010 where more code will lead it into other aspects of the program. If not a zero, however, it falls through to the familiar jump-to-subroutine $FFD2 which prints that character to the screen. Next the Y register is incremented (1 is added to it) and we JMP (jump. BASIC would be GOTO) back to load the next letter in the message.

This routine can be placed in lower (between 860 and 1000, decimal) RAM and used to check through the entire WordPro 4 code for any ASCII texts. WordPro 4 starts at 0400 and ends at 55D0. After such checking, it will be discovered that most of the text messages are strung together between addresses 0700 and 1000. This is helpful information.

Most Monitor Extension programs, such as Extramon and Supermon, contain a pattern-matching routine. This allows you to specify a particular piece of program code and all addresses where the same code appears in a program will be printed out for you. So, to find out where WordPro 4 is printing out something, you can match the pattern: JSR $FFD2 INY JMP and you will find a number of such routines. In addition, you could specify particular ASCII, such as "SYNTAX ERROR" and find the location of that ASCII pattern. In this way, you are building a map of some addresses within WordPro 4 which will later help you to understand it.

With a list of the starting addresses of the various ASCII texts, you can pinpoint where they are called from within the program. It is likely that a message printout of "Clear all tabs" will be called from within the section of the program which handles tabulation. Knowing that "Clear all tabs0" appears at, say, 0800, you will try pattern matching this: LDA $0800,Y. If this code appears anywhere, it is a request for that particular message. A map can begin to take vague shape from such matches.

Life, though, is not perfect. While this traditional printout routine does appear within WordPro 4, another method is also used. A separate subroutine, dedicated to screen message prints, wants you to split the target address between the X and Y registers before JSRing to it. The LSB (least significant half) of an address is loaded into the X and the MSB into Y. Then JSR to $1633. This $1633 routine operates like our example routine above, looking for the delimiting zero and all. The problems is that your pattern match will have to be, for target 0800, LDX #00 LDY #08 JSR $1633. And, when the program wants some leading blanks and a carriage return, the JSR is $1624. But, never mind. Learning these little variations makes your next mapping job easier.

But, one might well ask, how can we modify the program without mucking it up? It was easy enough (well, sommewhat easy) to break in at the start, but how can we break in where the code is packed together, wall-to-wall bytes? A reasonable question. To demonstrate, we might as well do something useful to WordPro 4. Let's get rid of that annoying start-up quiz.

As mentioned, programs must be fairly general. The author of WordPro could not know in advance if you are using a standard disk drive (device #8) and a standard printer (device #4) in the usual Commodore configuration. What's more, he does not know which printer you are using. It might be a Diablo, a NEC, a Commodore, a Spinwriter, a Centronics or something else. This requires a quiz. When you first load WordPro 4, it always asks several questions so it knows what sort of text codes your printer wants and the locations of your peripherals. This quiz quickly becomes boring and you wish that you could just skip it. You wish that the program could incorporate this information without having to waste your time.

The first thing that WordPro 4 does is to print:

What Kind of Printer:
Spinwriter, Diablo, Qume, TEC, or Other?

We'll get rid of this question. We want to put an "O" for "Other" in, but automatically. First, we locate (as described above) the printout of this question. We also remember that a GET from screen (usually) is JSR FFE4. We track this down to a zone of code starting at address $54CB. (See example 1).

At once we can see something familiar about 54CB and following. It is the load X, load Y and subroutine to 1633 for printout. Note that this particular ASCII message starts at $5539 instead of from within the ASCII table at 0730-1000. There is no particular reason for this; the location only suggests that it was added to the program late and stuck near the top. In any event, after the printout, we GET a byte with FFE4. You would be typing a D here for Diablo, or a Q for Qume, etc. But we want neither the printout nor the GET. Just write over it. Cover what you want to eliminate with something you want done.

You could always resort to the 3-byte JSR $0380 cover, which, in tightly packed code might be necessary. You would change nothing about 54d2, for example, if you were to replace it with JSR $0380 and then at $0380 you put in JSR FFE4 and at $0383 RTS. What you would have done is to take a quick trip out of WordPro 4 and

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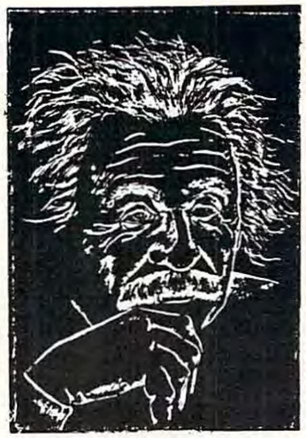

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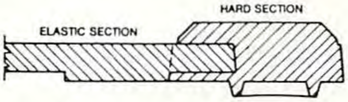

THE KEYBOARD

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

THE DISPLAY

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

The number of characters available in the memory

When the printer is in an error condition

When a pre programmed form layout has been selected

When the printer is operating from the internal memory.

What characters will be inserted into an existing text.

When the memory for the previous line has been selected.

A warning message that the end of the page is being approached.

That a hyphenation decision must be made

PRINT MODE

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

traditional printing;

underlined characters;

true bold characters where the horizontal component of the character is increased without disturbing the vertical component;

characters which are both bold and underlined, and;

a feature unique among computer printers-printing in reverse — white on black, sort of reverse video on paper.

MULTILINGUAL CAPABILITY

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

THE FEATURES

Automatic justification of the right margin

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

Phrase and format storage

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

Automatic centering

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

Automatic vertical lines

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

Automatic tab sequence recall

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

Paragraph indent

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

Automatic decimal point location

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

Column layout

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

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

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

When you do, you will realize the TYPRINTER 221 is an intelligent electronic typewriter, a text formatter — and a brilliant computer printer — available at a suggested list price of only $2850.

TYPRINTER 221 is available at your local computer shop — or we'll tell you where you can see and try one if you call us at

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simply replicate what it would have done. Clearly, though, you would add some tasks of your own since the purpose of such a trip would be to modify the program in some way. And, too, you would want to save all register and processor flag conditions as described above.

But we need not resort to a quick trip. We've got the space here to overlay our additions within the program proper. So, our job is to first eliminate the printing out of the question itself. At $54CB we can put in an LDA #$4F. This has the effect of putting an "O" into the Accumulator just as if the GET had taken place and we had typed "O" into the keyboard. Now, we can put in a JMP $54DB. This jumps over the $1633 printout, the $FFE4 GET, and lands right where we want to continue. All those CMP's are comparing the Accumulator to the number which follows. It compares for an "S" (53) Spinwriter and a "D" (44), and so on. And, based on these comparisons, it branches to appropriate addresses which set conditions within WordPro 4 to harmonize with those printers. This is machine language for ON GOTO. Since we've already loaded the Accumulator with our "O" we just jump right to the branch comparison at $54DB.

At this point, carpers will ask why, if you can see that the branch will send you immediately to $551F, why not JMP $551F directly? This would be poor modification technique. A program as grand, as interwoven, as WordPro 4, flies all around within itself. As with a Fourth of July sparkler, it is devilishly difficult to know exactly what patterns are being set up, what causes lead to what effects. You have a shimmering uncertainty in large machine language programs, a case of what physicists call the uncertainty principle. Touch one variable the wrong way and you can send devastating vibrations undulating throughout the entire structure. Put another way, the less you mess with it the better.

A CMP instruction is central to machine language. It is the IF/THEN and ON/GOTO decision making event. It subtracts the number in the Accumulator from the argument. In our example, 4F-4F. The result is zero so we BEQ (Branch if EQual — the number will be equal if a subtraction results in zero). It is important to note that while the numbers are not themselves affected, other things are. A CMP changes the processor flags. These flags represent the effects of any operation, such as CMP, which disturbs them. Later testing of these flags by the program had better find them in the appropriate states. CMP will set the Z flag if there is an equality (as in our example) or it will reset itself if there is an inequality. The N flag responds to the sign bit (the seventh bit) in the case of negative result. And the C flag responds by a set when the Accumulator is equal to or greater than the argument. A CMP is generally followed by a BEQ, BCS, etc. branch instruction which tests these flag conditions (without affecting them). What's important about all this is that you want the flags to remain as they would have been had you never tampered with the program. So, let the CMP take place and let it set flags the way it would have. Sometimes, trying to be too smart will result in much wasted time tracking down odd program behaviors. This is what the British, in their wisdom, call "too clever by half."

Now the question and the GET have been eliminated. One thing remains to be done. Unlike INPUT, GET does not leave anything on screen to echo what you typed. Therefore Wordpro JSR $FFD2's later on to put the result of the GET on the screen. We don't want a stray "O" up there, so we can replace the three bytes starting $5524 with EA EA EA. This is the instruction NOP (no operation) and the computer slides right over it.

Eliminating The Rest Of The Quiz

Similar operations will take care of the other questions. Fix $18C3 to remove "Printer Device #?,"$18E6 for "Printer: CBM, ASCII, or Spinwriter?," and $193C for "Disk Device #?". We are deliberately leaving one input — the question which decides the number of lines for main versus extra text. This could be removed, too, if it does not serve any purpose. Most users, though, will want to define it.

If you want to add a feature for text input (following an ESC) look into the loop at $1E55. Be sure to reload Y with #$08 and X with #E0 just before you RTS out of your parasite code. And if your printer does not respond correctly to the underline convention (brackets), modify the code around $410F. The #$08 is a backspace convention. This routine must, of course, take into account the need to avoid underlining margins when an underline runs over from one line to the next.

There are a variety of other ways to map machine language. You can write a routine which drags nested subroutine addresses out of the stack via PLA TAX PLA. You could look for JSR's to known routines in BASIC ROM — very few appear in WordPro 4 though. If you are lucky and can avoid SEI or other problems, you might try single-stepping. And, of course you can set BRK (break, STOP in BASIC) breakpoints to check things and isolate program routines. Problems do arise. For example, large programs will need space to store variables. It will probably be the space which you are hoping to use for your monitor extension (Extramon) helper. Interrupt vectors will be tampered with. And so on. Trying to get a disassembly following a run of the program can be sticky. Variables may have overwritten your disassembler. But, with patience and some luck, you'll get your map, you'll learn alot about machine language, and you'll have more fun than any other computer game could provide. ©

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A Floating Point Addition And Subtraction Routine

Marvin L. De Jong
The School of the Ozarks
Pt. Lookout, MO

I. Introduction

In previous articles in **COMPUTE!** we have described:

1) A program to convert a decimal number from the keyboard into a floating-point binary number,

Except for a few JSR and JMP instructions, the routine is relocatable. It would not be difficult to put all of these routines in PROM.

2) A program to convert a floating-point binary number to a decimal number and output the number.

3) A program to multiply two signed floating-point binary numbers,

4) A program to divide two signed floating-point binary numbers.

In this article we give a program that adds or subfracts two signed floating-point binary numbers. The programs complete a four-function package.

II. The Subtraction And Addition Routines

As before, three accumulators are used. The contents of accumulator A (ACCA in the program) are subtracted from the number in accumulator B (ACCB), and the result is stored in the result (RES) accumulator. Finally, the answer is moved back to a modified accumulator A that can be used by the output (floating-point binary to BCD routine) program. In the case of the addition program, the numbers in the two accumulators, A and B, are added rather than subtracted.

Accumulator A occupies locations $0000 through $0003 with a guard byte at $0004. The byte at $0000 is the most-significant byte. Accumulator B occupies locations $0020 through $0023 with a guard byte at $0024. The result accumulator is at $0010 to $0014. When the calculation is finished the answer is moved to the accumulator used by the floating-point binary to BCD routine to output the answer. Our accumulator architecture is identical in the four arithmetic function programs.

Here is the algorithm. It makes use of the fact that subtraction can be accomplished by changing the sign of the subtrahend and then adding. From algebra we know

$$a-b=a+(-b).$$

1. Entry point for subtraction. To subtract, complement the sign byte (ACCS) of A, then add.
2. Entry point for addition. Rotate smaller number right until exponents are the same (ACCX = BCCX).
3. Are the signs the same? Yes, go to 4. No, go to 8.
4. Sign of result = sign of addends.
5. Add the numbers.
6. If there is a carry, rotate right one place and increment exponent.
7. Go to round routine (part of multiplication listing).
8. Form the twos complement of the negative number.
9. Add the numbers.
10. If carry results, then the answer is +. Go to 7.
11. If no carry results, then the answer is –. Form the twos complement of the result. Go to 7.

These add and subtract routines use the same round instructions that the multiplication routine used, starting at DETOUR ($0C7D), and those instructions are not repeated here. Thus, you will find a JMP DETOUR instruction near the end of the routine. Except for a few JSR and JMP instructions, the routine is relocatable. It would not be difficult to put all of these routines in PROM. A driver program to test the routines is given in Listing 2.

Listing 2. An Input/Output/Add (or Subtract) Calling Program.

```
$0050 20 00 0E    JSR INPUT    Call the BCD to Floating-Point
                               Binary Routine.
$0053 30 B0 0F    JSR SUB1     Call the subroutine to modify
                               the accumulator.
$0056 20 C0 0F    JSR SUB2     Transfer ACCA to ACCB.
$0059 20 00 0E    JSR INPUT    Get the second number.
$005C 20 B0 0F    JSR SUB1     Fix the accumulator again.
$005F 20 00 09*   JSR SUB      Subtract the second number
                               from the first.
$0062 20 00 0B    JSR OUTPUT   Output the result using the
                               Floating-Point Binary to BCD
                               Routine.
$0065 00          BRK
*Change to 20 06 09 for addition.
```

```
SOURCE FILE: SUBADD
0C7D:          DETOUR  EQU  $0C7D
0027:          BCCS    EQU  $0027
0005:          ACCX    EQU  $0005
0007:          ACCS    EQU  $0007
0020:          ACCB    EQU  $0020
0025:          BCCX    EQU  $0025
0010:          RES     EQU  $0010
0000:          ACCA    EQU  $0000
----- NEXT OBJECT FILE NAME IS SUBADD.OBJ0
0900:                  ORG  $0900
0900:A5 07     SUB     LDA  ACCS       ;ENTRY POINT FOR SUBTRACTION
0902:49 FF             EOR  #$FF
0904:85 07             STA  ACCS
0906:A5 05     ADD     LDA  ACCX       ;ENTRY POINT FOR ADDITION
0908:C5 25             CMP  BCCX       ;COMPARE EXPONENTS
090A:F0 54             BEQ  OPRAT
090C:30 2A             BMI  ADJA
090E:A2 FB             LDX  #$FB
0910:A0 05             LDY  #05        ;CHECK FOR ZERO MANTISSA
0912:B5 25     BR1     LDA  ACCB+5,X
0914:D0 06             BNE  ROTB
0916:88                DEY
0917:F0 10             BEQ  ZEROB
0919:E8                INX
091A:D0 F6             BNE  BR1
091C:A2 FB     ROTB    LDX  #$FB       ;ROTATE MANTISSA RIGHT
091E:18                CLC              ;AND INCREMENT EXPONENT
091F:76 25     BR2     ROR  ACCB+5,X
0921:E8                INX
0922:D0 FB             BNE  BR2
0924:E6 25             INC  BCCX
0926:18                CLC
0927:90 DD             BCC  ADD
0929:A0 08     ZEROB   LDY  #08
092B:A0 08             LDY  #08        ;MY MISTAKE.  WHO NEEDS TWO LDY'S?
092D:A2 FB     UP      LDX  #$FB       ;MIGHT CATCH A COPYRIGHT VIOLATOR?
092F:76 05     HERE    ROR  ACCA+5,X
0931:E8                INX
0932:D0 FB             BNE  HERE
0934:88                DEY
0935:D0 F6             BNE  UP
0937:60                RTS
0938:A2 FB     ADJA    LDX  #$FB       ;CHECK FOR ZERO MANTISSA AGAIN
093A:A0 05             LDY  #05
093C:B5 05     BR3     LDA  ACCA+5,X
093E:D0 06             BNE  ROTA
0940:88                DEY
0941:F0 0F             BEQ  ZEROA
0943:E8                INX
0944:D0 F6             BNE  BR3
0946:A2 FB     ROTA    LDX  #$FB       ;ROTATE MANTISSA RIGHT
0948:18                CLC              ;AND INCREMENT EXPONENT
0949:76 05     BR4     ROR  ACCA+5,X
094B:E8                INX
094C:D0 FB             BNE  BR4
094E:E6 05             INC  ACCX
0950:90 B4             BCC  ADD
0952:A5 25     ZEROA   LDA  BCCX       ;ADDEND IS ZERO
0954:85 05             STA  ACCX
0956:A2 03             LDX  #03
0958:B5 20     BACK    LDA  ACCB,X
095A:95 01             STA  ACCA+1,X
```

```
095A:95 01           STA  ACCA+1,X
095C:CA              DEX
095D:10 F9           BPL  BACK
095F:60              RTS
0960:A5 07    OPRAT  LDA  ACCS        ;CHECK THE SIGNS OF THE ADDENDS
0962:C5 27           CMP  BCCS
0964:D0 19           BNE  OPPOS
0966:20 DC 09        JSR  ADDNUM      ;ADD NUMBERS OF LIKE SIGN
0969:90 11           BCC  BR8
096B:A5 05           LDA  ACCX
096D:69 00           ADC  #00
096F:85 05           STA  ACCX
0971:50 01           BVC  BR6
0973:00              BRK
0974:A2 FB    BR6    LDX  #$FB
0976:38              SEC
0977:76 15    BR7    ROR  RES+5,X
0979:E8              INX
097A:D0 FB           BNE  BR7
097C:4C 7D 0C BR8    JMP  DETOUR
097F:A5 07    OPPOS  LDA  ACCS        ;COMPLEMENT THE NEGATIVE NUMBER
0981:F0 40           BEQ  CMPB        ;THEN ADD
0983:A2 04           LDX  #04
0985:B5 00    BR9    LDA  ACCA,X
0987:49 FF           EOR  #$FF
0989:95 00           STA  ACCA,X
098B:CA              DEX
098C:10 F7           BPL  BR9
098E:A0 04           LDY  #04
0990:38              SEC
0991:B5 00    BR10   LDA  ACCA,X
0993:69 00           ADC  #00
0995:95 00           STA  ACCA,X
0997:CA              DEX
0998:10 F7           BPL  BR10
099A:20 DC 09 FORTH  JSR  ADDNUM
099D:90 06           BCC  BR11
099F:A9 00           LDA  #00
09A1:85 07           STA  ACCS
09A3:F0 1B           BEQ  BR14
09A5:A9 FF    BR11   LDA  #$FF
09A7:85 07           STA  ACCS
09A9:A2 04           LDX  #$04
09AB:B5 10    BR12   LDA  RES,X
09AD:49 FF           EOR  #$FF
09AF:95 10           STA  RES,X
09B1:CA              DEX
09B2:10 F7           BPL  BR12
09B4:A2 04           LDX  #04
09B6:38              SEC
09B7:B5 10    BR13   LDA  RES,X
09B9:69 00           ADC  #00
09BB:95 10           STA  RES,X
09BD:CA              DEX
09BE:10 F7           BPL  BR13
09C0:4C 7D 0C BR14   JMP  DETOUR      ;GO TO ROUNDING ROUTINE
09C3:A2 04    CMPB   LDX  #04
09C5:B5 20    BR16   LDA  ACCB,X
09C7:49 FF           EOR  #$FF
09C9:95 20           STA  ACCB,X
09CB:CA              DEX
09CC:10 F7           BPL  BR16
```

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Phone: (212) 889-8975

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```
09CE:A2 04              LDX   #04
09D0:38                 SEC
09D1:B5 20      BR15    LDA   ACCB,X
09D3:69 00              ADC   #00
09D5:95 20              STA   ACCB,X
09D7:CA                 DEX
09D8:10 F7              BPL   BR15
09DA:30 BE              BMI   FORTH
09DC:A2 04      ADDNUM  LDX   #04        ;SUBROUTINE THAT DOES THE ADDITION
09DE:18                 CLC
09DF:B5 00      KCAB    LDA   ACCA,X
09E1:75 20              ADC   ACCB,X
09E3:95 10              STA   RES,X
09E5:CA                 DEX
09E6:10 F7              BPL   KCAB
09E8:60                 RTS

