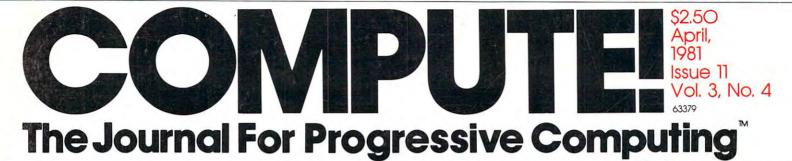
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Product Preview: Commodore's \$299 VIC-20 Computer

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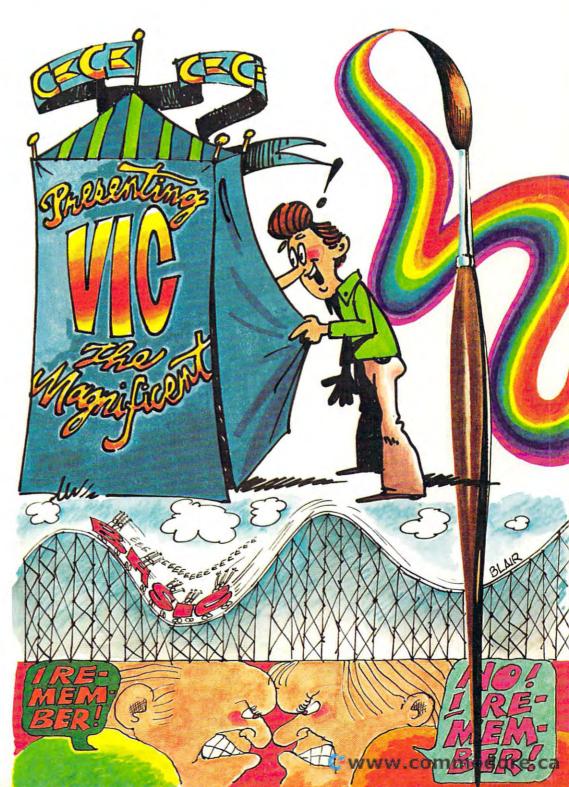
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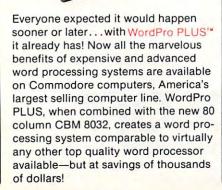


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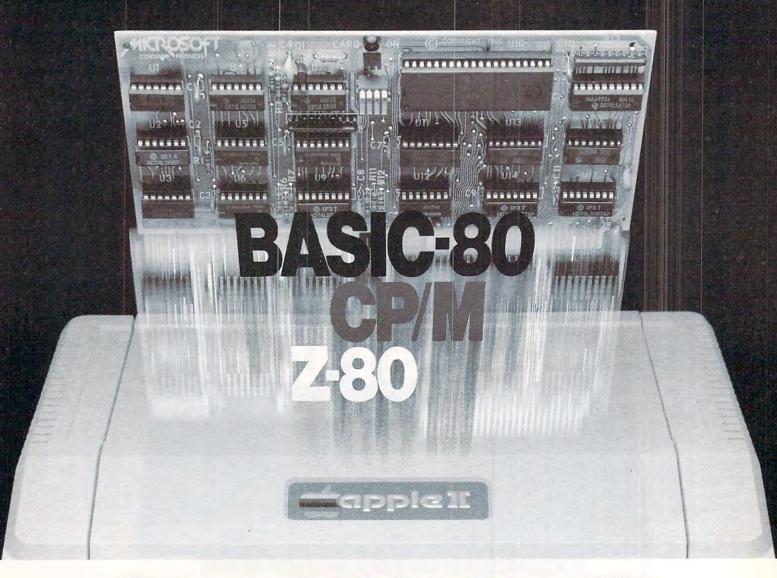
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Beginning in the May issue, you'll see a new and expanded Reader's Feedback column. One part will be as we've done in the past, with reader input regarding the Editor's Feedback card. (For those of you new to **COMPUTE!**, The Editor's Feedback card is your input "hotline" ... I read every single one that comes in, and use them to help with planning, problems, and so on.)

4

The second, and new, part of the column is called Ask The Readers. When you're trying to solve a particular programming or technical problem, and can't get it solved, drop a short note to Ask The Readers, c/o COMPUTE!, P.O. Box 5406, Greensboro, NC 27403 USA. If we think it's a shared problem, we'll run it, and in later issues run responses from our panel of experts (other readers who respond with answers). Don't be intimidated if you think it's a simple problem; conversely, don't be untimidated if you think the solution is simple. For beginner's, those are frequently the toughest kind.

Note To Our Authors— No Back Issues! Recently, we've been running more and more into the problem of **COMPUTE!** authors referring back to various and sundry early issues of **COMPUTE!** One

### **February's Mailing Problems And** Other Imprecisions. Ouch! Groan!

We have been aware that your subscription copies are reaching you later than store copies reach dealers. We are actively working on resolving the disparity, so no group of readers, whether newsstand or subscriber, is discriminated against. In this effort to promote timeliness and maintain quality, you subscribers will notice that we've returned to mailing the magazine in an envelope. This is done entirely to protect the magazine.

#### February's Problem

As far as we can tell, everyone received their magazine, albeit late. Murphey struck hard, but hopefully not again. As part of our effort to improve your speed of home delivery, we changed our mailing services to be geographically closer to our printer. Unfortunately, the local post office had not dealt with a magazine with a volume such as ours before and told our mailing personnel that the magazines needed to be bundled (e.g. by zone) only, and did not have to be bagged. Also unfortunately, the mailing service personnel believed them. The

Robert Lock, Editor/Publisher

problem this causes is that many of our readers don't have access to back issues. Please remember this in your articles. It's fine to refer back to an earlier issue, but please take the additional time to incorporate the information from that article that's necessary to your own point. Here's our checklist of available back issues:

#### Issue 1, 2, 3, 4, 5, 6, 7 SOLD OUT Issue 8, 9 and 10 Still available

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result was that the magazines went out promptly. They did not reach you promptly because, as far as we can establish, they sat in a regional bulk mail center for a week or two, waiting to be bagged. In effect, although they were in the hands of the Post Office, they were trickling out to their destinations. We apologize for the delay and concern it caused many of you. We are gradually speeding up the subscription delivery, and expect to reach par with newsstand/dealer delivery over the next few issues.

#### Subscription Price Increases

This probably isn't the optimal place to mention it, but I thought I'd take a moment to explain the new prices, and in particular the disparity between US and Canadian subscriptions. As of last issue, a twelve-issue subscription to COMPUTE is \$20.00 in the US, \$25.00 in US funds in Canada, and for surface delivery elsewhere in the world. You're all aware of the rising costs of production, postage, etc., and the price increase, in part due to the tremendous growth in physical size of COMPUTE! is quite necessary.

As of January 1, our postage cost for sending the magazine to Canada increased by 93%. We found out about this increase when we went to the post office to mail some individual magazines on January 2. We are actively looking for alternative methods of reducing these costs. When we find them, we'll pass the savings along.

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- Terry Cash, Typesetting/Production Harry Blair, Advertising/ Promotion Manager
- **Associate Editors**

Jim Butterfield, Toronto Canada Harvey Herman, Greensboro, NC

#### **Contributing Editors**

Robert Baker, 15 Windsor Drive, Atco, New Jersey 08004 Gene Beals, 115 E. Stump Road, Montgomeryville, PA 18936 Len Lindsay, 5501 Groveland Terrace, Madison, WI 53716 Craig Patchett, 2 Swan Terrace, Greenwich, CT 06830

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## An Interview With Dr. Chip

Robert Lock, Editor/Publisher

8

**RCL:** Dr. Chip, it's good to see you again. I understand you've been quite busy.

Chip: I've been trying to piece together some late happenings in this industry, that is, when I can get any work done. That character who's trying to adopt me, the Silver Streak, has taken to calling me up on the phone in the middle of the night trying to sell me stock in his new T-shirt factory.

**RCL:** I'll have to admit, Chip, that The Silver Streak got some appreciative mail the first time he wrote you.

**Chip:** Harumph! Can you imagine me on a T-shirt...? Never mind. Back to business. First things first. Commodore has taken their dealer relations problem squarely on the chin. A recent business/financial article raked them over the coals. I'll tell you this; if they don't resolve some of their communications and customer relations problems, they'll be in a 6502 pickle. Finke (the new President of Commodore) has apparently taken direct responsibility for getting the Northeast distribution region ship-shape. That's one of Commodore's seven US regions, and I think he'll set up a model for the rest of the country.

**RCL:** I've received a good bit of mail lately from readers complaining about never receiving their Commodore US PET Users Group Newsletter. Commodore US told me last fall it was all being taken care of.

Chip: I suspect they'll get it together. Just as an example of how other Commodore operations treat their customers, I'll point out that Commodore Canada has been making refunds direct to their Canadian customers who sent orders to the US and never received anything. They seem to have a good handle on customer relations up there.

**RCL:** I can tell. We have extensive Canadian circulation, and I never get customer relations letters from Canada like those I get from the US readers. **Chip:** Well, my money's on Finke.

**RCL:** I feel as though I've said this before, but we'll have to wait and see. By the way, have you found out what's happening to the KIM? (The KIM, for you uninitiated readers, is the "single-board" 6502

For those readers new to **COMPUTE!**, Dr. Chip is Professor of 6502 Science at Figment U. He's also head of the Figment U. 6502 User's Group, a collection of 6502 users located at various Figment U. branches around the world. From time to time he consents to these interviews.

computer from Commodore that started the 6502 family several years ago).

Chip: It looks as though they have stopped producing it. We can't find out what's going on. **RCL:** I tried to check on it and they said there were plenty in supply. Turns out, at least from the information that I get, that the plenty in supply aren't necessarily new units. Dealers we've heard from are completely out and can't get any. One industrial client called (he has an installed base of 175 KIMs running in an industrial environment), and all of a sudden he can't get any more. No warning, no comment, no answers. I'd like to hear from anybody caught up in the midst of this.

Chip: Sometimes I can't figure those guys out. RCL: Any other news Chip?

**Chip:** Bits and pieces. There's a lot going on in the language area. Atari's new PILOT, (previewed by David Thornburg in last issue's "Computers and Society" Column), looks quite exciting, especially for beginners at any level. There's a new language coming along from Commodore called COMAL, "Commodore Algorithmic Language". Reports have it that it's a combination of the structured preciseness of PASCAL and the simplicity of Basic. It was developed by a Danish educator and is being used extensively in the Danish educational system. We hear it may be given away as public domain material.

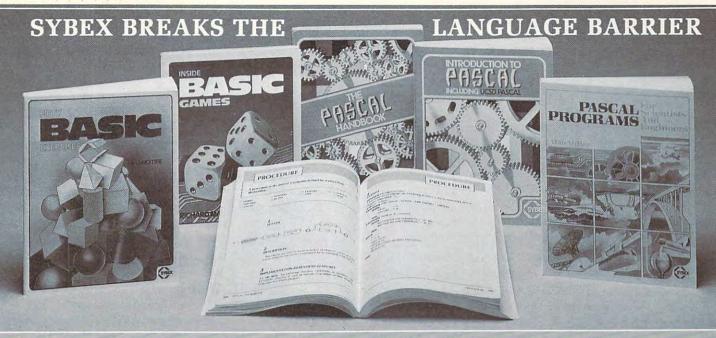
University of Waterloo also has some interesting projects underway at the moment, but I can't provide details until later.

**RCL:** That sounds interesting. Waterloo is where they've done extensive research and development on the advanced languages for the larger machines, isn't it?

Chip: That's the place. I'll fill you in on their latest projects next time.

RCL: What's happening with VIC, Chip?

**Chip:** Commodore's new color computer seems to have been pushed back in US introduction time to a May-June time frame. We do know they're in the process of final redesign to meet the new FCC regulations. There are mixed reports on the Apple II and compliance with the new regs as well, but we can't yet tell what Apple's doing about them. The Atari units appear to already meet the new specs from the FCC, a point consistent with their methodical approach to this marketplace from the beginning.



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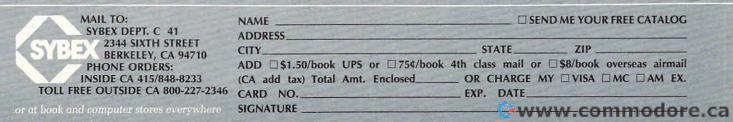
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## Computers and Society

David D. Thornburg Innovision P.O. Box 1317 Los Altos, CA 94022

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My last column concentrated on the software interface between people and computers. As I said at that time, the mechanical devices through which we communicate with our computers are no less deserving of attention. I find it both sad and amusing to see that the principal method by which humans interact with computers is through a keyboard whose 100 year old design is based on the limitations of antiquated mechanical devices.

I know that I touched on this topic in a previous column, but a phone call I received a few weeks ago has rekindled this issue for me, and perhaps it is time to talk about keyboards again. It was my pleasure to receive a phone call from Dr. Mary Humphrey in Canada. She told me of her experiences in working with children who use computers extensively in an educational environment. As I recall, these children range from the educationally handicapped to the gifted, and cover a wide range of ages. After working with the computers for a while, the children are asked to describe what things they like and what things they dislike. She told me that the major problem that children encounter with the computer is the arrangement of keys on the keyboard. "The keys are all mixed up." Some children even propose alternative keyboard layouts - all of which are alphabetical.

I know that this is a tender topic, and one which has been with us for a long time, but I persist in thinking that there is a golden opportunity, right now, for us to improve this interface between people and computers.

This month we will explore the development of the commonly used Sholes keyboard, the evolution of alternatives, and the promise of a new keyboard environment for the many millions of new computer users who have no training in typing.

Did you know that the 100 year old layout of the keyboard used on most personal computers was intentionally designed to be hard to use? This arrangement was developed in 1872 by typewriter inventor C. Latham Sholes (1) and his attorney, James Densmore, to overcome a major problem in the design of Sholes' original typewriter. Originally the keys were arranged in alphabetical order. Unfortunately, this arrangement made it very easy for certain commonly used keys to be typed in such quick succession that adjacent type elements would jam together before hitting the ribbon. To overcome this problem, Sholes and Densmore placed the most commonly typed letters as far apart in the type basket as possible, and the result was the QWERTY keyboard we have today (see Figure 1). The name QWERTY is derived from the first five keys in the top alphabet row of this keyboard, and is a folksy name for the Sholes arrangement.

Most of the effort applied to improvements on the Sholes keyboard has been geared towards improving typing speed and reducing operator fatigue.

#### ...the 100 year old layout of the keyboard used on most personal computers was intentionally designed to be hard to use...

In 1932, after many years of work, August Dvorak (2) suggested a keyboard arrangement similar to that shown in Figure 2. As with the Sholes keyboard, the DSK (for Dvorak Simplified Keyboard) requires a lot of training to use effectively. Its principal advantage for touch typists is that skilled DSK users can type at up to twice their previous typing speed with less fatigue.

If DSK is so much better than Sholes, it is logical to ask why the improved keyboard has not displaced the older inefficient model, especially since the original mechanical limitations leading to QWERTY have been overcome for many years. There seem to be two causes for this failure. The first is the inertia associated with displacing the many millions of Sholes keyboards in use today. Second, there is the understandable resistance on the part of typists trained on the Sholes arrangement, each of whom would have to spend about a month making the transition to a new and (presently) hard to obtain keyboard.

Neither of these problems has deterred other researchers however, and many other alternatives to QWERTY have been proposed in recent years. Among the more interesting concepts that have been studied is the "chord" keyboard. This idea, pioneered by E. T. Klemmer at IBM (3) in 1958, entails the use of a keyboard with only ten keys, one for each finger. Letters are typed by pressing the correct sequence of keys at the same time, much as one would play a chord on a keyboard instrument. With ten keys, 1023 different patterns can be generated. To make it easier on the user, Klemmer didn't ask the user to press more than two keys at once. Users of this system were able to type at more than 40 words per minute after intensive training. Klemmer felt that the real power of his keyboard would come from using additional finger chords for the entire words.





While Klemmer's keyboard was designed from the human's point of view (commonly used letters used single keystrokes and favored the stronger fingers), other keyboard designers have decided that people should change their behavior to match that of the machine. Several designers have introduced fivekey keyboards on which the user is expected to type the alphabet in raw ASCII-like code. While having certain appeal to some high-tech acquaintances of mine, most of these efforts have, thankfully, died a quiet death.

My concern is that neither the Sholes, the DSK arrangement, nor any of the chorded keysets makes any sense to the novice user. As the personal computer market continues to expand, an increasing number of people are being asked to type on a keyboard which makes no sense whatsoever. Anyone who has watched a child use a computer has seen the intense concentration with which he or she scans the keyboard looking for the right key. These novice "hunt and peck" typists typically use the index finger of one hand to do their typing, with "advanced" novices using the index fingers of both hands. When one considers the myraid applications for the computers used by novice typists, it seems almost criminal that a powerful modern tool like the personal computer should be constrained to use a keyboard designed as an apology to the limitations of nineteenth century mechanical skill.

Since you, most likely, have had some exposure to the Sholes keyboard, you might think I am overstating my case. You should perform the following experiment: Look at the DSK keyboard shown in Figure 2 and type: The quick brown fox jumped over the lazy dog.

Now imagine how a child feels when presented with

#### QWERTY for the first time!

I feel that a solution to this problem exists. It is logical to ask why I think the time is ripe for change when Dvorak had so much trouble forty years ago, and since none of the other systems has moved far from the research laboratory.

The answer to this question is that, for the first time since 1873, a major keyboard market has opened for which the purchasers and users of these keyboards are not already skilled typists. The personal computer market in the United States jumped from almost nothing in 1977 to 150,000 machines in 1979. The annual sales figure appears to be doubling every year, and sales this year might reach a rate of over one million computers per year. While there is no reliable figure on the saturation level of this market, conservative estimates of 50 million computers represent a probable lower bound for this marketplace. This massive market, coupled with the fact that the overwhelming majority of new personal computer users are not already "touch typists" is what gives encouragement to the concept of a new keyboard arrangement.

In thinking about new keyboard arrangements useful to novices, it is fairly obvious that the keys should be arranged in alphabetical order. Consider the environmental forces which lead to this conclusion. Children are taught their ABC's from the moment they can talk. One often hears children singing the alphabet song:

"Ay bee cee dee ee eff gee, aitch eye jay kay, ell em en oh pee..."

On the other hand, I have never heard a child sing: "Kew doubleyou ee are tee wy,

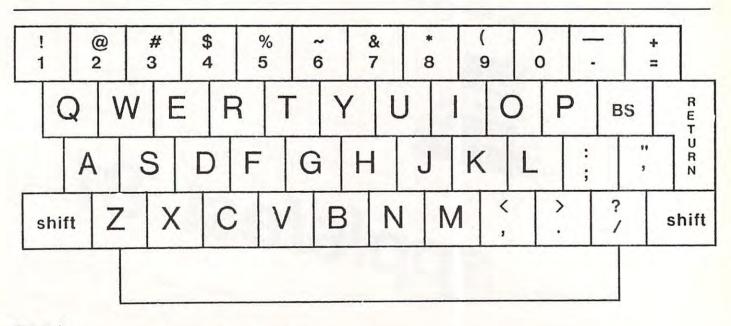


Figure 1: Modern keyboard layout based on the Sholes arrangement

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#### you eye oh pee, ay ess dee."

Later on, as reading skills are better developed, we teach our children how to use the dictionary. Once again, they encounter the letters in alphabetical order. The reason that words in dictionaries are arranged in alphabetical order is very simple. The user's pre-existent knowledge of the letter sequence allows rapid location of a chosen word among thousands of other words. Those of you who have learned a language which uses a different alphabet (such as Russian) probably experienced some frustration in learning to use a dictionary in that language until the "new" alphabetical order became entrenched in your mind.

If the QWERTY arrangement is so good, then one must ask why office workers who use it for typing don't also use it for filing documents.

As it turns out, some enlightened vendors of consumer products have realized the value of our early childhood education, and offer alphabetic keyboards on their products. The Texas Instruments' Speak & Spell, Mattel's Brain Baffler and the Craig "pocket translator" immediately come to mind. In one of the more ambitious projects of considerable relevance to computer using educators, Children's Television Workshop used alphabetical keyboard arrangements in the seventy-odd Apple computers located at Sesame Place in Bucks County Pennsylvania.

If these domestic projects aren't enough, consider the fact that the government of France will be performing a test of their electronic phone directory system by installing 250,000 computer terminals in people's homes this year. Within a few years three million of these terminals will be installed. A few years after that, perhaps 37 million such terminals will be in daily use - each of them with an alphabetic keyboard layout. The point is not just that alphabetical keyboard arrangements are possible, but that some companies are actually finding that these arrangements are commercially successful.

There are many merits to using an alphabetical keyboard arrangement. Unlike either of the keyboards shown in Figures 1 and 2, the user does not have to scan the whole keyboard to find a given key. This is important since the foveal regions of a user's eyes can only be focused on one or two keys at a time. Once a key is perceived (assuming it is the wrong key) the logic behind the alphabetic layout helps to reduce the time required to find the desired letter or symbol. The use of color coded keytops (with vowels having a different color than consonants, for example) may also be of benefit to some users.

The development costs associated with alphabetic keyboards are no different from those associated with the Sholes arrangement, so there is no particular reason for this new keyboard to be more expensive than the more traditional model.

Can a logical keyboard designed for novices find its way to the marketplace? The answer is yes if those millions of us who are buying computers make it happen. The tyranny of QWERTY can be stopped at last!

#### **References:**

1. C. L. Sholes, U. S. Patent 207,559 (1878).

2. A. Dvorak, et al., "Typewriting Behavior: Psychology Applied to Teaching and Learning Typewriting", American Book Co., New York (1936).

3. E. T. Klemmer, "A Ten-Key Typewriter", IBM Research Memo #RC-65 (1958).

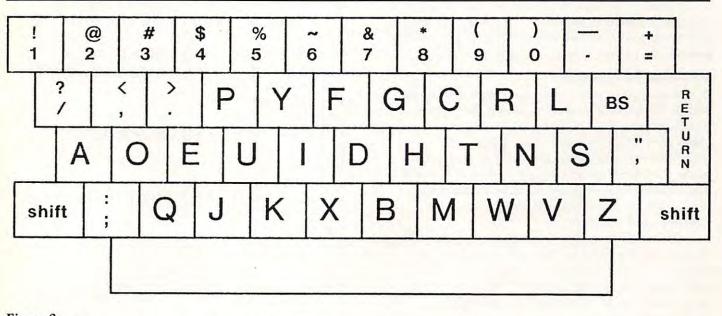


Figure 2: Modern keyboard layout based on Dvorak Simplified arrangement (except for numerals)

## The Beginner's Page

Robert Lock Editor/Publisher

This page is a continuing, "re-cycling" feature in **COMPUTE!**. It consists of a set of articles that repeat, in sequence, across issues. Thus, if you're a beginner to computing, you can pick up the series whenever you start with **COMPUTE!**, and within four or five issues, have the set. By then, you'll find you've advanced far beyond where you are now, especially if you have your hands on a computer.

## Part Two

#### Access to Resources

If you're just getting started, you'll find several important sources of information are available to you. Beyond the obvious channels, such as magazines and books, you'll quickly discover a community of users. Your local computer store can help there. They can frequently specialize in, or at least cover, your particular computer. Depending on the size of your user community, you may even find seminars for beginners, a lending library of back issues of magazines, and so on.

If you're in an area where activity hasn't yet grown to the point of established clubs, or there's not a computer store around to provide such information, drop a note to your machine's manufacturer or give a call to the district office. They may be able to provide the names of some clubs in your region.

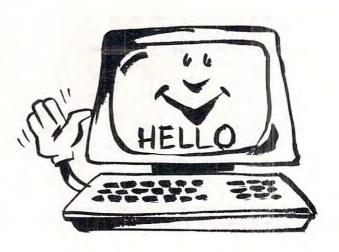
#### Learning To Program

Assuming you have no experience with computers, and no established local users group for support, where do you start? Well, you have the manuals that came with your computer. And depending on the manufacturer, you'll find there are several good books on BASIC programming around that will help. One sure method of plunging in is to take some of the simple programs that we present here, for example, and use them.

Once you've entered a program, and have it working as described by the author, go back and figure out how it works, and why it works. You'll soon find you can start to make additions to programs from books or magazines that help "customize" them for your own use. This is an ideal way to learn. My advice is to start at the very beginning, and use some feature of BASIC until you understand its usefulness and purpose. Continue to add on features as you need them or want to understand them. Above all, don't get frustrated. The best way to learn to program is to program.

Here's a sample of what I mean. Type this program into your computer (press return after each line):

10 REM PROGRAM #1 20 PRINT ''HELLO'' 30 END



#### NOW TYPE RUN, AND PRESS RETURN.

Your computer should print HELLO on the screen, followed by READY. Ta Da! A working program. Surely, you say, I bought this machine to do more than this. Of course you did. Let's turn our sample into a more useful program, adding a few more features common to all our BASIC languages.