*** SUCCESSFUL ASSEMBLY: NO ERRORS
```

```
  00 ACCA          20 ACCB          07 ACCS          05 ACCX
0906 ADD         09DC ADDNUM      0938 ADJA        0958 BACK
  27 BCCS          25 BCCX        0991 BR10        09A5 BR11
09AB BR12        09C0 BR14        0912 BR1         09B7 BR13
09D1 BR15        09C5 BR16        091F BR2         093C BR3
0949 BR4         0974 BR6         0977 BR7         097C BR8
0985 BR9         09C3 CMPB        0C7D DETOUR      099A FORTH
092F HERE        09DF KCAB        097F OPPOS       0960 OPRAT
  10 RES         0946 ROTA        091C ROTB       ?0900 SUB
092D UP          0952 ZEROA       0929 ZEROB
```

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By Netronics

ASCII/BAUDOT, STAND ALONE

Computer Terminal

COMPLETE FOR ONLY . . .

$149.95

ASCII/BAUDOT
Computer Terminal Kit

The Netronics ASCII/BAUDOT Computer Terminal Kit is a microprocessor-controlled, stand alone keyboard/terminal requring no computer memory or software. It allows the use of either a 64 or 32 character by 16 line professional display format with selectable baud rate, RS232-C or 20 ma. output, full cursor control and 75 ohm composite video output.

The keyboard follows the standard typewriter configuration and generates the entire 128 character ASCII upper/lower case set with 96 printable characters. Features include onboard regulators, selectable parity, shift lock key, alpha lock jumper, a drive capability of one TTY load, and the ability to mate directly with almost any computer, including the new Explorer/85 and ELF products by Netronics.

The Computer Terminal requires no I/O mapping and includes 1k of memory, character generator, 2 key rollover, processor controlled cursor control, parallel ASCII/BAUDOT to serial conversion and serial to video processing—fully crystal controlled for superb accuracy. PC boards are the highest quality glass epoxy for the ultimate in reliability and long life.

VIDEO DISPLAY SPECIFICATIONS

The heart of the Netronics Computer Terminal is the microprocessor-controlled Netronics Video Display Board (VID) which allows the terminal to utilize either a parallel ASCII or BAUDOT signal source. The VID converts the parallel data to serial data which is then formatted to either RS232-C or 20 ma. current loop output, which can be connected to the serial I/O on your computer or other interface, i.e., Modem.

When connected to a computer, the computer must echo the character received. This data is received by the VID which processes the information, converting to data to video suitable to be displayed on a TV set (using an RF modulator) or on a video monitor. The VID generates the cursor, horizontal and vertical sync pulses and performs the housekeeping relative to which character and where it is to be displayed on the screen.

Video Output: *1.5 P/P into 75 ohm (EIA RS-170)* • **Baud Rate:** *110 and 300 ASCII* • **Outputs:** *RS232-C or 20 ma. current loop* • **ASCII Character Set:** *128 printable characters—*

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

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

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- ☐ **Netronics Stand Alone ASCII Keyboard/Computer Terminal Kit, $149.95** plus $3.00 postage & handling.
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NEW!!!-THE ELECTRIC MOUTH*

for S100, Elf II, Apple, TRS-80 Level II*

From $99.95 kit

Now — teach your computer to talk, dramatically increasing the interaction between you and your machine.

That's right: the ELECTRIC MOUTH actually lets your computer talk! Installed and on-line in just minutes, it's ready for spoken-language use in office, business, industrial and commercial applications, in games, special projects, R&D, education, security devices — there's no end to the ELECTRIC MOUTH's usefulness. Look at these features:

- Supplied with 143 words/letters/phonemes/numbers, capable of producing hundreds of words and phrases.
- Expandable on-board up to thousands of words and phrases (just add additional speech ROMs as they become available).
- Four models, which plug directly into S100, Apple, Elf II and TRS-80 Level II computers.
- Get it to talk by using either Basic or machine language (very easy to use, complete instructions with examples included).
- Uses National Semiconductor's "Digitalker" system.
- Includes on-board audio amplifier and speaker, with provisions for external speakers and amplifier.
- Adds a new dimension and excitement to programming; lets you modify existing programs and games to add spoken announcements of results, warnings, etc.
- Installs in just minutes.

"Elf II" and "The Electric Mouth" are reg. trademarks of Netronics R&D Ltd. "Apple" is a reg. trademark of Apple Computer Inc. "TRS-80 Level II" is a reg. trademark of Tandy Corp.

Principle of Operation The ELECTRIC MOUTH stores words in their digital equivalents in ROMs. When words, phrases, and phonemes are desired, they are simply called for by your program and then synthesized into speech. The ELECTRIC MOUTH system requires none of your valuable memory space except for a few addresses if used in memory mapped mode. In most cases, output ports (user selectable) are used.

Spoken Material Included

ONE	SEVENTY	CONTROL	LEFT	POUND
TWO	EIGHTY	DANGER	LESS	PULSES
THREE	NINETY	DEGREE	LESSER	RATE
FOUR	HUNDRED	DOLLAR	LIMIT	RE
FIVE	THOUSAND	DOWN	LOW	READY
SIX	MILLION	EQUAL	LOWER	RIGHT
SEVEN	ZERO	ERROR	MARK	SS
EIGHT	AGAIN	FEET	METER	SECOND
NINE	AMPERE	FLOW	MILE	SET
TEN	AND	FUEL	MILLI	SPACE
ELEVEN	AT	GALLON	MINUS	SPEED
TWELVE	CANCEL	GO	MINUTE	STAR
THIRTEEN	CASE	GRAM	NEAR	START
FOURTEEN	CENT	GREAT	NUMBER	STOP
FIFTEEN	400HERTZ TONE	GREATER	OF	THAN
SIXTEEN	80HERTZ TONE	HAVE	OFF	THE
SEVENTEEN	20MS SILENCE	HIGH	ON	TIME
EIGHTEEN	40MS SILENCE	HIGHER	OUT	TRY
NINETEEN	80MS SILENCE	HOUR	OVER	UP
TWENTY	160MS SILENCE	IN	PARENTHESIS	VOLT
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FORTY	CENTI	IS	PLEASE	
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Please send the items checked below:

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- ☐ Elf II "Electric Mouth" kit $99.95
- ☐ Apple "Electric Mouth" kit $119.95
- ☐ TRS-80 Level II "Electric Mouth" kit $119.95

Add $20.00 for wired & tested units. All plus $3.00 postage & insurance. Conn. res. add sales tax.

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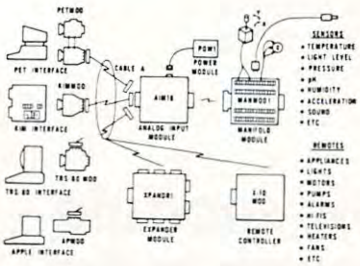

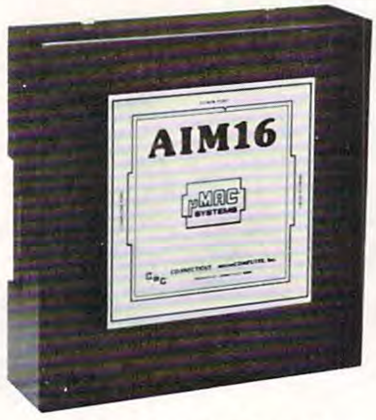

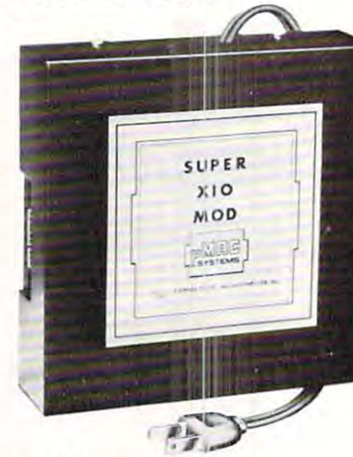

The world we live in is full of variables we want to measure. These include weight, temperature, pressure, humidity, speed and fluid level. These variables are continuous and their values may be represented by a voltage. This voltage is the analog of the physical variable. A device which converts a physical, mechanical or chemical quantity to a voltage is called a sensor.

Computers do not understand voltages: They understand bits. Bits are digital signals. A device which converts voltages to bits is an analog-to-digital converter. Our AIM 16 (Analog Input Module) is a 16 input analog-to-digital converter.

The goal of Connecticut microComputer in designing the uMAC SYSTEMS is to produce easy to use, low cost data acquisition and control modules for small computers. These acquisition and control modules will include digital input sensing (e.g. switches), analog input sensing (e.g. temperature, humidity), digital output control (e.g. lamps, motors, alarms), and analog output control (e.g. X-Y plotters, or oscilloscopes).

Connectors

The AIM 16 requires connections to its input port (analog inputs) and its output port (computer interface). The ICON (Input CONnector) is a 20 pin, solder eyelet, edge connector for connecting inputs to each of the AIM16's 16 channels. The OCON (Output CONnector) is a 20 pin, solder eyelet edge connector for connecting the computer's input and output ports to the AIM16.

The MANMOD1 (MANifold MODule) replaces the ICON. It has screw terminals and barrier strips for all 16 inputs for connecting pots, joysticks, voltage sources, etc.

CABLE A24 (24 inch interconnect cable) has an interface connector on one end and an OCON equivalent on the other. This cable provides connections between the uMACSYSTEMS computer interfaces and the AIM 16 or XPANDR1 and between the XPANDR1 and up to eight AIM 16s.

Analog Input Module

The AIM 16 is a 16 channel analog to digital converter designed to work with most microcomputers. The AIM 16 is connected to the host computer through the computer's 8 bit input port and 8 bit output port, or through one of the uMAC SYSTEMS special interfaces.

The input voltage range is 0 to 5.12 volts. The input voltage is converted to a count between 0 and 255 (00 and FF hex). Resolution is 20 millivolts per count. Accuracy is 0.5% ± 1 bit. Conversion time is less than 100 microseconds per channel. All 16 channels can be scanned in less than 1.5 milliseconds.

Power requirements are 12 volts DC at 60 ma.

POW1

The POW1 is the power module for the AIM16. One POW1 supplies enough power for one AIM16, one MANMOD1, sixteen sensors, one XPANDR1 and one computer interface. The POW1 comes in an American version (POW1a) for 110 VAC and in a European version (POW1e) for 230 VAC.

TEMPSENS

This module provides two temperature probes for use by the AIM16. This module should be used with the MANMOD1 for ease of hookup. The MANMOD1 will support up to 16 probes (eight TEMPSENS modules). Resolution for each probe is 1°F.

Remote Controller-Clock and Calendar

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1. Remote controller
   Controls up to 256 different remote devices by sending signals over the house wiring to remote modules. Uses BSR remote modules available all over the USA (Sears, Radio Shack, etc.). Does not require BSR control module. Does not use sonic link.
2. Clock/calendar
   Time of day - hours, minutes, seconds
   Date - month, day - automatically corrects for 28,29,30 and 31 day months. Day of the week.
3. Digital input/outputs
   8 inputs - TTL levels or switch closures. Can be used as a trigger for a stored sequence.
   8 outputs - TTL levels
   Power supply included 110VAC only.

XPANDR1

The XPANDR1 allows up to eight Input/Output modules to be connected to a computer at one time. The XPANDR1 is connected to the computer in place of the AIM16 or X10 MOD. Up to eight AIM16s or seven Aim 16s and one X10 MOD are then connected to each of the eight ports provided using a CABLE A24 for each module.

For your convenience the AIM16 and the X10 MOD come as part of a number of sets. The minimum configuration for a usable system is the AIM16 Starter Set 1 which includes one AIM16, one POW1, one ICON and one OCON. The AIM16 Starter Set 2 includes a MANMOD1 in place of the ICON. The minimum configuration for a usable system is the X10 MOD Starter Set which includes one X10 MOD, one ICON and one OCON. These sets require that you have a hardware knowledge of your computer and of computer interfacing.

For simple plug compatible systems we also offer computer interfaces and sets for many computers.

AIM16	179.00
SUPER X10 MOD (110 VAC only)	249.00
POW1a (POWer module-110 VAC)	14.95
POW1e (POWer module-230 VAC)	24.95
ICON (Input CONnector)	9.95
OCON (Output CONnector)	9.95
MANMOD1 (MANifold MODule)	59.95
CABLE A24 (24 inch interconnect cable)	19.95
XPANDR1 (allows up to 8 Input or Output modules to be connected to a computer at one time)	59.95
TEMPSENS2P1 (two temperature probes, -10°F to 160°F)	69.95
LIGHTSENS1P1 (light level probe)	89.95

The following sets include one AIM16, one POW1, one OCON and one ICON.

AIM16 Starter Set 1a (110 VAC)	189.00
AIM16 Starter Set 1e (230 VAC)	199.00

All prices and specifications subject to change without notice. Our 30-day money back guarantee applies.

The following sets include one AIM16, one POW1, one OCON and one MANMOD1.

AIM16 Starter Set 2a (110 VAC)	239.00
AIM16 Starter Set 2e (230 VAC)	249.00

The following modules plug into their respective computers and, when used with a CABLE A24, eliminate the need for custom wiring of the computer interface.

PETMOD (Commodore PET)	49.95
KIMMOD (KIM,SYM)	39.95
APMOD (APPLE II)	59.95
TRS-80 MOD (Radio Shack TRS-80)	59.95
AIM65 MOD (AIM 65)	39.95

The following sets include one AIM16, one POW1, one MANMOD1, one CABLE A24 and one computer interface module

PETSET1a (Commodore PET - 110 VAC)	295.00
PETSET1e (Commodore PET - 230 VAC)	305.00
KIMSET1a (KIM,SYM,AIM65 - 110 VAC)	285.00
KIMSET1e (KIM,SYM,AIM65 - 230 VAC)	295.00
APSET1a(APPLE II - 110 VAC)	295.00
APSET1e(APPLE II - 230 VAC)	305.00
TRS-80 SET1a (Radio Shack TRS-80 - 110 VAC)	295.00
TRS-80 SET1e(Radio Shack TRS-80 - 230 VAC)	305.00
AIM65 SET1a(AIM65-110 VAC)	285.00
AIM65 SET1e(AIM65-230 VAC)	295.00

The following sets include one X10 MOD, one CABLE A24, one ICON and one computer interface module.

PETSET2(Commodore PET)	295.00
KIMSET2(KIM,SYM)	285.00
APSET2(APPLE II)	295.00
TRS-80 SET2 (Radio Shack TRS-80)	295.00
AIM65 SET2 (AIM65)	285.00
SUPER X10 MOD/XPANDR1 SET2 (if you already have a SET1)	295.00

Printer And Communication Interfaces For The CBM/PET

SADI For Serial Two-way Communication, Parallel Printers, and Serial Printers

SADI - The microprocessor based serial and parallel interface for the Commodore PET. SADI allows you to connect your PET to parallel and serial printers, CRT's, modems, acoustic couplers, hard copy terminals and other computers. The serial and parallel ports are independent allowing the PET to communicate with both peripheral devices simultaneously or one at a time. In addition, the RS-232 device can communicate with the parallel device.

Special Features for the PET interface include:
- Conversion to true ASCII both in and out
- Cursor controls and function characters specially printed
- Selectable reversal of upper and lower case
- Addressable - works with other devices

Special Features for the serial interface include:
- Baud rate selectable from 75 to 9600
- Half or full duplex
- 32 character buffer
- X-ON, X-OFF automatically sent
- Selectable carriage return delay

Special Features for the parallel interface include:
- Data strobe - either polarity
- Device ready - either polarity
- Centronics compatible

Complete with power supply, PET IEEE cable, RS-232 connector, parallel port connector and case. Assembled and tested.
SADIa (110VAC) $295
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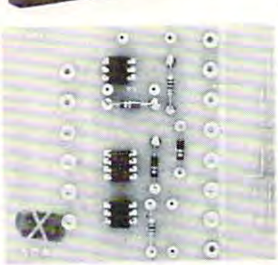

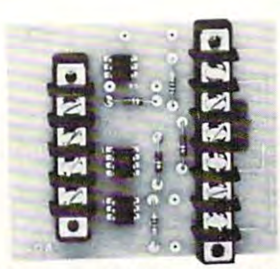

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Finding Square Roots In Assembly Language

Leo J. Scanlon
El Toro, CA

Many people who have transitioned into assembly language programming from a background in Basic have done so with the intention of speeding up their program's execution time (for a real-time application, perhaps) or reducing the program in an effort to get "closer" to the microprocessor machine code, for the sake of personal education.

The discussion given here should give you a sufficient background to develop a square root program for a binary number of any length.

In making such a transition, however, programmers quickly come to the stark realization that they no longer have FOR, NEXT, PRINT and all of the other nifty functions that are provided by Basic. All of these operations are still available to assembly language programmers, of course, but not in the form of a few simple words. If required, they must be *simulated* with an appropriate series of assembly language instructions.

The simpler Basic statements, such as FOR and NEXT, can usually be simulated with just a few assembly language instructions. More complex statements, such as PRINT, may require a dozen or more instructions in assembly language. The most complex Basic statements (RND, SIN, TAN and so on) can require a much more extensive routine in assembly language. In this article, we will discuss a possible approach to simulating a function of moderate complexity, **SQR** (square root) in 6502 assembly language. Specifically, *we will develop an assembly language program to extract the 8-bit square root of a 16-bit, unsigned, binary number.* The discussion given here should give you sufficient background to develop a square root program for a binary number of any length.

A Square Root Algorithm

The available literature includes a variety of algorithms for extracting the square root of a binary number. Perhaps the simplest is contained in one of my own books, **6502 Software Design** (Howard W. Sams & Co., Inc.; Indianapolis, IN; 1980). That algorithm states: *The square root of an integer is equal to the number of successively higher odd numbers that can be subtracted from it.* That is, you subtract -1, then -3, then -5 ... and so on, until the remainder becomes zero or negative; the count of odd numbers that have been subtracted represent the integer square root.

Although the algorithm works, it can be extremely slow, because each square root count must be preceded by one execution of the subtraction sequence. If we are processing a small number, such as 25, the 6502 will only execute the subtraction sequence five times. However, with progressively larger values, the 6502 will have to make more and more executions of this sequence. At the extreme, the square root of the largest number that can be represented in 16 bits (65,535) requires the microprocessor to execute this same double-precision subtract sequence *255 times*! As an alternative, let's discuss an algorithm that permits a square root to be found in exactly *eight executions* of the main program loop.

Raise Your Hand If You Know The Answer!

Many readers will recall the method we learned in elementary school or junior high to find the square root of a number using pencil and paper (don't all groan at once), the one where we pair off the digits to the left of the decimal point and find the square root of each pair. Well, as it turns out, this method is one of the best ways for calculating square roots on a computer, too. (Sonofagun, maybe old Miss McDonald was actually *ahead* of her time!) In fact, you'll see this algorithm written up in such blue-blooded references as Kai Hwang's **Computer Arithmetic** (John Wiley & Sons; New York; 1979).

For example, to take the square root of 4536, you would find the most-significant digit with this kind of procedure:

```
             6
          √ 45 36.
            36
12_          9
```

What is the "12_" sitting off to the left? It is the first digit of the square root (6), doubled with a space reserved for the next digit. The next step looks like this:

```
             6  7
          √ 45 36.
            36
127          9 36
             8 89
134_           47
```

If greater accuracy is desired, the process could be

continued to the right, to pick up the fractional square root. Ask Miss McDonald if you don't remember how to do it.

Essentially, the preceding algorithm is as follows:

1. Starting at the decimal point, pair off the digits to the left and (if appropriate) to the right. If the integer portion of the number contains an odd number of digits, the most-significant digit will be processed individually.
2. Find the square root of the most-significant digit(s), and enter this digit in the result.

... a fixed-point number is just a string of digits — ones and zeros, in this case ...

3. Subtract the square of this root from the most-significant digit(s) of the original number.
4. If there are more significant digits, continue; otherwise we are done.
5. Form a "dividend," by appending the next digit pair to the remainder from Step 3.
6. Form a "divisor," by doubling the current square root and reserving a least-significant digit position.
7. Compare the "divisor," to the dividend (assume 0 for the reserved digit position in the divisor), and proceed as follows:
   - **A.** If the divisor is greater than or equal to the dividend, enter a 0 in the result and return to Step 4.
   - **B.** If the divisor is less than the dividend, find the largest digit that will make the product of square root times divisor less than or equal to the dividend. Enter this digit in the result and the reserved position of the divisor, multiply, subtract the product from the dividend, and return to Step 4.

I don't know how you feel, but to me, that description is almost as difficult as memorizing how it's done!

Extracting The Square Root Of A Binary Number

The preceding algorithm applies to binary numbers as well as decimal numbers. And, with binary numbers, you gain one distinct advantage: because binary numbers are comprised of only ones and zeroes, their square roots are also comprised of only ones and zeroes. This means that while you're constructing the square root, if a result digit is not a one, it has to be a zero — and vice versa.

For this article, we'll use our pencil-and-paper algorithm to extract the 8-bit square root of a 16-bit unsigned, fixed-point number in memory. (Recall that a *fixed-point number* is just a string of digits — ones and zeroes, in this case — in which the binary point is assumed to be at some user-specified location in the string. The location of the binary point has no effect on the operations being discussed.) Let us assume that the low-order and high-order bytes of the 16-bit number are initially held in locations LOBYTE and HIBYTE, and that the 8-bit square root is to be returned in location ROOT. Based on these requirements, Example 1 shows a 6502 routine that will do the job.

This routine, called SQRT, begins by loading a count of 8 into the X register (since there are eight pairs of bits in a 16-bit number) and then clearing the dividend register (the A register, here) and the location ROOT. With this initialization completed, the 6502 enters the main program loop and rotates the first pair of bits into the dividend register (see Figure 1). In the next step — which is meaningless for the first bit pair, but required for all remaining pairs — ROOT is left-shifted, to make room for the next result bit, and then doubled to form the divisor.

Example 1. A 16-Bit Square Root Routine

This routine extracts the square root of an unsigned, fixed-point number in memory. The number is contained in locations LOBYTE and HIBYTE, and the 8-bit square root is returned in location ROOT. This routine affects the A, X and Y registers.

```
0000            LOBYTE  *=*+1          Low byte of number
0001            HIBYTE  *=*+1          High byte of number
0002            ROOT    *=*+1          Square root location
0003            DIVISR  *=*+1          Divisor location
0003                    *=$200
0200  A2  08    SQRT    LDX  #8        Count = 8
0202  A9  00            LDA  #0        Clear dividend register
0204  85  02            STA  ROOT        and square root location
0206  06  00    LOOP    ASL  LOBYTE    Rotate two MSB's into A
0208  26  01            ROL  HIBYTE
020A  2A                ROL  A
020B  06  00            ASL  LOBYTE
020D  26  01            ROL  HIBYTE
020F  2A                ROL  A
0210  06  02            ASL  ROOT      Left-shift current square root
0212  A4  02            LDY  ROOT
0214  84  03            STY  DIVISR
0216  06  03            ASL  DIVISR    and double it to form divisor
0218  C5  03            CMP  DIVISR    Dividend greater than divisor?
021A  F0  08            BEQ  DECCNT      No. Square root bit = 0
021C  90  06            BCC  DECCNT
021E  E6  02            INC  ROOT        Yes. Square root bit = 1
0220  E6  03            INC  DIVISR       and divisor LSB = 1
0222  E5  03            SBC  DIVISR    Calculate remainder (in A)
0224  CA        DECCNT  DEX            Loop until 16 bits
0225  D0  Df            BNE  LOOP        have been processed.
```

At this point, the 8-bit dividend (in A) is compared with the 8-bit divisor (in DIVISR), to determine whether the next bit of the result should be a 0 or a 1. If the dividend is less than or equal to

the divisor, the square root bit is 0, so the 6502 branches to DECCNT, where counter X is decremented. Otherwise, if the dividend is greater than the divisor, the square root bit is 1, so both ROOT and DIVISR are incremented, and a remainder (dividend - divisor) calculated, before the decrement operation takes place. Why don't we need to set the Carry bit before the subtraction? We don't need to do this because the fact that the branch instructions BEQ DECCNT and BCC DECCNT both failed *guarantees* that Carry is already set at this time!

Incidentally, note that the SQRT routine not only affects the A, X and Y registers, but destroys the original number in LOBYTE and HIBYTE as well. It's quite possible to save any or all of these parameters by pushing them into the stack before you execute the SQRT routine, and pulling them off the stack after SQRT has been executed. For example, to save A, X, Y, LOBYTE and HIBYTE on the stack, insert this sequence as the first nine instructions in the routine:

```
SQRT PHA            Save A
     TXA            Save X
     PHA
     TYA            Save Y
     PHA
     LDA  LOBYTE    Save LOBYTE
     PHA
     LDA  HIBYTE    Save HIBYTE
     PHA
```

As you know, data on the stack must be retrieved in the opposite order from which it was stored. To retrieve the "pushed" parameters, add this sequence to the end of the SQRT routine:

```
PLA            Pull HIBYTE
STA  HIBYTE
PLA            Pull LOBYTE
STA  LOBYTE
PLA            Pull Y
TAY
PLA            Pull X
TAX
PLA            Pull A
```

Trouble In Paradise

Since 16 bits in memory can hold hexadecimal values from 0 to $FF (where "$" means hexadecimal), the routine in Example 1 should be able to extract the square root of any number between 0 and 65,535. But, as I found out during the debugging process, *the routine returns a wrong answer if your original number is greater than $9FFB (decimal 40,952)*! It fails at that point because we're using an 8-bit divisor, so when ROOT has a 1 in the most-significant bit position and we execute the sequence

```
LDY  ROOT
STY  DIVISR
ASL  DIVISR
```

at locations $0212 through $0216, the 1 gets *lost* when we execute the instruction ASL DIVISR. Obvoiusly, what we need to handle the full range of 16-bit values is a routine that has a 16-bit divisor and a 16-bit dividend. Let's see how that's done.

An Improved 16-Bit Square Root Routine

A 16-bit divisor and dividend can be formed by simply taking the 8-bit divisor and dividend from Example 1 and adding a byte to each of them. For the dividend, we'll retain the A register to hold the high-order byte, and allocate a new memory location (DIVDND) to hold the low-order byte. For the divisor, we'll just make DIVISR into a two-byte parameter; DIVISR holds the low-order byte and the next location, DIVISR + 1, holds the high-order byte. Figure 2 illustrates the new 16-bit dividend and divisor.

With these new, double-size parameters, you would anticipate a considerably longer program — and you'd be right! The improved version of the SQRT routine is shown in Example 2. Except for the additional data manipulation, this routine is constructed exactly like Example 1, so I won't bore you with another detailed description of its operation. You may be interested in how fast this routine can extract a square root, however, If the base number is $0000, SQRT takes 605 machine cycles to extract the square root. If the base number is $FFFF, the square root will be extracted in 825 machine cycles. (If your computer has a 1-MHz 6502, these times translate to 605 s and 825 s.) Therefore, any number you use will execute somewhere within these extremes.

Example 2. An Improved 16-Bit Square Root Routine

This routine extracts the square root of an unsigned, fixed-point number in memory. The number is contained in locations LOBYTE and HYBYTE, and the 8-bit square root is returned in location ROOT. This routine affects the A, X and Y registers.

```
0000            LOBYTE  G=*+1          Low byte of number
0001            HIBYTE  *=*+1          High byte of number
0002            ROOT    *=*+1          Square root location
0003            DIVISR  *=*+2          16-bit divisor
0005            DIVDND  *=*+1          Low byte of dividend
0006                    *=$200
0200 A2 08      SQRT    LDX  #8        Count = 8
0202 A9 00              LDA  #0        Clear dividend,
0204 85 05              STA  DIVDND
0206 85 04              STA  DIVISR+1   high byte of divisor
0208 85 02              STA  ROOT       and square root location
020A 06 00      LOOP    ASL  LOBYTE    Rotate two MSB's into
                                       dividend
020C 26 01              ROL  HIBYTE
020E 26 05              ROL  DIVDND
0210 2A                 ROL  A
0211 06 00              ASL  LOBYTE
0213 26 01              ROL  HIBYTE
0215 26 05              ROL  DIVDND
0217 2A                 ROL  A
0218 06 02              ASL  ROOT      Left-shift current square root
021A A4 02              LDY  ROOT
021C 84 03              STY  DIVISR
021E 06 03              ASL  DIVISR     and double it to form divisor
0220 26 04              ROL  DIVISR+1
0222 C5 04              CMP  DIVISR+1  Dividend greater than divisor?
0224 90 17              BCC  DECCNT
0226 D0 08              BNE  INCSQ
0228 A4 05              LDY  DIVDND
022A C4 03              CPY  DIVISR
022C F0 0F              BEQ  DECCNT    No. Square root bit = 0
022E 90 0D              BCC  DECCNT
0230 E6 02      INCSQ   INC  ROOT      Yes. Square root bit = 1
0232 E6 03              INC  DIVISR     and divisor LSB = 1
0234 48                 PHA            Calculate remainder
0235 98                 TYA
0236 E5 03              SBC  DIVISR
0238 85 05              STA  DIVDND
023A 68                 PLA
023B E5 04              SBC  DIVISR+1
023D CA         DECCNT  DEX            Loop until done
023E D0 Ca              BNE  LOOP
```

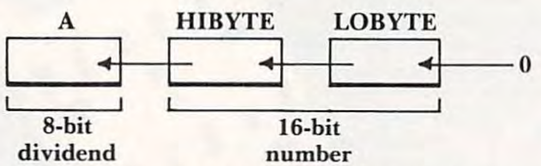

Figure 1. Forming a Dividend in Example 1

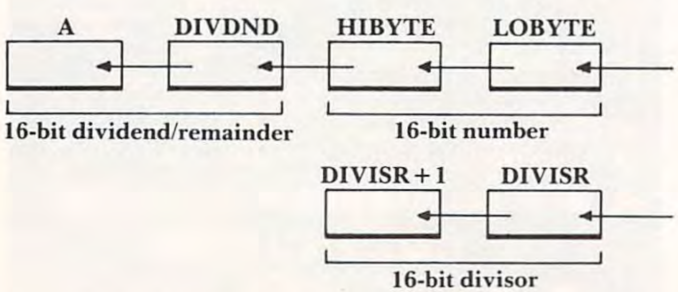

Figure 2. 16-Bit Dividend and Divisor ©

Ideal-Gas Law

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Gases are tricky things to work with. In the case of solids you can weigh them and know how much is present. Liquids are easier to work with because you can not only weigh them but you can also measure their volume and by multiplying by the density find the amount of the material present. With gases the problem is more complicated. To know how much gas you are dealing with, it is necessary to know the pressure of the gas, its volume, its temperature and the number of moles present. R is the Ideal-Gas constant. Luckily a relationship exists between these variables so that any one variable can be determined, provided you know the other three. This relationship is known as the Ideal-Gas law, which is simply stated as follows:

$$PxV = MxRxT$$

P is the pressure under which gas exists, **V** is the volume of the gas, **T** is the temperature of the gas and **M** is the moles of the gas (the mole of a gas is the molecular weight of the gas expressed in some units). Example: Nitrogen (mol. wt. = 28.0), therefore, 28.0 g would equal 1.0 gram-mole, or 28.0 lbs. would equal 1.0 lb.-mole. Or if the moles of a gas are known, the grams or lbs. may be found by multiplying by the molecular weight.

This relationship works very well for gases under ordinary pressures, say under a few atmospheres of pressure and at room temperature or higher. These are the conditions that we will be dealing with in the development of this program. There are improvements which can give better results at conditions other than those outlined above. These improvements are the Van der Waal's equation and the Varial equation. These, hopefully, will be dealt with in future articles.

However, when we speak of pressure, temperature, volume, moles and the gas constant, various types of units may be employed. Thus, for the physical scientist he may express the pressure in atmosphere units, the temperature in degrees Celsius (Centigrade), the volume in liters and the moles in gram-moles. The engineer, on the other hand, may express the pressure in lbs./sq. in., the volume in cubic feet, the temperature in degrees Fahrenheit, the moles as pound-moles and the universal gas constant R in the above units. So, if a universal program is to be written, it must take these possibilities into consideration. The numerical value of the Ideal-Gas constant R for scientific data is 0.08205 liter x atm/g-mole x K^0 and that for the engineer units is 10.731 cu. ft. x lbs./sq. in. x lb.-moles x R^0.

Discussion Of The Program

St. No.'s 130-180 (St. No. is the statement number) sets up a small menu so the units used in solving the equation may be either scientific units or engineering units. Once the choice has been typed in, the program branches to those locations which will solve the equation in appropriate units.

Thus, if the program branches to St. No. 220, scientific units are used or if branching to St. No. 1220 occurs, engineering units are utilized. Then another choice is offered so that the program can solve for the volume of a gas, or its temperature, or its pressure or the number of moles present provided the other three variables are known. This procedure is outlined in St. Nos. 230-290.

The choice taken above will direct the program via St. No. 300 to locations which will solve the problem and print out the results as follows:

Given the following data:
  The volume is 22.654 liters
  The temperature is 31.04 deg. C.
  The gram-moles present are 1.333
The pressure developed is 1.467 Atm.

Once the results are printed out, the program jumps to St. No. 990 and inquires if other variables are to be solved for. If so, the program again displays the choices and the program repeats. If engineering units are now to be used, the program is terminated with a "No" to question in St. No. 990 and the program is rerun. The choice between scientific or engineering units is offered again and if engineering units are chosen, choices of variables will again be presented and a print-out like the following will be displayed on the printer:

Given the following data:
  The volume is 38.5 cu. ft.
  The temperature is 84.5 deg. F.
  The lb.-moles are 1.06
  The pressure developed is 16.07 lbs./sq. in.

The program is written in Basic, which with very few modifications, can be used with most personal computers. The author used a "PET"* personal computer and a TTY Model 43 printer to process the program.

```
100 OPEN 2,3:CMD 2
110 REM THIS PROGRAM CALCULATES  THE ¬
      ¬VARIABLES  OF THE PERFECT GAS LAW ¬
      ¬GIVEN
120 REM THE NECESSARY DATA AND THE ¬
      ¬BASIC EQUATION, PV=MRT
130 PRINT"DATA MAY BE GIVEN IN THE CGS ¬
      ¬SYSTEM OR IN ENGINEERING UNITS":
      ¬PRINT
140 PRINT"TYPE THE NO. CORRESPONDING TO ¬
      ¬THE WAY THE DATA IS EXPRESSED":
```

```
     ¬PRINT
150 PRINT"THE DATA IS GIVEN AS FOLLOWS":
     ¬PRINT:PRINT
160 PRINT"1.-TEMPERATURE IN DEG. ¬
     ¬CELSIUS,PRESSURE IN ATM. & VOLUME ¬
     ¬IN LITERS":PRINT
170 PRINT"2.-TEMPERATURE IN DEG. F.,
     ¬ PRESSURE IN LBS/IN SQ., VOLUME ¬
     ¬IN CU.FT."
180 INPUT D
190 PRINT :PRINT
200 ON D GOTO 220,1200
210 PRINT
220 PRINT"ĥ","↓↓↓↓"
230 PRINT"TYPE THE NUMBER CORRESPONDING ¬
     ¬TO THE VARIABLE TO BE CALCULATED":
     ¬PRINT
240 PRINT,"1. VOLUME
250 PRINT,"2. TEMPERATURE"
260 PRINT,"3. PRESSURE"
270 PRINT,"4. MOLES PRESENT"
280 INPUT N
290 R =.08205:PRINT
300 ON N GOTO 320,460,640,800
310 PRINT
320 PRINT"TYPE THE PRESSURE IN ATM.":
     ¬INPUT P:PRINT
330 PRINT"TYPE THE TEMPERATURE IN ¬
     ¬DEG.C.":INPUT T:PRINT
340 PRINT"TYPE THE NO. OF GRAM-MOLES":
     ¬INPUT M:PRINT
350 V = M*R*(T+273)/P
351 V=INT(V*100)/100
360 CLOSE 2
370 OPEN 2,5:CMD 2
380 PRINT"GIVEN THE FOLLOWING DATA:"
390 PRINT
400 PRINT,"THE PRESSURE IS ";P;"ATM."
410 PRINT,"THE TEMPERATURE IS ";T;"DEG.C
     ¬."
420 PRINT,"THE NO. OF MOLES ARE ";M:
     ¬PRINT:PRINT
430 PRINT"THE VOLUME OF THE GAS ¬
     ¬IS";V;"LITERS"
440 PRINT:PRINT"-----------------------
     ¬-----------------------------------
     ¬"
450 GOTO 960
460 PRINT:PRINT
470 PRINT"TYPE THE PRESSURE IN ATM."
480 INPUT P:PRINT
490 PRINT"TYPE THE VOLUME IN LITERS"
500 INPUT V:PRINT
510 PRINT"TYPE THE NO. OF MOLES USED"
520 INPUT M:PRINT
530 T2=273
540 T1=(P*V)/(M*R):T=T1-T2
541 T=INT(T*100)/100
550 CLOSE 2:OPEN 2,5:CMD 2
560 PRINT"GIVEN THE FOLLOWING DATA:":
     ¬PRINT
570 PRINT,"THE PRESSURE IS";P;"ATM."
580 PRINT,"THE VOLUME IS ";V;"LITERS"
590 PRINT,"THE NO. OF MOLES ARE ";M:
     ¬PRINT:PRINT
600 PRINT"THE TEMPERATURE IS ";T;"DEG. ¬
     ¬C."
610 PRINT"-----------------------------
     ¬-----------------------------------
     ¬-"
620 PRINT:PRINT
630 GOTO 960
640 PRINT"TYPE THE VOLUME IN LITERS"
650 INPUT V:PRINT
660 PRINT"TYPE THE TEMPERATURE IN DEG. ¬
     ¬C."
670 INPUT T:PRINT
680 PRINT"TYPE THE NO. OF G-MOLES USED"
690 INPUT M:PRINT
700 P = M*R*(T+273)/V
701 P=INT(P*1000)/1000
710 CLOSE 2
720 OPEN 2,5:CMD 2
730 PRINT"GIVEN THE FOLLOWING DATA:"
740 PRINT:PRINT,"THE VOLUME IS";V;"LITER
     ¬S"
750 PRINT,"THE TEMPERATURE IS";T;"DEG.C.
     ¬"
760 PRINT,"THE MOLES PRESENT ARE";M:
     ¬PRINT:PRINT
770 PRINT"THE PRESSURE DEVELOPED ¬
     ¬IS";P;"ATM."
780 PRINT:PRINT"-----------------------
     ¬-----------------------------------
     ¬-"
790 GOTO 960
800 PRINT"TYPE THE PRESSURE IN ATM."
810 INPUT P:PRINT
820 PRINT"TYPE THE VOLUME IN LITERS"
830 INPUT V:PRINT
840 PRINT"TYPE THE TEMPERATURE IN DEG. ¬
     ¬C."
850 INPUT T:PRINT
860 M = (P*V)/(R*(T+273))
861 M=INT(M*100)/100
870 CLOSE 2
880 OPEN 2,5:CMD 2
890 PRINT"GIVEN THE FOLLOWING DATA:":
     ¬PRINT
900 PRINT,"THE PRESSURE IS";P;"ATMOSPHER
     ¬ES."
910 PRINT,"THE VOLUME IS";V;"LITERS
920 PRINT,"THE TEMPERATURE IS";T;"DEG.C.
     ¬":PRINT:PRINT
930 PRINT"THE NUMBER OF MOLES PRESENT ¬
     ¬ARE";M
940 PRINT:PRINT"-----------------------
     ¬-----------------------------------
     ¬-"
950 GOTO 960
960 CLOSE 2
970 OPEN 2,3:CMD 2
980 PRINT"ĥ","↓↓↓↓↓↓"
990 PRINT"DO YOU WISH TO SOLVE OTHER ¬
     ¬PROBLEMS? IF SO TYPE YES OTHERWISE
     ¬ NO"
1000 INPUT A$:PRINT
1010 IF A$="YES" THEN 220
1020 PRINT"============================
     ¬=========="
1030 PRINT"BYE NOW, HAVE A GOOD DAY!"
1040 PRINT"============================
     ¬=========="
1050 CLOSE 2:END
1200 ON D GOTO 220,1220
1210 PRINT
1220 PRINT"ĥ","↓↓↓↓"
1230 PRINT"TYPE THE NUMBER CORRESPONDING
     ¬ TO THE VARIABLE TO BE CALCULATED"
     ¬:PRINT
```

```
1240 PRINT,"1. VOLUME
1250 PRINT,"2. TEMPERATURE"
1260 PRINT,"3. PRESSURE"
1270 PRINT,"4. MOLES PRESENT"
1280 INPUT N
1290 R =10.731:PRINT
1300 ON N GOTO 1320,1460,1640,1800
1320 PRINT"TYPE THE PRESSURE IN ¬
     ¬LBS./IN.SQ.":INPUT P:PRINT
1330 PRINT"TYPE THE TEMPERATURE IN ¬
     ¬DEG.FAHRENHEIT":INPUT T:PRINT
1340 PRINT"TYPE THE NO. OF LBS.-MOLES":
     ¬INPUT M:PRINT
1350 V = M*R*(T+459.690)/P
1351 V=INT(V*100)/100
1360 CLOSE 2
1370 OPEN 2,5:CMD 2
1380 PRINT"GIVEN THE FOLLOWING DATA:"
1390 PRINT
1400 PRINT,"THE PRESSURE IS";P;"LBS/IN.S
     ¬Q."
1410 PRINT,"THE TEMPERATURE IS ";T;"DEG.
     ¬F."
1420 PRINT,"THE NO. OF LBS.-MOLES ARE ¬
     ¬";M:PRINT:PRINT
1430 PRINT"THE VOLUME OF THE GAS ¬
     ¬IS";V;"CU.FT."
1440 PRINT:PRINT"-----------------------
     ¬----------------------------------
     ¬-"
1450 GOTO 1960
1460 PRINT:PRINT
1470 PRINT"TYPE THE PRESSURE IN ¬
     ¬LBS./SQ.IN."
1480 INPUT P:PRINT
1490 PRINT"TYPE THE VOLUME IN CU. FT."
1500 INPUT V:PRINT
1510 PRINT"TYPE THE NO. OF LBS.-MOLES ¬
     ¬USED"
1520 INPUT M:PRINT
1530 T2=459.69
1540 T1=(P*V)/(M*R):T=T1-T2
1541 T=INT(T*100)/100
1550 CLOSE 2:OPEN 2,5:CMD 2
1560 PRINT"GIVEN THE FOLLOWING DATA:":
     ¬PRINT
1570 PRINT,"THE PRESSURE IS ";P;"LBS./SQ
     ¬.IN."
1580 PRINT,"THE VOLUME IS ";V;"CU.FT."
1590 PRINT,"THE NO. OF LBS.-MOLES ARE ¬
     ¬";M:PRINT:PRINT
1600 PRINT"THE TEMPERATURE IS ";T;"DEG. ¬
     ¬F."
1610 PRINT"-----------------------------
     ¬----------------------------------
     ¬--"
1620 PRINT:PRINT
1630 GOTO 1960
1640 PRINT"TYPE THE VOLUME IN CU.FT."
1650 INPUT V:PRINT
1660 PRINT"TYPE THE TEMPERATURE IN DEG. ¬
     ¬F."
1670 INPUT T:PRINT
1680 PRINT"TYPE THE NO. OF LBS.-MOLES ¬
     ¬USED"
1690 INPUT M:PRINT
1700 P = M*R*(T+459.69)/V
1701 P=INT(P*100)/100
1710 CLOSE 2
1720 OPEN 2,5:CMD 2
1730 PRINT"GIVEN THE FOLLOWING DATA:"
1740 PRINT:PRINT,"THE VOLUME IS";V;"CU.F
     ¬T."
1750 PRINT,"THE TEMPERATURE IS";T;"DEG.F
     ¬."
1760 PRINT,"THE LB-MOLES PRESENT ARE";M:
     ¬PRINT:PRINT
1770 PRINT"THE PRESSURE DEVELOPED ¬
     ¬IS";P;"LBS./SQ.IN."
1780 PRINT:PRINT"-----------------------
     ¬----------------------------------
     ¬--"
1790 GOTO 1960
1800 PRINT"TYPE THE PRESSURE IN ¬
     ¬LBS/SQ.IN."
1810 INPUT P:PRINT
1820 PRINT"TYPE THE VOLUME IN CU.FT."
1830 INPUT V:PRINT
1840 PRINT"TYPE THE TEMPERATURE IN DEG. ¬
     ¬F."
1850 INPUT T:PRINT
1860 M = (P*V)/(R*(T+459.69))
1861 M=INT(M*100)/100
1870 CLOSE 2
1880 OPEN 2,5:CMD 2
1890 PRINT"GIVEN THE FOLLOWING DATA:":
     ¬PRINT
1900 PRINT,"THE PRESSURE IS";P;"LBS./SQ.
     ¬IN."
1910 PRINT,"THE VOLUME IS";V;"CU.FT.
1920 PRINT,"THE TEMPERATURE IS";T;"DEG.F
     ¬.":PRINT:PRINT
1930 PRINT"THE NUMBER OF LB-MOLES ¬
     ¬PRESENT ARE";M
1940 PRINT:PRINT"-----------------------
     ¬----------------------------------
     ¬--"
1950 GOTO 1960
1960 CLOSE 2
1970 OPEN 2,3:CMD 2
1980 PRINT"ĥ","↓↓↓↓↓↓"
1990 PRINT"DO YOU WISH TO SOLVE OTHER ¬
     ¬PROBLEMS? IF SO TYPE YES OTHERWISE
     ¬ NO"
2000 INPUT A$:PRINT
2010 IF A$="YES" THEN 1220
2020 PRINT"============================
     ¬=========="
2030 PRINT"BYE NOW, HAVE A GOOD DAY!"
2040 PRINT"============================
     ¬=========="
2050 CLOSE 2:END
READY.
```

```
PRINT-OUT - IDEAL GAS LAW


GIVEN THE FOLLOWING DATA:

          THE PRESSURE IS  2.12 ATM.
          THE TEMPERATURE IS  36 DEG.C.
          THE NO. OF MOLES ARE  3.52


THE VOLUME OF THE GAS IS 42.09 LITERS

---------------------------------------------

GIVEN THE FOLLOWING DATA:

          THE PRESSURE IS 2.87 ATM.
          THE VOLUME IS  50.6 LITERS
          THE NO. OF MOLES ARE  4.16


THE TEMPERATURE IS  152.46 DEG. C.
---------------------------------------------



GIVEN THE FOLLOWING DATA:

          THE VOLUME IS 150.2 LITERS
          THE TEMPERATURE IS 52 DEG.C.
          THE MOLES PRESENT ARE 6.45


THE PRESSURE DEVELOPED IS 1.145 ATM.