10 REM PROGRAM TO ADD NUMBERS
20 PRINT "HOW MANY NUMBERS DO YOU
WANT TO ADD?"
30 INPUT N
40  FOR I = 1  TO N
<b>50 PRINT "ENTER THE NUMBER."</b>
60 INPUT J
70  K = K + J
80 NEXT I
90 PRINT "THE SUM OF THE NUMBERS IS
";K'
100 END

When your computer asks how many numbers you want to add, type in some small number like 5. It will then ask you, 5 times, to "Enter the number." Each time, type in one number that you want to add to the sum.

14

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#### SUPER STAR BASEBALL ALL TIME

SUPER STAR BASEBALL Sample Lineur

ALL TIME SUPER STAR BASEBALL Sample Lineup		SUPER STAR BASEBALL Sample Lineup	
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L. Gehrig	J. Foxx	W. Stargell	H. Aaron
J. DiMaggio	H. Greenberg	W. Mays	L. Brock
J. Jackson	R. Hornsby	P. Rose	R. Carew
G. Sisler	H. Wilson	O. Cepeda	H. Killebrew
5. Musial	B. Terry	C. Yazstremski	R. Allen
T. Cobb	M. Mantle	W. McCovey	R. Leflore
W. Mays	H. Aaron	R. Jackson	R. Zisk
C. Young-P	W. Johnson-p	G. Brett	B. Madlock
		R. Guidry-P	T. Seaver-p

action of actual batting and pitching data. Game can be played by one or two players with the computer acting as a second player when desired. Players select rosters and lineups and exercise strategic choices including hit and run, base stealing, pinch hitting, intentional walk, etc. Highly realistic, there are two versions, ALL TIME SUPER STAR BASEBALL, and SUPER STAR BASE-BALL featuring players of the current decade. Each includes about 50 players allowing nearly an infinite number of roster and lineup possibilities.

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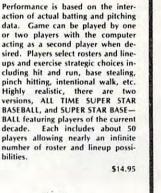
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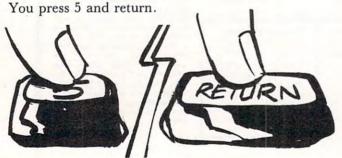
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Here's what you should see on your screen after typing run.

HOW MANY NUMBERS DO YOU WANT TO ADD?

. \_\_\_\_

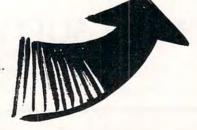


Now you should see: ENTER THE NUMBER.

Here you should type in the first number of your group of 5, and so on (5 times) until the computer says:

THE SUM OF THE NUMBERS IS:\_

This will be the sum.



Try this one out, and next time we'll expand it further, explaining how it works, and some nice ways to make it work more usefully.

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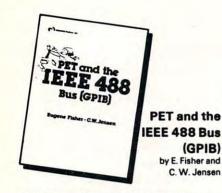
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by Adam Osborne and Carroll S. Donahue

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en on

especially the PET/CBM computer — can do for you. If you've just bought a PET or CBM this is the book you must have to really understand your computer. By using the examples found in this book, you will quickly get your PET/CBM up and running. These examples are thoroughly documented so you can learn how and why the programs work. It is the "how" and the "why" that are important if you want to learn how to make your PET or CBM work efficiently for you.

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## An Applications Commentary Stimulating Simulations

#### Gregory R. Glau Prescott, AZ

Well, there it sits: *your computer*. You've spent the past few months learning BASIC, writing all kinds of programs and learning how to use and interact with the computer and its tape or disk storage system. And, if you do say so yourself, you've turned into a pretty darned good programmer!

But gosh — after all those months — there it sits. Sure, it's still fun to demonstrate a game or two if a friend stops by, or perhaps you've invested in a modem and can access a Network...but by and large, if you made a list of the reasons why you bought your computer in the first place, a list of 'all the things I'll be able to do,'...well, you've done them. You find yourself spending a half hour or so a day working on the computer, perhaps keeping your checkbook up-to-date, or making a budget listing, or keeping track of the amortization for the new car...but it mostly just sits there!

Suddenly it dawns on most of us that finding the answers is not the problem — we understand BASIC enough and disk data files and tape loading that we can figure out an answer to a problem. The difficulty is in finding the problem itself, in *asking the questions*, in figuring out things we can have the computer do. And not just ideas that take ten minutes and display a cute drawing on the screen, or a program to print all odd numbers between ten and a thousand. The whole purpose of any computer is to save time and make us more efficient in our work and/or home affairs.

But where do you get ideas to — as the ad says — simplify your life?

The first place to look is to examine any and all paperwork you handle, whether you use your computer in your home or business.

The businessman has some obvious needs — invoicing, monthly statements, payroll. We've found that our APPLE II saves an hour or so every week by figuring and printing payroll checks. So-so. But it also automatically balances all the figures and keeps them on a disk for all employee's year-to-date totals. The old way, balancing those figures by hand every quarter, literally took hours and hours. Here's a case where the initial time-saving didn't seem too terrific, but since everything is always 'in-balance' and up-todate, over a period of a year it'll save hundreds of dollars in labor costs.

Accounts receivable and accounts payable are obvious savings, compared to the way we used to do things (and many small businesses still do) — by hand posting. Right out of the Middle Ages! Sending statements used to take a day...now it takes two hours.

But the businessman has to take a closer look at the other paperwork he's involved with.

How about keeping mileage and cost-per-mile records for any vehicles you own (the homeowner can do the same)?

While the businessman is making sales projections on his computer, the homeowner can project a budget/expense program on his.

#### The difficulty is in finding the problem itself, in asking the questions, in figuring out things we can have the computer do.

The businessman can keep a running record of each employee's job efficiency (is he making or losing money for you?)...and the homeowner can keep a record of what his wife (or husband) spends!

The businessman is able to *project* what a major investment will do to his cash flow and net profit, and the homeowner, with the right program, can readily tell if he can afford that Coleman tent-trailer.

The businessman can see exactly what will happen to his profits *if* sales drop ten percent. *If* the housing industry stays in its slump. *If* the Summer gets hot and his air conditioning units sell like crazy. And the homeowner can predict his cash situation nine months from now when the new arrival is due (they don't let you take babies home unless they're paid for!).

Could you forecast the weather based on past trends and current data?

Would you like to know who's got the best chance of winning the second race tomorrow?

Are you interested in your youngster's projected SAT test score?

Could you plan what you'd do if your health insurance costs increased 15% next month?

Would it help to know that if you spent X dollars for insulation that you'd save Y dollars on air conditioning costs? Or if you install that solar water heater what effect it'll have on your tax return?

Is it useful to understand that if you could somehow *save* so many dollars per month over the next so many months that you could save X dollars in interest for that awning/cooler/television/exercycle you wanted, by paying cash instead of financing it?

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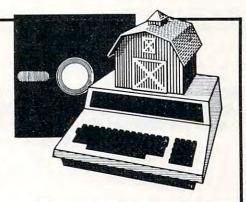
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Wouldn't it be interesting to program your computer to analyze the miles you and your next-door neighbor and Joe (he lives down the block) and your brother-in-Law around the corner each drive to work every day? To perhaps route a carpool for the four of you? To get an exact projection of the gas you'd save? To perhaps do the same thing with you wife and her friends...who all drive their kids to school? To program your computer with the basic items your family uses (Cheerios, ketchup, kleenex, soup,

#### Anything that you now do with data can be adapted into a simulation, a projection of the future and its results on you.

whatever), along with the average rate of usage... and then printout a grocery list *before* you ran out of anything?

Anything that you now do with *data* can be adapted into a simulation, a projection of the future and its results on you.

This — the area of simulation — is perhaps the most powerful thing a computer can do for any of us. Yes, it's wonderful to have the computer keep track of our monthly bills, to have it do the mundane record-keeping chores, but how much more invaluable it becomes when we project the future with our ideas!

Let's see...if we're making X number of dollars per year now, and inflation will average Y percent over the next so many years and my raises will give me a total income of X dollars at that time...will the kids be able to go to College? Will the wife and I be able to buy that motorhome?

The whole idea is to project — and thus *predict* — the future.

Now what if I get laid off work for ten days over the next year? What if the wife could find a parttime job (perhaps running ammortization schedules for banks in your area on your Computer?) — what would her income do to our net total? How about that duplex we've been wanting to buy and fix up? If we pay so much for it and it costs us this much to fix it up...we should be able to rent it for... And what will it do to our income tax situation to get all that depreciation from it as a rental? How much would I have to save every month to have enough to pay cash for a new car, say, in twenty months?

Well, you get the idea — *simulation* on your computer can help you find out what the future will bring, and perhaps in time to allow you to change things, if you don't like what it displays for you on your CRT!

#### The whole idea is to project and thus predict — the future.

Most simulations, by the way, can be generated from past data. The businessman can project labor costs based on the jobs he sold last year. The homeowner can predict what his salary needs are by basing his estimates on last year's budget printout (My God, Helen, did we spend *that much* on shoes?)

Once you've exhausted all the record-keeping and paper-work handling and forms-filling-out things that you once did by hand (but now your APPLE II or TRS-80 or OHIO SCIENTIFIC or PET does better and faster), the logical place to turn to is this area of *simulation*. And after all, there are only so many record-keeping chores we have to take care of, and once they're accomplished — and the computer is being used only an hour or so a day — the ideal place for one's creativity is in simulation.

And the best part is that you'll quickly discover that one idea leads to another — you might start projecting your net income and end up looking at life insurance values in relation to education costs ten years down the road. This in turn might lead to new record-keeping ideas, which will give you more simulation directions...

So, here are a baker's dozen ideas for simulation in areas the average programmer should have an interest in (after all, it's your money) in addition to the ideas already mentioned, so that perhaps a few will sound good to you and be of some help in your own financial planning:

1. Design a program to show you how much money you'd have to save weekly/monthly/yearly to end up with X dollars Y number of years from now. By being able to change every combination, you'll soon find a plan you can afford that'll give you the cash you need...when you need it.

2. Project the cash savings by replacing your present air conditioning system/furnace/water heater/ cookstove with a new energy-savings one. How long will it take to pay for itself at the present gas or electric rates? What if the rates increase X percent?

4. Printout the values of your stock portfolio if inflation goes up so much percent while the market goes down X percent.

3. Compare the overall costs of remodeling the basement vs. the cost of a new home.

20



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At last, there is an easy to understand Pascal sampler to help you learn Pascal programming, **LinkSampler**. And to fill the needs of the Pascal programmer, two Pascal utility programs to increase your programming productivity, **LinkVideo** and **LinkDisk**. Link Systems backs its commitment for quality Pascal software with fifteen years of mainframe and micro computer programming experience.

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5. Figure out what salary you'll need with an annual raise of X dollars, an inflation rate of Y percent...when you son starts college in 19—.

6. Estimate the cost savings of adding an evaporative cooler to your air conditioning system.

7. Find out what's best for your own situation by comparing the net cost of life insurance: whole life gets cash value plus dividends while term insurance doesn't. Which costs less?

8. Find out how much of a raise you'll have to ask for based on X percent inflation this year.

**9.** Get a budget projection comparing the number of movies you go see (the cost of tickets & popcorn) to what that new cable TV deal costs.

10. Discover what your annual car expenses are over the next five years if you either (A) keep your present car or (B) buy that new gas-saving model. Factor-in different per-gallon costs, and don't forget the new one costs more for insurance and license plates.

11. Figure out exactly how much life insurance you need right now — determine how much income your wife will need for how many years.

12. If you can save so many dollars per month, display or printout the various options you might have (money market funds, regular savings, certificates of deposit, mutual fund programs); which is best for you?

13. Find out exactly what happens if you buy a rental unit, by using forced inflation. The duplex might cost you X dollars, but if you spend Y dollars to fix it up, how much will it increase in value? Compare this duplex with that triplex. Which is best? If you fix a place up and then keep it, how much can you raise the rents? What does it do to your tax return?

Somewhere in all these ideas is a problem that you need a solution to. So...get your programming pad out and get to work...and all of a sudden you'll find your computer in almost constant use...and not just sitting there any more!

Editor's Note: Once you have one of these programs up and running, write a tutorially descriptive article to go with it, and send it in to me at **COMPUTE!** We'll look forward to it, and so will all our readers who aren't quite programmers yet. RCL.



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## The Commodore VIC-20: A First Look

#### David D. Thornburg Innovision P.O. Box 1317, Los Altos, CA 94022

It seems surprising to realize that it was only three years ago when the Commodore PET started to show up in dealer's showrooms. At a price of \$799, this astounding machine (along with its temporal counterparts from Apple, Radio Shack, and others) broke down many price/performance barriers in the computer field.

It wasn't much later that people started wondering if the small computer industry was going to copy the calculator industry, with ever more sophisticated machines being made available at the same, or lower, cost than that of earlier models. Mythical price barriers were erected, only to be smashed by new product announcements.

It was the breaking of the \$400 barrier last fall by Radio Shack's TRS-80 Color Computer that caused some industry observers to predict the final arrival of the true "consumer" computer (see the review on this machine which appeared in the November-December 1980 issue of **COMPUTE!**). But almost before the TRS-80 Color Computer (which I will refer to as the TRS-80 from now on) was in full production, Commodore announced the collapse of yet another barrier with the introduction of the VIC-20, priced at only \$299.

For those of you who have yet to see a photograph of the VIC, it is about the smallest size a computer could be and still have a full-sized keyboard. This compact size makes the VIC fit easily into almost any imaginable home location — an important feature which other manufacturers have yet to understand.

Before going into details, I want to mention a little about the "ambience" of the VIC. Those of you who are familiar with the PET will find many of the good PET features on the VIC. Running a program from tape, for example, requires merely pressing SHIFT RUN and the cassette PLAY button. The full screen editor (using cursor control keys) is supported by the VIC, as is the PET graphics character set.

In a move which is certain to guarantee much

support from the indigenous PET software community, Commodore even kept the tape formats identical so that PET programs could be loaded directly into the VIC. Most of the PET programs I have run on the VIC required only a few lines of revision to work perfectly. This suggests that outside software support for the VIC will appear instantaneously upon its arrival in the marketplace.

As a sign of Commodore's attention to detail in this area, both the user port and the cassette connector are identical to their PET counterparts, so many plug-in peripherals for the PET will plug into the VIC as well.

An IEEE-488 interface (standard with the PET) is available as an add-on for the VIC. Except for this interface, the PET and VIC interface environments are quite similar.

That the VIC-20 is an astounding machine for

#### ...it is about the smallest size a computer could be and still have a full-sized keyboard.

the price is unquestioned. What we will try to do in this review is describe the VIC's capabilities and features in comparison with the machines with which it is likely to share the limelight — the TRS-80 (Color Computer) and the Atari 400.

In order to provide some structure to this review, I have prepared a table which shows the salient features of each machine. This table is divided into four categories: OUTPUT, INPUT, EXTER-NALS, and INTERNALS. We will discuss each of these in turn.

#### OUTPUT ....

Communication from the computer to the user requires (for all three machines) a television set. All three computers support color and generate user programmable sounds which are heard through the TV loudspeaker. All three computers come with RF modulators, thus making the connection to the home television a moderately trouble-free task.

These similarities between machines should in no way be taken to imply that there are no substantiative differences between these computers, however; the differences are *most* important. In the area of alphanumeric display, for example, the VIC displays a maximum of 23 lines of 22 characters, compared to 16 lines of 32 characters for the TRS-80, and 24 lines of 40 characters for the Atari 400. In terms of character display quality, I rank the machines in the order: Atari, VIC, TRS-80; with the VIC and Atari both having a very high quality display. It should be noted that the

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COMPUTE!

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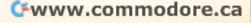
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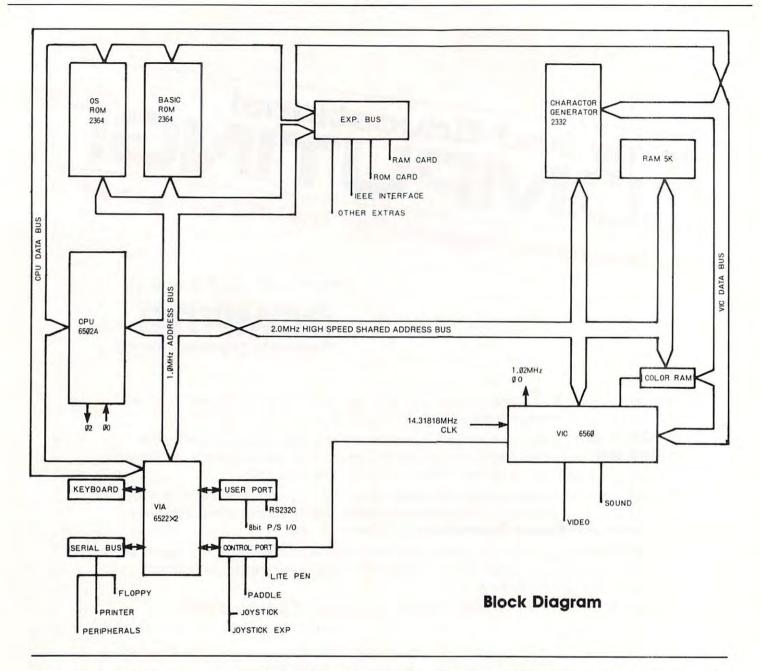
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Atari has more display modes than either of the other computers, and has the ability to display 24 lines of 20 characters, and 12 lines of 20 characters as well as its default  $(24 \times 40)$  arrangement.

Both the VIC and Atari 400 display upper and lower case characters, and have an alphamosaic (graphics character) display feature also. The TRS-80 does not.

True "bit map" graphics modes are available on all three machines, with each machine's format being unique. The *maximum* display resolution for the VIC or 176 x 176 pixels (picture elements) compares favorably with the TRS-80 limit of 256 x 192 and the Atari maximum resolution of 320 x 192 pixels.

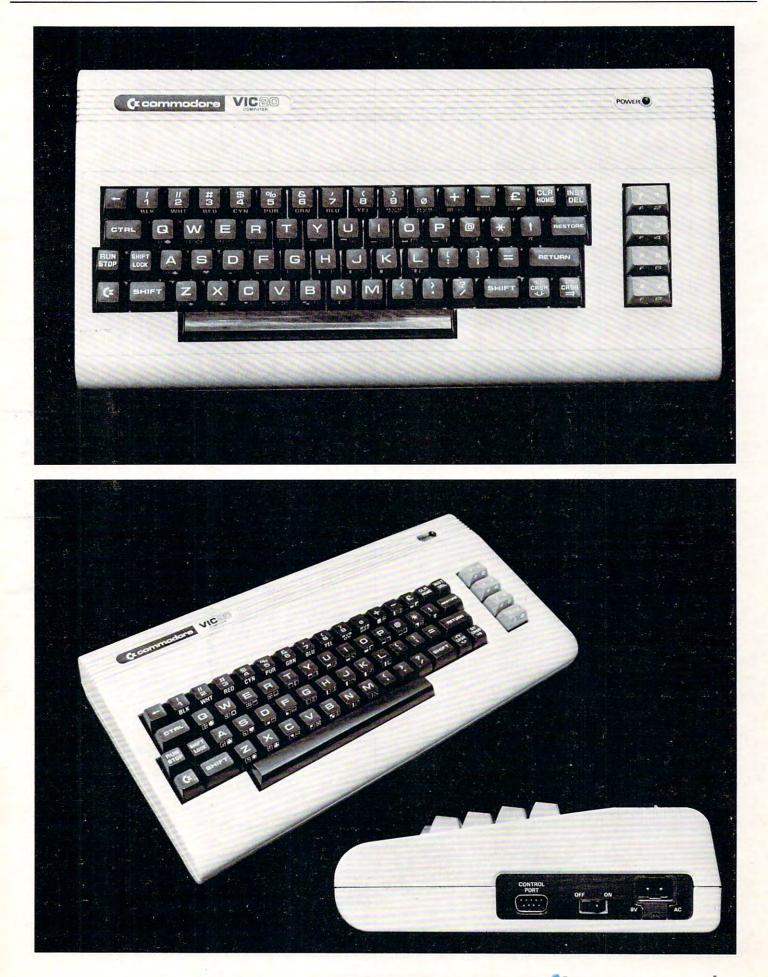
In terms of color control, the Atari is way out in front, since it has independent control over hue and luminance to achieve 128 colors. For most normal programs, however, the Atari user can only work with any four of these 128 colors on the screen at a time, compared with eight fixed colors for the TRS-80 and 16 fixed colors for the VIC.

Just as color is important for many applications, the creative use of sound can do much to enhance one's programs. The VIC supports three musical tone generators (3 octaves each) and one "sound effects" generator. The TRS-80, by comparison, only supports one musical sound channel. The Atari 400 has four sound generators, each of which is capable of musical sounds (4 octaves), or a wide variety of user programable sound effects.

#### Input...

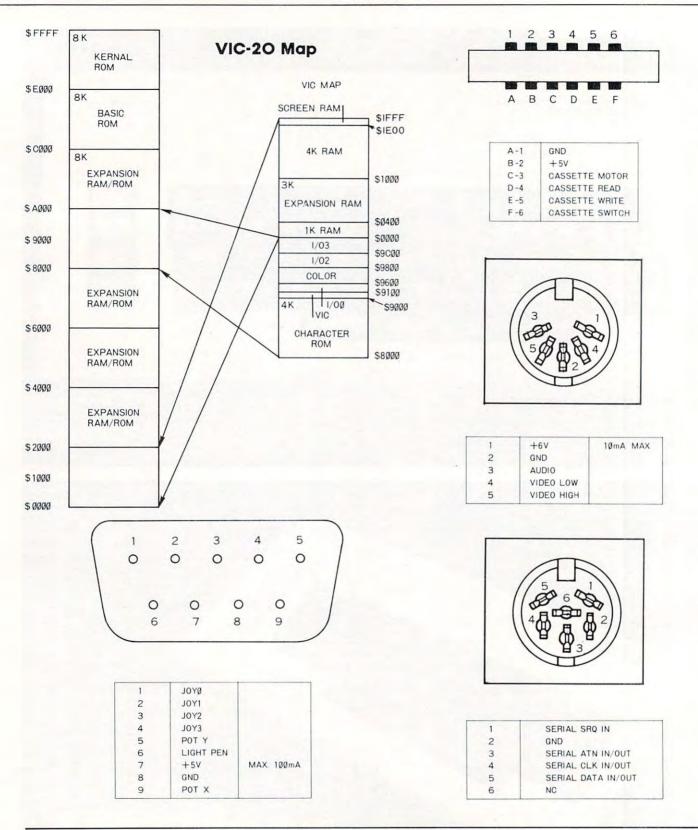
Those of you who appreciate nice keyboards will love the VIC-20. It is supplied with a 66 key arrangement with full typewriter-like key travel. Physically, the VIC keyboard resembles that on the Atari 800. The

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TRS-80, on the other hand, has a medium travel "clicky" keyboard, and the Atari 400 (which places third in this comparison) has a membrane "micromotion" keyboard.

In terms of overall keyboard layout, I find that the keys on the Atari keyboard are slightly easier to find than those on the VIC, but presumably this is a result of my much longer experience with the Atari key arrangement.

#### Externals...

All three computers come with connections to support external cassette tape units for program and data storage. Unlike the Atari and Radio Shack pro-

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ducts, the VIC provides its own power to the recorder, thus reducing the number of power connections needed to get everything running. This is an important consideration when one realizes that most power outlets in the house have two sockets on them. With the VIC connected to a television set, both power outlets are used. With the Atari and Radio Shack computers, a third outlet is needed to connect the tape recorder.

Floppy disk drives are plannned for the VIC and TRS-80, and are available for the Atari 400. All three machines support printers, and can be connected (through an external modem and coupler) to the telephone line. This latter feature will be a crucial test for *all* modern computers as the growth of information utilities continues.

Additional input devices are also supported by the three computers. The VIC supports one (Atarilike) joystick, while the TRS-80 accepts two joysticks, and the Atari 400 accepts up to four. Rotary paddles are also supported on all three machines. The VIC can handle one, the TRS-80 can accept four, and the Atari 400 can accept up to eight game paddles. Both the VIC and the Atari 400 work with a light pen, but the TRS-80 does not.

As you can see, the VIC has many features which are not available on the TRS-80.



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#### Internals...

The VIC uses the 6502 microprocessor, but has one important architectural difference from the PET. In keeping with the designs of the TRS-80 and Atari 400, the VIC uses a special display controller chip (after which the VIC was named). The use of dedicated graphics chips is most beneficial to the end user, since it takes some of the load off the processor and makes the computer capable of feats which would otherwise be quite hard to perform in an eight-bit machine.