---------------------------------------------

GIVEN THE FOLLOWING DATA:

          THE PRESSURE IS 1.54 ATMOSPHERES.
          THE VOLUME IS 30.65 LITERS
          THE TEMPERATURE IS 25.9 DEG.C.


THE NUMBER OF MOLES PRESENT ARE 1.92

---------------------------------------------

GIVEN THE FOLLOWING DATA:

          THE PRESSURE IS 15.9 LBS/IN.SQ.
          THE TEMPERATURE IS  44 DEG.F.
          THE NO. OF LBS.-MOLES ARE  1.22


THE VOLUME OF THE GAS IS 414.73 CU.FT.

---------------------------------------------
```

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THE apple® GAZETTE

Apple II High Resolution Character Generator

Peter Gehris and Ken Reinert
Wyomissing, PA

Are you dissatisfied with the small size of the characters on the video screen? Do you have need for a character generator for TV or videotape recording? Would you like to display your own shapes in variable size and position on the screen? Here is a way to achieve these goals using the shape table provision of the APPLE II. The amazing aspects of this program are: (1) you can vary the size of each shape; (2) you can change or add shapes as desired; (3) you can rotate the shapes on the screen even to the point of displaying them upside down or backwards; and (4) you can customize this program to your own programs to yield variable letter forms, sizes and positions for neater looking displays of data and text. The program which positions and draws each character uses high resolution graphics on the video monitor. A copy of the program is in diagram 2. All of the keyboard characters are available except the ›@› which is used as an underline. The instructions to draw each character are stored in a shape table. The creation of the shape table, which is in Chapter 9 of the APPLESOFT II Basic Programming Reference Manual, will not be discussed here.

The Shape Table

In diagram 1, you will see the hexadecimal codes for a shape table beginning at address 37000 (hex 9088) and ending at address 37944 (hex 9440). Please note these addresses are for a 48K system. This table provides the shapes for all characters on the keyboard, except the ›@› key, which is an underline. The shape table should fit right below DOS. HIMEM must then be set at the beginning of the table to protect it from being written over by APPLESOFT variables.

Use this chart to see where the table should be loaded into your system:

Memory size	Address dec.	hex.	HIMEM:	POKE 232,	POKE 233,
32K	21000	$5208	21000	8	82
36K	25000	$61A8	25000	168	97
48K	37000	$9088	37000	136	144

(NOTE: the POKEs will be explained later.)

Loading The Shape Table

By now, the shapes should be defined and converted into hexadecimal code. Now, the codes can be typed into the memory. (It is best if two people do this: one to read the codes and another to type them in.) First, get into the monitor by typing CALL -151. Then, type the address of the shape table: 9088 (for a 48K system) followed by a colon and up to 127 hex codes. The start address will vary according to system size (see chart). The display should look like this:

9088: 3B 00 78 00 7A 00 81 00 ...

(see page 44 of the APPLE II Reference Manual.) After pressing ‹RETURN›, type the new address (start address plus the number of codes entered) followed by a colon and more hex codes.

To save the shape table, type: 9088,9437W (for tape) or BSAVE (name), A$9088,L$3B0 (for disk). (These addresses are for the shape table listed.) Then, to load it back into memory, type: 9088,9437R (for tape) or BLOAD (name) (for disk), and the table will load into memory, ready for use.

Shape Table Demo Program

The list of the program in diagram 2 will demonstrate the use of the shape table in developing characters on the video screen. Note that for this demo you can control the rotation, scale, position and space between letters through input. We have used a GOSUB in line 60 and a RETURN to show that this can be used as a subroutine within a program. The variables P$, A, B, H, V and Z can be defined by ways other than input prior to each use of the subroutine. The screen is divided into 31 horizontal positions and 17 vertical positions. The rotation angles start at 0 for an upright character. Increasing the rotation equal to 16 will set the shape on its right side (90 degrees); 32 will invert the character 180 degrees, etc. A rotation of 64 will return the shape to an upright position.

A scale of one prints the characters at their normal size (double the size of text). A scale of two doubles the size, a scale of three triples the size, etc. A normal hi-res screen has 280 horizontal dots and

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192 vertical dots. Line 1030 converts the H,V coordinates of the 31x17 screen to the X,Y coordinates of the 280x192 hi-res screen. The FOR-NEXT loop at line 1050 prints out the string, one character at a time. Each character is picked out of the string by the MID$ function. That character's ASCII code, minus 31, is used to identify which shape number to draw. Line 1060 increments the X-coordinate to the new position to print the next character in the string.

Line 20 tells the computer where the shape table begins. This is where POKE 232 and POKE 233 are used. Line 40 sets himem to the beginning of the table, so the table is not written over by variables.

Diagram 3 shows another program which uses the secondary page (page 2) of hi-res graphics, which is available only on a 36K or a 48K system. The variables are defined within the program instead of by using input. The routine to enlarge the letters is located at lines 1000-1020.

Customizing The Program

The routine for enlarging the characters can be added to most any program. However, the display cannot be output to a printer, since it is in the hi-res graphics mode. Just remember that there are only 17 lines of 31 characters per screen page (at a scale of 1). With this in mind, you should be up and running with the enlarged characters in no time.

Shapes can be added to the shape table; however only the more advanced programmers should attempt this, as it does require moving blocks of the shape table around and manipulating the shape table index. More on this can be found in Chapter 9 of the APPLESOFT Manual.

Summary

Without a doubt, the work for this program involves the construction of the shape table. Many hours can be spent drawing, plotting vectors, coding in binary and hexadecimal and typing the codes. The program to use the shape table is fairly simple. Uses for the creation of shapes of both usual and unusual types are numerous. Besides, generating the normal alphanumeric and graphics characters, special characters can be created for math/science, foreign languages, etc., and the basic ideas can also be applied to music, art and in creating games.

```
APPLE II HI RESOLUTION GRAPHICS GENERATOR
P. GEHRIS AND K. REINERT    4/8/81


1  REM
2  REM       HI RES DEMO PROGRAM #1
3  REM            FOR 32K SYSTEM
4  REM
10  REM   POKE SHAPE TABLE ADDRESS
20  POKE 232,8: POKE 233,82
30  REM   SET HIMEM TO BEGINNING OF TABLE
40  HIMEM: 21000
50  REM   INPUT DATA
60  TEXT : HOME : INPUT "ENTER STRING : ";P$
70  INPUT "ENTER ROTATION : ";A
80  INPUT "ENTER SCALE : ";B
90  INPUT "ENTER HORIZONTAL POSITION : ";H
100  INPUT "ENTER VERTICAL POSITION : ";V
110  INPUT "ENTER SPACES BETWEEN LETTERS";Z
120  REM  CALL SUB. TO PRINT STRING
130  GOSUB 1000
140  REM   DELAY, THEN CLEAR SCREEN
150  FOR T = 1 TO 7500: NEXT T: HOME : PRINT  CHR$ (7): GOTO 50

1000  REM    CLEAR SCREEN OF TEXT, PRODUCES FULL PAGE OF HI-RES
      GRAPHICS,SETS COLOR, ROT-ATION AND SCALE
1010  HOME : HGR : POKE 49234,0: HCOLOR= 3: ROT= A: SCALE= B
1020  REM   COMPUTE LOCATION TO PRINT STRING
1030 X = 9 * H - 7:Y =  INT (11 * V - 8):P =  LEN (P$)
1040  REM   PRINT STRING ONE CHARACTER AT A TIME
1050  FOR I = 1 TO P: DRAW  ASC ( MID$ (P$,I,1)) - 31 AT X,Y
1060 X = X + ((9 * B) + Z)
1070  NEXT I
1080  RETURN
```

```
APPLE II HI RESOLUTION GRAPHICS GENERATOR
P. GEHRIS AND K. REINERT   4/8/81

1  REM
2  REM        HI RES DEMO PROGRAM #2
3  REM             FOR 48K SYSTEM
4  REM
10  POKE 232,136: POKE 233,144: REM  POKES SHAPE TABLE STARTING
     ADDRESS
20  HIMEM: 37000: REM   SETS HIMEM TO BEGINNING OF SHAPE TABLE

30  IF  PEEK (37000) <  > 59 THEN  PRINT  CHR$ (4)"BLOAD SHAPES
     ": REM  LOADS SHAPE TABLE INTO MEMORY IF NOT ALREADY IN ME
     MORY
40  HOME : HGR2 : POKE 49234,0: HCOLOR= 3: ROT= 0: SCALE= 1: REM
      SETS HI-RES GRAPHICS PARAMETERS; USES PAGE 2 OF HI-RES M
     EMORY
50 P$ = "THIS DEMONSTRATION PROGRAM":H = 4:V = 2: GOSUB 1000
60 P$ = "USES THE HI-RES":H = 9:V = 5: GOSUB 1000
70 P$ = "CHARACTER GENERATOR":H = 7:V = 8: GOSUB 1000
80 P$ = "AND SHAPE TABLE":H = 9:V = 11: GOSUB 1000
90 P$ = "TO PRINT THIS":H = 10:V = 14: GOSUB 1000
100 P$ = "DISPLAY":H = 13:V = 17: GOSUB 1000
110  FOR W = 1 TO 5000: NEXT
120  TEXT : HOME : END
1000 X = 9 * H - 7:Y =  INT (11 * V - 8):P =  LEN (P$)
1010  FOR I = 1 TO P: DRAW  ASC ( MID$ (P$,I,1)) - 31 AT X,Y:X =
     X + 9
1020  FOR T = 1 TO 50: NEXT T: NEXT I: RETURN
```

```
9088- 3B 00 78 00 7A 00 81 00
9090- 88 00 99 00 AD 00 C3 00
9098- D6 00 DA 00 E5 00 EE 00
90A0- 01 01 0C 01 14 01 1A 01
90A8- 21 01 2B 01 3C 01 48 01
90B0- 59 01 6A 01 7B 01 8B 01
90B8- 9F 01 AB 01 BE 01 D3 01
90C0- DA 01 E3 01 EF 01 F9 01
90C8- 03 02 0E 02 15 02 27 02
90D0- 3B 02 4A 02 5A 02 6C 02
90D8- 7B 02 8D 02 9E 02 AA 02
90E0- B7 02 C8 02 D1 02 E3 02
90E8- F6 02 06 03 16 03 28 03
90F0- 3C 03 4D 03 57 03 65 03
90F8- 73 03 85 03 95 03 A1 03
9100- 01 00 49 36 36 36 96 06
9108- 00 31 36 4D 21 24 04 00
9110- 89 36 36 36 6E 21 24 24
9118- 24 95 1F FF 96 0D 6D 05
9120- 00 49 36 36 36 36 26 D8
9128- AB 6D 2D 20 E4 FF 3F 20
9130- 0C 6D AD 05 00 32 0E 05
9138- 20 07 28 2D 2D 36 1E 1E
9140- 1E 1E 1E 1E 4D 21 0C 15
9148- F6 05 00 12 76 0E 0E 0E
9150- 0D 16 1C 1E 3F 3F 20 0C
9158- 0C 08 24 1C 3F 00 49 36
9160- 36 00 49 09 1E 1E 1E 36
9168- 76 0E 0E 06 00 A9 15 15
9170- 36 F6 1E 1E 06 00 72 0E
9178- 8E 71 0E DE 23 24 24 24
9180- 6C 11 17 17 D7 BA 17 07
9188- 00 92 2A 2D 2D B5 DA 23
9190- 24 20 24 00 49 92 92 37
9198- 35 1E 06 00 92 52 2D 2D
91A0- 5A 00 92 92 52 29 3E 04
91A8- 00 49 49 F2 1E 1E 1E 1E
91B0- 1E 06 00 12 36 36 76 0E
91B8- 2D 05 28 20 24 24 1C 1C
91C0- 3F 17 05 00 2D 35 36 36
91C8- 36 36 3F 6F 09 2D 05 00
91D0- 12 0C 0C 2D 2D 32 1E 1E
91D8- 1E 1E 1E 1E 2E 2D 2D 2D
91E0- 00 2A 28 2D AD 36 1E 3F
91E8- 37 49 31 36 1E 3F 3F 07
91F0- 20 00 49 29 36 36 2E 96
91F8- 1A 24 24 3F 3F 27 05 28
9200- 28 28 00 2D 2D 2D DE DB
9208- 33 36 2D 2D AD 36 F6 3F
9210- 3F 27 00 92 32 36 76 2D
9218- 2D 05 20 24 1C 3F 3F 07
9220- 20 64 2D 2D 15 05 00 2D
9228- 2D 2D 36 1E 1E 1E 1E 1E
9230- 36 05 00 32 B6 36 76 2D
9238- 2D 05 20 24 04 20 E4 3F
9240- 3F 96 2A 2D 2D 00 02 36
9248- 96 12 0E 2D 2D 05 20 24
9250- 24 24 1C 3F 3F 16 12 2D
```

```
9258-  2D  05  00  52  29  3E  96  35
9260-  37  00  52  29  3E  96  35  77
9268-  1E  06  00  49  09  1E  1E  1E
9270-  1E  0E  0E  0E  0E  06  00  12
9278-  2D  2D  2D  96  3A  3F  3F  3F
9280-  00  A9  15  15  15  1E  1E  1E
9288-  1E  06  00  2A  28  2D  AD  36
9290-  1E  BF  36  16  05  00  93  2D
9298-  2D  2D  2D  05  00  32  36  36
92A0-  36  6E  49  21  24  24  24  E4
92A8-  3F  3F  96  2A  2D  2D  00  36
92B0-  36  36  36  2E  2D  2D  05  20
92B8-  24  04  20  E4  3F  3F  96  2A
92C0-  2D  2D  00  29  2D  AD  B6  92
92C8-  F6  3F  3F  07  20  24  24  24
92D0-  04  00  2D  2D  15  15  36  36
92D8-  F6  1E  3F  3F  24  24  24  24
92E0-  24  00  2D  2D  2D  DE  DB  33
92E8-  36  2D  2D  DE  1B  36  36  2D
92F0-  2D  2D  05  00  2D  2D  2D  DE
92F8-  DB  33  36  2D  2D  DE  1B  36
9300-  36  05  00  29  2D  AD  DF  92
9308-  2A  AD  36  1E  3F  3F  07  20
9310-  24  24  24  04  00  36  36  36
9318-  36  6E  49  21  24  24  3F  3F
9320-  67  49  21  24  04  00  29  2D
9328-  F5  33  36  36  36  06  3F  4D
9330-  2D  00  49  49  36  36  36  36
9338-  1E  3F  3F  07  20  04  00  36
9340-  36  36  36  6E  49  E1  1C  1C
9348-  1C  1C  0C  0C  0C  0C  05  00
9350-  36  36  36  36  2E  2D  2D  2D
9358-  00  36  36  36  36  6E  49  21
9360-  24  24  24  24  17  17  17  07
9368-  38  28  00  36  36  36  36  6E
9370-  49  21  24  24  24  24  DF  9B
9378-  15  15  15  15  05  00  29  2D
9380-  AD  36  36  36  F6  3F  3F  07
9388-  20  24  24  24  04  00  2D  2D
9390-  AD  36  1E  3F  3F  04  C0  30
9398-  36  36  36  36  05  00  32  36
93A0-  36  36  0E  2D  6D  1C  07  68
93A8-  24  24  24  1C  3F  3F  07  00
93B0-  36  36  36  36  6E  49  E1  1C
93B8-  1C  1C  07  28  2D  2D  20  E4
93C0-  3F  3F  07  00  29  2D  AD  DF
93C8-  DB  36  0E  2D  2D  15  36  F6
93D0-  3F  3F  07  28  00  2D  2D  2D
93D8-  DE  33  36  36  36  36  00  36
93E0-  36  36  36  0E  2D  2D  05  20
93E8-  24  24  24  24  00  36  36  36
93F0-  0E  0E  0E  05  28  28  20  24
93F8-  24  24  00  36  36  36  36  0E
9400-  2D  20  24  24  24  6C  31  36
9408-  36  36  F6  3F  00  76  0E  96
9410-  1E  1E  6E  49  21  1C  1C  1C
9418-  64  0C  0C  24  00  76  0E  16
9420-  92  0A  24  24  64  0C  0C  24
9428-  00  2D  2D  2D  36  1E  1E  1E
9430-  1E  1E  1E  2E  2D  2D  2D  00
```

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How Do I Fit A 16K Program Into A 6K Space?

(Simple – You Don't)

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Dept. of Chemistry
Notre Dame, IN

When an Apple II Plus is turned on, default values are assigned to a region in random access memory which is used to control certain system functions. Examples of these functions include system machine language programs, "stacks", input lines by programs, and certain visual display modes of the Apple. The first 2048 bytes (or pages 0 through 7, each page comprising 256 bytes) are reserved for these functions, with the balance of RAM utilized for BASIC, machine language programs, binary data, or DOS. Figure 1 depicts the outlay of user-accessible memory assuming a 48K Apple, with both HI-RES pages also included.

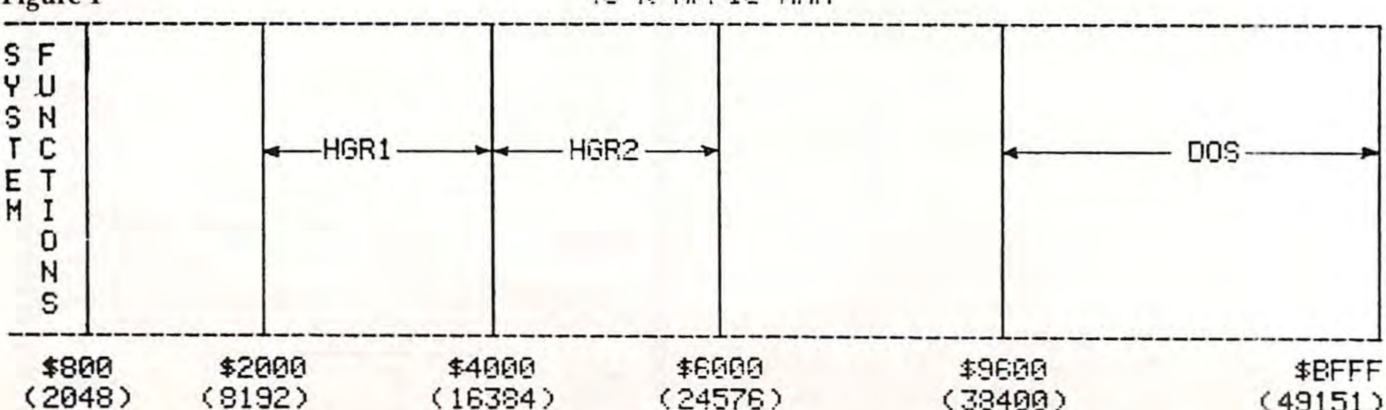
Other areas of RAM may also be used by peripheral devices or functions that are included in Applesoft (the version of BASIC designed for the Apple). If the Apple is interfaced to a disk drive, the disk operating system (DOS) is loaded automatically into the top portion of RAM (38400K-49151K on a 48K Apple; a corresponding upper RAM region is used on Apples with less memory). This upper 10K region can be used by a BASIC program if your Apple is cassette supported. The contiguous portion of memory from 8192K-24576K however can generate frustrating problems. If your program exceeds 6K and extends into the first or second HI-RES page, this problem becomes self-evident when the program attempts to use a "BASIC-loaded" HI-RES page.

For example, the Apple by default starts loading a BASIC program at $800 (2048k). And of course one of the excellent features of the Apple is the use of the HI-RES pages for animation or detailed graphics effects. However, when either HI-RES page is used from BASIC (by the use of either the HGR or HGR2 command), the respective HI-RES region in memory is literally filled with zeroes. If your program is larger than 6K bytes (that region from 2K-8K), then the portion of BASIC extending into the first HI-RES page memory region will be destroyed upon use of the HGR command since the 8K-16K region will be "erased". An analogous situation occurs if the program extends into the 16K-24K region of RAM and the HGR2 command is used. A solution to this problem involves loading the BASIC program into a different region of RAM, and hence overriding certain default values that the Apple assigns when it is turned on.

There are two memory locations in the zero page of Apple's RAM which dictate where BASIC programs are loaded (See Applesoft Memory Map (Page 0) by Jim Butterfield, Issue 6 of **COMPUTE!** or page 140 in the Applesoft BASIC Programming Reference Manual). The pointer to the start of a BASIC program is comprised of the most significant byte 104 ($68) and the least significant byte 103 ($67), and their contents may be changed by using the POKE command. By POKEing 104 and 103 prior to loading a program, the portion of RAM used for BASIC storage can be altered.

Most of my programs occupy about 16K of RAM, require the first HI-RES page for graphics, and operate on a 32K diskless Apple II Plus. It should now be recognized that if the pointer to the beginning of the program (locations 104 and 103) is left at the default value of 2048 ($800), approximately the last 10K of my program would be destroyed upon usage of the first HI-RES page. The simplest solution is to load the BASIC program immediately above this HI-RES page in memory, which can be accommplished on either a cassette or disk-supported machine, but must be done prior to loading the program.

Figure 1 48 K Apple RAM



For cassette supported systems, after turning on your Apple type the following, then press return.

POKE 104,64:POKE 103,1:POKE 16384,0 ‹RET›

LOADing of a BASIC program now starts at decimal location 16385 (= 256*64+1; the most significant byte is multiplied by 256 and added to the least significant byte for most pointers), and can occupy the upper 16K of RAM (16385K-32768K). The byte immediately before the memory location where LOADing is initiated must be a zero, hence location 16384 contains a zero. (To change this pointer to any RAM location divide the chosen decimal value by 256, POKE the integer portion of the answer into 104 and POKE the remainder into 103.)

The identical results can be obtained on a 48K disk supported Apple, using a slightly more sophisticated method. An EXEC file may be created, which when EXECed by the HELLO program initializes the pointer to the beginning of the program and then loads the program. The following program creates the EXEC file "LOADER".

```
10 D$ = CHR$(4)
20 PRINT D$"OPEN LOADER"
30 PRINT D$"WRITE LOADER"
40 PRINT "POKE 104,64"
50 PRINT "POKE 103,1"
60 PRINT "POKE 16384,0"
70 PRINT "LOAD TITRATION"
80 PRINT "CLOSE LOADER"
```

The following HELLO program would then EXEC the file LOADER.

```
10 D$ = CHR$(4)
20 PRINT D$"EXEC LOADER"
```

The same diskette must of course contain the HELLO program (which is run when the system is booted), the BASIC program "TITRATION", and the EXEC file "LOADER". The use of an EXEC file saves the tedium of POKEing locations from the keyboard, followed by a "LOAD TITRATION" DOS command (which gives the same results but is considered less time-efficient). This now BASIC-vacated region from 2K-8K usually stores shapes which are displayed on the first HI-RES page under control of the newly located BASIC program. ©

Apple Authors

COMPUTE! is looking for applications articles aimed at beginners and intermediate programmers. We're specifically interested in programming hints, tutorials, articles written to help users get more out of their machine.

Editor's Note: Here's the first in a series of assembler programs to enhance your Integer BASIC. RCL

Ever Expanding Apple Power

Mitchell Bushin
Scarsdale, NY

I am an Apple II owner who found Apple Integer Basic a rather limited language. In order to improve the language's power, I have written assembler programs to "attach" to Integer Basic programs.

The first of my sample programs is an idea stolen from Wang Labs. They have a row of Special Function keys on their machine. These keys can be used to allow a user to type a whole word in answer to an input statement by touching one key. I liked the feature and wrote a program that allows an Apple-ite (Apple-user) to use the number keys as special function keys.

This is the Basic part:

```
1   w=0: rem this must be the first statement
100 rem this is a piece of a home accounting program
110 respond=2048: rem address of routine
500 call -936: rem clear screen
510 vtab 10:print "commment on expense:"
520 call respond: if w#1 or w#2 or w#3 then goto 600
530 dim ans$(30): rem the answer we want
540 if w#1 then goto 550:ans$="oil":s=24
550 if w#2 then goto 560:ans$="petty-cash refill":
    s=36
560 if w#3 then goto 570:ans$="electric":s=29
570 vtab 10:tab 20:print ans$: rem automatic ans is
    printed
580 vtab 10:tab s:input a$: rem wait for return to
    continue
590 goto 610
600 vtab 10:tab 20:input ans$
610 rem rest of program
```

Together with the assembler program, this program types an answer automatically when a pseudo-S.F. key is hit. There can be up to 9 different automatic answers. This is good for an office Apple that runs a program that would normally have a specific number typed to give an answer. In addition, with the S.F. keys, hitting the space bar allows the Apple-ite to type in any answer he wants.

The assembler part:

```
loc in hex
800       JSR    $FF4A    SAVE REG.
803       BIT    $C000    IS KEY PRESSED
          BPL    $0803    NO-GOTO 803
          LDA    $C000    WHAT IS CODE
          CMP    #$BA     IS IT A NUMBER
          BCS    $0813    NO-GOTO 813
```

```
        AND     #$0F        WHAT IS THE
                            NUMBER
        BPL     $0815       GOTO 815
813     LDA     #$00        LET W BE ZERO
815     LDY     #$04        W IS THE 4TH BYTE
                            IN VARIABLE LIST
        STA     (4A),Y      4A IS ADDR. OR VAR.
                            LIST
        BIT     $C010       RESET KEY STROBE
        JMP     $FF3F       RETURN REGISTERS
81F
```

After loading the assembler program set lomem so that it does not interfere with the variable list. Lomem:2079 is good enough. This program is portable and can be placed anywhere in memory. ©

THE ATARI® GAZETTE

A Tutorial

Plotting In Atari Basic

N. L. Wheeler
Charleston, WV

This article gives a program for making (x,y) plots on the ATARI, and shows how to scale data for plotting on any computer. By changing only lines 20 and 25, you can plot any function that you can write in BASIC.

Perhaps your first experience with plotting on the ATARI was like mine. I set out to make a straight line (what could be simpler?). Six hours later I finally had a plot, but the thrill was gone. Two types of errors occured. First frequent occurrences of Error 141 "value out of range." Then the line did not slope in the direction that it should. The program listed here solves these problems and includes a general purpose subprogram for scaling and plotting data. In fact, the problem of wrong slope is solved simply by saying PLOT X,Y-GRAPHICS-Y instead of PLOT X,Y, where YGRAPHICS is the largest Y value that can be plotted in the graphics mode which you are using.

Before explaining the program, some words about plotting. Whether you are using a personal computer, or a piece of paper, the concepts are the same. You must scale your data to fit the medium where you plan to plot it. To illustrate this, suppose you are drawing a map to scale and you wish to represent a road 20 miles long with a landmark at mile 15, but you have to fit this on a 4 inch piece of paper. Here's one way you might solve the problem:

```
|_____|_____|_____|_____|
0     5     10    15    20  Miles

|_____|_____|_____|_____|
0     1     2     3     4   Inches
```

To find the SCALE, take (20–0)/4–0) = 5 miles/inch. To calculate where, in inches, to place 15 miles, calculate (15–10) miles / (5 miles/inch) = 3 inches. This is easy, partly because we have specific numbers to work with. If you do this process frequently, with different mileages and inches, you might develop the following formula:

SCALE = (LARGEST –SMALLEST values of real data) / (LARGEST –SMALLEST value of plot medium).

Any point to be plotted would be placed at point M in the plot medium, where M = SMALLEST value of plot medium (usually 0) + (point to be plotted – SMALLEST value of real data)/SCALE.

Further complications in computer plotting are that we don't know the smallest and largest values if we are using the computer to generate the points to plot, so we have to calculate the SMALLEST and LARGEST values. Also, we must use a slightly bigger number than SCALE to prevent roundoff error. (I multiply SCALE by 1.01).

Here then are the steps to go through in producing a computer plot. The numbers correspond to comments in the program.

1. Choose the graphics mode and determine the largest X and Y values that you can plot in this mode. For the ATARI these values are 159 and 79 for GRAPHICS 7 and 319 and 159 for GRAPHICS 8. (Always use 1 less than the value in the manual).

2. Choose the number of points to plot and write the DIM statement.

3. Generate the points to be plotted and store them in an X and Y array. Thus X(1) will be plotted vs. Y(1), etc.

4. Find the largest and smallest values of your X and Y values.

5. Determine the scale as described above, and multiply by a small fudge factor.

6. Do the actual plotting. First you must scale each x and y value, then plot them.

7. Put in axes and label them. Because labeling the Y axis requires PEEK and POKE, I chose not to illustrate it in this tutorial. I used the text window to label the X axis.

The following program uses these techniques to plot the sine of X in radians. You can easily

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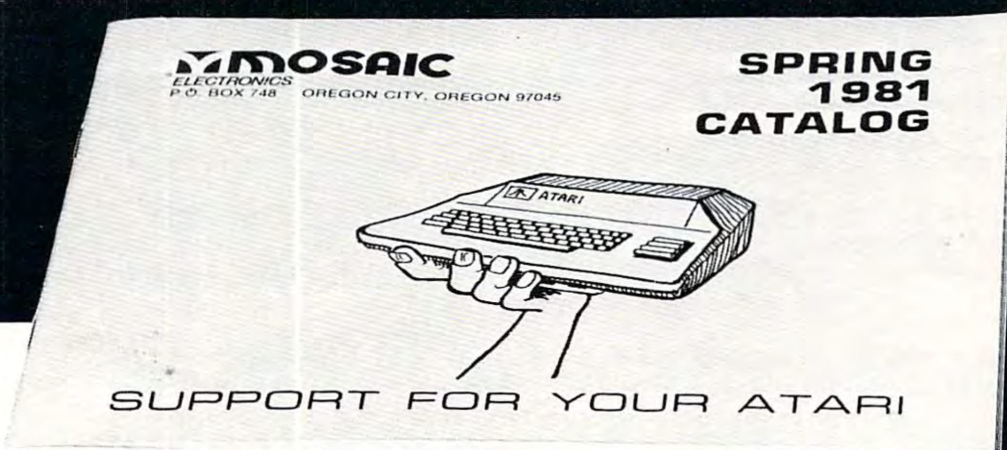

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Empty 8K 32K	40K RAM	**Danger!** This Configuration Can Damage Computer
8K 32K 8K	48K RAM 40K With BASIC Cartridge	**Danger!** This Configuration Can Damage Computer
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adapt it to any function by changing lines 20 and 25. Line 20 gives the range of values you want X to take on and line 25 describes how to calculate Y from X.

The program also illustrates what professional programmers call "defensive code". If you try to calculate more values than you have specified with MXPTS, it will warn you. If for some reason, you do try to plot outside the valid values (which shouldn't happen if you type carefully), it will tell you.

What might you like to add to this or change? In GRAPHICS 7, you can have four colors. You could introduce a new variable Z(I), where Z stored the color of the point (0 to 3). Then add a line 5125 COLOR Z(I). I used this program to plot the maximum scores for each level of Star Raiders, but I have to report that it did not help my game.

NOTE TO APPLE OWNERS: A friend who owns an Apple tried an earlier version of this program and reported that it worked. YGRAPHICS should be 191, and XGRAPHICS 279. You may have to change the X labeling in lines 5156 to 5168.

```
1 GRAPHICS 0:PRINT :PRINT "A GENERAL PLOTTING PROGRAM":PRINT :PRINT "CHANGE LINE
 20 TO SPECIFY RANGE OF X "
2 PRINT "AND LINE 25 TO SPECIFY CURVE.":PRINT "ENTER TITLE AT 19":PRINT :PRINT "
LINE 25 MUST BE A VALID EQUATION"
3 PRINT "DON'T DIVIDE BY ZERO OR ANYTHING":PRINT "LIKE THAT":PRINT :PRINT "WHEN
YOU HIT ENTER, WE'LL DO A SAMPLE"
4 DIM Z$(1):INPUT Z$
5 REM *** STEP1 *** Choose the graphics mode, and determine maximum values you c
an plot based on mode
6 GRAPHICS 8:XGRAPHICS=319:YGRAPHICS=159:REM . Use either statement 6 or 7
7 GRAPHICS 7:XGRAPHICS=159:YGRAPHICS=79
8 REM *** STEP2 *** Choose the number of points to plot and write DIM statement
9 MXPTS=200:BAD=0
10 DIM X(MXPTS),Y(MXPTS)
15 REM *** STEP3 *** Generate points to plot, store in an X and Y array.
16 REM . Count the points with I as you go, be sure I does not exceed MXPTS set
earlier.
17 DIM LEGEND$(60),LABEL$(20):REM used in line 5160 to approximate X axis label
18 I=0:DIM TITLE$(40):REM .Initialize I, counter for the arrays X and Y.
19 TITLE$="          A SINE WAVE ":REM Leave some spaces at front to center
20 FOR X=0 TO 2*3.1416 STEP 0.2:REM from 0 to 2  PI
25 Y=SIN(X)
31 IF I=MXPTS THEN PRINT "> YOU MUST INCREASE MXPTS IN LINE 8,PLOTTING CONTINUES
 ":FOR J=1 TO 500:NEXT J:GO TO 41
32 I=I+1
33 IF I=1 THEN PRINT TITLE$:PRINT "GENERATING DATA, (X,Y)=";
34 PRINT "(";X;",";Y;") ";:REM You may wish to take this out, I like to see how
I am progressing
35 X(I)=X:Y(I)=Y:REM store the values
39 NEXT X
41 COUNT=I:REM Count is the total number of points to be plotted
60 GOSUB 5000:REM call PLOTTING routine
70 PRINT TITLE$;
80 INPUT Z$:GRAPHICS 0:PRINT :PRINT "DO YOUR GRAPH NOW":LIST 19,25:PRINT "RUN
 ":END
4999 REM . What follows should not change for any plots
5000 REM *** PLOTTING SUBROUTINE ***
5001 REM *** STEP4 *** Find the smallest and largest values of X and Y
5002 XSML=X(1):YSML=Y(1):XLRG=X(1):YLRG=Y(1):REM Set the maximum and minimum to
the first value,then compare
5010 FOR I=1 TO COUNT
5015 IF X(I)>XLRG THEN XLRG=X(I)
5020 IF X(I)<XSML THEN XSML=X(I)
5025 IF Y(I)<YSML THEN YSML=Y(I)
5030 IF Y(I)>YLRG THEN YLRG=Y(I)
5040 NEXT I
5050 COLOR 1:REM .You must have this for the graphs to show
5055 REM *** STEP 5 *** Calculate the scaling factor as discussed in the article
5060 YSCALE=(YLRG-YSML)/YGRAPHICS*1.01:IF YSCALE=0 THEN YSCALE=1
5065 XSCALE=(XLRG-XSML)/XGRAPHICS*1.01:IF XSCALE=0 THEN XSCALE=1
5068 IF ABS(LOG(XSCALE/YSCALE))>5 THEN PRINT " WARNING- THE RELATIVE RANGE OF X
AND Y VALUES IS VERY LARGE"
```

```
5070 IF 0<XSML OR 0>XLRG THEN GO TO 5080
5075 X=(0-XSML)/XSCALE:Y=0:GOSUB 5400:Y=YGRAPHICS:GOSUB 5300:REM YAXIS
5080 IF 0<YSML OR 0>YLRG THEN GO TO 5100
5085 Y=(0-YSML)/YSCALE:X=0:GOSUB 5400:X=XGRAPHICS:GOSUB 5300:REM X AXIS
5090 REM *** STEP 6 *** Scale each (X,Y) pair for plotting
5100 FOR I=1 TO COUNT:REM Now we are ready to plot
5110 X=(X(I)-XSML)/XSCALE
5120 Y=(Y(I)-YSML)/YSCALE
5130 GOSUB 5400
5140 NEXT I
5150 REM *** STEP 7 *** ADD AXES AND LABEL THEM.  TO PUT IN Y AXIS LABELS YOU MU
ST USE PEEK AND POKE
5153 PRINT :PRINT
5154 PRINT "|    |    |    |    |    |    |    |"
5158 LEGEND$="                                         "
5159 REM a point x on the text scale would be at z=x*(xgraphics+1)/40 in the gra
phics window.
5160 FOR X=2 TO 32 STEP 10:LABEL$=STR$(INT(XSML+(10*X*XSCALE*(XGRAPHICS+1)/40))/
10):LEGEND$(X-1)=LABEL$:NEXT X
5161 FOR X=2 TO 32 STEP 10:LABEL$=STR$(INT(10*(XSML+X*(XGRAPHICS+1)/40*XSCALE))/
10):LEGEND$(X-1)=LABEL$:NEXT X
5162 IF LEN(LEGEND$)>38 THEN PRINT LEGEND$(1,38)
5164 IF LEN(LEGEND$)<=38 THEN PRINT LEGEND$
5168 IF BAD>0 THEN PRINT BAD;" POINTS OUT OF RANGE ";
5200 REM . Check X and Y to see if in range
5210 IF X<0 THEN X=0:BAD=BAD+1
5220 IF X>XGRAPHICS THEN X=XGRAPHICS:BAD=BAD+1
5230 IF Y<0 THEN Y=0:BAD=BAD+1
5240 IF Y>YGRAPHICS THEN Y=YGRAPHICS:BAD=BAD+1
5245 RETURN
5300 GOSUB 5200:DRAWTO X,YGRAPHICS-Y:RETURN
5400 REM *** STEP 6 *** This statement does the actual plotting, note how the Y
value is plotted
5401 GOSUB 5200:PLOT X,YGRAPHICS-Y:RETURN
```

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Mixing Atari Graphics Modes 0 And 8

Douglas Crockford
Irvine, CA

Graphic mode 0 is the ATARI text mode. It supports upper case, lower case, inverse video, and has a position function for placing text anywhere within a 40 by 24 display field. Graphic mode 8 is the ATARI high resolution plot mode. It supports the plotting of points and lines in a 320 by 160 (or 192) display field. It would be very nice to use both modes at the same time. The text window is some help, but it confines the plot to the top and the text to the bottom. Modifying the display list provides a partial solution, but it is awkward and doesn't permit the mixing of text and plot on the same line.

A better solution is to use graphic mode 8 and plot the dots that make up the text characters. This can be done very quickly by a 6502 subroutine, which does things in software which are very similar to what the display hardware does 60 times a second.

The subroutine is called with the USR function. It has four arguments:

- the horizontal cursor position
- the vertical cursor position
- the address of the string to be displayed
- the length of the string to be displayed.

So, the code

```
GR.0
POSITION X,Y
PRINT STRING$;
```

will produce similar results to

```
GR.8
A=USR(ADR(PRINT$),X,Y,ADR(STRING$),LEN
(STRING$))
```

PRINT$ is a string containing the subroutine. The STRING$ should not extend past the last column on a row. Any imbedded function codes (cursor movement, insert, etc.) will be displayed literally. The position of the PLOT/DRAWTO pointer is not changed, nor is the current COLOR.

An interesting bonus is that adding 40*R to the horizontal argument causes the text to be displayed R plot rows lower than usual. This permits the display of subscripts, mathematical expressions, 1½ line spacing, underlining, and so on.

The program was prepared with the ATARI Assembler Editor. Following is an explanation of the program.

Lines	Explanations
1110.	SAVMSC contains a pointer to the first byte of display memory. (Not the display list, but the display itself.)
1120.	CHBAS contains the high order byte of the address of the character generator. Normally, this points to the character generator in the OS ROM. However, if a user defined character generator is in effect, then it will be used. Note that by changing the character generator between calls, several character sets could be on the screen at the same time.
1130–1220.	The temporary variables are put in the page 0 space reserved for the floating point package.
1270.	Pull the number of arguments off the stack.
1280–1360.	If there aren't exactly 4 arguments, then pull all the arguments off and return. This section of code isn't completely necessary, but without it, accidentally forgetting an argument could kill the system. It's a small price to pay.
1400–1430.	Pull off the horizontal position and store it in DISP.
1440–1460.	Pull off the vertical position and put it in Y for now.
1470–1500.	Pull off the string address and store it in STR.
1510–1540.	Pull off the string length. Return if it is 0. Otherwise, store it in LEN.
1580–1640.	Add SAVMSC to DISP.
1650–1740.	Add (Y * 320) to DISP by adding 320, Y times. 320 = 40 * 8 = (1 * 256) + 64
1780.	Y contains 0, so store it in SCAN. There are 8 plot lines in a character, and we will use SCAN to remember which one we're on.
1820–1830.	CHAR will remind us of which character of STRING$ we're on.
1880–1930.	Get the next character and save it in X. INV gets set to $FF if the MSB of the character is set, and 0 otherwise. INV is used to do inverse video.
1940–2100.	ATASCII codes don't go directly into display memory. Bits 5 and 6 get shuffled around first. This is done so that lower case in GR.1 would display as upper case of another color, instead of as digits and special characters.
2150–2220.	GENP is set to point to the beginning of the 8 byte section of the character generator for this generator for this character. The multiplication by 8 is done by shifting left 3 times.
2350–2380.	Select the proper byte from the character generator. If INV is $FF, then flip its bits. Put the byte in the display.
2350–2380·	Increment CHAR. If there are more characters in the string, then repeat.
2420–2470.	Advance DISP to the next row.
2480–2520.	Increment SCAN. If there are more scans to do, then repeat. Otherwise, return. The number returned to BASIC is meaningless.

The subroutine is position independent because it contains no JPs, JSRs, or data references to itself. It can run anywhere in memory. It is also under 256 bytes, so it can also run in page 6. It can be put into your program using the techniques in the BASIC Reference Manual and the Assembler Editor User's Manual. It can also be loaded from disk by a BASIC program. The DEMO program shows the subroutine being loaded into a string called PRINT$, and shows a few of the things it can do.