The entry level RAM of 5 Kbytes (of which 3583 bytes are available for program space) places VIC above the TRS-80 (4 Kbytes of RAM) and under the Atari 400 (8 Kbytes of RAM). In what appears to be a unique packaging idea, the VIC has a single external cartridge slot which accepts combinations of RAM and ROM. A 3 Kbyte RAM expander will be available from Commodore soon. This plug-in cartridge also has sockets for up to 24 Kbytes of ROM.

The VIC BASIC follows in the Microsoft tradition, and has the same "feel" as the PET BASIC, while adding capabilities associated with the color and sound features of the VIC.

To get some idea for the execution speed of VIC BASIC language, I ran the following program on the VIC, the TRS-80 Color Computer and on the Atari 400.

5 FOR J = 1 TO 100 10 FOR I = 1 TO 100 20 A = (I\*I)/I 40 NEXT I 50 NEXT J

The execution times (in seconds) are shown below for each computer.

VIC-2077 secondsTRS-80 Color Computer103 secondsAtari 400159 seconds

As can be seen from these figures, the VIC has the clear lead. Next I added one line to this program:

30 PRINT A

and ran the experiment again with the following results:

VIC-20	347 seconds
TRS-80 Color Computer	280 seconds
Atari 400	540 seconds

This time the Radio Schack entry is the leader of the BASIC race.

#### Additional Comments...

From the comparisons shown above, it is pretty clear that the VIC will provide very stiff competition to the TRS-80 Color Computer. To help cement the VIC in the marketplace, Commodore has announced a plan by which they will help cottage industry software developers in their development of cartridgebased firmware. It is as though Commodore genuinely realizes the positive impact of outside software

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Table I			
	VIC	TRS-80	Atari 400
Price:	\$299	\$399	\$499
OUTPUT			
Display Incl.:	NO	NO	NO
Color Display:	YES	YES	YES
Characters:	22x23	32x16	40x24
Upper/Lower:	YES	NO	YES
Alphamosaic:	YES	NO	YES
Bit Map:	176x176	256x192	320x192
Sound Gen .:	4	1	4
INPUT			
# Keys:	66	53	57
Kbd. Type:	Full Stroke	Med. Stroke	Flat Panel
EXTERNALS			
Tape:	YES	YES	YES
Disk:	SOON	SOON	YES
Printer:	YES	YES	YES
Joysticks:	1	2	4
Light Pen:	YES	NO	YES
Paddles:	1	4	8
Modem:	YES	YES	YES
INTERNALS			
Processor:	6502	6809	6502
Display Chip:	YES	YES	YES
RAM:	5K	4K	8K
ROM:	?	8K	18K
MAX RAM:	see text	16K	16K
MAX ROM:	see text	16K	26K
Plug-in ROM:	YES	YES	YES

on hardware sales — a fact which Texas Instruments, for example, has only begun to appreciate.

I expect that the VIC will be quite popular with children, and that it will thus find its way into primary grade classrooms as well as into homes. Personally, I find the 22 character display to be too small to support any but the most rudimentary business applications — perhaps including home finance applications. But at a price of \$299, that is hardly the point. The VIC is a much more valuable computer literacy tool than either the hand held Sharp computer being sold by Radio Shack, or any of the similarly priced single board computers which have been on the market for several years. It comes with a very fast, high quality BASIC, and with some excellent graphic and sound capabilities.

VIC will create its own market, and it will be a big one.

Editor's Note: Two vendors have recently announced memory expansion modules for the Atari 400. These modules bring the max RAM capacity of the 400 to 32K. Both the VIC-20 and the TRS-80 Color Computer have built-in RS-232C serial ports; the Atari 400 does not.

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#### Advice to PET Owners: How To Be A VIC Expert Jim Butterfield, Toronto

There are going to be a lot of VIC computers arriving very soon. All those new VIC owners are going to look to you for advice and counsel. After all, you've owned a PET for several months; and a VIC is just a junior version of a PET, right?

You don't want to blow your chance to become the block's VIC guru. It really is very much the same as the PET, but there are new things you will need to get used to.

I'll give a few hints here: Basic is the same as on the PET, right down to the LOG, SQR, and ATN functions. Because the VIC has fewer columns, you can link up to four rows together to generate a line of Basic. Many of the advanced VIC features, like color, are done the same way as programmed cursor on the PET. You clear the PET screen by printing a special reverse-character; you'll set color on the VIC exactly the same way.

The old familiar PEEK the POKE locations have moved around; when you find them, they will work the same as in the PET...but that's a whole other story.

A good way to start is with a sample program. Here's a VIC program which you can type in on your PET, and save on tape. It won't work properly on the PET, but your tape will load in nicely on the VIC, and you'll get an insight into how some of the VIC things work. By the way, your cassette unit itself will plug into the VIC, so carry both tape and cassette unit over to the new machine.

```
100 remark: bis letter disclay
110 rem by Jim butterfield
120 rem peeks the VIC character senerator
130 rem in hex 8080 to 8FFF
140 inout "srawhic/text";sf
150 sf =s71 then b=0:soto 190
170 if g=84 then b=2048:soto 190
178 if g=84 then b=2048:soto 190
180 stop
190 inout"character #":n
200 if n(0 or n)255 or n()int(n) soto 140
210 m=32768tb+8m
220 print chr$(176); for j=1 to 8:print chr$(192);:
next j:print chr$(174)
230 for k=1 to 8
278 y=146:x=x$2:if x)255then x=x-256:y=18
280 print chr$(221);
290 next k
200 next k
300 print chr$(146);chr$(221)
310 next j
320 print chr$(173);:for j=1 to 8:print chr$(192);:
next j:print chr$(18);
330 soto 140
```

What does the above program do? It prints out the 256 characters used by VIC in large size. The user picks a character (from 0 to 255) and it is displayed on VIC's screen. The characters are screen format, not ASCII, so that a value of 1 gives an A character. You'll find that the characters are similar to those used by the PET.

How does this program behave in the VIC?

You'll find a few differences that will cause you to change your programming style when you shift to the new machine. The first thing you'll notice is that you'll have trouble stopping the program. The INPUT statement on line 140 does not stop the machine if you press RETURN with no input. It continues running, and leaves variable G\$ at its previous value. That's different: it means that you can set up a default for G\$ and the user can invoke it by just pressing RETURN. It also means that you have to find another way of stopping the program. The trick here is to input a character such as X when asked, "GRAPHIC/TEXT". The program will continue only on a response of G or T - or no response, as noted before.

You'll have noticed that the program is very PET-compatible. In fact, it will run on the PET with two small differences. First, the PET can't read its own character generator, so you'll get nonsense displayed. Secondly, the PET behaves a little differently on the INPUT statement as we have noted.

Here's a puzzler: when you punched up your program on the PET, it occupied memory space starting at decimal 1025. On the VIC, the program will want to take up residence starting at decimal 4096. How can your PET program load properly to the VIC? Easy: VIC has a relocating loader; it just moves the program to the new place. Transferring programs the other way — from the VIC to the PET — isn't as easy, since the PET does not relocate programs.

A final note on the coding. There's a lot of use of CHR\$ characters: why didn't I use the more familiar characters in quotes, which would certainly work? Answer: it would drive the staff of **COM-PUTE!** wild, since they wouldn't be able to typeset all those fancy characters. Then they would substitute their own symbols, with a translation legend somewhere near, and you'd be driven wild in turn trying to type it in. Trust me: it's better this way. As an exercise, you can work out how to recode most of the CHR\$ expressions into screen characters.

Thought for the day: if the character generator is accessible in memory, do you think that you might be allowed to code your own set of characters in RAM memory? The answer, of course, is yes; but you'll have to encode the whole character set you need since all characters must be grouped together. But that's another story...

You've generated your first VIC program. Hopefully, you've discovered a few things about how the VIC works. Much of it will be the same as with the PET, but a few features are different.

Now, when all of the new VIC owners on the block beat a path to your door, practice saying wise things like, "Of course, on the big machines, we do it this way..."

# Channel Data System o Dook TRS-80

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# Basically Useful BASIC

### Ascending/ Descending Sort

Rick Keck Overland Park, KS

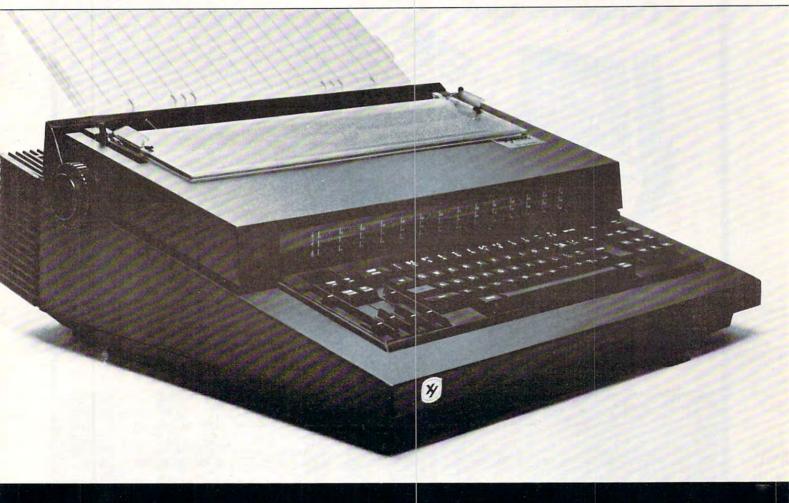
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At some point in time, every computer system user needs the services of a sort program. There has been much work done in the field of "sorting theory" and from this there has come a variety of different sorting methods. Some of these include the bubble sort, shell sort, binary sort, and tag sort. The benefit of this exists in the ability to select a method which is best for sorting data based upon the data's unique characteristics (if any). The factors which influence the decision of which sorting method to use include the following data characteristics: volume, relative order, and storage form (random access or sequential files). In a majority of cases, a simple sorting method will work fine. The standard order of sorting data is to have it sorted from smallest to biggest (ascending order). On occasion, sorting of data may need to be done from biggest to smallest (descending order). The following modified bubble sort routine allows the data to be sorted in either ascending or descending order. Note that the data is handled by character string variables so as to allow alphanumeric data to be sorted.

100	REM来来来来来来来来来来 REM来	*****		
120	REM* ASCENDING	/ DESCENDIN		
140		ROUTINE	<u>事</u> 奉	
	REM* REM* BY RICK	KECK 01/01	*	
170	尼日州東東東東東東東東東	*********		
	DIM C\$(100)			
200	DATA "JOHN","BI DATA "CAROLINE"	LL", "MHRY" , "EPET" "SUM	- 11	
210	DATA "JOE"		-	
	REM* N HOLDS # N=7	OF DATA		
	REM* READ DATA	TNTO CS		
250	FOR J=1 TO N	11110 04		
	READ C\$(J) NEXT J			
	REM# ASCENDING	OR DESCENDIN	JG	
290	PRINT: PRINT: PRI	NT		
300	PRINT: PRINT"WHA PRINT: PRINT"	T ORDER DO 4	OU WISH TO	SORT:"
320	PRINT PRINT"	D = DESCEN	ADING (SMALL ADING (BIG	TO SMALLS"
	PRINT PRINT	C2.0.022020		
	INPUT A\$ IF A\$<>"A" AND	0+000 TUP		
360	PRINT: PRINT			
370	民日川米米米米米米米米米米米			BILL
	REM* SORT REM*******	BEGINS		CAROLINE FRED
400	FOR K=1 TO (N-1	)	1.1.1.1	JOE
	IF A\$="A" THEN			JOHN MARY
	IF C\$(K)>=C\$(K+ IF A\$="D" THEN			SUE
440	IF C\$(K)<=C\$(K+	-1) THEN 540		
	FOR J=K TO 1 ST IF A\$="A" THEN			
	IF C = (J) = C = (J+			
	IF A≢="D" THEN			
	IF C\$(J)<=C\$(J+ T\$=C\$(J)	-1) THEN 540		SUE
510	C\$(J)=C\$(J+1)			MARY
	C\$(J+1)=T\$			JOHN JOE
	NEXT J NEXT K			FRED
550	民日州米米米米米米米米米米米		***	CAROLINE
	REM* SOF REM******	RT ENDS	来 来	DILL
	FOR L=1 TO N		41+41+4 <b>1</b> +	
	PRINT C\$(L)			
	NEXT L PRINT:PRINT"NOF	MAL TERMINA	TION"	
	END			©

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now contain	IEEE to IEEE	CBM to 2nd IEEE Peripheral
operating system	8010	IEEE 300 Baud Modem
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	1	RELATIVE DRAW	Draw a straight line to the point specified by relative coordinates.
UBL	м	MOVE	Move with pen up to the point specified by absolute coordinates.
commands	R	RELATIVE MOVE	Move with pen up to the point specified by relative coordinates.
Vector co	L	LINE TYPE	Specify solid or broken line.
	В	LINE SCALE	Specify the pitch of a broken line (0.1 - 12.7mm).
<e>A</e>	×	AXIS	Draw X or Y coordinate axis.
	н	HOME	Return to the origin with the pen up.
- 5	S	ALPHA SCALE	Specify character size (1 to 16 times basic 0.7mm x 0.4mm)
Character commands	Q	ALPHA ROTATE	Specify character orientation. (Four directions)
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0 8	N	MARK	Draw mark centered on the pen position. (Six kinds)

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# Program Compactor

#### Edward H. Carlson Okemos MI

There are two evils that sneak up on you as your programs attain moderate length. The programs begin to take up too much space in memory, and they become increasingly obtuse. These evils combine in positive feedback. Increased internal documentation by **REM**ark statements is a partial antidote to program complexity but this, of course, compounds the problem of fitting the whole glob into memory.

The answer is to have two copies of each program: a "working copy" occupying minimum space, and a fully documented "archives copy" that may,

#### The first 2 bytes of a BASIC line are a pointer to the start of the next BASIC line.

in fact, be too long to be run in your machine. (It must be short enough to fit in your memory as source code, sans variable tables, of course.)

But consider, you say, how much finger tapping, eyeball twitching, and obsessive concentration it takes to go through a program and remove all the REMarks, especially those buried inside lines of active code, and most especially those "invisible" REM statements like this one:

#### 120 GOTO 232:NO "REM" NEEDED HERE

(In such a statement, the BASIC interpreter jumps to another line before passing the colon and so does not detect the syntax error caused by the omitted REM.)

Looky here, I say, repetitive decisions are just what the logic machine was invented to perform! One needs to write a "program compacting" program, and that is just what I have done, showing my results in Listing 1. The program was written for use with my Ohio Scientific C2-4P, but should work with little change in other Microsoft BASIC machines, such as the PET. All that needs changing is the starting address of the source code, \$0300 for OSI BASIC, and the numerical values of the tokens, which differ in the OSI and PET versions of Microsoft BASIC.

This compactor is a moderately complex program in itself. It is put at high line numbers so as to be out of the way of any program you are writing. When you have a version of your own program that needs compacting, first save it to tape, then read in the Compactor (from a tape that does not have the Test Program in front). Do a "RUN 62000". The compacted program will then be POKEd into memory, ready to SAVE to tape or to RUN. The Compactor will still be in memory, but now invisible to you and inaccessible to BASIC.

Listing 1 starts off with a very short Test Program that has most of the features that would give trouble in a poorly contrived Compactor. Then follows the compactor itself. After initializing addresses, etc., a loop over I is started. Each time through, one line is compacted. Line 62036 contains the exit from the compacting process. This occurs when the line number to be processed is above 9999. You may wish to change this, but all my programs use only line numbers below 9000. Next, leading colons and spaces are removed. I haven't used such things in my own code, but it is legal and so I include that case in the Compactor Program.

Following these preliminaries, the program enters a loop over K, at line 62050, which walks through a single line. Spaces are removed, and the line is terminated if a REM, STOP, RETURN, or GOTO is encountered. The compacted line is stored in an array called L(I). This is an artifact left over from the program construction period. Before allowing my infant program to actually POKE into tender source code memory, I had it make a string and print it. Upon reaching voting age, the string became the L array.

During all this, it is necessary to keep a sharp eye out for quotation marks, as you do not want to alter any of the text inside them. Line 62080 detects opening quotes and jumps to a routine to march along looking for the closing quotes so that control can be returned to the main loop. If a colon or a null is found before the closing quotation marks, the statement or line has terminated and analysis of the next is begun.

Every Microsoft BASIC line ends in a null. Detection of a null character sends control to the top of the "I" loop. The next command sends control to the subroutine at 62600 where the compacted line is POKEd into memory. Some tricky address changing is needed here. The first 2 bytes of a BASIC line are a pointer to the start of the next BASIC line. This chain of pointers must remain intact during interpretation of any part of the Compactor that would do a line number search. Such a search would start at the first line of the program to be compacted, even though the code being interpreted is all above line number 62000. So lines 62601 and 2 pick up the starting address of the code that is next to be compacted in POKEs it into the first two bytes of the newly compacted line.

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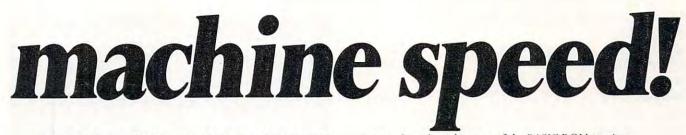
**Program Compactor** 

42

1 A=1:REM \*\*\* TEST PROGRAM \*\*\* 2 REM "RUN 62000" TO COMPACT THE TEST Create · Read • Write View PROGRAM · Sort · Merge · Directory 3 : ::C=3:D=4:REM AAAAA · Print \*\*field updating of file \*Sort by fields 4 END: DON' T SEE THIS AFTER COMPACTION 5 RETURN: NOR THIS 6 GOTO 11111:NOR THIS 7 A\$="SEE THIS":REM NOT THIS More informative menu 999 STOP 62000 REM PLUS 62001 REM \*\*\* COMPACTOR \*\*\* 62002 REM making system LABEL Label making system 62003 REM Edward H. Carlson · keyboard or data file 3872 Raleigh Drive 62004 REM ADD (16.8 value size) 62005 REM Okemos MI 48864 62006 REM (517) 349-1219 EASY TO USE - MENU BASED -62007 REM 62010 PRINT: PRINT: PRINT "COMPACTING": sional uses! PRINT: PRINT 62015 DIM L(80):A=3\*256:AP=A+1:AD=A-3 62020 FOR I=1 TO 9999:A=A+4:REM NEW 9020 Eby 1 TNF 62025 IF L<>0 THEN GOSUB 62600 62035 L=PEEK(A-1)+PEEK(A)\*256:AN=0 62036 IF L>9999 THEN POKE AP, 0: POKE AP+1,0:END 62039 REM REMOVE LEADING COLONS AND SPACES 62040 A=A+1:B=PEEK(A):IF (B=32)OR(B=58) THEN 62040 62050 A=A-1:FOR K=1 TO 255:A=A+1:B=PEEK(A) 62060 IF B=0 THEN NEXT I 62065 IF B=142 THEN GOTO 62100 62068 IF (B=128)OR(B=143)OR(B=141) THEN L(AN)=B:AN=AN+1:GOTO 62100 62070 IF B=58 THEN GOTO 62400 52072 REM STORE CHAR. FOR COMPACT LINE 62073 IF B(>32 THEN L(AN)=B:AN=AN+1 62075 IF B=136 THEN GOTO 62200 62080 IF B=34 THEN GOTO 62300 62090 NEXT K: STOP 62100 FOR K=1 TO 255:A=A+1:B=PEEK(A):REM LOOKING FOR LINE END 62110 IF B=0 THEN NEXT I 62120 NEXT K 62200 FOR K=1 TO 255:A=A+1:B=PEEK(A):REM FOUND "GOTO" 62210 IF B=0 THEN NEXT I 62215 IF B=32 THEN A=A+1:B=PEEK(A):GOTO62210 62220 IF B=58 THEN GOTO 62100 62225 L(AN)=B:AN=AN+1:NEXT K 62300 FOR K=1 TO 255:A=A+1:B=PEEK(A):REM FOUND " CHAR. 62320 IF B=34 THEN L(AN)=B:AN=AN+1:GOTO 62090 62325 IF B=0 THEN NEXT I 62327 IF B=58 THEN 62400 62330 L(AN)=B:AN=AN+1:NEXT K 62400 A=A+1:B=PEEK(A):IF (B=32)0R(B=58) THEN 62400:REM FOUND : 62410 IF B=0 THEN NEXT I 62420 IF B=142 THEN GOTO 62100

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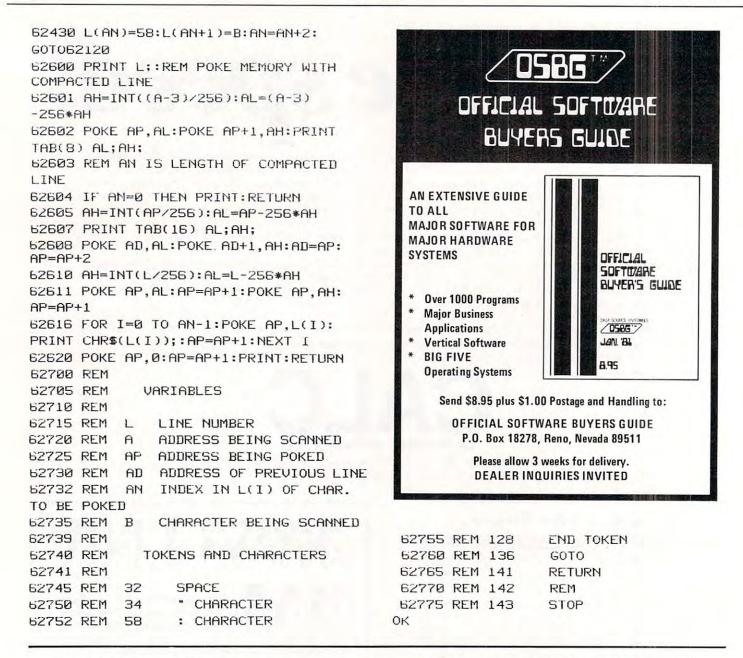
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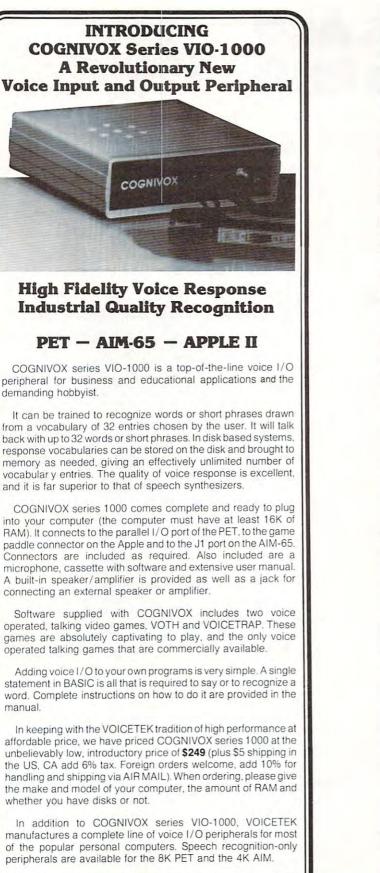


Now if the compacted line is zero length, one returns to the "I" loop and starts compacting the next line. If not, one has to update the pointer in the previous compacted line and this is done in lines 62605 and 7. This restores continuity to the chain of pointers. Then the line number is POKEd in, and then the line of compacted text and finally the null at the end.

While developing this program, I used a somewhat longer "Test Program" than I am giving here. The final test was made on two of my old war horses. The first is a Knight's Tour and the other I informally call "Godzilla Eats Tanks". Both programs are rather long, involved, and use PEEKed and POKEd graphics extensively. "Godzilla" uses PEEKed keyboard input with ANDed and ORed data. ("Godzilla" is invisible and lays down an invisible trail that is sniffed out by a "stench seeking" guided missile.) Both programs ran successfully after compacting to about 75% of their original length. However, I did need to repair the Knight's Tour because I had some GOTO's that went to free standing REM's. These REM's were removed by the Compactor and had to be put back in by hand. I have since learned my lesson. Never GOTO or GOSUB to a REM.

This program is very useful but not yet the ultimate in compaction technique. At least one of the large software houses sells a compactor that is combined with a "branch locator" so that statements which are not the target lines of a GOSUB or GOTO are candidates to be put on the same line, separated by colons. It would certainly be faster and easier to buy such an efficient compactor in preference to tapping this one in through the keyboard, but if your interest is in playing around with logical tasks, you may prefer to modify this program to have multistatement-per-line capability.

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#### Bob Albrecht and George Firedrake

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If you don't know about these games, we suggest you get rule books from the following companies.

- Dungeons and Dragons (D & D) from TRS Hobbies, P.O. Box 756, Lake Geneva, WI 53147.
- Runequest from the Chaosium, P.O. Box 6302, Albany, CA 94706.
- Tunnels and Trolls from Flying Buffalo, Inc., P.O. Box 1467, Scottsdale, AZ 85252.