```
1 REM DEMO
2 REM THIS PROGRAM SHOWS HOW TO LOAD
3 REM A MACHINE LANGUAGE SUBROUTINE
4 REM AND EXECUTE IT.
5 REM DOUGLAS CROCKFORD
10 OPEN #5,4,0,"D:PRINT.OBJ":GET #5,L:GET #5,H
20 GET #5,L:GET #5,H:BEGIN=H*256+L
30 GET #5,L:GET #5,H:LET END=H*256+L-BEGIN+1:DIM PRINT$(END)
40 FOR I=1 TO END:GET #5,L:LET PRINT$(I)=CHR$(L):NEXT I
60 CLOSE #5
90 GRAPHICS 8
1000 A=USR(ADR(PRINT$),10,10,ADR("[1+(3n-2)]TR = RRRRR"),20)
1010 A=USR(ADR(PRINT$),101,9,ADR("n"),1)
1020 A=USR(ADR(PRINT$),105,9,ADR("3n -n"),5)
1030 A=USR(ADR(PRINT$),267,8,ADR("2"),1)
1040 A=USR(ADR(PRINT$),221,10,ADR("2"),1)
1050 A=USR(ADR(PRINT$),227,10,ADR("2"),1)
2000 DIM TEXT$(40)
2010 TEXT$="Mixing ATARI graphics modes 0 and 8"
2020 A=USR(ADR(PRINT$),3,0,ADR(TEXT$),LEN(TEXT$))
2030 COLOR 1:PLOT 24,9:DRAWTO 304,9
2100 PLOT 64,60:DRAWTO 260,60:DRAWTO 260,100:DRAWTO 64,100:DRAWTO 64,60
2110 PLOT 64,100:DRAWTO 74,110:DRAWTO 270,110:DRAWTO 270,70:DRAWTO 260,60
2120 PLOT 260,100:DRAWTO 270,110
```

```
            1020 ; A=USR(1536,X,Y,ADR(STRING$),LEN(STRING$))
            1040 ; THIS PROGRAM GIVES A TEXT DISPLAY CAPABILITY IN BASIC
            1050 ; GRAPHIC MODE 8.  IT RECEIVES X AND Y CHARACTER
            1060 ; COORDINATES FOR THE GRAPHIC WINDOW, AND A STRING OF
            1070 ; 40 OR FEWER CHARACTERS.
            1090 ; DOUGLAS CROCKFORD   02/28/81
0058        1110 SAVMSC =    $58        ; POINTER TO DISPLAY MEMORY
02F4        1120 CHBAS  =    $02F4      ; PAGE POINTER TO THE CHARACTER GENERATOR
00D4        1130 LEN    =    $D4        ; THE LENGTH OF THE STRING TO DISPLAY
00D5        1140 INV    =    $D5        ; INVERSE VIDEO CHARACTER FLAG
00D6        1150 DISPL  =    $D6        ; DISPLAY TEXT POINTER
00D7        1160 DISPH  =    $D7
00D8        1170 STRL   =    $D8        ; SOURCE STRING POINTER
00D9        1180 STRH   =    $D9
00DA        1190 GENPL  =    $DA        ; CHARACTER GENERATOR POINTER
00DB        1200 GENPH  =    $DB
00DC        1210 CHAR   =    $DC        ; CURRENT CHARACTER INDEX
00DD        1220 SCAN   =    $DD        ; CURRENT SCAN LINE
0000        1230           *=   $600
            1250 ; VERIFY THAT THE NUMBER OF ARGUMENTS IS CORRECT.
0600 68     1270           PLA
0601 C904   1280           CMP  #4
0603 F009   1290           BEQ  FI3
0605 AA     1300           TAX
0606 F005   1310           BEQ  FI2
0608 68     1320 DO1       PLA
0609 68     1330           PLA
060A CA     1340           DEX
060B D0FB   1350           BNE  DO1
060D 60     1360 FI2       RTS
            1380 ; RECEIVE THE ARGUMENTS
060E 68     1400 FI3       PLA
060F 85D7   1410           STA  DISPH
0611 68     1420           PLA
0612 85D6   1430           STA  DISPL
0614 68     1440           PLA
0615 68     1450           PLA
0616 A8     1460           TAY
0617 68     1470           PLA
0618 85D9   1480           STA  STRH
061A 68     1490           PLA
061B 85D8   1500           STA  STRL
```

```
061D 68              PLA
061E 68              PLA
061F F0EC            BEQ  FI2
0621 85D4            STA  LEN
          ;
          ; SET THE DISPLAY POINTER
          ;
0623 18              CLC                 ; DISP := SAVMSC + X + (Y * 320)
0624 A5D6            LDA  DISPL
0626 6558            ADC  SAVMSC
0628 85D6            STA  DISPL
062A A559            LDA  SAVMSC+1
062C 65D7            ADC  DISPH
062E 85D7            STA  DISPH
0630 98              TYA
0631 F00F            BEQ  FI5
0633 A5D6       DO4  LDA  DISPL
0635 6940            ADC  #64
0637 85D6            STA  DISPL
0639 A5D7            LDA  DISPH
063B 6901            ADC  #1
063D 85D7            STA  DISPH
063F 88              DEY
0640 D0F1            BNE  DO4
          ;
          ; LOOP FOR THE EIGHT PLOT LINES IN A CHARACTER
          ;
0642 84DD       FI5  STY  SCAN
          ;
          ; LOOP FOR EACH CHARACTER IN THE STRING
          ;
0644 A000       DO6  LDY  #0
0646 84DC            STY  CHAR
          ;
          ; FETCH A CHARACTER. SET  INV  IF THE MSB IS SET.  CONVERT
          ; IT FROM ATASCII TO THE DISPLAY CHARACTER SET.
          ;
0648 B1D8       DO7  LDA  (STRL),Y
064A A000            LDY  #0
064C AA              TAX
064D 1001            BPL  FI8
064F 88              DEY
0650 84D5       FI8  STY  INV
0652 8A              TXA
0653 2960            AND  #96
0655 D004            BNE  CA9
0657 A940            LDA  #64
0659 100E            BPL  FIB
065B C920       CA9  CMP  #32
065D D004            BNE  CAA
065F A900            LDA  #0
0661 1006            BPL  FIB
0663 C940       CAA  CMP  #64
0665 D002            BNE  FIB
0667 A920            LDA  #32
0669 85DA       FIB  STA  GENPL
066B 8A              TXA
066C 291F            AND  #$1F
066E 05DA            ORA  GENPL
0670 85DA            STA  GENPL
          ;
          ; MAKE A POINTER TO A CHARACTER IN THE CHARACTER
          ; GENERATOR.
          ;
0672 A900            LDA  #0             ; GENP := (TRANSLATED CHARACTER * 8)
0674 A203            LDX  #3             ;    + (CHBAS * 256)
0676 06DA       DOC  ASL  GENPL
0678 2A              ROL  A
```

```
0679 CA              DEX
067A D0FA            BNE  DOC
067C 6DF402          ADC  CHBAS
067F 85DB            STA  GENPH
            ;
            ; FETCH A CHARACTER SEGMENT FROM THE CHARACTER GENERATOR.
            ; COMPLEMENT IT IF INV IS SET.  STORE IT IN DISPLAY MEMORY.
            ;
0681 A4DD            LDY  SCAN
0683 B1DA            LDA  (GENPL),Y
0685 45D5            EOR  INV
0687 A4DC            LDY  CHAR
0689 91D6            STA  (DISPL),Y
            ;
            ; TEST FOR END OF STRING
            ;
068B C8              INY
068C 84DC            STY  CHAR
068E C4D4            CPY  LEN
0690 D0B6            BNE  D07
            ;
            ; ADVANCE THE DISPLAY POINTER.  TEST FOR LAST SCAN.
            ;
0692 18              CLC
0693 A5D6            LDA  DISPL
0695 6928            ADC  #40
0697 85D6            STA  DISPL
0699 9002            BCC  FID
069B E6D7            INC  DISPH
069D E6DD       FID  INC  SCAN
069F A908            LDA  #8
06A1 C5DD            CMP  SCAN
06A3 D09F            BNE  D06
06A5 60              RTS
06A6                 .END
```

©

An Atari Disassembler And Memory Lister

Charles Fortner
Lawrenceville, GA

Thomas Gordon's "A 6502 Disassembler" was published in the January, 1981, issue of **COMPUTE!**. The following program is a conversion for use on an Atari, and also includes an option to sequentially list the contents of memory.

The major obstacle in converting this program is caused by the lack of string arrays in Atari Basic. However, the conversion is not as difficult as might be suspected due to Atari's ability to dimension a string variable to any length. R$ is dimensioned to handle the 255 different opcodes of four digits each in line 5. R$ is then cleared in line 12, and the opcodes inserted by the subroutine at line 250. String manipulations are then used to check for the different opcodes.

The user may press "SELECT" during disassembly/listing to choose a new starting address or press "START" to choose a different mode of operation.

The disassembler as listed will request a new starting address if an invalid opcode is encountered. One possible program change is to convert line 75 to increment the current memory address (S) by one, and then branch to line 40 instead of 20 when an invalid opcode is encountered. This will allow a continuous listing to occur which can help in locating the next segment of legitimate code.

Many mysteries of the Atari can be uncovered by using the disassembler on the operating system and the basic cartridge. How many can you find?

```
1 REM DISASSEMBLER ORIGINALLY BY THOMAS G. GORDAN-COMPUTE MAGAZINE 1/81
2 REM CONVERTED TO ATARI BY CHARLES G.FORTNER 1/81
5 DIM R$(1032),M$(4),A$(4),B$(1),C$(1),D$(1),E$(1),F$(4),FR$(1),TH$(1),TW$(1),OE
$(1),U$(1),ANS$(3),DIS$(3)
10 ? "↰6502 DISASSEMBLER AND MEMORY LISTER ":? :?
11 ? "PLEASE WAIT WHILE I SET UP"
12 FOR X=1 TO 1032:R$(X,X)=" ":NEXT X
15 GOSUB 250:REM FILL IN ALL OPCODES
16 ? :? "DO YOU WANT DISASSEMBLER":INPUT DIS$
20 PRINT "ENTER STARTING ADDRESS IN 4 DIGIT HEX":? :? "ADDRESS";
21 INPUT A$:IF DIS$="NO" THEN 1505:REM GOTO MEMORY LISTER ROUTINE
35 GOSUB 900:REM CONVERT HEX TO DECIMAL
40 Z=PEEK(S):A=S:IF PEEK(53279)=5 THEN ? :GOTO 20:REM IF 'SELECT' PRESSED THEN G
ET NEW ADDRESS FOR DISASSEMBLER
41 IF PEEK(53279)=6 THEN 16:REM IF 'START' PRESSED THEN GIVE CHOICE OF DISASSEMB
LER OR MEMORY LISTER
55 GOSUB 1000:REM GET HEX ADDRESS
60 PRINT ,;FR$;TH$;TW$;OE$;" ";
70 A=Z:GOSUB 1000
75 ? ;TW$;OE$;" ";:IF R$(Z*4+1,Z*4+1)=" " THEN ? "IS AN INVALID OPCODE":GOTO 20
76 ? R$(Z*4+1,Z*4+3);" ";
80 U$=R$(Z*4+4)
90 IF U$=" " THEN PRINT ;U$:S=S+1:GOTO 40
95 IF U$="N" THEN PRINT ;"A∂";:GOTO 600
100 IF U$="A" THEN PRINT ;U$:S=S+1:GOTO 40
105 IF U$="Z" THEN PRINT ;"A∂";:GOTO 625
110 IF U$="∂" THEN PRINT ;"∂$";:GOTO 625
115 IF U$="X" THEN PRINT ;"A∂";:GOTO 645
120 IF U$="Y" THEN PRINT ;"A∂";:GOTO 665
125 IF U$="B" THEN PRINT ;" (";:GOTO 685
130 IF U$="C" THEN PRINT ;" (";:GOTO 700
135 IF U$="U" THEN PRINT ;"A∂";:GOTO 715
140 IF U$="R" THEN PRINT ;"TO ";:GOTO 765
145 IF U$="J" THEN PRINT ;" (";:GOTO 735
150 IF U$="V" THEN PRINT ;"A∂";:GOTO 755
250 REM SUBROUTINE TO FILL IN ALL OPCODES
251 FOR X=0 TO 255:READ M$:R$((X*4)+1,(X*4)+4)=M$:NEXT X
255 DATA BRK ,ORAB,,,,ORAZ,ASLZ,,PHP ,ORA∂,ASLA,,,ORAN,ASLN,,BPLR,ORAC,,,,ORAU,A
SLU,,CLC ,ORAY,,,,ORAX
260 DATA ASLX,,JSRN,ANDB,,,BITZ,ANDZ,ROLZ,,PLP ,AND∂,ROLA,,BITN,ANDN,ROLN,,BMIR,
ANDC,,,,ANDU,ROLU,,SEC ,ANDY,,,
```

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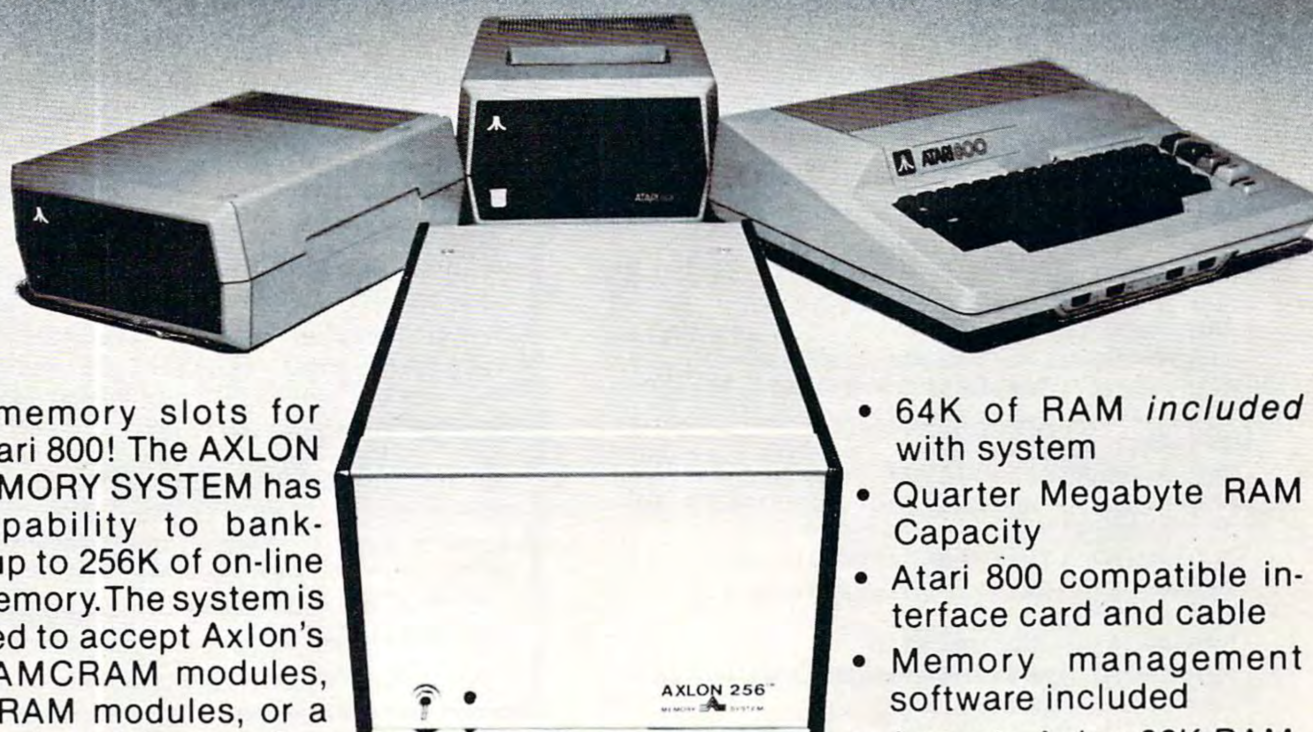

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```
265 DATA ANDX,ROLX,,RTI ,EORB,,,,EORZ,LSRZ,,PHA ,EOR@,LSRA,,JMPN,EORN,LSRN,,BVCR
,EORC,,,,EORU,LSRU,,CLI ,EORY,,,
270 DATA EORX,LSRX,,RTS ,ADCB,,,,ADCZ,RORZ,,PLA ,ADC@,RORA,,JMPJ,ADCN,RORN,,BVSR
,ADCC,,,,ADCU,RORU,,SEI ,ADCY,,,
275 DATA ADCX,,,,STAB,,,STYZ,STAZ,STXZ,,DEY ,,TXA ,,STYN,STAN,STXN,,BCCR,STAC,,,
STYU,STAU,STXV,,TYA ,STAY,TXS ,,
280 DATA STAX,,,LDY@,LDAB,LDX@,,LDYZ,LDAZ,LDXZ,,TAY ,LDA@,TAX ,,LDYN,LDAN,LDXN,,
BCSR,LDAC,,,LDYU,LDAU,LDXV,
285 DATA CLV ,LDAY,TSX ,,LDYX,LDAX,LDXY,,CPY@,CMPB,,,CPYZ,CMPZ,DECZ,,INY ,CMP@,D
EX ,,CPYN,CMPN,DECN,,BNER
290 DATA CMPC,,,,CMPU,DECU,,CLD ,CMPY,,,,CMPX,DECX,,CPX@,SBCB,,,CPXZ,SBCZ,INCZ,,
INX ,SBC@,NOP ,,CPXN,SBCN,INCN,
300 DATA BEQR,SBCC,,,,SBCU,INCU,,SED ,SBCY,,,,SBCX,INCX,
310 RETURN
600 A=PEEK(S+2):GOSUB 1000
605 PRINT ;TW$;OE$;
610 A=PEEK(S+1):GOSUB 1000
615 PRINT ;TW$;OE$
620 S=S+3:GOTO 40
625 A=PEEK(S+1):GOSUB 1000
630 PRINT ;TW$;OE$
632 S=S+2:GOTO 40
645 A=PEEK(S+2):GOSUB 1000
650 PRINT ;TW$;OE$;
655 A=PEEK(S+1):GOSUB 1000
660 PRINT ;TW$;OE$;",X":S=S+3:GOTO 40
665 A=PEEK(S+2):GOSUB 1000
670 PRINT ;TW$;OE$;
675 A=PEEK(S+1):GOSUB 1000
680 PRINT ;TW$;OE$;",Y":S=S+3:GOTO 40
685 A=PEEK(S+1):GOSUB 1000
690 PRINT ;TW$;OE$;",X)":S=S+3:GOTO 632
700 A=PEEK(S+1):GOSUB 1000
705 PRINT ;TW$;OE$;"),"
715 A=PEEK(S+1):GOSUB 1000
720 PRINT ;TW$;OE$;",X":GOTO 632
735 A=PEEK(S+2):GOSUB 1000
740 PRINT ;TW$;OE$;
745 A=PEEK(S+1):GOSUB 1000
750 PRINT ;TW$;OE$;")":S=S+3:GOTO 40
755 A=PEEK(S+1):GOSUB 1000
760 PRINT ;TW$;OE$;"Y":GOTO 632
765 A=PEEK(S+1):IF A<128 THEN 790
770 A=255-A
775 A=S+1-A:GOSUB 1000
780 PRINT ;FR$;TH$;TW$;OE$:GOTO 632
790 A=S+A+2:GOSUB 1000
795 GOTO 780
900 REM SUBROUTINE TO CONVERT HEX TO
    DECIMAL-S=DECIMAL VALUE
901 B$=A$(1):C$=A$(2,2):D$=A$(3,3):
    E$=A$(4,4):F$=B$
925 FOR X=1 TO 4
930 IF F$="A" THEN A=10:GOTO 965
935 IF F$="B" THEN A=11:GOTO 965
940 IF F$="C" THEN A=12:GOTO 965
945 IF F$="D" THEN A=13:GOTO 965
950 IF F$="E" THEN A=14:GOTO 965
955 IF F$="F" THEN A=15:GOTO 965
960 A=VAL(F$)
965 IF X=1 THEN S=A*4096:F$=C$
970 IF X=2 THEN S=S+A*256:F$=D$
975 IF X=3 THEN S=S+A*16:F$=E$
980 IF X=4 THEN S=S+A
985 NEXT X
990 RETURN
```

```
1000 REM SUBROUTINE TO CONVERT DECIMAL TO HEX
1001 F=INT(A/4096)
1005 R=A-F*4096
1010 TH=INT(R/256)
1015 R=R-TH*256
1020 TW=INT(R/16)
1025 OE=R-TW*16:H=F
1030 FOR X=1 TO 4
1035 IF H=10 THEN F$="A":GOTO 1070
1040 IF H=11 THEN F$="B":GOTO 1070
1046 IF H=12 THEN F$="C":GOTO 1070
1050 IF H=13 THEN F$="D":GOTO 1070
1055 IF H=14 THEN F$="E":GOTO 1070
1060 IF H=15 THEN F$="F":GOTO 1070
1065 F$=STR$(H)
1070 IF X=1 THEN FR$=F$:H=TH
1075 IF X=2 THEN TH$=F$:H=TW
1080 IF X=3 THEN TW$=F$:H=OE
1085 IF X=4 THEN OE$=F$
1090 NEXT X
1095 RETURN
1500 REM START MEMORY LISTER ROUTINE
1501 ? "ENTER STARTING ADDRESS IN 4 DIGIT HEX":? :? "ADDRESS";
1502 INPUT A$
1505 GOSUB 900
1510 Z=PEEK(S):A=S:IF PEEK(53279)=6 THEN ? :GOTO 16:REM IF 'START' PRESSED THEN
GIVE CHOICES AGAIN
1520 GOSUB 1000:REM GET HEX ADDRESS
1530 ? ,;FR$;TH$;TW$;OE$;" ";S;" ";
1540 A=Z:GOSUB 1000
1550 ? ;TW$;OE$
1560 S=S+1:IF PEEK(53279)=5 THEN 1585:REM IF 'SELECT' PRESSED THEN GET NEW ADDRE
SS FOR MEMORY LISTER
1570 GOTO 1510
1585 ? :GOTO 1500
```

©

Computerized Greeting Cards

For The Atari Computer

John Victor
Greenwich, CT

The idea of computerized greeting cards is not new — versions have been printed in other computer publications for the TRS-80 and the Apple computers. However, the Atari computer allows the programmer to go beyond simply designing and printing graphics Christmas trees. Instead, the programmer can produce really spectacular personalized computer shows that can be sent to friends on cassette (if the friends are fortunate enough to own an Atari computer). The cassette can include graphics, sound effects, music and a spoken message.

The program that I designed for this article was sent to my nephews Christopher and Eric who were getting an Atari 400 for Christmas. I realize that Christmas is now over, but the reader may want to use this one as a model for other holiday greetings.

Line 10 in the program indicates the locations of the subroutines used in this program. TREE starting at line 1000 draws a Christmas tree using regular keyboard characters (colored green). Every other * is actually printed in reverse type, but my printer will not print in reverse.

When the Christmas tree is printed on the screen, it appears all green. However, when the FLASH subroutine at line 1080 is activated, the reverse characters suddenly change color and flash on and off.

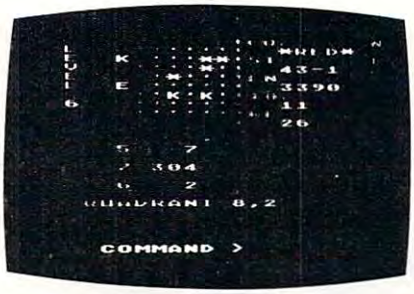
There are two music subroutines in this program, each of which plays a different type of music. The first (called MUSIC at line 1500) uses one voice and plays a short Christmas theme. The sound is "shaped" using the variable called LOUD. When the sound register is first turned on, LOUD is set to 15. The routine then rapidly reduces the value in LOUD, which creates a "plunking" sound like a piano. Each note is "plunked" as it is played. MUSIC2 plays "Joy To The World" in three part harmony.

At three points in the program the cassette player is turned on with a POKE 54018,52 instruction. The program then goes to KEYPRESS which times the cassette player. This allows a spoken message to be delivered from cassette for a given

```
5 REM COMPUTERIZED CHRISTMAS CARD
6 REM JOHN VICTOR, PROGRAM DESIGN, INC.
10 MUSIC=1500:TREE=1000:DIM NAME$(20):KE
YPRESS=1600:FLASH=1080:MUSIC2=1550
100 GRAPHICS 2+16:POSITION 0,1:PRINT #6;
"____________________":POSITION 3,2:SETC
OLOR 4,1,0:PRINT #6;"MERRY"
110 POSITION 5,4:PRINT #6;"CHRISTMAS":PR
INT #6;"____________________"
115 FOR X=1 TO 20:SOUND 0,INT(RND(1)*255
),10,8:FOR Y=1 TO 50:NEXT Y:NEXT X
116 FOR Y=1 TO 50:NEXT Y
120 NAME$="christopher AND eric":FOR X=0
 TO 19:POSITION X,7:PRINT #6;"*":FOR Y=1
 TO 10:NEXT Y
121 SOUND 0,13*X,8,8
125 POSITION X,7:PRINT #6;NAME$(X+1,X+1)

126 FOR Y=1 TO 10:NEXT Y:NEXT X:SOUND 0,
0,0,0:FOR X=1 TO 600:NEXT X:GOSUB MUSIC
150 POKE 54018,52:TALKTIME=10:GOSUB KEYP
RESS
200 GOSUB TREE:POKE 54018,52:TALKTIME=5:
GOSUB KEYPRESS:GOSUB FLASH:GOSUB MUSIC
220 NAME$="christopher and eric":FOR X=0
 TO 19:POSITION X,10:PRINT #6;"*":FOR Y=
1 TO 10:NEXT Y
221 SOUND 0,13*X,8,8
225 POSITION X,10:PRINT #6;NAME$(X+1,X+1
)
226 FOR Y=1 TO 10:NEXT Y:NEXT X:SOUND 0,
0,0,0:POKE 54018,52:TALKTIME=8:GOSUB KEY
PRESS
230 GOSUB MUSIC2:END
1000 GRAPHICS 2+16
1001 SOUND 0,PT,10,LOUD
1010 PRINT #6:PRINT #6:PRINT #6
1020 PRINT #6;"         *"
1030 PRINT #6;"        ***"
1040 PRINT #6;"       *****"
1050 PRINT #6;"      *******"
1060 PRINT #6;"     *********"
1070 PRINT #6;"         i"
1071 PRINT #6;"MMMMMMMMMMMMMMMMMMMM"
1075 SETCOLOR 0,12,6:SETCOLOR 2,12,6:RET
URN
1080 FOR COUNT=1 TO 10:SETCOLOR 2,4,15:F
OR DELAY=1 TO 50:NEXT DELAY:SETCOLOR 2,4
,4:FOR DELAY=1 TO 50:NEXT DELAY
1090 NEXT COUNT:POSITION 9,2:PRINT #6;"+
":SETCOLOR 2,1,15:SETCOLOR 4,8,0
1100 RETURN
1500 READ PITCH,TIME
1510 POKE 20,0:IF PITCH=0 AND TIME=0 THE
N RESTORE :RETURN
1520 LOUD=15
1521 SOUND 0,PITCH,10,LOUD:LOUD=LOUD-LOU
D/5:C=PEEK(20):IF C<TIME THEN GOTO 1521
```

SOFTWARE FOR THE ATARI 800* AND THE ATARI 400*



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By Fabio Ehrengruber

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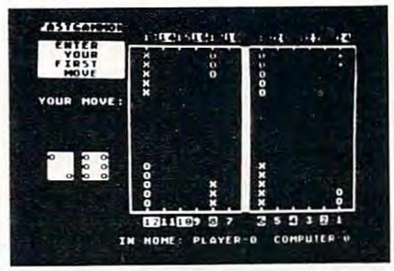
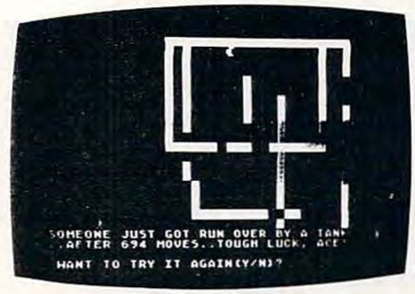


FASTGAMMON™
By Bob Christiansen

Play backgammon against a talented computer opponent. This is the latest and best version of the most popular backgammon-playing program for personal computers - FASTGAMMON. Roll your own dice or let the computer roll them for you. Adjust the display speed to be fast or slow. If you wish you can play a game using the same dice rolls as the previous game - a great aid in improving your skills at backgammon. Beginners find it easy to learn backgammon by playing against the computer, and even very good players find it a challenge to beat FASTGAMMON. The 12-page instruction booklet includes the rules of the game. Written in machine language. Requires only 8K of RAM and runs on both the Atari 400 and the Atari 800.

On cassette only - $19.95



TANK TRAP
By Don Ursem

A rampaging tank tries to run you down. You are a combat engineer, building concrete barriers in an effort to contain the tank. Use either the keyboard or an Atari joystick to move your man and build walls. If you trap the tank you will be awarded a rank based on the amount of time and concrete you used up. But they'll be playing taps for you if you get run over. There are four levels of play. Higher levels of play introduce slow curing concrete, citizens to protect, and the ability of the tank to shoot through any wall unless you stay close by. Music, color, and sound effects add to the excitement. Written in BASIC with machine language subroutines. Requires at least 16K of user memory. Runs on the Atari 800 and on an Atari 400 with 16K RAM.

Cassette - $11.95 Diskette - $14.95

QS FORTH™ By James Albanese. Step into the world of the remarkable FORTH programming language. Writing programs in FORTH is much easier than writing them in assembly language, yet FORTH programs run almost as fast as machine code and many times faster than BASIC programs. QS FORTH is based on fig-FORTH, the popular model from the FORTH Interest Group that has become a standard for microcomputers. QS FORTH is a disk-based system that can be used with up to four disk drives. There are five modules included:

1. The FORTH KERNEL (The standard fig-FORTH model customized to run on the Atari computer).
2. An EXTENSION to the basic vocabulary that contains some handy additional words.
3. An EDITOR that allows editing source programs (screens) using Atari type editing.
4. An IOCB module that makes I/O operations easy to set up.
5. An ASSEMBLER that allows defining FORTH words as a series of 6502 assembly language instructions.

Modules 2-5 may not have to be loaded with the user's application program, allowing for some efficiencies in program overhead. Full error statements (not just numerical codes) are printed out, including most disk error statements. QS FORTH requires at least 24K of RAM and at least one disk drive. For the Atari 800 only.

On diskette only - $79.95

★ ★ ★ ★ ★ ★ ★ ★ ★ ★

ASSEMBLER by Gary Shannon. Write your own 6502 machine language programs with this inexpensive in-RAM editor/assembler. Use the editor to create and edit your assembler source code. Then use the assembler to translate the source code into machine language instructions and store the code in memory. Simple commands allow you to save and load the source code to and from cassette tape. You can also save any part of memory on tape and load it back into RAM at the same or at a different location. The assembler handles all 6502 mnemonics plus 12 pseudo-ops that include video and printer control. Commenting is allowed and error checking is performed. A very useful feature allows you to view and modify hexadecimal code anywhere in memory. Instructions on how to interface machine language subroutines to your BASIC programs are included. ASSEMBLER requires 16K of user memory and runs on both the Atari 800 and the Atari 400.

On cassette only - $24.95

★ ★ ★ ★ ★ ★ ★ ★ ★ ★

6502 DISASSEMBLER by Bob Pierce. This neat 8K BASIC program allows you to disassemble machine code, translating it and listing it in assembly language format on the video and on the printer if you have one. 6502 DISASSEMBLER can be used to disassemble the operating system ROM, the BASIC cartridge, and machine language programs located anywhere in RAM except where the DISASSEMBLER itself resides. (Most Atari cartridges are protected and cannot be disassembled using this disassembler.) Also works as an ASCII interpreter, translating machine code into ASCII characters. 6502 DISASSEMBLER requires only 8K of user memory and runs on both the Atari 800 and the Atari 400.

Cassette - $11.95 Diskette - $14.95

QS **QUALITY SOFTWARE**
6660 Reseda Blvd., Suite 105, Reseda, CA 91335
(213) 344-6599

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```
1522 GOTO 1500
1550 RESTORE 3000
1551 READ PT1,PT2,PT3,TIME:IF TIME=0 THEN RETURN
1552 SOUND 1,PT1,10,8:SOUND 2,PT2,10,8:SOUND 3,PT3,10,8
1553 POKE 20,0
1554 C=PEEK(20):IF C<TIME THEN 1554
1555 FOR X=1 TO 3:SOUND X,0,0,0:NEXT X:GOTO 1551
1600 POKE 19,0:POKE 20,0
1601 IF (PEEK(19)*256+PEEK(20))/60<TALKTIME THEN 1601
1606 POKE 54018,60
1610 IF PEEK(764)<>255 THEN POKE 764,255:RETURN
1611 GOTO 1610
2000 DATA 121,10,121,10,121,20,91,10,91,10,91,20,96,10,91,10,81,10,72,10,68,10,81,10,72,30
2010 DATA 68,10,60,20,53,10,68,10,72,10,91,10,81,20,91,60,0,0
3000 DATA 53,108,172,60,57,108,144,45,64,108,162,15,72,108,144,90,81,96,128,30
3010 DATA 85,108,144,60,96,114,144,60,108,172,217,90,72,108,172,30,64,81,108,90,64,81,162,30
3020 DATA 57,96,144,90,57,81,144,30,53,85,144,210,53,85,144,30,53,85,144,30,57,72,0,30
3030 DATA 64,81,108,30,72,85,0,30,72,85,108,45,81,96,0,15,85,108,144,30,53,85,144,30
3040 DATA 53,85,144,30,57,72,0,30,64,81,108,30,72,85,0,30,72,85,108,45,81,96,0,15,85,108,144,30
3050 DATA 85,108,217,30,85,108,144,30,85,108,144,30,85,108,128,30,85,108,128,15,81,128,0,15,72,108,144,90
3060 DATA 81,108,128,15,85,0,0,15,96,114,144,30,96,114,144,30,96,114,162,30,96,114,162,15,85,172,0,15
3070 DATA 81,114,193,90,85,114,144,15,96,162,0,15,108,172,217,30,53,85,144,60,64,108,162,30,72,108,144,45
3080 DATA 81,114,193,15,85,108,217,30,81,96,128,30,85,108,144,60,96,114,144,60,108,172,217,120,0,0,0,0
```

interval. The programmer times this interval by setting the TALKTIME variable to a number given in seconds. When the time is up, the cassette player is shut off, and the program user must press a key to go on. (The prerecorded message must instruct the user to press the key.) LET TALKTIME = 10 will set the subroutine at 1600 to run for 10 seconds before it shuts off, and the greeting card recipient will have to press a key to keep the message coming.

The program can be recorded on the beginning of the cassette with the voice part recorded after the program. The voice will have to be timed carefully with a stopwatch so that it fits within the time allowed when the program is run. ©

Color Burst For Atari

Robert Blacka
Wyndmoor, PA

If you are looking for a way to display the Atari's excellent color graphics capabilities, here is a simple program that is guaranteed to amuse those friends which don't appreciate the finer points of calculating compound interest or the circumference of bicycle wheels.

The program starts out by selecting at random a point on the screen and a color after which the color appears to burst out in all directions. The program then selects a second point and color and the process repeats itself. Eventually, the colors begin to intermix creating complex intricate patterns. Just when the screen appears to be saturated with color, the display goes blank and the process starts all over.

Because the colors and points are selected completely at random, every design is unique and I have yet to see the same design repeated twice.

The Program works like this:

Line 110 sets the setcolor register to 0.
Line 112 limits the number of color bursts to 10.
Line 115 selects the color register corresponding to the setcolor statement.
Line 120, 130, 140 select the random start points and color.
Line 200 sets the number of color rays to be generated.
Line 210-220 select the end points of each color ray.
Line 250 delays the next color burst and makes the display more effective.
Line 260 selects a new color register.
Line 270 initiates another color burst.
Line 280 clears the screen and starts the process over again.

Some interesting variations can be created by changing Line 112 so that more or less color bursts are generated. Likewise, try experimenting with Line 200. As many as 100 color rays have been tried; however, these tend to saturate the screen rather quickly.

```
100 GRAPHICS 7+16
110 N=0
112 FOR R=1 TO 10
115 M=N+1
120 COLR=INT(16*RND(0))
130 X1=INT(159*RND(0))
140 Y1=INT(95*RND(0))
150 SETCOLOR N,COLR,10
160 COLOR M
200 FOR I=1 TO 12
210 X2=INT(159*RND(0))
220 Y2=INT(95*RND(0))
230 PLOT X1,Y1:DRAWTO X2,Y2
240 NEXT I
250 FOR Z=1 TO 200:
    NEXT Z
260 N=N+1:
    IF N>2 THEN N=0
270 NEXT R
280 GOTO 100
```

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Binary/ Decimal Conversions For Atari

Jerry White
Levittown, NY

Sooner or later, just about every computer programmer will be faced with the task of converting a number from decimal to binary or from binary to decimal. I recently found myself in this situation. I got a scrap of paper and started calculating when I realized that my Atari could do it much faster than I can. It didn't take long to write the program since the logic is fairly simple and I've written dozens of programs in Atari Basic. Since a program like this may not be so easy for a less experienced programmer or a beginner, I dressed up the display and sent it to **COMPUTE!**

I used some special characters that will not print on the listing of the program. When you key in the program, you can leave out the REM statements but be sure to read them. For example, read lines 97 thru 99. After the first set of quotes in line 100, there should be 8 spaces in inverse video. Then we need two normal spaces and two up arrows. When you type that line, after the first set of quotes, press the Atari key, the space bar 8 times, the Atari key, the space bar twice, the ESC key, then hold the CTRL key and press the UP ARROW key, repeat the ESC-CTRL-UP ARROW procedure once more, then type the closing quotes.

When the user of this program is going to type a binary number, we want to remind the person that the program expects 8 digits. As the binary number is typed, it will replace the line of 8 inverse video spaces or cursors. This is a good way to display what is expected at an input instruction. There is also a drawback to this method. Suppose you typed in 11 then hit return. The input, in this case B$, would be two ones and six ATASCI character 160's. You may have to check for CHR$(160) in the string before accepting it. In this program, it doesn't matter. B$ is our binary number. We will be checking this string one position at a time to see if that position is a zero. If not, we will assume it is a one. We will also check the first position for the letters E and R. In any case, if we don't find what we are looking for, we will assume that we found the number one.

The rest of the program is straight forward. The variables used are B$ for binary number, D$ for decimal number in string form, D for decimal number in numeric form, D2 is that value divided by two, and GC is the character typed in the GET character routine (line 34).

When you have to convert from OR to binary numbers, run this program and let your computer do the work.

```
0 REM BINARY TO DECIMAL AND DECIMAL TO BINARY CONVERSION PROGRAM BY JERRY WHITE.