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play *Tunnels and Trolls*. Why? Because T & T is the simplest game for beginners to begin with.

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The Prime Attributes are usually abbreviated, as follows.

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INT or IQ
LK
CON
DEX
CHR

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In T & T (**Tunnels and Trolls**), these are the Prime Attributes:

**STRENGTH** is primarily the ability to exert force lifting, shoving, pushing down, etc. It shows how much junk (measured in weight units, see below) the character can move around. If his strength is ever depleted until it goes to 0, the character is dead.

**INTELLIGENCE** is the measure of a character's ability to reason clearly, solve problems, remember well, etc. It is also a factor in language ability.

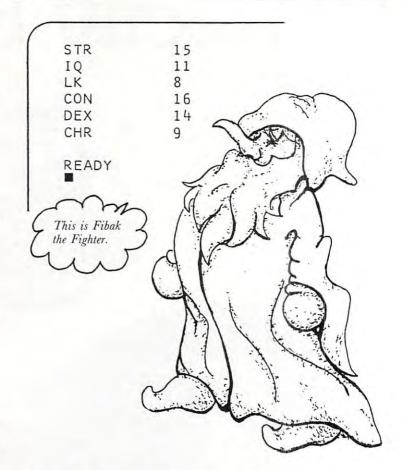
**LUCK** is the ability to be in the right place at the right time, or to put something else in the right place at the right time. It is useful in avoiding traps, striking luck blows with weapons, and gambling of all sorts.

**CONSTITUTION** is the general measure of a character's health. It is also the measure of endurance and how much punishment the body can absorb before it dies. Hits taken in combat are subtracted from Constitution. If CON ever goes to 0, the character dies.

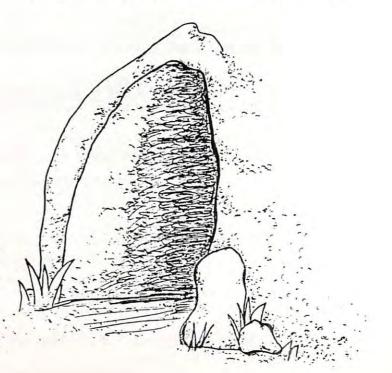
**DEXTERITY** refers to manual dexterity and general agility.

**CHARISMA** is the measure of one's personal attractiveness and leadership ability. It is not necessarily synonymous with personal beauty, although there is often a high correlation. Charisma is the only attribute which can fall to 0, or even go negative, without resulting in death. Generally speaking, characters with charismas less than 7 are unappreciated in human society, and anything less than 3 is positively unwelcome. Monstrous characters, when rated with attributes, have negative charismas.

And so we come to the final tasks of this booklet. **Exercise 15.** Write a program to roll a T & T character. A RUN might look like this.



Hmmm...obviously a fighter. Remember, when we roll three dice, the possible outcomes are 3 to 18. So, our character is strong (STR = 15), agile (DEX = 14), with a very high ability to sustain damage (CON = 16). He or she is about average in intelligence (IQ = 11), obviously *not* a leader (CHR = 9) and must depend on skill, not luck (LK = 8).



The definitions of the Prime Attributes are taken from the rulebook TUNNELS & TROLLS, copyright 1975, 1977, 1979 by Ken St. Andre, published by Flying Buffalo, Inc., P.O. Box 1467 Scottsdale, AZ 85252 and is reprinted by permission.



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In fantasy games, usually a bunch of characters get together to explore the Gamemaster's universe. So, let's roll some more characters to accompany Fibak the Fighter, who awaits in the frontier town of Ziredrac, hoping to collect a company of adventurers to explore the caves under Mt. Skybison, a place of jagged (but sometimes fuzzy) peaks and mysterious dark valleys that sometimes light up with brilliant flashes of wisdom.

We RUN the program again.



This is, indeed, a strange character! Strong (STR = 14), but easily damaged (CON = 7). Clumsy (DEX = 6). But look at luck (LK = 15) and charisma (CHR = 14). This character will convince others to follow her or him into...what? (Again, look at INT = 8.) But, there is that luck.

Help! Let's roll another adventurer.



STR = 11 = 17 INT LK 12 = 12 CON = DEX = 8 CHR =15 READY Ahhh ... Windstar the Wise.

Saved! Our group is saved! Windstar the Wise wandered by, saw our forlorn little group of adventurers and decided to take charge.

**Exercise 16.** Describe Windstar as we described Fibak and Clutz. Also describe the way in which Windstar, Fibak and Clutz might work together to explore the Gamemaster's universe, overcome monsters, acquire treasure and...survive!

**Exercise 17.** (and last of this booklet...) The group of adventurers now numbers three: FIBAK, CLUTZ, WINDSTAR.

Too small a group! They could never survive in the Gamemaster's world. They need at least four more adventurers. More are OK. So, you roll up four more adventurers, then tell who they are and how they relate to and work with our three adventurers.

The Dragons of Pern wish you well in your adventuring.

Do it wisely with luck.

Editor's Note: Next time we come to the end of a series, we'll be printing "Solutions & Stuff"; the author's solutions to the problems raised in this series. Hope you've enjoyed it.  $\mathbb{O}$  meet a

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# Micros With The Handicapped

#### Susan Semancik and The Delmarva Computer Club

One of our major objectives at this time is to devise an inexpensive means for providing a listing for a blind programmer. The possibilities we've considered to date are as follows:

- a) Have someone continuously available to read the program to the programmer.
- b) Buy a speech synthesizer that will vocalize BASIC words, letters, punctuation marks, numbers, graphics characters, and control characters.
- c) Build a tactile device that will pulse Braille equivalents of each character encountered in a listing.
- d) Sound out the Braille equivalents of each character encountered in a listing by using a different note or sound for each dot in the Braille cell using the CB2 line.

We know that possibility a) works. We have been forced through lack of money and/or equipment to use this means to solve the blind programmer's needs. But, it is certainly not a desirable solution, especially to the programmer. One thing that is soon apparent to anyone working with the handicapped is that the majority have an overwhelming desire for independence and self-reliance. To support this desire, we must look beyond possibility a).

Possibility b) is possible since Commodore has announced the development of a synthesizer for the PET, but we do not yet have access to one. It's price of almost \$400 may or may not be a deterrent to its wide-spread use. We'll have to wait and see. Possibility c) is being considered by the Delmarva Computer Club at this time, and hopefully we can give you details on its use and cost in the very near future. The other devices that we know about that are currently on the market are very expensive and/or computer dependent. For example, Maryland Computer Services, Inc., Bel Air, Maryland, has advertised a Hewlett-Packard desktop computer and a talking interface that provides spoken output of 64 ASCII characters for \$10,500. Triformation Systems, Inc., Stuart, Florida, has advertised a high-speed braille output on paper tape from computer via builtin acoustic coupler for \$2,950. And this past March, ELINFA, Inc., Washington, D.C., announced a portable braille recorder with braille display and computer interface for \$4,600.

That brings us to possibility d), which is immediately available to anyone with an amplifier and speaker connected to the PET's CB2 line. Since this is commonly used already to produce sound and music, this would mean no additional expense for most people, and so seems to be a good place to start exploring. It is certainly inexpensive, and an ear plug can be used with the speaker so that only the user can hear the sounds. This would require the blind programmer to learn something new; but, essentially the code is the same; only the method of perceiving the code is new. Rather than feeling the dot's position within the braille cell, the user will listen to determine a note's position within a range of notes.

The program entitled "A Sound Idea for the Blind" is an assembly language program that will run on either an OLD or NEW ROM 8K PET computer. It is designed to teach anyone the Braille equivalents of letters in both a visual and auditory form. After typing RUN, the user can type any letter on the keyboard and will automatically see that letter's braille dot configuration, and hear the notes that correspond to those dots. The user can also hit any number from 1 through 6 to hear singly the notes assigned to each dot position. This program could be used by the visual user to learn Braille or by the non-visual to learn the sounds associated with each position of the Braille cell.

The speed at which the notes are sounded is controlled by the data number in line 240. To speed it up, put a smaller number like 75 in place of the 200. If a change in either the quality of the sound or the pitch is desired, the data numbers in line 310 can be changed. These are listed pairwise for the six dot positions of the cell.

To test how well the sounds have been learned, this program can be modified as in the program entitled "Braille Letter Tester". The Braille codes of the 26 letters of the alphabet are randomly sounded and printed on the screen for the user to identify. The sound can be repeated by pressing the equal sign key instead of a letter. The line

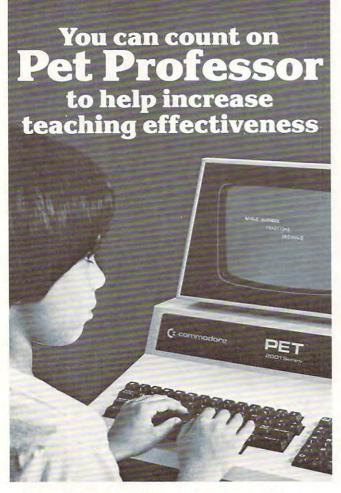
455 IF A\$ <"A" OR A\$ >"Z" THEN 430

must be added so that the program is not terminated with an illegal value when a non-alphabetic character is entered. If the visual user really wants to "see" what the code would sound like to someone blind, the printing of the Braille code on the screen can be eliminated by changing six operation codes to NOP with the addition of the following line:

295 POKE 838, 234: POKE 839, 234: POKE 840, 234: POKE 883, 234: POKE 884, 234: POKE 885, 234

We hope to be able to expand this "sound" concept to realize our full objective of a program's listing for a blind programmer. Let us know if this is a realistic alternative, or if there are other possibilities that we haven't considered.

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#### **Snoken Material Included**

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DNE INVO INVO FIGEE POUR PIVE SIX SEVEN EIGHT VINE EIEVEN VINE EIEVEN NUELEEN SUTEEN SUTEEN SUTEEN SUTEEN VINETEEN VINETEEN VINETEEN VINETEEN SUTEN SU	SPORCH ON BECKITY BIGHTY MINETY HENDRED HEDISAND AGAN AMPRE AND AT AMPRE AND AT AMPRE AND AT AMPRE CASE CENT 400HERIZ TUNE BIHENCE MONSTLENCE 200MS SILENCE CHIL CHECK COMMA	CONTROL DANCER DECREE DOLLAR DOWN EQUAL EROOR FEET FLOEL CALLON GO GRAAM GREATER HAVE HIGH HUGHER HOUR IN NCCHES IS IT KILD	LEFT LESSE LESSER LESSER LIMIT LOW MARK MILL MINUTE MINUTE MINUTE NEAR MINUTE NEAR NUMBER OF OFF ON OVER PAREINTHESIS PERCENT PELCASE PLISS POINT	POUND PILISES RATE RE REATE READY READY RECHT SS SECOND SET SPACE STAR STAR STAR STAR STAR STAR STAR THAN THE TIME TRY UP VOLT WEIGHT
ORTY TFTY TFTY	AT CANCEL CASE CENT 400HERTZ TONE 80HERTZ TONE 80MS SILENCE 160MS SILENCE 160MS SILENCE 100MS SILENCE CENTI CHECK COMMA	INCHES IS IT KILO	PERCENT PLEASE PLUS POINT	WEIG

10 REM \*\*\* BRAILLE LETTER TESTER \*\*\* 20 REM - YOU WILL HEAR & SEE THE CODE --FOR A RANDOM LETTER REM - TYPE THE LETTER OR TYPE = TO ¬ 30 -HEAR IT AGAIN 40 REM - ASSEMBLY PROGRAM CODE 5Ø I=826 60 READ OP: IF OP <> -1 THEN POKE I, OP: ¬I=I+1:GOTO 6∅ 100 I=5000 110 READ OP: IF OP <> -1 THEN POKE I, OP: ¬I=I+1:GOTO 11∅ 120 REM %%% OLD/NEW CONVERSION %%% 130 ON PEEK(50003) GOSUB 310 140 DATA 169,147,32,210,255 150 DATA 160,0,177,6,170,169,46,157,121, -129,200,192,6,208,243,96 160 DATA 169,168,133,0,169,19,133,1 170 DATA 169,136,133,6,169,19,133,7 180 DATA 32,58,3,160,0 190 DATA 177,6,160,0,24,106,144,15,133, -252,177,6,170,169,81 200 DATA 157,121,129,32,129,3,165,252, -200, 192, 6, 208, 232, 96, 169210 REM +++ TO CHANGE SPEED OF SOUND, - CHANGE DATA LINE 220 +++ 220 DATA 200 230 DATA 133,253,152,10,168,177,0,141, 74,232,200,177,0 240 DATA 141,72,232,136,152,74,168,162, -255,202,208,253,198,253,208,247 250 DATA 169,0,141,72,232,96,-1 260 DATA 0,80,160,2,82,162,1,3,9,25,17, -11,27,19,10,26,5,7,13,29,21,15,31, -23 270 DATA 14,30,37,39,58,45,61,53 REM +++ TO CHANGE SOUND, CHANGE ¬ 280 ¬DATA LINE 290 +++ 290 DATA 15,240,200,180,15,120,35,90, -100,60,15,30,-1 300 GOTO 360 310 REM %%% CONVERSION ROUTINE %%% 320 POKE 834,15:POKE 858,15:POKE 862,16: -POKE 869,15:POKE 877,171:POKE 879, -15 330 POKE 890,171:POKE 900,172:POKE 925, -172 340 RETURN 350 REM - SET SOUND PARAMETERS AND -CURSOR CONTROL VALUE POKE 59467,16:POKE 59466,51: 360 -X=RND(-TI):B=224-PEEK(50003)\*28 370  $L=26:DIM L(26):C=\emptyset:FOR I=1 TO 26:$ ¬L(I)=I:NEXT I REM - GET A RANDOM LETTER FROM ¬ 380 THOSE REMAINING 390 N=INT(L\*RND(1))+1:Y=L(N):A=Y+64 400 REM ACTIVATE THE SOUND AND PRINT ¬ -ROUTINE FOR THE CELL AND PRINT A ? 410 POKE 867, Y+5:SYS (847): POKE 33448,63 420 REM - GET RESPONSE FROM THE USER 430 GET A\$:IF A\$="" THEN 430 440 REM - IF RESPONSE IS =, THEN SOUND ¬ JIT AGAIN 450 IF A\$="=" THEN 410 REM - INCREASE THE COUNTER FOR -460 -NUMBER OF TRIES 470 C=C+1 480 REM - PRINT THE USER'S RESPONSE

490	POKE 33450, ASC(A\$)-64
	REM -PRINT THE RIGHT ANSWER AND -
	¬POSITION THE CURSOR FOR COMMENT
510	POKE 33466, Y: POKE B, 168: POKE B+1,
	-130:POKE B+2,5
520	REM - IF ANSWER IS CORRECT, ¬
	-ELIMINATE THE LETTER FROM THE LIST
53Ø	IF A\$=CHR\$(A) THEN PRINT "CORRECT!":
	$\neg X = L(N) : L(N) = L(L) : L(L) = X : L = L - 1 :$
	¬GOTO 55Ø
54Ø	PRINT "WRONG."
55Ø	PRINT TAB(4); "THIT ANY KEY TO ¬
	¬CONTINUE."
560	REM - WAIT FOR USER TO HIT A KEY -
	¬BEFORE CONTINUING
570	GET A\$: IF A\$="" THEN 570
58Ø	REM - CONTINUE IF THERE ARE ANY ¬
	¬MORE LETTERS
59Ø	IF L>Ø THEN 390
600	REM - TELL THE USER THE NUMBER OF ¬
	¬TRIES TAKEN TO COMPLETE THE TEST
610	PRINT "RYOU COMPLETED THE 26 -
	¬LETTERS IN"; C: PRINT "TRIES."
620	REM - RESET PARAMETERS BEFORE ENDING
630	POKE 59467, Ø: POKE 59466, Ø: POKE ¬
	-59464,12
640	END
READ	Ζ.
100	
10	REM *** A SOUND IDEA FOR THE BLIND ¬
	_***

- 20 REM === ASSEMBLY PROGRAM CODE ===
- 3Ø I=826
- 40 READ OP:IF OP<>-1 THEN POKE I,OP: -I=I+1:GOTO 40
- 50 REM === SCREEN LOCATIONS FOR BRAILLE ¬ ¬DOT POSITIONS (5000-5005) ===
- 60 REM === AND BRAILLE CODES (5006-5031)
- 70 REM === AND ALTERNATING TIMBRE AND ¬ ¬NOTE VALUES (5032-5043)
- 8Ø I=5000
- 90 READ OP:IF OP<>-1 THEN POKE I,OP: -I=I+1:GOTO 90
- 100 REM %%% OLD/NEW CONVERSION %%%
- 110 ON PEEK(50003) GOSUB 330
- 120 PRINT "ĥ": SYS 847
- 130 DATA 169,147,32,210,255
- 140 DATA 160,0,177,6,170,169,46,157,121, -129,200,192,6,208,243,96
- 150 DATA 169,168,133,0,169,19,133,1,169, -16,141,75,232,169,15,141,74,232
- 160 DATA 169,136,133,6,169,19,133,7
- 170 DATA 32,228,255,240,251,201,3,208, -14,169,0,141,75,232,141,74,232, -169,12
- 180 DATA 141,76,232,96,133,252,32,58,3, -165,252,201,65,48,7,201,91,16,3, -76,172,3
- 190 DATA 201,49,48,211,201,55,16,207,56, -233,49,168
- 200 DATA 177,6,170,169,81,157,121,129, -32,207,3,76,105,3
- 210 DATA 56,233,59,168,177,6,160,0,24, -106,144,15,133,252,177,6,170,169, -81
- 220 DATA 157,121,129,32,207,3,165,252, -200,192,6,208,232,76,105,3,169

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0

230	REM +++ TO CHANGE SPEED OF SOUND,
	- CHANGE DATA LINE 240 +++
240	DATA 200
250	DATA 133,253,152,10,168,177,0,141,
	74,232,200,177,0
260	DATA 141,72,232,136,152,74,168,162,
200	-255, 202, 208, 253, 198, 253, 208, 247
270	
	DATA 169,0,141,72,232,96,-1
280	DATA 0,80,160,2,82,162,1,3,9,25,17,
	-11,27,19,10,26,5,7,13,29,21,15,31,
	-23
300	REM TO CHANGE SOUND, CHANGE DATA ¬
	¬LINE 31Ø
310	DATA 15,240,200,180,15,120,35,90,
	-100,60,15,30,-1
320	END
330	
340	
540	¬POKE 897,171:POKE 902,171:
	¬POKE 927,15
250	
350	POKE 945,15:POKE 953,171:POKE 955,
	-15:POKE 966,171:POKE 978,172:
	¬POKE 1003,172
360	RETURN

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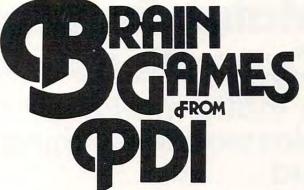
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**ASTRO-QUOTES** This is an anagram-type game. The goal of the game is to guess a famous quotation. Clues are letters that the computer inserts in the correct slots in the quotation when the player correctly guesses the definitions of a series of words.

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Program Design, Inc. Department CA 11 Idar Court Greenwich, CT 06830

## Matrix Row Operations A mathematics classroom-teaching aid

William L. Hinrichs Rockford, III.

After teaching the elementary row operations on matrices and their applications on a chalkboard or overhead projector for many years, I have found a better teaching tool. Using a computer and this program, Matrix Row Operations, has eliminated a major stumbling block to learning. Detailed fraction arithmetic always obscured the big picture concepts and techniques. All of the input and output for this program is in the common fraction form used in textbooks and familiar to the students. However, all fraction arithmetic including multiplication, addition, and reducing is done by the computer. This allows us to concentrate on the big picture while avoiding the details during classtime.

#### Easy Conversion For Apple & TRX-80

This program was written for a Commodore PET computer, but with minor modifications it will run on an Apple, TRS-80, or other machine. No machine language is used and the BASIC used is standard. Due to a lack of standardization of screen control statements, most of the PRINT statements will have to be modified. Loop index variables have been left off some NEXT statements and may have to be added.

#### **Classroom Equipment Set-up**

All that is required to use this program with a small group is a PET computer with 8-K RAM and any ROM version. Due to the array size limitation of version 1.0, the program's use is limited but it will run and can be used effectively. For a large group, I use a Petunia video interface board from HUH Electronics to connect our PET to a TV monitor and then connect that monitor to a second monitor with very satisfactory results. This arrangement has worked well with up to 40 students in a class.

#### Sample Run

Before I describe the program, a sample run is in order. We will solve a system of two equations in two unknowns by matrix row reduction.

Problem:

Find all solutions, if any, of this system of linear equations:

5x + 3y = 9 and -4x + 2y = -16.

#### **Mathematical Analysis**

We will set up a matrix representation of this system of equations and manipulate it by applying the elementary row operations. At each step, we will have a matrix representation of a system of equations with the same solutions as the original one. Our goal is to end up with a matrix representation in rowreduced form, from which the solution to all the systems can be easily read. The original and rowreduced matrices are illustrated in the computer solution below. For more information on the mathematics of matrices, I would recommend College Algebra, Gustafson & Frisk, Brooks/Cole Pub. Co., 1980, pp. 116-175. Most other college algebra texts also have a chapter on matrices.

#### **Computer Demonstration**

- LOAD the program and RUN it. The displays which follow are exact copies of the screen. Each display has had all inputs added to the right of the ?, and when the RETURN key is pressed we go on to the next screen. COM-MAND? is always the first input requested on each screen. For some commands, additional inputs are requested above the COMMAND? line.
- 2. The command menu will be displayed and our response to COMMAND? is 'EM' for enter matrix.

COMM	AND MENU	
?	DISPLAY MENU	
EM	ENTER MATRIX	
*R	MULTIPLY ROW	
*R+	MULTIPLY ROW AND ADD	
IR	INTERCHANGE ROWS	
DOM	DISPLAY ORIGINAL MATRIX	
DIM	DISPLAY CURRENT-1 MATRIX	
DCM	DISPLAY CURRENT MATRIX	
В	BACKUP 1 STEP	
Q	QUIT	
	AND? EM	

56

# **80 COLUMN GRAPHICS**



The Integrated Visible Memory for the PET has now been redesigned for the new 12" screen 80 column and forthcoming 40 column PET computers from Commodore. Like earlier MTU units, the new K-1008-43 package mounts inside the PET case for total protection. To make the power and flexibility of the 320 by 200

### The image on the screen was created by the program below.

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

bit mapped pixel graphics display easily accessible, we have designed the Keyword Graphic Program. This adds 45 graphics commands to Commodore BASIC. If you have been waiting for easy to use, high resolution graphics for your PET, isn't it time you called MTU?

K-1008-43M Manual only \$10 (credited toward purchase) k-1008-43 Complete ready to install package \$495

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Write or call today for our full line catalog describing all MTU 6502 products, including our high speed 8" Floppy Disk Controller for up to 4 megabytes of PET storage.



Company and the second s

**NOW 80 COLUMN PETS CAN HAVE MTU HIGH RESOLUTION GRAPHICS** 

*						*
*		3	9			*
ŧ	1					*
*		5	5			*
*						*
*						*
*	-4	2	-16			*
*						*
*						*
*						*
*	ROW	TO BE	MULTI	PLIED?	1	*
*		IPLIE			7	*
*				T0? 2		*
*						*
*	COMM	AND? *	KR+			*
*						*
.1	1-1-1-1-L-L	deded about		L.L.I.L.L.L.L.		a bala bala bala bala

- \*\*\*\*\*\*\*\*\*\*
- We now get a 1 in the second row, second column by responding with \*R for COMMAND?, 2 for ROW TO BE MULTIPLIED?, and 5/22 for MULTIPLIER?.

*	****	****	****	******	*****
*					*
*		3	9		*
*	1				*
*		5	5		*
*					*
*		22	-44		*
*	0				*
*		5	5		*
*					*
*					*
*					*
*					*
*				PLIED? 2	2 *
*			R? 572	22	*
*	COMM	AND?	<b>*</b> R		*
*					*
**	****	****	*****	*******	******

7. Our last row operation creates a 0 in the first row, second column by responding a COMMAND? with \*R +, ROW TO BE MULTIPLIED? by 2, MULTIPLIER? by -3/5, and ROW TO BE ADDED TO? by 1. The final or row-reduced matrix will then be displayed.

		.1111111111111.	*****
	3	9	*
1			*
	5	5	*
			*
			*
0	1	-2	*
			*
			*
			*
ROW	TO BE	MULTIPLIED? :	2 *
MULT	IPLIE	R? -3/5	*
ROW	TO BE	ADDED TO? 1	*
			*
COMM	AND?	*R+	*
			*

3. We can now enter our matrix row by row. In response to the prompt, we follow each entry by pressing the RETURN key. The number of rows is 2 and the number of columns is 3. We follow these responses with the matrix values by row. The COMMAND? response now is 'DOM' which causes the original matrix to be displayed in row, column form.

58

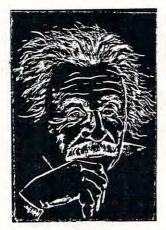
K							3
		MAN		SOM2.			3
e Hi	DM I	MAN			MNS?	3	3
E M.	( 1		1 :	) =?	5		э
: M	( 1	,	2		3		9
1 M	( 1			) =?	9		;
M	( 2			) =?	-4		,
M		,	2		2		
M			3		-16		
	-						
							*
	OMME			MOC			

4. We need a 1 in the first row, first column so our COMMAND? is \*R for multiply a row. We are then prompted to enter ROW TO BE MULTIPLIED?, to which we reply 1. Next we enter 1/5 to the prompt MULTIPLIER?. Note that the entry is a common fraction. Following the last entry the screen clears and the new or current matrix is displayed with all fractions reduced.

******	*****	*******	*****	
				,
	-			3
	3	9		,
				,
				,
				;
-4	2	-16		
				,
DOLL T	0.00		-ma +	
		MULTIPLI	ED? I	
MULTI				*
COMMA	ND? *	R		3
				*
******	****	*******	*****	*****

5. We now need a 0 in the second row, first column so our COMMAND? is \*R + for multiply a row and add to another row. We answer ROW TO BE MULTIPLIED? with a 1, MULTIPLIER? with a 4, and ROW TO BE ADDED TO? with a 2. Those operations are performed and the result is displayed.

# An Intelligent Alternative

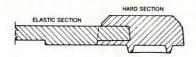


In the research you are doing before purchasing your computer printer, you are probably confused by the various claims, speeds, choices, shapes and prices. Well, we'd like to clear the air a bit and tell you about the most unusual computer-printer around — the TYPRINTER 221.

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

#### THE DAISY WHEEL

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



#### THE KEYBOARD

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

#### TYPRINTER 221

#### 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 What characters will be inserted in the memory When the printer is in an error

condition When a pre-programmed form lay-

out has been selected When the printer is operating from the internal memory.

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:

made

into an existing text,

line has been selected.

When the memory for the previous

A warning message that the end of

That a hyphenation decision must be

the page is being approached.

traditional printing;

- underlined characters;
- true bold characters where the horizontal component of the character is increased without disturbing the vertical com-
- nonent: characters which are both bold and under-
- lined, and;
- a feature unique among computer printersprinting 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 oneration

#### 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



- 8. We now interpret this row reduced matrix as a system of equations with the same solution as the original system
  - x = 3 and y = -2.

60

			*
1	0	3	
		100	
			*
0	1	-2	
			* * *
			*
			*
			*
			*
			*
COM	1AND? 0	2	*
			*

9. Our last COMMAND? is Q for quit. This allows a clean exit from the program.

In class, we can handle systems of 5, 6, or more equations with no more difficulty than solving two on the chalkboard. The example was kept small to conserve space in the article. Please note that the input concerned strategy decisions involved in the rowreduction method and not with the details of the matrix row operations. Another nice command in the menu is B for backup one step. If we don't get the desired results at any step, B returns us to the status prior to the last command. At any step, we may display the original, current, or current-1 matrix. If an interchange of rows is desired the command IR causes it to happen.

#### Mathematics Topics Taught

I have found this program useful in teaching the strategies and application of row-reduction to solve systems of linear equations, finding the inverse of any square matrix that has one, and finding the value of a determinant of a square matrix by first zeroing all entries under the diagonal and then finding the product of the diagonal entries. Discussion of the algebra of the simplex method is clarified and simplified when using this program. The simplex method is a matrix technique for the solution of linear programming problems.

#### Non-Classroom Uses

Students can use this program on a PET in a learning center or library to practice and reinforce their understanding of matrix strategies. I have also found the program valuable for producing step by step handouts to supplement the examples contained in our textbook. I have been aided greatly in this last application by the KEYPRINT program written by Charles Brannon, **COMPUTE!** #7, pp. 84, 86. I LOAD and initialize KEYPRINT first, then whenever I want a copy of the current screen contents I proceed as usual.

#### Structure Of The Program

The program is a menu driven set of ten subroutines referenced from the main program by one of the menu commands. Their locations and functions are:

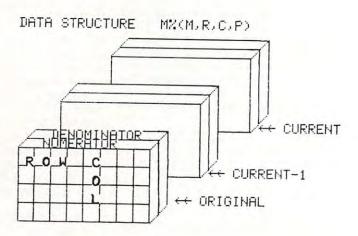
#### COMMAND LOCATION FUNCTION

COMMANNALID	LOOMINI	I UNULIUN
?	2200-2310	Displays menu.
*R	1900-1996	Multiplies row.
*R +	1700-1880	Multiplies entries of one row and adds to another.
IR	2000-2090	Interchanges any two rows.
В	2400-2430	Backs up 1 step. Current and current-1, matrices are switches.
DOM	1205-1310	Displays original matrix.
DIM	1210-1310	Displays intermediate (current-1) matrix.
DCM	1215-1310	Displays current matrix.
EM	1000-1090	Accepts input of the original matrix.
Q	2100-2120	Clears screen and exits program.

In addition, there are four workhorse subroutines that are called by most of the main subroutines listed above. A fraction reducer routine at 1400-1470 reduces all fractions and also serves to find least common denominators for additions. A matrix switcher at 1500-1560 is the entry routine and the \*R and \*R + routines. The move current to current-1 routine at 1600-1650 is used by the \*R, \*R +, IR, and B routines.

#### DATA STRUCTURE

\*\*\*\*\*\*\*\*



#### \*\*\*\*\*\*\*\*\*

Three matrices are stored as one four-dimensioned array M%(M,R,C,P). M is the matrix number with 1 = original, 2 = current-1, and 3 = current. R is the

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Microphys is pleased to announce the availability of its educational software for use with the Commodore PET/CBM and Apple/Bell & Howell microcomputers. These programs have been successfully employed in Chemistry, Physics, Calculus and Mathematics classes on both the high school and college levels.

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A partial list of the programs available appears below. Please write for the Microphys Winter Catalog which describes the complete line of educational software for use on the PET/CBM and Apple/Bell & Howell microsystems.

#### CALCULUS CASSETTES

PC726-Differentiation of Algebraic Functions PC727-Maxima/Minima Problems: Part I PC728-Maxima/Minima Problems: Part I PC729-Relative Rate Problems: Part I PC730-Relative Rate Problems: Part I PC730-Integration of Algebraic Functions PC732-Differentiation of Trigonometric Functions PC733-Integration of Trigonometric Functions PC734-Integration of Trigonometric Functions PC735-Integration: Volumes of Solids PC735-Integration: Volumes of Solids PC737-Integration: Surface Areas of Solids

M4 Calculus I Diskette contains 726-737

#### PHYSICS AND CHEMISTRY CASSETTES

	Linear Kinematics		Series Parallel Circuit Analysis
	Projectile Motion		Faraday's Law
	Momentum and Energy		Gram-Molecular Mass
	Energy and the Inclined Plane		The Mole Concept
5.	Inelastic Collisions		The Molarity Concept
6.	Centripetal Force	26.	The Normality Concept
7.	Pulley Systems - Machines	27	The Molality Concept
8.	Specific Heat Capacity	28	Stiochiometry: Mass/Mass
9.	Calorimetry	29	Stoichiometry: Mass/Volume
	Heats of Fusion/Vaporization	30.	Stoichiometry: Volume/Volume
	Specific Gas Laws		Stoichiometry: General
12.	General Gas Laws		Percent Concentration
13.	Thermodynamics I	33.	pH Concept
	Thermodynamics II		EMF of Electrochemical Cells
	Transverse Standing Waves		Electric Field Analysis
	Longitudinal Standing Waves		Photoelectric Effect
	Lenses and Mirrors	37.	Symbols and Valence Drill
	Refraction of Light		Names of Compounds Drill
	Series Circuit Analysis		Formulas of Compounds Drill
	Parallel Circuit Analysis I		Total Internal Reflection
	Parallel Circuit Analysis II		
P1	Physics I Diskette - contains the following	a prinqr	ams
P2	1 2 3 4 5 6 7 8 9 10 301 302 305 306 Physics II Diskette - contains the followin		

2 Physics II Diskelle - crintains the following programs 11 12 13 14 15 16 17 18 19 20 20A 21 35 36 40 303 304

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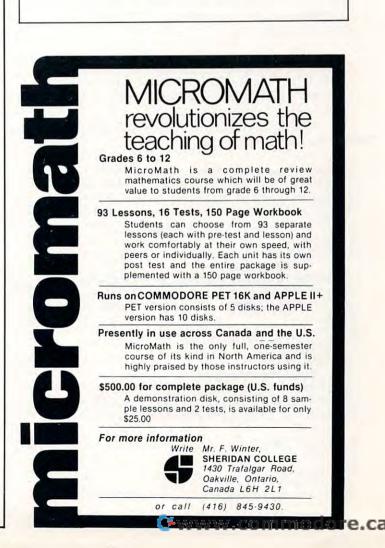
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row number and C is the column number. P = 1means numerator and P = 2 means denominator. The denominator for any integer has a value of 1. An integer array name (M%) was chosen to conserve memory so that this program can be effective in an 8K machine. This limits any numerator or denominator to the maximum integer size and occasionally causes overflow problems. This occurs in large matrix problems with many relatively prime factors. It happens seldom but a check has been patched in to detect this and give you the chance to back up one step and try something else.

#### Summary

This program has three notable weaknesses. It has no provisions for work on matrices with decimal entries and it's use in the classroom does require a minimal amount of time and planning for equipment set-up. It also bombs occasionally as mentioned above under data structure. The strengths of this program far outweight the weaknesses and make it an effective teaching tool. It allows concentration on strategy and concepts rather than details. It handles fractions the way the students are expected to, displaying results and accepting input in a human rather than a computer way. It has saved my students and me valuable classtime and has led them to a better understanding of the ideas being taught. In addition, it can be used outside of class for a variety of applications.

I hope other mathematics teachers will find this program as useful as I have. If you don't wish to spend your time keying the program into your machine, I will be happy to send you a copy on tape. Send a check for \$10.00 and your name and complete address to William L. Hinrichs, 5056 Welsh Ct., Rockford, Ill., 61107.

```
5
 REM ***MATRIX ROW OPERATIONS****
 6
7
 REM **(C)1981 WILLIAM HINRICHS**
 8
9 REM *** ROCK VALLEY COLLEGE ****
10 EX=0
20 PRINT" htt tt tt
     "OPERATIONS"
30 PRINT "♦>>>> CLASSROOM DEMONSTRATION "
4Ø PRINT"♥>>>> (C) 198Ø
                   WILLIAM ¬
     ¬HINRICHS"
50 T=TI
60 IF TI-T<600 THEN 60
70 PRINT"ĥ"
100 GOSUB2200
110 GOSUB900:GOTO110
900 REM*** COMMAND INPUT ***
910 DATA?, *R, *R+, IR, B, DOM, DIM, DCM, EM, Q
¬";
930 INPUTA$
940 I=1
950 READB$
960 IFA$=B$THEN980
965 I=I+1:IFI>10THENRESTORE:GOTO920
```

```
970 GOT0950
980 ONIGOSUB2200,1900,1700,2000,2400,
       -1205,1210,1215,1000,2100
990 RESTORE: RETURN
1000 REM*** INPUT MATRIX ***
1005 PRINT"A"
1010 INPUT"HOW MANY ROWS"; NR
1020 INPUT"HOW MANY COLUMNS"; NC
1030 DIM M%(3,NR,NC,2)
1040 FOR R=1 TO NR
1050 FOR C=1 TO NC
1060 PRINT"M("R","C") ="::INPUTAS
1070 GOSUB1100
1080 M%(1,R,C,1)=N%:M%(1,R,C,2)=D%
1085 M%(2,R,C,1)=N%:M%(2,R,C,2)=D%
1086 M%(3,R,C,1)=N%:M%(3,R,C,2)=D%
1090 NEXT:NEXT:RETURN
1100 REM*** FRACTION SPLITTER ***
1110 L=LEN(A$)
1120 FOR I=1TO L
1130 IFMID$(A$,I,1)="/"THENN%=VAL(LEFT$(
      -A$, I-1)):D%=VAL(RIGHT$(A$,L-I)):
      -I=L:K=1
1140 NEXT I
1150 IF K<>1THENN%=VAL(A$):D%=1
1160 K=0:RETURN
1200 REM*** MATRIX PRINTER ***
1205 M=1:GOTO1217
1210 M=2:GOT01217
1215 M=3
1217 PRINT"A"
1218 IFNC>7THENT=4
1219 IFNC<8THENT=5
1220 FOR R=1 TO NR
1230 FOR C=1TONC
1240 N%=M% (M,R,C,1):D%=M% (M,R,C,2)
1246 GOSUB1400
1248 IFD%=-1THENN%=-N%:D%=1
1250 N$=STR$(N%):LN=LEN(N$):D$=STR$(D%):
      ¬LD=LEN(D$)
1260 IFD%=1AND(T-LN)<>0THENPRINT"V"SPC(T
      --LN) N$"1";:GOTO1280
1262 IFD%=1AND(T-LN)=ØTHENPRINT"\"N$"1";
      ¬:GOT01280
1265 IF(T-LN)>ØTHENPRINTSPC(T-LN);
1270 PRINTN$" << < $ CCC << < < $ ";: IF (T-LD) > 0T
      ¬HENPRINTSPC(T-LD);
1275 PRINTD$"^^";
1280 NEXT C
1290 PRINT"***
1300 NEXT R
1310 RETURN
1400 REM*** FRACTION REDUCER ***
1405 IFN%=0THEND%=1:B=1:RETURN
1410 IF N%>D% THEN A=N%:B=D%:GOTO1440
1420 IF N%<D% THEN A=D%:B=N%:GOTO1440
1430 IF N%=D% THENN%=1:D%=1:B=1:RETURN
1440 Q=INT(A/B):RZ=A-Q*B
1450 IFRZ=0THEN N%=N%/B:D%=D%/B:RETURN
1460 A=B:B=RZ
1470 GOTO 1440
1500 REM*** MATRIX SWITCHER ***
1510 REM SWITCH MATRIX M1 WITH MATRIX M2
1520 FOR R=1 TO NR
1530 FOR C=1 TO NC
1540 FOR P=1 TO 2
1550 T%=M% (M1,R,C,P):M% (M1,R,C,P)=M% (M2,
      -R,C,P):M%(M2,R,C,P)=T%
```

```
1560 NEXT P,C,R:RETURN
```

#### April, 1981. Issue 11.

#### COMPUTE!

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0

```
1600 REM*** MOVE CURRENT MATRIX TO PRIOR
1610 FORR=1TONR
1620 FORC=1TONC
1630 FORP=1TO2
1640 M%(2,R,C,P)=M%(3,R,C,P)
1650 NEXTP, C, R: RETURN
1700 REM*** R2=R1*CONSTANT+R2 ***
1725 PRINT"h****************
1730 INPUT ROW TO BE MULTIPLIED";R1
1732 IFR1<10RR1>NRTHEN1725
1735 GOSUB1600
1740 INPUT"MULTIPLIER";A$
1750 GOSUB1100
1760 INPUT"ROW TO BE ADDED TO";R2
1770 IFR1<10RR1>NRORR2<10RR2>NRORR1=R2TH
      -EN1725
1780 GOSUB1400:NC%=N%:DC%=D%
179Ø FORC=1TONC
1791 N%=NC%:D%=M%(2,R1,C,2):GOSUB1400
1792 N1%=N%:D2%=D%
1793 N%=M%(2,R1,C,1):D%=DC%:GOSUB1400
1794 N2%=N%:D1%=D%
1795 P=N1%:Q=N2%:IFABS(P*Q)>32767THEN245
      -0
1796 P=D1%:O=D2%:IFABS(P*Q)>32767THEN245
      ¯
1800 N%=N1%*N2%
1810 D%=D1%*D2%
1815 GOSUB1400
1816 N1%=N%:D1%=D%
1818 N%=D1%:D%=M%(2,R2,C,2)
1819 GOSUB 1400
1820 LC=D1%/B*M%(2,R2,C,2)
1825 N%=LC/D1%*N1%+LC/M%(2,R2,C,2)*M%(2,
      ¬R2,C,1)
1830 D%=LC
1840 GOSUB1400
1850 M%(3,R2,C,1)=N%:M%(3,R2,C,2)=D%
1860 NEXTC
1870 GOSUB1215
1880 RETURN
1900 REM*** MULTIPLY A ROW ***
1930 INPUT"ROW TO BE MULTIPLIED";R1
1935 IFR1<10RR1>NRTHEN1910
1938 GOSUB1600
1940 INPUT"MULTIPLIER";A$
1950 GOSUB1100:NC%=N%:DC%=D%
1960 FOR C=1TONC
1961 N%=NC%:D%=M%(3,R1,C,2):GOSUB1400
1962 N1%=N%:D2%=D%
1963 N%=M%(3,R1,C,1):D%=DC%:GOSUB1400
1964 N2%=N%:D1%=D%
1965 P=N1%:O=N2%:IFABS(P*Q)>32767THEN245
      ¯
1966 P=D1%:Q=D2%:IFABS(P*Q)>32767THEN245
      ٦Ø
1970 N%=N1%*N2%:D%=D1%*D2%:GOSUB1400
1990 M%(3,R1,C,1)=N%:M%(3,R1,C,2)=D%
1995 NEXTC
1996 GOSUB1215:RETURN
2000 REM *** ROW INTERCHANGE ***
2010 PRINT"h****************
2020 INPUT"INTERCHANGE WHICH TWO ¬
      ¬ROWS";R1,R2
2030 GOSUB1600
2040 FORC=1TONC
2050 T%=M%(3,R1,C,1):M%(3,R1,C,1)=M%(3,
```

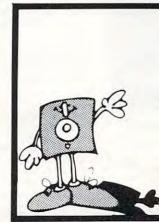
-R2,C,1):M%(3,R2,C,1)=T%

		1012	D2 C 21-	DID.		
0070		:M*(3,	R2,C,2)=	1.2		
	NEXTC		TO DOUDD	08 1		
2080	EX=EX+1:F	EM EX	IS POWER	UF -1		2
			IG THE DE	TERMII	NAN T	
2085		)				
	RETURN					
2100	REM*** QU	JIT ***	e			
	PRINT"h"					
2120	END		Same in			
2200						
	PRINT"ĥ		IAND MENU			
2220	PRINT"	?	DISPLAY			
	PRINT"V		ENTER M			
2240	PRINT"*	*R	MULTIPL	Y ROW		
2250	PRINT"V	*R+	MULTIPL	Y ROW	AND	-
	¬ADD					
2260	PRINT"*	IR	INTERCH	ANGE 1	ROWS	
2270	PRINT"*	DOM	DISPLAY	ORIG	INAL	٦
	MATRIX					
2280	PRINT"V	DIM	DISPLAY	PRIO	R ¬	
	MATRIX					
2290	PRINT"*	DCM	DISPLAY	CURR	ENT -	
Comerce.	MATRIX					
2295	PRINT"*	В	BACKUP	1 STE	P	
2300	PRINT"V	0	OUIT			
	RETURN	~	-			
2400	REM*** BA	ACK UP	1 STEP *	**		
	M1=2:M2=3					
	GOSUB1500		31600:GOS	UB121	5	
	RETURN					
2449		ICT TO	LARGE E	RROR	MESSA	AGE
2450	PRINTT	+++++++++	VVALUE	TOO	7	
2450	-LARGE!	II" . PR	INT"TO CO	NTTNI	E.	
	- PRESS					
2460	GETA\$: IFA			N2460		
2400		1917 CIII				
READ						

2060 T%=M%(3,R1,C,2):M%(3,R1,C,2)=M%(3,

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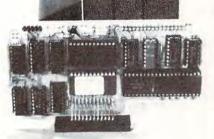
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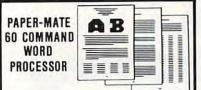
Record size limit is 250 characters. The number of records per disk is limited only by the size of each record and the amount of free space on the disk. File maintenance lets you step forward or backward through a file, add, delete or change a record, go to a numbered record, or find a record from a specified field. The Find command locates any record when you enter all (or a portion of) the desired key field. Field lengths can vary from record to record provided the sum of the fields does not exceed the size of the record. This allows maximum packing of information. The file can be sorted by any field. Any field can be specified as a key field at any time. Sequential files from other programs can be converted to random files, and random can be converted to sequential. Maximum record size, fields per record, and order of fields can be changed at any time.

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Paper-Mate text editing includes floating cursor, scroll up or down, page forward or back, and repeating insert and delete keys. Text Block handling includes transfer, delete, append, save, load, and insert.

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#### MAILING LABELS

\$229

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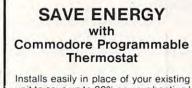
When record size is 127 characters (typical for mailing list), each disk can handle over 1000 records (about 2800 with the 8050 drive). Labels can be printed any number of labels across, and in any column position. Any number of fields can be printed on a label in any order, and two or three fields can be joined together on one line (like first name, last name, and title). A "type of customer" field allows selective printing.

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The contents of any field can be placed in any column. Numerics can be decimal point justified and rounded to any accuracy. Any column can be defined as a series of mathematical functions performed on other columns. These functions may include  $+, -, x, \checkmark, \%$ , and various log and trig functions. Results of operations such as running total may be passed from row to row. At the end of the report a total and/or average can be calculated for any column. Complete record selection, including field within range, pattern match, and logical functions can be specified individually or in combination with other parameters.

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# A Floating-Point Binary To BCD Routine

Marvin L. DeJong Department of Mathematics-Physics The School of the Ozarks Pt. Lookout, MO 65726

#### Introduction

A previous issue of **COMPUTE!** carried a BCD to Floating-Point Binary Routine that can be used to convert a series of decimal digits and a decimal exponent to a binary number in a floating-point format. The purpose of such a routine is to enable the user to perform floatingpoint arithmetic. The program described in this article performs the reverse operation; that is, it converts a floating-point binary number to a decimal number and a decimal exponent. With these two routines and an Am9511 Arithmetic Processing Unit one can do most of the functions found on scientific calculators. I hope to provide a few simple arithmetic routines in the near future. In the meanwhile, you can amuse yourself by converting numbers to floatingpoint binary numbers and then back to decimal numbers.

#### Hindsight

The BCD to floating-point binary routine described previously used a divide-by-ten routine that was part of the main program. With my excellent hindsight I now realize that the divide-by-ten routine should have been written as a *subroutine*, to

Listing 1.	A New	Divide-by-T	en Routine.
------------	-------	-------------	-------------

COEDE OD OF OF	Concentration of the	ICD DIVERSI	
\$0EBF 20 C5 0E	ONCMOR	JSR DIVTEN	Jump to divide-by-ten subroutine.
0EC2 B8		CLV	Force a jump around the routine.
0EC3 50 51	DIVERN	BVC ARND	The new subroutine is inserted
0EC5 A9 00	DIVTEN	LDA \$00	here. Clear accumulator for use
0EC7 A0 28		LDY \$28	as a register. Do \$28 = 40 bit
0EC9 06 00	BRA	ASL OVFLO	divide. OVFLO will be used as
0ECB 26 04		ROL LSB	"guard" byte.
0ECD 26 03		ROL NLSB	Roll one bit at a time into the
0ECF 26 02		ROL NMSB	accumulator which serves to hold
0ED1 26 01		ROL MSB	the partial dividend.
0ED3 2A		ROL A	Check to see if A is larger than
0ED4 C9 0A		CMP \$0A	the divisor, $0A = 10$ .
0ED6 90 05		BCC BRB	No. Decrease the bit counter.
0ED8 38		SEC	Yes. Subtract divisor from A.
0ED9 E9 0A		SBC \$0A	
0EDB E6 00		INC OVFLO	Set a bit in the quotient.
0EDD 88	BRB	DEY	Decrease the bit counter.
OEDE DO E9		BNE BRA	
0EE0 C6 05	BRC	DEC BEXP	Division is finished, now normalize
0EE2 06 00		ASL OVFLO	For each shift left, decrease the
0EE4 26 04		ROL LSB	binary exponent.
0EE6 26 03		ROL NLSB	Rotate the mantissa left until a
0EE8 26 02		ROL NMSB	one is in the most-significant bit.
0EEA 26 01		ROL MSB	3
0EEC 10 F2		BPL BRC	
<b>OEEE A5 00</b>		LDA OVFLO	If the most-significant bit in the
0EF0 10 12		BPL BRE	guard byte is one, round up.
0EF2 38		SEC	Add one.
0EF3 A2 04		LDX \$04	X is byte counter.
0EF5 B5 00	BRD	LDA ACC,X	Get the LSB.
0EF7 69 00		ADC \$00	Add the carry.
0EF9 95 00		STA ACC,X	Result into mantissa.
<b>OEFB CA</b>		DEX	
0EFC D0 F7		BNE BRD	Back to complete addition.
<b>OEFE 90 04</b>		BCC BRE	No carry from MSB so finish.
0F00 66 01		ROR MSB	A carry, put in bit seven,
0F02 E6 05		INC BEXP	and increase the binary exponent.
0F04 A9 00	BRE	LDA \$00	Clear the OVFLO position, then
0F06 85 00		STA OVFLO	get out.
0F08 60		RTS	ger out
020000			
			Empty memory locations here.
			Empty memory locations here.
0F16 A9 00	ARND	LDA \$00	Remainder of BCD-to-floating
V. 10 110 00			accounter of DOD-to-monthing
		-	point routine is here.
			Point routine is nere.