20 DIM D$(3),B$(8):B$="00000000"
30 GRAPHICS 0:SETCOLOR 2,0,0:POKE 752,1:POSITION 5,5
32 ? "TYPE B TO CONVERT FROM BINARY":? :? "   TYPE D TO CONVERT FROM DECIMAL"
34 OPEN #1,4,0,"K:":GET #1,GC:CLOSE #1
36 IF GC=66 THEN 50
38 IF GC=68 THEN 500
40 GOTO 34
49 REM LINE 50 BEGINS WITH A PRINT ESC-CTRL-CLEAR (CLEAR SCREEN) BETWEEN QUOTES
50 ? "}":SETCOLOR 2,0,0:DV=0:POKE 752,1:? :? "BINARY TO DECIMAL CONVERSION PROGR
AM:":GOTO 355
97 REM LINE 100 HAS 8 INVERSE VIDEO SPACES FOLLOWED BY
98 REM TWO NORMAL VIDEO SPACES FOLLOWED BY TWO UP ARROWS
99 REM WITHIN THE QUOTES
100 ? :? ,"            "
110 ? :? ,;:INPUT B$:IF B$(1,1)="E" THEN GRAPHICS 0:END
112 IF B$(1,1)="R" THEN RUN
120 DV=0:TRAP 360
200 IF B$(1,1)="0" THEN 220
210 DV=DV+128
220 IF B$(2,2)="0" THEN 240
230 DV=DV+64
240 IF B$(3,3)="0" THEN 260
250 DV=DV+32
260 IF B$(4,4)="0" THEN 280
270 DV=DV+16
```

```
280 IF B$(5,5)="0" THEN 300
290 DV=DV+8
300 IF B$(6,6)="0" THEN 320
310 DV=DV+4
320 IF B$(7,7)="0" THEN 340
330 DV=DV+2
340 IF B$(8,8)="0" THEN 355
350 DV=DV+1
355 POSITION 2,3:? :? ,"BINARY ";B$;"="
356 POSITION 26,6:? "   ":POSITION 2,5
360 ? :? ,"DECIMAL VALUE=";DV
370 ? :? ,"TYPE E TO END":? ,"TYPE R TO RERUN":? ,"OR TYPE A BINARY NUMBER."
400 TRAP 40000:GOTO 100
499 REM LINE 500 BEGINS WITH A PRINT ESC-CTRL-CLEAR (CLEAR SCREEN)
500 ? "}":SETCOLOR 2,0,0:POKE 752,1:? :? "DECIMAL TO BINARY CONVERSION PROGRAM:"
:GOTO 800
509 REM LINE 510 HAS 5 SPACES THEN TWO UP ARROWS WITHIN THE QUOTES
510 ? :? ,"       ";
520 ? :? :? ,;:INPUT D$:IF D$(1,1)="E" THEN GRAPHICS 0:END
530 IF D$(1,1)="R" THEN RUN
540 TRAP 500:IF VAL(D$)>255 THEN 500
545 DN=VAL(D$):B$=""
550 FOR DIGIT=1 TO 8
560 D2=VAL(D$)/2:D=INT(D2)
570 IF D2=INT(D2) THEN B$(9-DIGIT,9-DIGIT)="0":GOTO 590
580 B$(9-DIGIT,9-DIGIT)="1"
590 D$=STR$(D)
600 NEXT DIGIT
800 POSITION 2,3:? :? ,"DECIMAL ";DN;"=     "
810 ? :? ,"BINARY VALUE=";B$
820 ? :? ,"TYPE E TO END":? ,"TYPE R TO RERUN":? ,"OR TYPE A DECIMAL NUMBER."
830 TRAP 40000:GOTO 510
```

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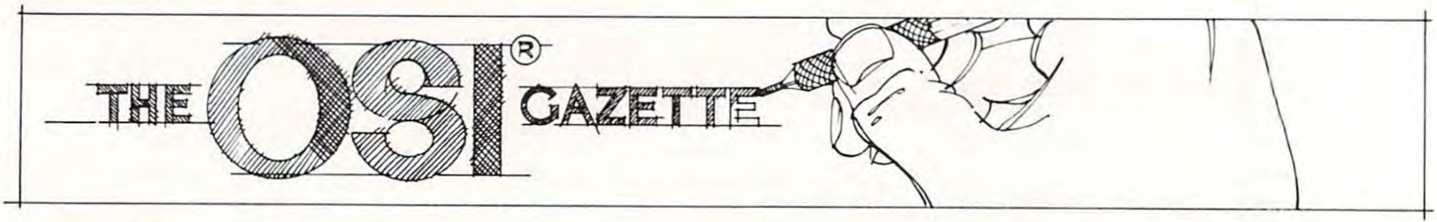

Autoloader For OSI

Charles Stewart
Adrian, MI

Almost anyone who has worked with an OSI computer in machine language has asked the question — "How can I save machine language programs?" There are various ways, most are in machine language themselves and load thru the monitor. But if the routines are to be interfaced with BASIC, the simplest way is to utilize the READ from DATA and POKE into memory.

The following routine is a BASIC program that will read a machine language program in memory and produce a BASIC load and go program with the machine language data in basic data statements (already decoded for you from the HEX the monitor requires to decimal).

To use, place the machine language program in memory via the monitor, assembler/editor etc. Unused memory locations in page two $0222 to $02FF in the standard OSI or locations above $0800 may be used. When you have the routine working as you want it, hit BREAK, COLD START, and answer 2048 to the prompt MEMORY SIZE. You should have 1297 Bytes free which is the minimum requirement to run the autoloader routine. You will still have your machine language routine in memory since an answer to MEMORY SIZE by a decimal number eliminates the memory check done by prom on a cold start.

How It Works

LINE 155 Requests the starting and ending addresses of the machine language program you wish to save. Respond with the decimal equivalent of the routine. The computer stores these in variables A and B. Next the program requests line number start and increment. Respond with the line number you wish to start the generated basic poke program with, followed by the line number to increment factor: i.e. a response of 100,10 will generate a BASIC program starting with line 100 followed by 110 and so on. The program stores these variables in D and E.
LINE 175 sets the maximum line length to 255 characters and places your OSI in the save mode.
LINE 180 prints to tape and screen the beginning line number and the statement For X = (decimal number entered as the start of the ML routine) TO (number entered as the end of the machine routine):READ Y:POKEX,Y:NEXT
LINES 210 to 275 are the meat of this program, where we look at the memory locations specified in variables A and B, and strip off the space always returned by basic in case the number may be negative. Then we print line number, the statement DATA followed by the actual data in the specified memory locations.

The Routine Works As Follows:

LINE 210 Sets two FOR NEXT loops from the address set as the start of the ML routine, the step 23 increments the memory addresses for the variable J
LINE 220 Reads the data in memory locations specified by line 210.
LINE 230 Strips off the leading space of the decimal number returned by basic. Not really necessary but saves considerable memory.
LINE 240 Prints line number and the statement DATA.
LINE 250 Prepares for print of the data and tests for the end of the routine.
LINE 251 Prints the machine code in decimal followed by a comma (CHR$(44))
LINE 270 Performs the same function as line 250.
LINE 271 Same as 251
LINE 280 Optional — used to automatically start the generated program when loaded into the computer.
LINE 290 Turns save flag off.

I have utilized this routine for the past 6 months and have found it to be quite a useful utility. It should function as described on most any computer utilizing microsoft basic with minor changes. Routine written on an OSI C1P.

```
 10 REM CHARLES A STEWART
 20 REM 3033 MARVIN DR.
 30 REM ADRIAN MI 49221
 40 REM 517-265-4798
 50 REM AUTOLOAD PROGRAM FOR OSI C1P
 80 POKE133,0:POKE134,8
 90 DIMA$(24),B$(24):POKE15,0
 100 FORX=0TO40:PRINT:NEXT:PRINT" AUTO L
OAD OF MACHINE LANG PROG"
 110 PRINT" IN PAGE 2 OR MEMORY LOC ABOV
E $0800
 120 PRINT"PROGRAM REQUIRES 2047 BYTES T
O OPERATE
 150 FORX=1TO10:PRINT:NEXT
 155 INPUT"START,END ADDRESS IN DECIMAL"
;A,B
 170 PRINT:PRINT:INPUT"SOURCE PROGRAM LI
NE # START & INC";D,E
 175 POKE15,255:SAVE
 180 PRINTD;"FORX="A"TO"B":READY:POKEX,Y
:NEXT"
 210 FORI=ATOBSTEP23:FORJ=0TO22
 220 A$(J)=STR$(PEEK(I+J))
 230 A$(J)=RIGHT$(A$(J),LEN(A$(J))-1):NE
XTJ
 240 D=D+E:PRINTD;"DATA";
 250 FORJ=0TO11:IFI+J>BTHEN280
 251 PRINTA$(J);CHR$(44);:NEXT:PRINTA$(J
):
 260 D=D+E:PRINTD;"DATA";
 270 FORJ=13TO21:IFI+J>BTHEN280
 271 PRINTA$(J);CHR$(44);:NEXT:PRINTA$(J
):
 275 NEXTI
 280 PRINT:PRINT"POKE515,1:RUN"
 290 POKE517,0
```

Program Listing

```
START,END ADDRESS IN DECIMAL? 0,222

SOURCE PROGRAM LINE # START & INC? 100,1
0
 100 FORX= 0 TO 222 :READY:POKEX,Y:NEXT
 110 DATA76,116,162,76,195,168,5,174,193
,175,76,136,174
 120 DATA0,0,255,56,17,0,49,48,48,44
 130 DATA49,48,0,0,69,0,49,55,44,48,32,0
,78
 140 DATA34,0,75,0,53,49,53,44,49,58
 150 DATA82,85,78,34,0,82,73,78,84,65,36
,40,74
 160 DATA41,58,32,0,84,34,32,0,82,84
 170 DATA32,38,32,73,78,67,34,59,68,44,6
9,32,0
 180 DATA71,34,0,177,128,128,11,96,171,3
4
 190 DATA58,0,0,0,0,0,0,0,0,104,101,0,1
 200 DATA249,6,165,143,174,225,141,32,8,
6
 210 DATA247,1,32,25,0,251,1,3,226,5,12,
6,226
 220 DATA6,115,7,106,7,0,8,220,0,155
 230 DATA0,236,4,164,237,0,3,25,0,74,0,8
,6
 240 DATA71,6,255,164,0,83,0,104,0,4
 250 DATA76,30,180,19,6,227,5,0,0,6,6,13
6,0
 260 DATA0,175,33,0,0,136,161,0,0,33
 270 DATA56,0,8,0,230,195,208,2,230,196,
173,255,4
 280 DATA201,58,176,10,201,32,240,239,56
,233
 290 DATA48,56,233,208,96,128,79,199,82,
47,140,164,171
 300 DATA5,229,231,
POKE515,1:RUN
```

©

Example 1

Part One Of Two

OSI C1P Newspaper Route Listing Program

Charles L. Stanford
Cinnaminson, NJ

This program, like most, started out as a very simple task to fulfill a stated need. And like too many, it got very, very complicated. My son, John, has a paper route. In a big city suburb, newspaper routes are very volatile; the customer list changes as the promotions of the various papers attract readers, and as the residents move on with their corporations. So the route list is hard to keep current. Each day off requires a new hand-written list for the sub (too often Dad). A Paper Route program seemed like a natural. And the program was easy to write. It started out in much the same form as listed here. The data save method is similar to the one in **COMPUTE!**, Issue 2, "Home Accounting" article, with the exception that I added $trings for the customer's names. All seemed to be fine. But then the bug showed up. The program wouldn't save $trings to data statements when new customers were added! Everybody ended up with the same name.

A week (and a lot of POKEing around in RAM) later, I knew one heck of a lot more about my C1P's method of storing variable arrays, and the program ran. I think that a quick review of what I learned, and how the computer can be "fooled" by some $tring manipulation tricks, will be useful to many readers.

Microsoft BASIC Source Code Storage

Much has been written on the method Microsoft

BASIC uses to store programs. I think one of the best explanations if found in Edward H. Carlson's book "OSI BASIC In ROM". To simplify, the source code is stored in RAM starting at Hex address $0300. The first byte is 00. The next two hold the address of the next line, in the standard notation of lo byte first, hi byte second. To convert to decimal, multiply the decimal value of the second byte by #256 and add the value of the first. The next two bytes are the line number, in the same form. For example, line 100 would read 64 00 (the Hex value of Dec 100 followed by 0 * 256). Now comes the line itself, with the BASIC commands in their token form and all other information represented by its ASCII value. See Table 1 for the representation of a typical line.

Each successive line is ended by a 00, and each new line starts as above. The last line is followed by three bytes of 00. Next comes the variable table, with the simple variables stored first. The numeric variables are stored in four-byte floating point binary. I won't go into that here, except to say that a decimal number is represented in a manner similar to a logorithm, with the characteristic (exponent) first and the mantissa (base value) next. The $tring variables are stored in a much different manner. The second byte of a $tring variable is the ASCII value of the second character of the variable plus $80 (Dec 128). Where the next four bytes of a numeric variable are the value for the numeric, they are, for a $tring, the length of the $tring; the address of the location of the actual $tring elsewhere in memory; and 00 to end the variable.

This latter characteristic is what brought me to not inconsiderable grief. The same difference exists for the storage of numeric and $tring arrays. Arrays start a bit differently, but the idea is the same. The first seven bytes define the array. For a string array, they are as shown in Table 1. The array used is dimensioned at two, which will give it three elements (remember that "0" is a place for a computer). In addition, you must remember that non dimensioned variables default to ten. Thus they have eleven elements, counting the 0th to the tenth. The third byte of each array is a pointer so the program can easily find the next array without searching through every element of each. It represents 7 + (No. of elements) * 4, which is the number of bytes to the next array. The fourth through seventh bytes contain $00, $01, $00, and (No. of elements + 1), respectively.

Next is the elements of the array, with four bytes each. They are, in order, the length of the $tring for that element; the address of the $tring elsewhere in memory; and 00 to end the element. If the $tring's value is established in the source code, whether in a DATA statement or as a $tring constant, its location stays with the source code. If the $tring is etablished during the run of the program, by keyboard input or through $tring manipulation, it is placed in high memory, working from the top of RAM down. However, you can fool the program. By concatenating a $tring with a zero length string, the BASIC routine thinks a new $tring has been established, and puts it at top of memory as well as in source code. A$ = A$ + "" does it. The disadvantage is that the $tring is now in two places, with attendant use of extra memory.

But why would you want to do this? One reason came to light during the creation of the Paper Route program. When a new customer is added, the routine at Line 525 of Listing 2 opens a space, and readdresses all of the Name $trings from the insertion location up. This means that the $tring in source code which used to be N$(X) is now N$(X + 1), and so on. Everything works fine, as the new N$(X) is INPUT and placed at top of memory. The problem arises when you try to save all the $trings, old and new, to DATA by the routines between Lines 800 and 995. I at first tried to save from N$(1) to N$(75) in all cases. It worked whenever customers were deleted. But if customers were added, everyone from the new one to the end had the new person's name. As it turned out, the program was trying to pick itself up by its own bootstraps!

If a customer is added at number 3, then old customer 3 becomes number 4. But the name is still stored in the third DATA statement. Now you start to rePOKE the DATA statements, from 1 to N. What happens? Old 3 is replaced by new 3. But now you try to read new 4 (which was old 3), and you, instead, get new 3. Sounds simple. But it sure was perplexing until I reached a fairly complete understanding of the $tring variable storage system discussed above.

Several solutions appeared possible, with the easiest to just concatenate each string. But that turned out to use up more than my 8K of RAM with 75 customers. The best answer seemed to be to reverse the order for adds and deletes. The disadvantage here is time; it takes about 35 seconds for the save routine, and it must be done once each for adds and deletes. On the other hand, more efficient solutions would involve machine language routines or complicated $tring manipulations. ©

Editor's Note: I've been intending to do this for several months, but Liz's closing comments, and this excellent summary, helped provide the final motivation. Following this article you'll find the full texts of her references (2, 3, 4). These are unavailable since these issues are out of print. The other references are all still available, either at your local dealer or from **COMPUTE!** *Robert Lock*

Relocation Of Basic Programs On The Pet

Elizabeth Deal
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This article shows an easy way to relocate any Basic program by use of the APPEND command of the TOOLKIT(tm). It is written for the upgrade ROM Pet but the idea is transferable to all Pets. Palo Alto ICx TOOLKIT is used. The method should, however, work with the Skyles chip, as well as with any append or merge machine code program.

Background

In the past two years, several writers have shown how to partition the Pet into little Pets. If you are unfamiliar with this exciting development, read all of the references listed at the end. All of the necessary programming tricks have been described thoroughly in those articles.

Herman and Brannon described one of the reasons why one may want to partition the Pet's memory — quick access to different programs. The key reason why I value the idea of partitions is that I like to use several utilities during the program development stage without having to save or delete those utilities each time I save a program I am working on. The kind of utilities that come to mind are tape indexing systems, base conversions, logical bit operations and whatever other debugging aids are needed at the time. Though I have converted some to machine code, and can place them out of the way of a Basic program, others are just too tough to convert. Hence the value of at least two partitions in my Pet.

Whatever the reason, the procedure involves dividing the Pet's memory into smaller units. Herman showed a way to do it in Basic (2). Brannon did it in machine code (4). Hudson demonstrated a way of allocating space for machine code where Basic programs usually live, while parking a Basic program upward in memory.

Once the partitions are established, the desired Basic programs can be written into and saved from the partitions. This method, however, does not permit us to load an *existing* program into a partition other than at 1024 or $0400 hex. Old Pet owners got some relief when Young provided a relocation program (7). New Pet owners were out of luck. The Retyping of old programs (being prohibitively expensive activity) implied something better had to be found. The missing link was the forward pointer chaining which Harvey Herman explained in his "Hooray for SYS" article. And this has pointed me into the simplest solution of all.

How To Relocate The Lazy Way

It is clear from reading the references that the necessary conditions for program relocation are to:

1. set up one or more partitions
2. adjust all Basic pointers
3. change the tape header information
4. correct the forward pointers in the relocated program.

It is equally clear to me that the easiest way to take care of these tasks within my existing system is to use the APPEND command of the TOOLKIT. This is not an exotic solution, since I understand that a large proportion of Pet owners have some form of the TOOLKIT. Here is how to do it:

1. partition the Pet via the Brannon, Herman or Hudson method, paying careful attention to all required pointer adjustments, else face an unbelievable mess,
2. type NEW — don't ever forget this,
3. type APPEND "name" and wait for the load to complete.

That's all there is to it. The four conditions necessary for relocation have been met and the Basic program now resides in a place of your choice. The TOOLKIT didn't know, or care, that it appended a program to a nonexistent program.

Assorted Comments

There are several limitations that, at the moment, do not cause me any trouble, but you may have to face them. The APPEND command of my TOOL-

KIT works only with tape systems. It also works only in direct mode. Thus if you do not have a tape system or if you want to relocate Basic programs during a program execution (insanity!) another *machine code* appending program will have to be used. In both cases the original or somewhat modified Wollenberg (3) procedure should do the job. Please, write it up for **COMPUTE!**.

Do not forget that as the code is moved from one place to another, all saving must be done via the Machine Language Monitor, and not by the normal SAVE command.

A lot of complicated system designs can be done by use of partitions. However, the price we pay is the need for immaculate housekeeping. Forgetting even one little detail can cause a lot of grief. You may literally lose your program, you may crash and you may have a very confused Pet. Special attention needs to be paid in relocating programs which change Basic pointers during execution. Such changes must be transparent or must be communicated in some fashion to the "partition supervisor". In the Quadrapet, for example, pointer values will have to be reflected, at correct times, in the table of pointers in the tape buffer.

Relocation by appending permits us to lift one of Hudson's restrictions. If needed, we *may* now increase the size of the machine language partition in mid-stream by saving the Basic program via the Monitor and relocating it by the procedure described here.

As a result of this work I think I found one typo in the Quadrapet — line 1080 needs "32" where "2" now exists.

Thanks To All

One of the features of **COMPUTE!** I treasure is that it provides a forum for *exchange* and growth of better and better ideas. Robert Lock should be congratulated for *not* taking a "we already published it once" stance, for such a position usually stifles any possibility of improvements. Without the sources listed below relocation of Basic programs would still be just a wish.

References

(1) Butterfield, *Watching A Cassette Load*, Pet User Notes, vol. 2, #1

(2) Herman, *Memory Partition Of Basic Workspace*, **COMPUTE!**, Jan.-Feb. 1980

(3) Wollenberg, *Machine Language Code For Appending Disk Files*, **COMPUTE!**, July-Aug., 1980

(4) Brannon, *Quadrapet*, **COMPUTE!**, Sept.-Oct., 1980

(5) Herman, *Hooray For SYS*, **COMPUTE!**, Jan. 1981

(6) Hudson, *An 'Ideal' Machine Language Save For The Pet*, **COMPUTE!**, Jan. 1981.

(7) Young, *Relocate*, **COMPUTE!**, Feb. 1981 ©

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Memory Partition of BASIC Workspace

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A 6502 microprocessor can address a total of 65K bytes of memory (RAM plus ROM). The address space for BASIC programs (RAM) is necessarily restricted to less than that without resorting to hardware tricks. However, most BASIC programs do not take up anywhere near the maximum amount of reserved memory (32K bytes for the PET). Occasionally it would be useful to have several short noninteracting BASIC programs in memory at the same time. For example, we use short programs to check student laboratory calculations (J. Chem. Ed., Vol. 55, p. 654 (1978)). When multiple laboratories are in process it would be simpler to LOAD a tape containing a number of programs and have each student run the program appropriate for his experiment.

One way to combine programs is to renumber and merge individual programs with a subsequent re-save of the combination. There are several disadvantages to this approach. It is important to keep line numbers separate in each program to be merged else you may not be able to delete or LIST parts of the program (unnerving at first). An ordinary LIST of the program will show frequently unrelated parts as one program (not esthetically pleasing). The student user must remember to RUN with a line number specified for his chosen segment (or risk being hopelessly confused. Finally this approach will not allow placing utility programs (written in BASIC) in reserved areas of memory unless they are merged with every program (a formidable task).

Since I frequently use a number of short programs and have unused memory I thought it would be helpful to partition the BASIC workspace for storage of individual programs. For example, an 8K PET (7167 bytes free) could have three 2K partitions under control of a 1K master program. It is possible to make other configurations as long as the total does not overrun the free memory available. If the partitioning is done properly the stored programs would not interact with each other. Each program would "think" it was in a 2K PET. (I actually owned a 2K PET once when I had a memory failure.) The master program would be in charge of adjusting the necessary pointers so a given program could be accessed when requested by the user.

Microsoft BASIC (for the PET and other microcomputers) uses pointers to subdivide free memory. The table summarizes important pointers (at least for this discussion) for both old and new PETs. The following material is for the old ROMs. It is not necessary to do any hex arithmetic to use the method I will describe. However, it does help to understand a little about pointers. If BASIC program text is stored beginning at location hex 401 (it is assumed location hex 400 contains a zero) the pointers to start of text (location 122/123) would read 1 and 4 for low and high byte respectively. That example was not too difficult but it must be remembered that the value returned is in decimal. If start of text was changed to, say hex 1001, location 123 would now read 16 corresponding to the decimal representation of the most significant half of that number (hex 10). To activate a new partition it is only necessary to set pointers to start of BASIC text (122/123), end of BASIC text (124/125) and top of memory (134/135). Subsequently executing CLR will set all the other pointers automatically (e.g., bottom of strings, etc.) and after END we find ourself in the new partition.

As an exercise I wrote a short master program (1K workspace) controlling three short donothing BASIC programs (each in a 2K workspace). They are shown in the figure. The master program asks the user for a program number and automatically sets the pointers to activate that program. At this point the user is in a 2K workspace with one program active which can be RUN or modified as desired. The last statement in each of the short programs returns the user to the master program. Each program is completely independent of the others, snug and protected in its own private world.

Setting up the example or one like it is not difficult. Each program could be typed in after the partition is activated by the master program (NEW first). Keep track of the size of each program by PEEKing at locations 124 and 125. This information should be stored in the master program so one can enter and leave the partition without destroying the BASIC text (c.f., line 210 in master program). The size of the master program should also be recorded and restored before returning to it (c.f., line 40 in program 1).

Relatively long programs are a nuisance to type into each partition. If the program is on cassette tape it can be relocated to any partition using the procedure described in my article "MOVE IT" (MICRO 16:17 and 17:18). Normally tapes load starting at hex 400. By reading in the tape header first and changing the load parameters in the tape buffer information on cassette tape can be stored elsewhere in memory. Keep two points in mind. One, before using the relocated programs for the first time the BASIC line links (see p. A-9 in PET