\$0E54 18		CLC	Clear carry for addition.
0E55 A5 05		LDA BEXP	Get binary exponent.
0E57 69 20		ADC \$20	Add \$20 = 32 to place binary
0E59 85 05		STA BEXP	point properly.
0E5A EA		NOP	
0E5B EA		NOP	
\$0D53 A0 20	BR7	LDY \$20	Y will limit the number of
0D55 A5 01	<b>BR10</b>	LDA MSB	left shifts to 32.
0D57 30 0D		BMI BR11	If mantissa has a one in its
0D59 18		CLC	most-significant bit, get out.
0D5A A2 04		LDX \$04	
0D5C 36 00	BR9	ROL ACC,X	Shift accumulator left one bit.
OD5E CA		DEX	
0D5F D0 FB		BNE BR9	
0D61 C6 05		DEC BEXP	Decrement binary exponent for each
0D63 88		DEY	left shift.
0D64 D0 EF		BNE BR10	No more than \$20 = 32 bits shifted.
0D66 60	BR11	RTS	That's it.

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be called by both the BCD to floating-point binary routine and the binary to decimal routine described here. So my first task was to rewrite the divide-by-ten routine as a subroutine. I also discovered that the divide-by-ten routine described in the previous article did not give sufficient precision. In any case, the divide-by-ten routine was completely revised and appears in Listing 1 in this article. It uses the location \$0000, called OVFLO, as a "guard" byte to give the necessary precision. It actually starts at \$0EC5, but our listing starts at \$0EBF to indiciate a few changes that must be made in the original listing to insert the subroutine.

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Some other minor modifications to the program are given in Listing 2. Although the BCD to Floating-Point Binary program will work without these changes, it will work better if you introduce the changes shown in Listing 2. The development of the program described in this article enabled me to find some places to improve the other routine. The modifications are simple and short.

#### **The Conversion Routine**

The program to convert a normalized floating-point binary number and its exponent to a BCD number and then output the result is given in Listing 3. A 32-bit binary to BCD conversion subroutine is called by this program and it is found in Listing 5. A flowchart of the entire process is given in Figure 1. The normalized floating-point binary mantissa is operated on by a series of "times ten" or "divide by ten" operations until the binary point is moved from the left of the mantissa to the right of the 32 bit mantissa. In other words, we multiply by ten or divide by ten until the binary exponent is 32. Then the mantissa represents an integer and can be converted to a BCD number using the subroutine in Listing 5. The algorithm for this latter routine is from Peatman's (John B)

Listing 3. A Floating-Point Binary to BCD Routine

ating-Point	Binary to BCD	Routine.
BEGIN	LDA MSB	Test MSB to see if mantissa is zero.
	BNE BRT	If it is, print a zero and then
	JSR CLDISP	get out. Clear display.
	LDA \$30	Get ASCII zero.
	JSR OUTCH	Jump to output subroutine.
	LDA \$0D	Get "carriage return."
	JSR OUTCH	Output it.
	RTS	Return to calling routine.
BRT	LDA \$00	Clear OVFLO location.
	STA OVFLO	
BRY	LDA BEXP	Is the binary exponent negative?
	BPL BRZ	No.
		Yes. Multiply by ten until the
		exponent is not negative.
		Decrement decimal exponent.
		Force a jump.
BRZ		Compare the binary exponent to
		\$20 = 32.
		Equal. Convert binary to BCD.
		Less than.
	the second se	Greater than. Divide by ten until
		BEXP is less than 32.
		Force a jump.
		Class OVELO
		Clear OVFLO
BRW		Multiply by top
DRW	•	Multiply by ten. Then normalize.
		Decrement decimal exponent.
		Test binary exponent.
		Is it 32?
		Yes.
		It's less than 32 so multiply by 10.
		It's greater than 32 so divide.
		Increment decimal exponent.
BRU		Test binary exponent.
		Compare with 32.
		Shift mantissa right until exponent
	LSR MSB	is 32.
	ROR NMSB	
	ROR NLSB	
	ROR LSB	
	ROR TEMP	Least-significant bit into TEMP.
	INC BEXP	Increment exponent for each shift
	CLV	right.
	BVC BRU	and the second se
BRV	LDA TEMP	Test to see if we need to round
	BPL BCD	up. No.
	SEC	Yes. Add one to mantissa.
BRS	LDA ACC,X	
	ADC \$00	
DCD		
		Jump to 32 bit binary-to-BCD routine.
BRM	LDY \$04	Rotate BCD accumulator right until
BRP	LDX \$04	non-significant zeros are shifted
	CLC	out or DEXP is zero, whichever
BRQ	ROR BCDN,X	comes first.
BRQ	DEX	comes first.
BRQ	DEX BPL BRQ	comes first.
BRQ	DEX	comes first.
BRQ	DEX BPL BRQ DEY BNE BRP	
BRQ	DEX BPL BRQ DEY	comes first. Increment exponent for each shift right. Get out when DEXP = 0.
	BEGIN BRT BRY BRZ BRY BRZ BRW BRW BRW BRU BRU BRU BRU	BRU BRW JSR TENX JSR OUTCH LDA \$30 JSR OUTCH LDA \$00 STA OVFLO BRT LDA \$00 STA OVFLO BRY LDA BEXP BPL BRZ JSR TENX JSR TENX JSR NORM DEC DEXP CLV BVC BRY Repeat. BRZ LDA BEXP CMP \$20 BEQ BCD BCC BRX JSR DIVTEN INC DEXP CLV BVC BRY BRW JSR TENX JSR NORM DEC DEXP CMP \$20 BEQ BCD BCC BRX JSR DIVTEN INC DEXP CLV BVC BRZ LDA \$00 STA OVFLO BC BRX JSR DIVTEN INC DEXP CLV BVC BRZ LDA BEXP CMP \$20 BEQ BCD BCC BRX JSR DIVTEN INC DEXP CLV BVC BRZ LDA BEXP CMP \$20 BEQ BCD BCC BRW JSR TENX JSR NORM DEC DEXP LDA BEXP CMP \$20 BEQ BCD BCC BRW JSR DIVTEN INC DEXP CMP \$20 BEQ BRV LSR MSB ROR NLSB ROR NLSB ROR NLSB ROR NLSB ROR LDA TEMP

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#### **Microprocessor Based Design** (McGraw-Hill).

Of course, each time the binary number is multiplied by ten or divided by ten the decimal exponent is adjusted. Thus, we are left with a BCD number in locations \$0020 - \$0024 (five locations for ten digits) and a decimal exponent in \$0017. The rest of the routine is largely processing required to give a reasonable output format. Since we don't want to print a group of non-significant zeros, the BCD number is rotated right until all the zeros are shifted out or the decimal exponent is zero, whichever comes first.

Next the routine starts examining the BCD number from the left and skips any leading zeros. Thus, the first non-zero digit is the first digit printed. Of course, if the number is minus (a non-zero result in location \$0007) a minus sign is printed. Next the decimal point is printed, and finally the exponent is printed in the form "E XX." Thus, the format chosen always has the decimal point to the right of the significant digits, 3148159. E-6 for example. If you want scientific notation for non-integer results you can modify the output routine. It's simply a matter of moving the decimal point. The flowchart and the comments should allow you to understand and modify the code.

	0007 15 00			
	0B87 A5 20		LDA LBCDN	Has a non-zero digit been shifted
	0B89 29 0F		AND \$0F	into the least-significant place?
	0B8B F0 E9	DRO	BEQ BRM	No. Shift another digit.
	OB8D EA	BRO	NOP	Oops. These NOPs cover an
	OB8E EA		NOP	earlier mistake.
	OB8F EA		NOP	
	0B90 EA		NOP	
	0B91 EA		NOP	the second s
	0B92 20 9B 0F		JSR CLDISP	This routine simply clears the
	0B95 A5 07		LDA MFLAG	AIM 65 20-character display.
	0B97 F0 05		BEQ BRN	If the sign of the number is minus,
	0B99 A9 2D		LDA \$2D	output a minus sign first.
	0B9B 20 A6 0F		JSR OUTCH	ASCII " - " = \$2D. Output
				character.
	0B9E A9 0B	BRN	LDA \$0B	Set digit counter to eleven.
	0BA0 85 0B		STA TEMP	
	0BA2 A0 04	BRI	LDY \$04	Rotate BCD accumulator left to
	0BA4 18	BRH	CLC	output most-significant digits
	OBA5 A2 FB		LDX \$FB	first. But first bypass zeros.
	0BA7 36 25	BRG	ROL BCDN	*1
	<b>OBA9 E8</b>		INX	
	<b>OBAA DO FB</b>		BNE BRG	
	<b>OBAC 26 00</b>		ROL OVFLO	Rotate digit into OVFLO.
	<b>OBAE 88</b>		DEY	notate argit into o ri not
	OBAF DO F3		BNE BRH	
	0BB1 C6 0B		DEC TEMP	Decrement digit counter.
	0BB3 A5 00		LDA OVFLO	
	0BB5 F0 Eb		BEQ BRI	Is the rotated digit zero?
	0BB7 18	BRX	CLC	Yes. Rotate again.
		DRA		Convert digit to ASCII and
	0BB8 69 30		ADC \$30	output it.
	0BBA 20 A6 0F		JSR OUTCH	
	0BBD A9 00		LDA \$00	Clear OVFLO for next digit.
	0BBF 85 00		STA OVFLO	
	0BC1 A0 04		LDY \$04	Output the remaining digits.
	0BC3 18	BRL	CLC	
	0BC4 A2	\$FB	LDX \$FB	
	0BC6 36 25	BRJ	ROL BCDN,X	Rotate a digit at a time into
	0BC8 E8		INX	OVFLO, then output it. One digit
	0BC9 D0 FB		BNE BRJ	is four bits or one nibble.
	0BCB 26 00		ROL OVFLO	
	0BCD 88		DEY	
	OBCE D0 F3		BNE BRL	
	0BD0 A5 00		LDA OVFLO	Get digit.
	0BD2 C6 0B		DEC TEMP	Decrement digit counter.
	0BD4 D0 E1		BNE BRX	
	0BD6 A5 17		LDA DEXP	Is the decimal exponent zero?
	0BD8 F0 48		BEQ ARND	Yes. No need to output exponent.
	OBDA A9 2E		LDA \$2E	Get ASCII decimal point.
	<b>OBDC 20 A6 0F</b>		JSR OUTCH	Output it.
	<b>OBDF A9 45</b>		LDA \$45	Get ASCII "E".
	0BE1 20 A6 0F		JSR OUTCH	
	0BE4 A5 17		LDA DEXP	Is the decimal exponent plus?
	0BE6 10 0D		<b>BPL THERE</b>	Yes.
	0BE8 A9 2D		LDA \$2D	No. Output ASCII "-"
	<b>OBEA 20 A6 OF</b>		JSR OUTCH	and a sub-sub-sub-sub-sub-sub-sub-sub-sub-sub-
	0BED A5 17		LDA DEXP	It's minus, so complement it and
	OBEF 49 FF		EOR \$FF	add one to form the twos
	ODDI 15 II		LOR VII	complement.
	0BF1 85 17		STA DEXP	complement.
	0BF3 E6 17		INC DEXP	
		THEPE		Clear OVELO
	0BF5 A9 00 0BF7 85 00	THERE	LDA \$00 STA OVELO	Clear OVFLO.
	OBF7 85 00		STA OVFLO	C
	0BF9 F8		SED	Convert exponent to BCD.
	0BFA A0 08		LDY \$08	
	0BFC 26 17	BR1	ROL DEXP	
	0BFE A5 00		LDA OVFLO	
Ş	SOC00 65 00		ADC OVFLO	
	0C02 85 00		STA OVFLO	
	0C04 88		DEY	
	0C05 D0 F5		BNE BR1	

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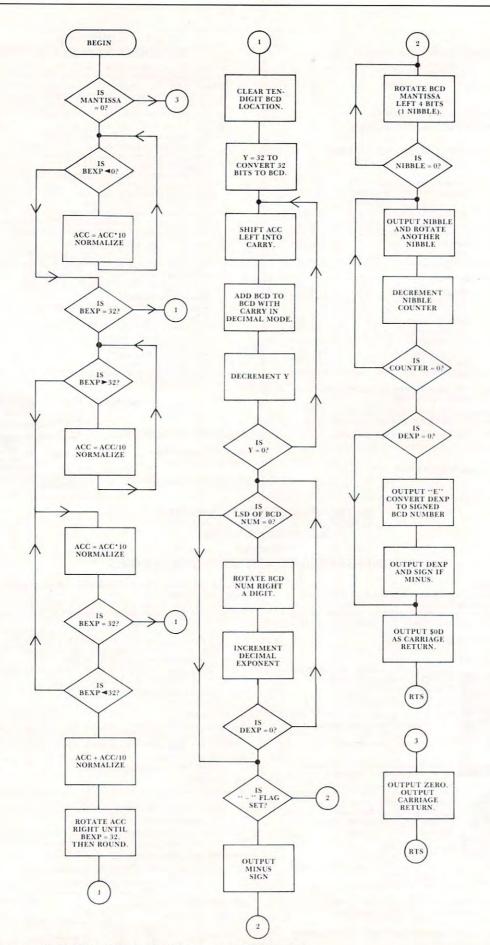


Figure 1. Flowchart of the Floating-Point Binary to BCD Routine.

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AIM 65 monitor subroutine.

0C07 D8		CLD	
0C08 18		CLC	
0C09 A5 00		LDA OVFLO	Get BCD exponent.
0C0B 29 F0		AND \$F0	Mask low-order nibble (digit).
0C0D F0 09		BEQ BR2	
0C0F 6A		ROR A	Rotate nibble to the right.
0C10 6A		ROR A	and the second second second second
0C11 6A		ROR A	
0C12 6A		ROR A	
0C13 69 30		ADC \$30	Convert to ASCII.
0C15 20 A6 0F		JSR OUTCH	Output the most-significant digit.
0C18 A5 00	BR2	LDA OVFLO	Get the least-significant digit.
0C1A 29 0F		AND \$0F	Mask the high nibble.
0C1C 18		CLC	
0C1D 69 30		ADC \$30	Convert to ASCII.
0C1F 20 A6 0F		JSR OUTCH	
0C22 A9 0D	ARND	LDA \$0D	Get an ASCII carriage return.
0C24 20 A6 0F		JSR OUTCH	and the second sec
0C27 60		RTS	All finished.

#### Listing 4. Subroutine OUTCH For the AIM 65.

\$0FA6 20 00 F0 OUTCH 0FA9 20 72 0F 0FAC 20 60 0F 0FAF 60 RTS

JSR MODIFY JSR DISPLAY RTS See previous article in COMPUTE!

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## Listing 5. A 32 Bit Binary-to-BCD Subroutine.

\$0D67 A2 05 CONVD	LDX \$05	Clear BCD accumulator.
0D69 A9 00	LDA \$00	
0D6B 95 20 BRM	STA BCDA,X	Zeros into BCD accumulator.
0D6D CA	DEX	
0D6E 10 FB	BPL BRM	
0D70 F8	SED	Decimal mode for add.
0D71 A0 20	LDY \$20	Y has number of bits to be
0D73 06 04 BRN	ASL LSB	converted. Rotate binary number
0D75 26 03	ROL NLSB	into carry.
0D77 26 02	ROL NMSB	
0D79 26 01	ROL MSB	
D7B A2 FB	LDX \$FB	X will control a five byte
0D7D B5 25 BRO	LDA BCDA,X	addition. Get least-significant
0D7F 75 25	ADC BCDA,X	byte of the BCD accumulator,
0D81 95 25	STA BCDA,X	add it to itself, then store.
0D83 E8	INX	Repeat until all five bytes have
0D84 D0 F7	BNE BRO	been added.
0D86 88	DEY	Get another bit from the binary
0D87 D0 EA	BNE BRN	number.
0D89 D8	CLD	Back to binary mode.
0D8A 60	RTS	And back to the program.

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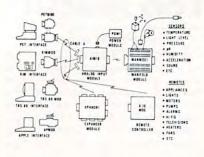
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# **Microcomputer Measurement And Control For PET, APPLE, KIM and AIM65**



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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.

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 durbat control (e.g. lamps motors) humidity), digital output control (e.g. lamps, motors, alarms), and analog output control (e.g. X-Y plotters, or oscilloscopes).

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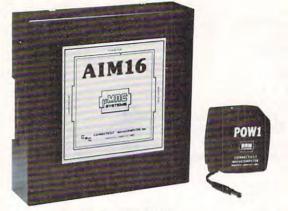
AIM16

cable)

The AIM 16 requires connections to its input port (analog inputs) and its output port (computer inter-face). The ICON (Input CONnector) is a 20 pin, solder eyelet, edge connector for connecting inputs to each of the AIMI6's 16 channels. The OCON (Output CONnector) is a 20 pin, solder eyelet edge connector for connecting the computer's input and output ports

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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 inter-faces 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 in-The input voltage range is 0 to 5.12 volts. The in-put voltage is converted to a count between 0 and 255 (00 and FF hex). Resolution is 20 millivolts per count. Accuracy is  $0.5\% \pm 1$  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.



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.



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- Can be used as a trigger for a stored
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VAC)	

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# ADA1600 • For Parallel NEC and Centronics Standard Printers

The ADA1600 is a low cost easy to use interface for the Commodore Computers. It allows the PET and CBM computers to use standard Centronics type printers (including the NEC 5530) for improved quality printing. The ADA1600 has a two foot cable which plugs into the PET IEEE port. Another IEEE card edge connector is provided for connecting disks and other peripherals to the PET. The ADA1600 is addressable and does not tie up the bus. The address is switch selectable. A four foot cable with a standard 36 pin Centronics connector is provided. A switch selects upper/lower case, upper/lower case reversed (needed for some Commodore machines) and upper case only for clearer program listings. Works with WORDPRO, BASIC and other software. No special programming is required. The case measures  $3 1/2 \times 5 3/4$  inches. Comes complete, assembled and tested, with case and cables. Power is obtained from the printer or an external power supply may be used. Retail price for the ADA1600 is \$129.

# ADA1450 • Serial Printer Adapters

The ADA1450 is a low cost, easy to use serial interface for the Commodore Computers. It allows the PET and CBM computers to use standard serial printers for improved quality printing. The ADA1450 has a two foot cable which plugs into the PET IEEE port. Another IEEE card edge connector is provided for connecting disks and other peripherals to the PET. The ADA1450 is addressable and does not tie up the bus. The address is switch selectable. A six foot RS-232 cable is provided with a DB25 connector. Pin 3 is data out. Pins 5,6 and 8 act as ready lines to the printer. Pins 4 and 20 act as ready lines from the printer. These lines can be switched for non-standard printers. Baud rate is selectable to 9600 baud. A switch selects upper/lower case, upper/lower case reversed (needed for some Commodore machines) and upper case only for clearer program listings. Works with WORDPRO, BASIC and other software. No special programming is required. The case measures 3 1/2 x 5 3/4 inches. Comes complete, assembled and tested, with case, cables, power supply and software on cassette for graphing functions, formatting data etc. The ADA1450 has a female DB25 connector at the end of the RS-232 cable for most standard printers. The ADA1450N has a male DB25 at the end of the RS-232 cable for the DIABLO serial printers. Retail price for the ADA1450 or 1450N is \$149.

# ADA730 Parallel • For the Centronics 730 and 737 Printers

The ADA730 is a low cost easy to use interface for the Commodore Computers. It allows the PET and CBM computers to use Centronics type 730 and 737 printers. The ADA730 has a two foot cable which plugs into the PET IEEE port. Another IEEE card edge connector is provided for connecting disks and other peripherals to the PET. The ADA730 is addressable and does not tie up the bus. The address is switch selectable. A cable with a 36 pin card edge connector is provided. A switch selects upper/lower coase, upper/lower case reversed (needed for some Commodore machines) and upper case only for clearer program listings. Works with WORD-PRO, BASIC and other software. No special programming is required. The case measures 3 1/2 x 5 3/4 inches. Compete, assembled and tested, with case and cables. Power is obtained from the printer or an external power supply may be used. Retail price for the ADA is \$129.

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Applesoft

Programs Start

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24576

16384

8192

2048

0



# Resolving Applesoft and Hires Graphics Memory Conflicts

# Jeff Schmoyer

This article will attempt to divulge solutions to memory usage conflicts that can occur when an Applesoft program becomes large enough to start taking up residence in a Hires screen page. Of course the problems only appear when a program utilizing Hires graphics is executed. Throughout this article, numbers will be used in both decimal and hexadecimal (base 16). Hexadecimal numbers are represented with a dollar sign (\$) preceding them, i.e. \$800.

First, it is necessary to understand the memory layout of the region of RAM with which we are concerned. Applesoft programs may reside anywhere in memory from \$800 to \$BFFF in a 48K Apple II. If a disk is being used, the top boundary will be lower, generally \$9600. The top boundary is not really important to this duscussion so it will be referred to as the top of memory. It makes no difference where it is.

The two Hires screens are in fixed positions in memory, the first located from \$2000 to \$3FFF, and the second from \$4000 to \$5FFF. Figure 1 is a map demonstrating what is known so far.

As may be seen in the drawing, if an Applesoft program is confined to the area from \$800 to \$1FFF, there is no conflict. This allows 6K of program space.

Now it's time to introduce another variable, variables! Not only does the program itself take up space, but as variables are allocated in the program, they too have to exist in memory.

String variables are no problem. They allocate space from the top of memory down. Plenty of unused space is available in this region.

Simple variables and numeric and string arrays on the other hand, start at the end of the program



\$0

\$6000

\$4000

\$2000

\$800

Top of memory

and move up through memory. If there are enough of them, they will cruise right into the Hires page. If this happens, whenever the Hires screen is altered by an HGR or some other command, the variables in the screen space will be changed or erased!

Hires Screen

**Hires** Screen

1

Other Apple

Stuff

At this point it can be seen that there is 6K of memory available for the program and simple variables and arrays altogether. Now the space is starting to get tight.

The first solution that comes to mind is simply to switch screens and use the second graphics page instead of Hires page 1. That will free up an additional 8K of memory yielding 4K total.

This is not really a bad way to go except that some Hires features are not fully supported for the second screen, such as the mixed text and graphics mode. For Hires page 2, the four lines of text at the bottom are always filled with garbage. (The lines are not actually full of garbage but that will have to be considered in a future article.) There is also the possibility of needing both Hires screens in the program for animation or some other purpose. So this solution may not be totally acceptable.

One acceptable solution deals solely with the variables. If it can be determined that the program itself does not infringe on the Hires territory, the variables may be dealt with separately. This determination may be made by loading the questionable program, entering HGR, entering TEXT, and then listing the program. (Make sure the program has been saved somewhere first.) If the end of the program is still intact, the program fits in the room available. If it is gone then move directly to the next solution. This one will not do it.

If the program fits and the variables do not, the variables may be easily moved to another region of memory. To do this, as the first line of the Applesoft program enter 0 LOMEN:16384. This line must be executed before any variables are allocated. In this

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way variables are stored above Hires page 1 and out of the way. If both screens usage are required, 0 LOMEN:24576 may be alternately entered to start variable allocation above screen 2. Be sure to check that the additional program line did not extend the program past the Hires boundary.

If the program itself is too large for the available space, it must be moved to a more roomy area of memory, in this case above the Hires pages. There are two page zero locations which control where an Applesoft program starts, \$67 and \$68. By altering these locations and reloading the program, it can be run from the new location. These alterations may be made from the direct mode or by a startup program. As long as Applesoft is not reinitialized the changes will remain in effect.

In reality only location \$68 in page zero need be changed since \$67 will be set to 1 in any case. The necessary poke is POKE 104,96. 104 translates to location \$68, while the 96 in hex is \$60. This is the high order byte of the new program starting address, \$6001. Alternatively POKE 104,64 may be used to locate the program at \$4001. This operation has set up the new address for the program to be loaded and run from. For the programs to execute correctly at the new location, one other poke is necessary. The location preceding the program must be set to zero. This would be \$6000 for the program at \$6001 or \$4000 for the program at \$4001. POKE 24576,0 or POKE 16384,0 respectively will accommodate this change for programs at \$6001 and \$4001.

After the program is moved, a 'dead zone' is left in memory from \$800 to \$1FFF. Neither the program nor any of its variables will use this space. Its best use would be for machine language routines and tables.

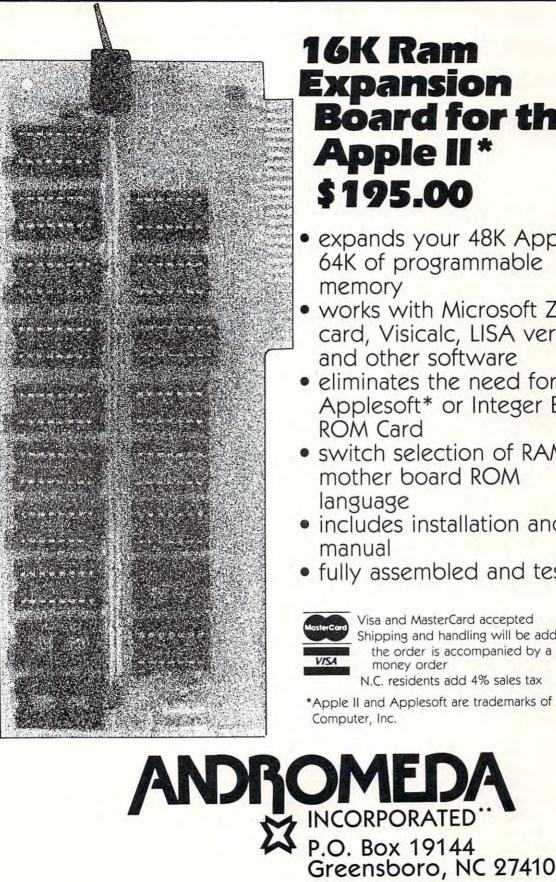
To reiterate, for a program to load and run above Hires page 1, POKE 104,64: POKE 16384,0 is necessary. For a program to load and run above Hires page 2, POKE 104,96: POKE 24576,0 is necessary.

Remember, the program will not actually be moved by this operation. Only programs loaded and run after this point will be above the Hires screen. Also, reinitialization of Applesoft will reset the pointers to \$800. Setting LOMEM as with the previous technique is not necessary and should not be done.

To recap, three techniques to avoid memory conflicts with Applesoft and the Hires screens were outlined. The first is to use Hires page 2 instead of Hires page 1. The second is to move the simple variables and arrays out of the way with the LOMEM command. The third is to change the program start pointers to reset the program load and run point above the Hires pages. There are other ways to accomodate the screens but these few should suffice in most cases.



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# Fill The Screen With Your Message: Generating Large Multi-Colored Characters Using Apple **Low-Resolution Graphics**

REN

Francis A. Harvey Rosann W. Collins Theodore C. Hines School of Education University of North Carolina at Greensboro Greensboro, North Carolina 27412

Programs written by beginning programmers can often be distinguished from more elaborate "commercial" programs by the fact that the commercial programs make such extensive use of color and graphics. Computers such as the Apple and Atari have very good graphics capability, but many users lack the time or programming background, or both, to take full advantage of these capabilities. As a result their programs, while they may be carefully designed and interesting, lack the pizzazz that children expect from computers as a result of their experiences with commercial programs and computer games at home and in game rooms.

As part of a series of utilities of this kind, we have developed a set of subroutines in Applesoft which will display the characters in any string on the screen as large, colorful letters. With these subroutines program instructions, prompts, positive reinforcement, and negative responses to user input can look just like those in "real" computer games. Very little modification of an existing program is required to convert screen output to this form.

Each character is defined (with a combination of PLOT, VLIN, and HLIN commands) on a matrix which uses seven blocks in the vertical dimension and which varies in width depending on the shape of the character. With the character set defined in this way, each line of text can have between six and nine characters, and a total of four lines of text can be displayed. Each letter is approximately one-fifth as

10 -- LETTER MATCH 20 REM -- 10/20/80 VERSION--30 REM . RY -- FRANCIS A. HARVEY -40 REM 50 REM ---- ROSANN H. COLLINS -REM -- & THEODORE C. HINES 60 REM --- COPYRIGHT 1980 65 70 HOME : GR : GOSUE 5020 80 TITLE PAGE REM -90 Y = 3:A\$ = "MATCH": GOSUE 6010 100 Y = Y + 12:A\$ = "THE": GOSUB 6010 110 Y = Y + 12:R\$ = "LETTERS": GOSUB 6010 PRINT : PRINT : PRINT 120 FOR I = 1 TO 1000: NEXT I 130 PRINT "BY FRANCIS A. HARVEY" 141 ROSANN H. COLLINS" THEODORE C. HINES" PRINT " 142 PRINT " 143 FOR I = 1 TO 2500: NEXT I 145 146 PRINT : PRINT : PRINT 160 A\$ = "COPYRIGHT OCTOBER 1980": 60SUB 4020 FOR I = 1 TO 4000: NEXT 170 180 PRINT : PRINT : PRINT : REM -CLEAR TEXT 190 E = 5: REM - FOR DEMO PURPOSES REM :E IS NUMBER OF ATTEMPTS REM ---- USER INSTRUCTIONS-----200 210 220 GR : 60SUB 5020 230 X = 0:Y = 0: REM — RESETS LETTER POSITION 240 A\$ = "I TYPE": GOSUB 6010 250 Y = Y + 12260 A\$ = "A": GOSUB 6010 270 Y = Y + 12:A\$ = "LETTER.": 60SUB 6010 FOR I = 1 TO 5000: NEXT I: GR 280 290 GOSUB 5020  $300 \ Y = 3$ 310 A\$ = "YOU TYPE": GOSUB 6010 320 Y = Y + 9 330 A\$ = "THE SAME" 60SUB 6010 340 345 Y = Y + 9:A\$ = "LETTER.": GOSUB 6000 350 FOR I = 1 TO 4000: NEXT I 360 Y = Y+ 10 370 A\$ = "READY?": GOSUB 6000 380 HOME 390 INPUT "STRIKE 'RETURN' WHEN READY. ";A\$ 400 REM 410 REM ----BEGIN MAIN PROGRAM 420 430 L = RND (1) \* 26 + 1 440 C1 = C1 + 1: REM --COUNTS LETTERS TRIED INT (L) + 64 450 L = 460 Y = 3 470 A\$ = CHR\$ (L): GR : GOSUB 5020: GOSUB 6010 480 HOME 490 PRINT "TYPE THE SAME LETTER." 500 GET B\$ REM --DISABLE RETURN KEY 510 ASC (B\$) = 13 THEN 500 ----DISABLE SPACE BAR IF 520 REM 530 540 TF ASC (B\$) = 32 THEN 500 550 Y = Y + 8 560 A\$ = B\$: GOSUB 6010 FOR K = 1 TO 500: NEXT 570 580 IF B\$ = CHR\$ (L) THEN IF B\$ ( > CHR\$ (L) THEN 60SUB 2010 590 GOSUB 1010:Y = 3: GOTO 500 CHR\$ (L) THEN FOR I = 1 TO 2000: NEXT I IF C1 < E THEN 420 600 610 GR : GOSUB 5000:Y = 3 620 HOME 630 640 A\$ = "THAT'S": GOSUB 6010 650 Y = Y + 12660 A\$ = "ALL": GOSUB 6010 670 Y = Y + 12 680 A\$ = "FOR NOH.": GOSUB 6010

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high as the screen and about oneeighth of a screen wide.

82

Color can be set within the program or randomly selected each time a line of characters is displayed. The upper-left corner of the matrix is defined as (X,Y), and each character is "drawn" from this reference point.

Each line of characters is passed to the subroutine as the string A\$. An initial value of X, the horizontal beginning point of each character, is calculated which will center the characters on the line, and the characters are drawn one at a time.

The subroutines that draw each character automatically increment the value of X the appropriate number of spaces to the right. Messages longer than one line (e.g., "You are sharp!") can be subdivided; the value of the string A\$ is set to the contents of each line, and Y is incremented by at least nine before calling the subroutine which centers and plots the characters.

The sample program listed demonstrates two ways in which these techniques can be used. The program, LETTERMATCH, was developed to familiarize primary school students with the letters of the alphabet and the computer keyboard. A randomly selected letter is displayed on the screen, and the user is asked to type the same letter. The GET command is used for input and all non-letter keys, the RETURN key, and space bar are disabled.

If the student enters the wrong letter, the computer responds with a large "TRY IT AGAIN," then clears the screen of the student's response and redisplays the original letter. The student responds until the correct letter is selected. When the student does enter the correct letter, the computer responds (again, in large, multi-colored letters) with one of five randomly selected positive responses, such as "RIGHT!" or "YOU ARE SHARP!". Each student is asked to identify five letters correctly.

```
690
      FOR I = 1 TO 2000: NEXT I
 700
      GR :
           GOSUB 5000: REM -CLEARS SCREEN
 710 Y = 3
 720 A$ = "NEXT": GOSUB 6000
 730 Y = Y + 12:A$ = "PERSON,": 60SUB 6000
 740 Y = Y + 12:A$ = "PLEASE.":
                                  60SUB 6800
 745
      FOR I = 1 TO 2000: NEXT I
      PRINT
 750
      PRINT "TYPE ":: FLASH : PRINT "S":: NORMAL : PRINT " TO STOP."
 760
      PRINT "STRIKE ANY KEY TO GO ON."
GET Z$: IF Z$ \langle \rangle "S" THEN C1 = 0: GR : GOTO 380
 770
 780
      6R : 60SUB 5000:Y = 3
 790
      HOME
 300
 810 A$ = "OK!": GOSUB 6000
     Y = Y + 12:A$ = "600DBYE"
 820
      GOSUB 6000
 830
 840 Y = Y + 12:A$ = "FOR NOH.": GOSUB 6000
899
      END
      REM
1010
     REM -
              -SUBROUTINE FOR WRONG ANSHERS
1020 Y = Y + 8
1030 A$ = "TRY IT": GOSUB 6010
1040 Y = Y + 8:A$ = "AGAIN.": GOSUB 6010
      FOR I = 1 TO 1500: NEXT I
1050
1060 Y = 11: 60SUB 3000
1070
      RETURN
2000
      REM
              -SUBROUTINE FOR RIGHT ANSHERS
2010
      REM -
     \Psi = \Psi + 12
2020
2030 H = INT ( RND (1) * 5) + 1
      ON H GOTO 2050,2060,2070,2090,2100
2040
2050 A$ = "RIGHT!": GOSUB 6000: RETURN
2960 A$ = "OK!2:60SUB 6010: RETURN
     A$ = "YOU ARE": 60SUB 6010
Y = Y + 8:A$ = "SHARP!": 60SUB 6010: RETURN
2070
2080
2090 A$ = "GREAT!2:GOSUB 6010: RETURN
2100 R$ = "SUPER!": GOSUB 6010: RETURN
      RETURN
2110
      REM -BLANKS REST OF SCREEN
3000
      COLOR= 0
3010
      FOR T = Y TO 39
3020
3030
      HLIN 0,39 AT T
3040
      NEXT
3050
      60SUB 5020
      RETURN
3060
4000
      REM
4010
      REH *****************
4020
      REH
              CENTERS AND PRINTS
              REGULAR TEXT-
4030
      REM
4040
     Z = (40 - LEN (R$)) / 2
4959
      HTAB Z: PRINT AS
4060
      RETURN
5000
      REH
5910
      REM --- PICKS RANDOH COLOR-
5020
5939
      COLOR=
               INT ( RND (1) * 15) + 1
5040
      RETURN
6000
      REM
           ******************
6010
      REM -LARGE PRINT SUBROUTINE
             -AS IS STRING TO-
BE PRINTED -
6020
      REH
6030
      REH
6640
      REM
                CENTERS TEXT
6050
     X =
          ABS (20 -
                     LEN (A$) * 2.5)
6060
      FOR H = 1 TO LEN (A$)
          ASC ( MID$ (A$,H,1)) = 32 THEN X = X + 2: 60T0 6160
MID$ (A$,H,1) = "?" THEN 60SUB 8010: 60T0 5160
5070
      IF
6080
      IF
                                THEN
                                       60SUB 8010: 60TO 6160
          HID$ (A$,H,1) = "!"
6030
      IF
                                       GOSUB 8080: GOTO 6160
                                THEN
6100
      IF
          HID$ (A$,H,1) = ","
                                THEN
                                       60SUB 8130: 60TO 6160
6110
      IF
          HID$ (A$,H,1) = "."
                                THEN
                                       GOSUB 8189:
                                                   GOTO 6160
          HID$ (A$,H,1) = """
6120
      IF
                                THEN
                                       60SUB 8230: 60TO 6160
6125
          HID$ (A$,H,1) = ";"
      IF
                                THEN
                                       GOSUB 3270: GOTO 6160
6130 P =
          ASC ( MID$ (A$,H,1)) - 64
      ON P GOSUB 6200,6270,6350,6420,6490,6560,6620,6700,6750,6810,6860,69
6140
     00,6950,7010,7070,7130,7190,7270,7360,7440,7480,7530,7590,7650,7700,7
     759
6150 X = X + 6
6160
      MEXT
6170
      GOSUB 5020
5180
      RETURN
5200
      REM -
                  PRINTS LETTER A
      PLOT X + 2,Y
6210
      PLOT X + 1, Y + 1: PLOT X + 3, Y + 1
6220
```

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We have found that LET-TERMATCH provides an excellent introduction to computers for quite young children. It can be modified (for example, by considerably shortening the delay loops) for use to introduce other users to computers and to sharpen keyboarding skills of users of any age.

84

LETTERMATCH occupies about 6400 bytes of memory. The subroutines which format and plot the characters (beginning in line 5000) occupy about 3700 bytes. Thus, any Applesoft program which leaves 3700 bytes of memory free when loaded can be modified to give large, multi-colored responses by merging these subroutines with the existing program (using the Apple **RENUMBER** program), making minor changes in the main program (adding GR, selecting colors, etc.), then modifying each PRINT statement to use the subroutine. For example, the line "200 PRINT "VERY GOOD!" would be changed to "200 A\$ .= "VERY GOOD!": GOSUB 6000."

The character set as developed includes the upper case letters A to Z and the question mark, exclamation point, comma, period, single quotation marks, and semicolon. The set could easily be expanded to include lower case letters, numerals, and other punctuation. The program randomly selects the color of each line of characters.

Copies of LETTERMATCH on diskette or cassette are available from the authors at the above address for the cost of duplication. While we reserve all commercial rights to these programs, we offer them free to any user for any noncommercial educational purpose. Other utilities of this kind which we have developed include routines for adding sound effects and music to programs, additional graphics (such as screen borders), and others. These will appear in later issues of **COMPUTE!** We hope that teachers and other computer users will find these procedures a useful addition to their program collection.

7030

7949

ULIN Y,Y + 6 AT X + 4

```
6230
      ULIN Y + 2,Y + 6 AT X + 4
      HLIN X, X + 4 AT Y + 4
ULIN Y + 2, Y + 6 AT X
6240
6250
6260
       RETURN
6270
      REM -
                PRINTS B
       ULIN Y.Y + 6 AT
6280
6290
      HLIN X,X +
                   2 AT
       HLIN X, X + 2 AT Y + 3
HLIN X, X + 2 AT Y + 6
ULIN Y + 1, Y + 2 AT X + 3
6300
6310
6320
      ULIN Y + 4, Y + 5 AT X + 3
IF X > 0 THEN X = X - 1: RETURN
6330
6340
6350
       REM -
                 PRINTS
                         £
       ULIN Y.Y + 6 AT
6360
6370
       HLIN X.X +
                   3 AT
                         Y
       HLIN X.X + 3 AT Y
6380
      PLOT X +
                 3,4 +
6390
6400
       PLOT X + 3, Y + 5
6410
     X = X - 1: RETURN
6420
       REM
                 PRINTS D
       ULIN Y,Y + 6 AT X
ULIN Y + 1,Y + 5 AT X + 3
6430
6440
       HLIN X,X + 2 AT Y
HLIN X,X + 2 AT Y
6450
6460
                           + 6
6470
     X = X
               1: RETURN
6480
       PRINT "1799": END
6490
                    -PRINTS E
       REH -
       ULIN Y,Y + 6 AT
6500
       HLIN X,X + 3 AT Y
6510
       HLIN X.X + 2 AT Y +
6520
                              3
       HLIN X.X + 3 AT Y + 6
6530
6540
      X = X
               1
6550
       RETURN
                    PRINTS F
6560
       RFH
       VLIN Y,Y + 6 AT X
6570
       HLIN X.X + 3 AT Y
6580
6590
       HLIN X,X + 2 AT Y + 3
      X = X -
6600
               1
       RETURN
6610
6620
                       PRINTS 6
       REH
       VLIN Y,Y + 6 AT X
6630
       HLIN X.X + 3 AT Y + 6
6640
6650
       HLIN X.X + 3 AT Y
       PLOT X + 3, Y + 5: PLOT X + 3, Y + 4
6669
       PLOT X + 2, Y +
                        4
6670
6680
      X = X
               1
6690
       RETURN
                       PRINTS H
6700
       REM
       ULIN Y,Y + 6 AT X
6710
       ULIN Y,Y + 6 AT X +
6720
                              3
       HLIN X,X + 3 AT Y + 3
6730
6740
      X = X - 1: RETURN
6750
                          PRINT I
       REH
6760
       HLIN X.X + 2 AT Y
       HLIN X,X + 2 AT Y + 6
ULIN Y,Y + 6 AT X + 1
6770
6780
6790
      X = X -
6800
       RETURN
6810
                    PRINTS J
       REH
       HLIN X.X + 4 AT Y
ULIN Y.Y + 5 AT X + 3
6820
6830
       PLOT X, Y + 5: HLIN X + 1, X + 2 AT Y + 6
6840
6850
       RETURN
6860
       REH
                          PRINTS K
       ULIN Y,Y + 6 AT X
6870
       PLOT X + 3, Y + 1: PLOT X + 2, Y + 2: PLOT X + 1, Y + 3: PLOT X + 1, Y +
6880
      4: PLOT X + 2, Y + 5: PLOT X + 3, Y + 6
6890
      X = X - 1: RETURN
6990
       REM -
                           PRINTS L
       ULIN Y.Y + 6 AT X
6910
       HLIN X.X + 3 AT Y + 6
6920
      X = X - 1: RETURN
6930
6940
       RETURN
6950
       RFH
                           PRINTS M
       ULIN Y,Y + 6 AT X
6960
       ULIN Y.Y + 6 AT X + 4
6970
6980
       PLOT X + 1, Y + 1: PLOT X + 3, Y + 1
6990
       PLOT X + 2, Y + 2
7000
       RETURN
7010
                           PRINTS N
       REH
       ULIN Y,Y + 6 AT X
7020
```

PLOT X + 1,Y + 1: PLOT X + 2,Y + 2: PLOT X + 2,Y + 3: PLOT X + 3,Y +

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Since Will Crowther and Don Woods created it years ago, ADVENTURE has been programmed to run on nearly every computer known to man. The original Fortran version ran on a large PDP machine requiring nearly 300K of storage. At least three other versions of ADVENTURE exist for the APPLE. Some claim to be the only complete version; some claim to fill whole disks with program and data. All, however, require diskette access during the game to retrieve text for display on nearly every command. All added "features" of their own, changed some of the original text, or omitted something from the original.

In this version of ADVENTURE you get nothing but the real thing. NOTHING has been added or left out. By using a text compression technique seldom used on microcomputers, the nearly 44K bytes of text fit in less than 25K. This means no disk access is needed during the game and that it can be played on 48K systems without disk drives. Both tape and Disk versions are identical, only the media is different. The tape version includes instructions for making a disk copy. All versions work with either 3.2 or 3.3 APPLE disks and APPLE 2 or APPLE 2 Plus machines.



7060 F	PLOT X + 3,Y + 5 RETURN REMPRINTS 0	Computer House Division	-
7080 \ 7090   7100   7110 \ 7120 \ 7130   7140 \ 7150   7150   7150   7170   7170   7180 \ 7190   7200   7210   7220   7230	$\begin{array}{l} \begin{array}{l} \begin{array}{l} \begin{array}{l} \begin{array}{l} \begin{array}{l} \begin{array}{l} \begin{array}{l} $	Legal accounting Program99Machine Part Quote Demo1Machine Part Quote Program32Mailing/phone list8Political Mail/phone list13Beams, structural11Trig/Circle Tangent11Spur Gears3Bolt Circles2Filament Wound TAnks12	DLE           5.00           5.00           5.00           5.00           5.00           5.00           5.00           5.00           5.00           5.00           5.00           5.00           5.00           5.00           5.00           5.00           5.00           5.00
7240 1 7250 1 7250 1 7250 1 7250 1 7250 1 7290 1 7390 1 7390 1 7390 1 7390 1 7390 1 7390 7 7390 7 7390 7 7390 7 7390 7 7390 7 7400 7 7500 7 7600 7 7500 7 75	PLOT X + 3, Y + 5: PLOT X + 2, Y + 4 PLOT X + 2, Y + 4 RETURN RETURN REM —PRINTS R JLIN Y, Y + 6 AT X HLIN X, X + 3 AT Y + 3 ALIN Y, Y + 3 AT Y + 4 PLOT X + 1, Y + 4: PLOT X + 2, Y + 5 PLOT X + 1, Y + 4: PLOT X + 2, Y + 5 PLOT X + 3, Y + 6 IF X > 1 THEN X = X - 1 RETURN REMPRINTS S HLIN X, X + 3 AT Y + 6 HLIN X, X + 3 AT Y + 6 HLIN X, X + 3 AT Y + 7 JLIN Y, Y + 3 AT X JLIN Y, Y + 3 AT X JLIN Y, Y + 6 AT X + 3 = X - 1 RETURN REMPRINTS U JLIN Y, Y + 6 AT X + 2 HLIN X, X + 3 AT Y + 6 = X - 1: RETURN REMPRINTS U JLIN Y, Y + 3 AT X JLIN Y, Y + 3 AT X JLIN Y, Y + 3 AT X + 4 HLIN X, X + 3 AT Y + 6 = X - 1: RETURN REMPRINTS U JLIN Y, Y + 5 AT X + 1: ULIN Y + 4, Y + 5 AT X + 3 PLOT X + 2, Y + 6 RETURN REMPRINTS H JLIN Y, Y + 5 AT X + 4 PLOT X + 1, Y + 6; PLOT X + 3, Y + 6 VLIN Y, Y + 5 AT X + 4 JLIN Y, Y + 5	PROGRAMS FOR COMMODORE ONLY         A/P, A/R, Job Cost & Job Est.       37         Inventory       9         Financial       17         Real Estate Listings       26         Check Writer       27         File Editing Tools (FET)       6         Screen Dump/Repeat       33         Docu-Print       22         Sof-Bkup       44         Sorter (Mach. Language)       33         Trace-Print       22         ASK FOR CATALOG #80-C2 Dealers Ward         Computer House Div.       1407 Clinton R         Jackson, Michigan       49202         (517)       782-2132	0.00 5.00 5.00 5.00 5.00 5.00 5.00 5.00
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# Decrementing The For... Next & Endless Loops

# Derek Kelly

Scrolling text *backward* in a RUNning program can be programmed almost as easily as scrolling text forward. Scrolling text forward can be easily accomplished, as can be seen in the program in figure 1: 10 For I = 1 to 20

20 Print A\$(I)

30 Get G\$

40 Next I.

The GET command in Applesoft BASIC allows a pause-until-any-key-is-hit way for a user to control the progress of a program. Here, after every string printed (A(1), a pause is inserted. After each pause, the printing of strings will proceed in a sequential manner, incrementing the counter for 'I' by 1 each time. This is forward scrolling.

But what if you want to go backward? Suppose you want the previous string by a count of 1, 2, to the first printed string? Can you go backward? The answer is Yes, and it's simple to accomplish. But like the various problems associated with For...Next loops generally, if not properly constructed, e.g., with no GOTO's that branch away totally from the loop, is that For...Next loops can involve endless loops, whether such loops run forward or backward.

In any well-constructed rogram module, there should be only one point of entrance to that module, and only one real exit. Some programmers who use GOTO, and related statements, have been known to construct programs where *under normal use* the program will "hang" somewhere, a somewhere often caused by a GOTO or a number of GOTO's which send the program around in circles. For example, consider programs A and B below. A has one entrance and exit, B has many:

10 GOSUB 100

100 For I = 1 to 230: Print "!";: GOSUB 5 110 GOSUB 200: GOSUB 300 120 NEXT I 130 RETURN Program A

```
10 For I = 1 to 33

20 If I = Int(I/11) Then GOTO 101

30 GET G$: If G$ = "?" Then GOTO

163

.

.

163 Print " = ": GOTO 194

101 For J = 1 To 3: If I = J

Then GOTO 121: Next J

102 GOTO 30

Program B
```

Program A is called by a GOSUB from line 10. Program A does one set of functions in the program as a whole. When called, it does what it's supposed to, and then returns. Program B, on the other hand, GOTO's all over the place, and one can't predict that any one GOTO will even find its way back to the place that started the GOingTO process. Under normal conditions, and presupposing that the GOSUBs called by Program A are well-constructed, then we can reasonably predict that program A will not cause an endless loop, while Program B most certainly *may* contain an endless loop or two that will "hang" your computer.

The two short programs above affect the forward running of For...Next loops. If a user desires to decrement rather than increment a For...Next loop so as to reverse the order of a printout, and be able to review previously printed items, then other endless loop possibilities arise.

Take Program A as an example. I might want to add a pause to the program, so I add III Get G\$: If G\$ = ''?'' Then GOTO 130. This GOTO is OK because it takes place *within* the routine.

Now I want to add a provision to reverse the loop. Since the "NEXT I" statement increments a counter by 1 (or whatever), to reverse print, I must subtract 2 from the I counter to get the next previous record. So my program now looks like PROGRAM C:

100 For I = 1 to 230: Print "!";: GOSUB 5 110 GOSUB200 : GOSUB300) 111 Get G\$: If G\$ = "-" Then I = I-2 120 NEXT I 130 RETURN Program C

As soon as Program C is RUN, you will see that it decrements to 1 then to -1 and so on. You don't want negative numbers, so another line of code will have to be added. In addition, when the counter gets to '-1', the computer — at least my APPLE hangs and prints out a steady, unstoppable — except by RESET, stream of 1's...1.1.1.1.1.1.1.1. This problem can be avoided by changing line 111 to read:

111 Get G\$: IF G\$ = "-" Then I = I-2: If

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 $I \le 0$  Then I = 0 If I = 0 or less than zero, then the first item will be printed, as I will = 0 *before* the execution of the NEXT which will increment I by 1 (or more) to 1.

The simple program C, if improved to include the line 111 above, will be able to process the forward and backward scrolling in any program in which it is called.

In general, there is no formula that can guarantee that a program has no endless loops. It is always possible for some bug such as an endless loop to exist under certain conditions in any program. Since you can't be sure about the absence of bugs, you have to make do with the presence of controls to limit the possibility of harmful bugs.



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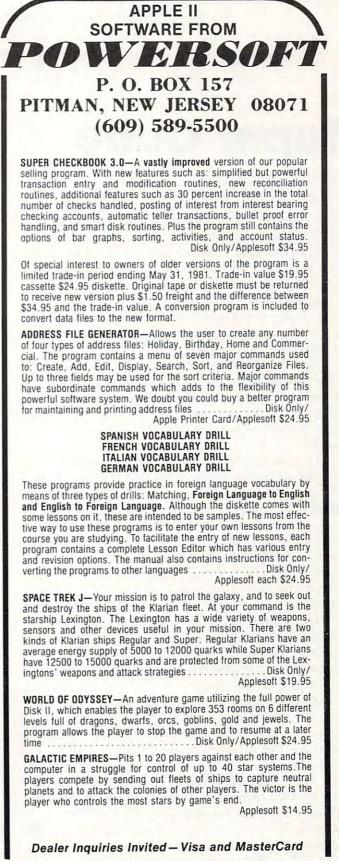
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If you own an Atari and like to fiddle with graphics you're going to love this one. It's a program that allows you to draw cubes in different sizes and colors and also to use the cube itself as a cursor to make three dimensional bars, columns, and drawings reminiscent of the works of Escher. It can create some of the most impressive graphics displays you've yet seen on your monitor, and, to crow just a bit, it *can't* be done on an Apple.

Now, after all that buildup, a bit of mea culpa. While this program proves that a relative novice (never touched a computer until I bought my Atari last year) can make things happen on a home computer, the program is really nothing more than a synthesis of other people's work.

It all began when I started fooling around with the brilliant little program by David D. Thornburg that appeared in the May/June 1980 issue of **COM-PUTE!** Mr. Thornburg's program enables you to draw a shaded three dimensional cube and change the colors by use of the keyboard. While playing with that one, Ray Daly of the Program Store in Washington, D.C., was kind enough to give me a program he wrote that puts a cursor on the screen and allows you to draw with a joystick. My question: why not change Ray's PLOT X,Y to GOSUB to a subroutine that will draw with a cube instead of with a point? My solution, with a few minor embellishments: to take David Thornburg's DRAW sequence and do just that.

Sound simple? It was, almost unbelievably so. Since then, I've been having a ball creating skyscrapers, harbors, cubist drawings and the like, and while I plead guilty to the charge of total plagiarism, it would be a shame not to share my fun with other Atari owners. Sorry, I can't tell you exactly how Ray's program works. I never really had to know. I can tell you that lines 600 to 670 set up the colors for the cube (sorry about that too, you can only get about 90 different color combinations!). Lines 720 to 830 are the cube drawing itself, with the input variable SQ setting the size. As far as the joystick commands are concerned, check them out in Atari's Basic Reference Manual; it's fairly easy to figure out what they do. Now, for operating the program. The first thing the computer will ask you for is a dimension for the cube. Actually, you can enter numbers as large as 40 to 45, but this will cause problems if the cube or your drawing run off the screen, so until you've had a little practice, stick to dimension sizes between 1 and 10. Once you've entered your cube dimension, press RETURN and your Atari will go to the Graphics 7 mode.

The cursor is in the upper left hand corner of the screen. It may be a little difficult to see if you have a dark initial color, but you can change the display colors at any time by pushing the joystick button when the cursor is anywhere at the far left of the screen.

Next, using your joystick, move the cursor to wherever you want to begin your work of art and push the joystick button. Voila, a cube!

Whenever you let go of the joystick button, the cursor returns to the upper left hand corner of the screen. This keeps it out of the way of your drawing, since the cursor draws an erase line as it moves along. If you want to draw a bar or a column, or draw diagonally, hold the joystick button down while moving the cursor.

When you want to draw with a different sized cube, move the cursor to the bottom of the screen and press the joystick button. In the text window at the bottom of the screen, you'll be asked for a new dimension for the cube. Enter it, hit RETURN, and the cursor goes back to the upper left hand corner.

Certain three dimensional effects require that you go over what you have drawn. For example, to make a square shaped "O": Give yourself a cube dimension of, say, 6. Start somewhere near the center of the screen. Go up, straight up, about ten increments, across to the right another ten, down ten, and then draw carefully to the left, stopping when the left hand side of the drawing is just joined. Now, go back across to the right, stopping at the end of your original bottom bar line, and draw back up to the top.

Again, any time you want to change colors (it's more fun when whatever you're drawing is complete) either release the joystick button so that the cursor goes back to the upper left hand corner or just move the cursor to the far left of the screen and press the joystick button. Every now and then when you change colors, a cube will appear at the far left. If anyone figures out why this happens, please let me know.

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This program is on the border line between 8K and 16K, so if you have only an 8K computer you will probably want to pack some of the program lines together, and eliminate the first two print statements. I've checked it out with only 8K in my Atari, and I can assure you it will work.

The program also provides a dramatic demonstration of how much memory graphics require. Try this: load the program, type RUN, then BREAK, and then PRINT FRE(0) and RETURN, which will tell you how much memory you have left. Now RUN the program again, enter an initial cube dimension, and when the program goes to Graphics Mode 7, type BREAK and then PRINT FRE(0), and RETURN again. Where did it all go?

One final note: As I've mentioned, I'm a novice at all this and Super Cube could certainly use some additional improvement. For example, how about using a second joystick to draw pyramids?

Or controlling the colors with the keyboard instead of making them random? I'd be pleased to hear from anyone who has any further ideas to offer. In the meantime, Picasso! Move over! A new generation of cubists is about to begin work! Editor's Note: As you update Steve's program, send in your enhancements and we'll keep you posted. RCL

10 ? ")":POSETION 10,5:? "3-D DRAWING":? :? :? "PRESS JOYSTICK BUTTON TO DRAW" 20 PRINT :PRINT :PRINT "TO CHANGE CUBE D IMENSION MOVE CURSOR TO BOTTOM OF SCREE N AND PRESS BUTTON" 30 ? :? :? "ENTER CUBE DIMENSION, THEN H IT RETURN:(Note: Dimensions larger than 10 may cause Errors)":INPUT SQ 40 GRAPHICS 7

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50 PRINT "TO CHANGE COLORS PRESS BUTTON WHEN CURSOR IS AT EXTREME LEFT OF SCR EEH" 70 GOSUB 600 80 IF STRIG(0)<>0 THEN GOSUB 500:GOTO 14 Û 90 IF Y>75 THEN PRINT "ENTER NEW DIMENSI ON FOR CUBE"; : INPUT SQ: X=0: Y=0 120 POKE 77,0 130 IF STRIG(0)=0 THEN GOSUB 700 140 GOSUB 1000 150 X=X+XDIF : Y=Y+YDIF 200 IF X>143 THEN X=143:GOTO 300 210 IF Y>80 THEN Y=80:GOTO 300 300 IF XK0 THEN X=0:GOTO 400 310 IF YK7 THEN Y=7 400 GOTO 80 500 COLOR 1: PLOT X, Y: FOR I=1 TO 5: NEXT I :COLOR 4:PLOT X, Y:RETURN 600 A=INT(RND(1)%15)+1 610 B=INT(RND(1)\*14)+2 620 IF BK4 THEN B=10 630 SETCOLOR 1, A, B 640 SETCOLOR 2, A, B-2 650 SETCOLOR 0, A, B-4 660 IF X<10 THEN GOTO 120 670 RETURN 700 IF X=0 THEN IF STRIG(0)=0 THEN GOSUB 600 710 TRAP 80 720 COLOR 1 730 FOR I=0 TO SQ 740 PLOT X,Y+I:DRAWTO X+SQ,Y+I 750 NEXT I 760 COLOR 2 770 FOR I=1 TO INT(3\*S0)/5 780 PLOT X+I, Y-I:DRAWTO X+I+SQ, Y-I 790 NEXT I 800 COLOR 3 810 FOR I=1 TO INT(3\*SQ)/5 820 PLOT X+SQ+I, Y-I:DRAWTO X+SQ+I, Y+SQ-I +1 830 NEXT I 840 IF STRIG(0)<>0 THEN X=0:Y=0 850 RETURN 1000 WHAT=STICK(0):XDIF=0:YDIF=0 1100 IF WHAT=15 THEN RETURN 1110 IF WHAT=14 THEN YDIF=-1: RETURN 1120 IF WHAT=13 THEN YDIF=1:RETURN 1130 IF WHAT=11 THEN XDIF=-1: RETURN 1140 IF WHAT=10 THEN XDIF=-1:YDIF=-1:RET URH 1150 IF WHAT=9 THEN YDIF=1:XDIF=-1:RETUR N 1160 IF WHAT=7 THEN XDIF=1:RETURN 1170 IF WHAT=6 THEN YDIF=-1:XDIF=1:RETUR N 1180 IF WHAT=5 THEN XDIF=1:YDIF=1:RETURN @

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# **Printing Characters In Mixed Atari Graphics** Modes

# Craig Patchett 2 Swan Terrace Greenwich, CT 06830

For those of you who have been anxiously awaiting this appendum, I apologize. Time conflicts and the discovery of redefinable character sets have prohibited me (until now, of course) from writing it. For those of you who haven't, get hold of the Sept/Oct 1980 issue of COMPUTE! and read up on "Designing Your Own Atari Graphics Modes." This article won't be of much use to you until you do.

The problem, if you recall, is with printing characters on mode lines that are out of the usual range of that mode. For example, if we design a graphics mode such that the thirtieth line is mode two, we would get an error message if we attempted to print on that line. This is because the Atari thinks it is in the regular mode two, which only allows twelve lines of characters. We must therefore find another way to put the characters on the screen.

As you may already realize, the screen is just a type of window looking into a part of memory. If you change that memory, what you see on the screen also changes. The solution, therefore, is just to POKE the characters into the memory locations that correspond to the positions on the screen where we want them to appear.

# Where is the screen in memory?

We already know where the display list is in memory; we used the variable BEGIN to point to it last time:

## BEGIN = PEEK(560) + PEEK(561)\*256 + 4

But, you may well ask, what does this have to do with the screen memory, or display memory as we will call it here? It just so happens that the first two memory locations in the display list point to the beginning of display memory in the following fashion:

# DISMEN = PEEK(BEGIN) + PEEK(BEGIN + 1)\*256

If you recall, we never used the first two memory locations in the display list last time; now you know why.

# How do we calculate the exact memory locations to POKE into?

COMPUTE!

Each mode line used up a certain amount of memory. As you might guess, different modes use different amounts of memory per line. To be more exact:

MODE	0	1	2	3	4	5	6	7	8	
MEM/LINE	40	20	20	10	10	20	20	40	40	

So all we have to do is figure out how much memory is used before the mode line that we want to print on, and add that to DISMEM to determine where we want to start POKEing. As an example of how to do this, let's suppose we have a gaphics mode with four lines of mode 1, fifty lines of mode seven, three lines of mode four, and three lines of mode two (4X8 + 50X2 + 3X4 + 3X16 =

32 + 100 + 12 + 48 = 192; and we want to print on the second line of mode two. Checking the table above, we go:

4 lines of mode $1 = 4X20 =$	80	
50 lines of mode $7 = 50X40 =$	2000	
3  lines of mode  4 = 3X10 =	30	
1 line of mode $2 = 1X20 =$	20	(rer
		cou
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member, we only int the lines above one we want to print on)

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Therefore, memory location DISMEM + 2130 represents the first character in the second line of mode 2 *for this particular mode*. Memory location DISMEM + 2131 represents the second character, and so on up to DISMEM + 2149 for the twentieth character.

We know that POKEing the appropriate value into the appropriate location will cause the desired character to appear at the desired screen location. Since we already know how to determine the appropriate memory location, we now ask:

# How do I calculate the appropriate value for a character?

It turns out that the value to poke for a given character corresponds to the order in which the character descriptions are stored in ROM (see "Designing Your Own Atari Character Sets" in the March 1981 issue of COMPUTE!). As a quick memory refresher:

ATASCII VALUE	VALUE TO POKE	
0-31	64-95	
32-95	0-63	
96-127	96-127	

For reverse characters, just add 128 to the value of the normal character.

# My brain is in hibernation; how do I convert a character string to its appropriate values?

I'll leave you with the folowing self-explanatory subroutine that will take the (predefined) character string PRNTME\$ and the starting memory location STARTHERE (also predefined and equal to DISMEM + offset) and POKE PRNTME\$ into the appropriate (love that word!) memory locations. Enjoy!

30000 REM /\*This loop will act on each c haracter in PRINTME\$\*/ 30010 FOR ME=1 TO LEN(PRNTME\$) 30020 REM /\*Find ATASCII value of charac ter\*/ 30030 VALUE=ASC(PRNTME\$(ME.ME)) 30040 REM /\*Subtract 128 temporarily if it's a reverse character\*/ 30050 VALUE=VALUE=128\*(VALUE)127):REM /\* see note below\*/ 30060 REM /\*Make the appropriate value a djustments\*/

30070 VALUE=VALUE+64%(VALUE(32)-32%(VALU E)31 AND VALUE(96)

30080 REM /%Convert back to reverse if n ecessary%/

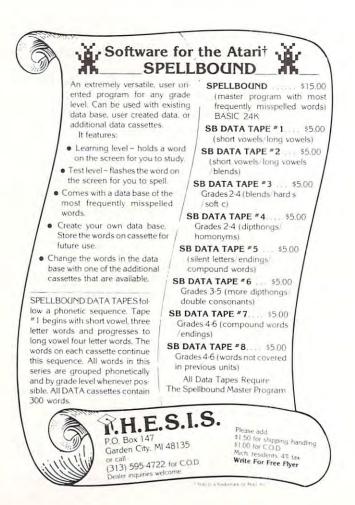
30090 VALUE=VALUE+128\*(ASC(PRNTME\$(ME)ME )))127) 30100 POKE STARTHERE+ME-1.VALUE:REM /%re member, ME starts at 0, not 1%/ 30110 ? VALUE 30120 REM /%Go to next character%/ 30130 NEXT ME 30140 REM /%All done, say soodbye%/ 30150 RETURN

Note that (condition) equals 1 if the condition is true,  $\emptyset$  if it's not. Thus, X = 126:PRINT (X = 126) :PRINT (X = 127) will print a 1 followed by a  $\emptyset$ .

# SPECIAL CORRECTION NOTE

The original article, "Designing Your Own Atari Graphics Modes," was incorrect in that the graphics mode you use initially should be a full screen mode. In other words, if graphics mode six is the mode that uses the most memory out of the modes you will be mixing, you should use GRAPHICS 22, not GRAPHICS 6 (just add 16 to the mode number). In the example used in the article, line 10 should read: 10 GRAPHICS 17 and not 10 GRAPHICS 1

My apologies for any problems caused by this mistake.





# Invaders From Outer Space An Atari Program Using One Joystick

David H. Markley Reynoldsburg, Ohio

This program is a simplified version of an earlier program I wrote called "Alien Landers" and is designed to run in 8K of memory. The object of the game described here, is to protect your galactic base from an invasion of allien saucers of unknown origin. Your weapon against the alien saucer is a sophisticated photon cannon which you control by a joystick connected to controller port #1. The saucer on the other hand, is equipped with a mysterious paralyzing death ray which when energized, will immobilize and possibly vaporize your photon cannon. The game is played by defending your base against the saucers and achieving the highest score possible before your 3 photon cannons are destroyed. The program keeps track of the highest score obtained during any individual game and displays the final game score and the high game score at the end of each battle. After starting the game using the RUN command, additional battles are initiated by holding the start button down until the new game begins.

This program utilizes many of the fine features of the ATARI personal computer, such as the exciting sound effects and the advanced player/missile graphics. The player/missile graphics are used to enable the program to provide good animation without the overhead of saving and restoring the background as the player or missile image moves through the playfield. Another ATARI feature used here is the player/missile collision registers. These registers are associated with the ATARI's graphics and indicate when a player or missile overlaps with another player, missile, or playfield image.

The program from line 30 thru line 600 provides background setup and player/missile initialization. Initialization begins by allocating space for the player/missile image buffers. The buffers are placed in a free area of memory just below the graphics memory with the base address located 2048 bytes (8 pages) from the top of memory. This leaves the top 1K of memory for the graphics 2 display list and mapping data.

The functional player/missile (P/M) graphics area begins with the missile image buffer. Since the program uses the double resolution mode of P/M graphics, the missile image buffer begins 384 bytes from the base address and is followed by four player image buffers. Each buffer occupies 128 bytes of memory. Invaders from Outer Space uses only two of the four available players which are in the form of a saucer (player 1) and a photon cannon (player 2). The images of the saucer and cannon are formed by placing a bit pattern of the shapes into their corresponding player image buffers.

COMPUTE!

Lines 600 and 700 initialize the game's counters and registers. The high game score counter initialized by line 600 is used to keep track of the highest score obtained for all games played during any program run. This counter is only initialized one time. Registers and counters which are initialized every time a new game is played are all located at line 700.

With the playfield and players enabled and the games counters and registers initialized, the program is ready to begin antimating the graphics by entering the game's antimation sequencer loop (lines 1000 thru 2000). This section of the program is used to control the movement of the saucer, cannon, and photon. It also determines when to fire the saucer's death ray and checks for P/M collisions.

The sequencer loop begins by determining the saucer's horizontal position in relation to the play field. Normally the saucer will travel across the field in a left to right direction in steps of 5 horizontal increments. If the saucer is within the range of fire of the cannon however, and is currently under attack (M>0) the saucer will take evasive action by moving randomly within a short distance of either side of its current position. With the position of the saucer determined, the sequencer's next task is to produce the saucer's sound effect. This effect is created by stepping through a series of six frequencies in which the frequency is changed one step for each loop cycle. Once the saucer has been placed in its new position, a test is made to see if it is in attack range of the cannon. If the test (line 1060) indicates that the saucer is within 15 increments of the cannon, the program will go to the death ray handler (line 3100).

The next sequencer task to be handled is the control of the cannon and its associated photon missile (lines 1100 thru 1220). The program begins by checking to see if the photon is ready to be fired. If it is ready to fire or has reached the top of the playfield (M < J + 8), its sound is turned off and the joystick trigger is examined. If the trigger is not pressed, the program will continue through the sequencer loop and will examine the trigger is finally pressed, the M pointer will be set to an address of the missile image buffer which corresponds to a vertical position directly above the cannon's muzzle.

The horizontal position of the photon is handled by calculating the horizontal position of the cannon's center and placing it into the cannon's horizontal positioning missile register. Line 1110 controls the

movement of a photon which is enroute to its target. To move an object vertically using the P/M graphics, the image is first removed from its current position within the image buffer and then rewritten into its new location. The P/M graphics function in such a way that as the base address of the image data is moved to a lower numbered address in the buffer, the image will appear to move upward on the screen. After each photon movement, the player/missile collision register is checked to see if the saucer has been hit. When a hit is detected the program exits the sequencer loop and goes to the routine at line 3000 to handle the collision. If the saucer is not hit the sequencer loop enters the code which handles cannon movement. When the joystick is moved to the left or right the cannon is shifted 5 increments to the left or right of its current position each pass through the loop. With the completion of this code, the sequence loop is now ready for the next pass.

The routine starting at line 3000 is used to control hits on the saucer. It begins by removing the photon from the playfield by clearing the first 29 bytes of the missile image buffer. This area represents the area on the playfield in which the photon can collide with the saucer. When the buffer has been cleared, the missile position pointer M is reset to zero as an indication that it is ready to be fired again. To help produce the effect of more than one saucer, the saucer's color is randomly changed each time it is hit. Finally the score is updated and the background flag (BK) is set to indicate an above ground explosion. The program then goes to the explosion handler routine (line 4000).

The routine starting at location 3100 is used to generate the saucer's death ray. It begins by positioning the ray at the center of the saucer. This is done by calculating the center of the saucer and placing this position into the ray's horizontal position missile register. The sound and visual effects are handled by lines 3120 thru 3140. The ray is first drawn by setting bits 0 and 1 for every third byte in the missile image buffer. It is then erased by again accessing every third byte and clearing bits 0 and 1 to zero. As the ray is removed, the frequency of its associated sound generator is decreased. Upon completing the death ray, the program examines the P/M collision register corresponding to the ray missile and the cannon player. If the collision took place, an explosion effect is produced by moving the cannon to a position off the playfield and setting the explosion back ground flag for the bottom text window before calling the explosion handler at line 4000.

The explosion handler is used to produce the explosion effect for both the saucer and the cannon. To begin, the explosion handler resets the P/M collision registers. The collision registers are designed to be latching and must be reset each time a collision has been registered. After terminating the sound of the photon which may have caused the explosion, the program begins to produce the visual and audio effects of the explosion. This is done by stepping the variable X from 14 to 0 and using its value to control the intensity of the color and sound. The background which is determined by BK was selected by the calling program before the explosion handler was entered. When the explosion is complete, the playfield colors are returned to their normal hue.

When the explosion effect is complete, the program is ready to display the cannon number or score. Since the program displays all messages at the top of the screen using graphics 2, the saucer must be removed from the screen by setting its P/M color registers to zero. The saucer's original color is stored in X and will be again restored at the completion of the message display cycle. After a short delay while the message is being displayed, a test is made to determine if the last cannon has been hit. If not, the message is removed and the background is restored and the game continues. When the game is finally completed, the score is compared to the high game score. If the score resulting from the last game is higher, the high game score is updated. The program indicates the end of the game by alternately displaying the last game and high game scores. After each display of the high game score the start switch is examined to see if a new game is requested.

10 REM INVADERS FROM OUTER SPACE 15 REM COPYRIGHT (c) 1980 20 REM BY DAVID H. MARKLEY Print title 25 GRAPHICS 2 30 PRINT #6;" INVADERS" 35 PRINT #6;" FROM" 40 PRINT #6;" OUTER SPACE" Start player/missile data list 2K from top of memory. Place in P/M base register and calculate beginning address of the player data lists. 50 I=PEEK(106)-8:POKE 54279, I 60 J=I\*256+384 Clear P/M buffer area 70 FOR X=J TO J+384 80 POKE X.0 90 NEXT X Generate play field 100 GRAPHICS 2 110 SETCOLOR 2,11,6 120 COLOR 3 130 FOKE 84,0:POKE 85,4:? #6;"." 11 140 POKE 84,5:POKE 85,2:? #6; \*\* 150 POKE 84,3:POKE 85,8:? #6; ".", "." 160 POKE 84,7:POKE 85,14:? #6;" Enable player/missile DMA for double line resolution.

200 POKE 559,46

Place saucer image data into first player's image buffer area and set its color to green (200). Set the saucer's initial horizontal position to 70.