A Buyer's Guide To Commodore 64 Languages

COMPUTE!'s GAZETTE

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January 1986
Issue 31, Vol. 4, No. 1
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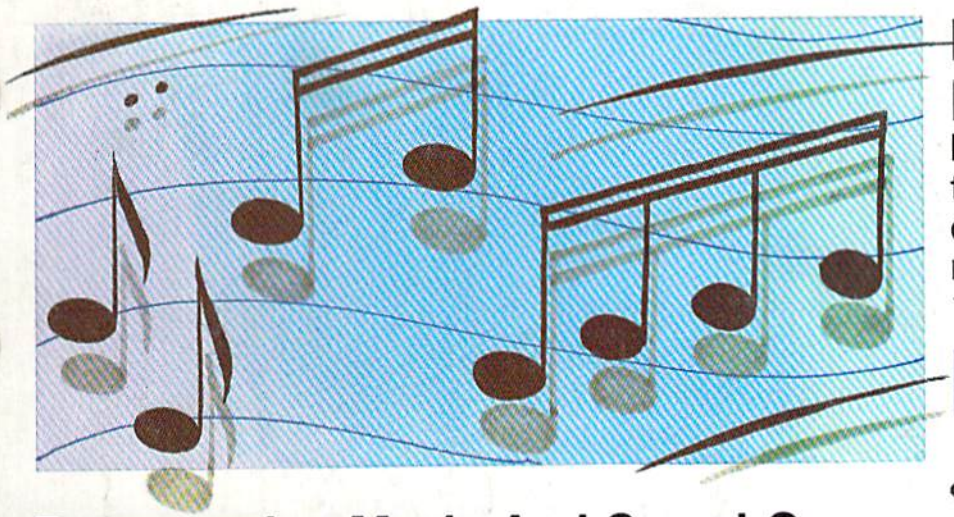
FOR **COMMODORE** PERSONAL COMPUTER USERS

Sprint

Complete Inside: A BASIC compiler that can make your Commodore 64 programs run up to 50 times faster!



Power BASIC: Print Maker

Design your own screen, then this program will convert it to a BASIC subroutine. For the 64, Plus/4, 16, and VIC.

Programming Music And Sound On The Commodore 128

With the powerful BASIC commands of the 128, making music is easier than ever.

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An efficient machine language assembler for the 64.

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Horizons:
Another Look At C

Disk Disassembler

Software Reviews

And More

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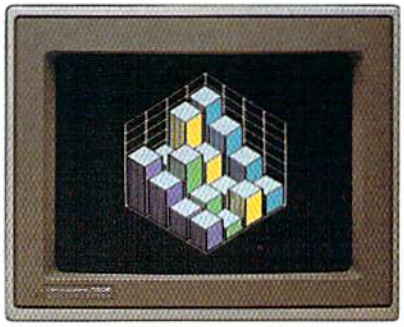
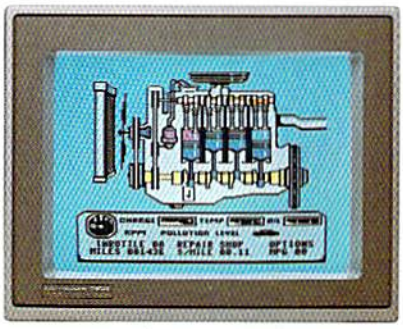
All you need to do this



graph a spreadsheet



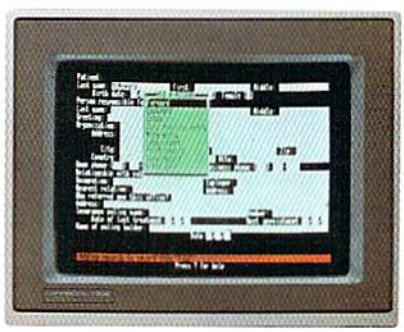
fix an engine

write a novel

learn to fly

do your banking

study astrology



organize a data base

tell a story

forecast sales

win a gold meda

ıake a birthday card

compose a song

design a dream house

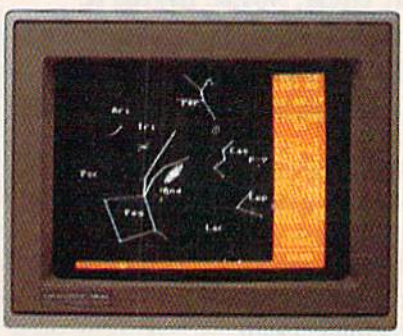
master logic

paint a picture

learn to type

dissect a frog

improve your chess



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GAZETTE contents

January 1986 Vol. 4, No. 1

features

reviews

games

programming

departments

program listings

† All Commodore 64 programs in this issue work on the Commodore 128 in 64 mode.

*=General, **V**=VIC-20, **64**=Commodore 64, **+4**=Plus/4, **16**=Commodore 16, **128**=Commodore 128

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editor's notes

This represents the first time in the history of our publications that we're printing the same set of *Editor's Notes* in both COMPUTE! and in COMPUTE!'s GAZETTE. The reason for this change of heart is a rather massive set of announcements—at least massive to me. In the space of two weeks, we've learned that two of our major competitors have chosen to close up shop. *Creative Computing* magazine and *Popular Computing* magazine are both reportedly ceasing publication with their December issues. To understand the significance of news such as this, you have to be aware of a bit of the history and folklore of our industry. COMPUTE! was first published as a fall 1979 quarterly issue. At that time, the largest, most successful publications in the industry were *BYTE* magazine, *Creative Computing, Interface Age, Kilobaud Microcomputing,* and *Personal Computing. Popular* didn't come along until the fall of 1980. I remember my determination to someday catch up with *Creative Computing* magazine in circulation. But before we could pursue 100,000 or even 50,000, we had to pursue 5,000, and it took many months for us to achieve that goal.

I remember too the twinge of jealousy I felt when McGraw-Hill, then owner of *BYTE* and publisher of the new *Popular Computing* announced in a flurry all of the many expenditures being made in the launch of their newest magazine. I was even approached about the position of editor-in-chief with a promise of funds and staffing and the many things not so readily available to us at COMPUTE! without a McGraw-Hill behind us.

Creative Computing, under David Ahl's leadership, was at one time the premier magazine of consumer computing. Time and changes in the market eventually led to David's decision to sell to Ziff-Davis Publishing. Again, time and changes in the market have led to their apparent decision to close up the magazine.

Popular never seemed to establish its market niche with the clarity once demonstrated by *Creative*. It was always a junior introductory magazine that never seemed to bridge the gap between first time buyer and *BYTE*, its very successful parent. Perhaps *Popular* is the best example of that portion of our industry that came to rely on a massive influx of new computer buyers for growth. When, seemingly suddenly, our market dropped from 300 percent growth per year to 20 percent, the bottom fell out for many.

I applaud the immeasurable contribution to the personal computing industry made by *Creative Computing* and its founder David Ahl. I regret the demise of *Creative* and the demise of *Popular* as well even though it doesn't represent the same loss of industry-impacting personality that *Creative* does.

This is a rather significant time, both for my own personal reflection of what we here at COMPUTE!/ABC Publishing have accomplished, and on times past. We will assure you here and now that COMPUTE! Publications is and continues to be quite successful, quite proud of our place in the market, and quite determined to continue to provide you, our readership, with all of the many services that have enabled us to grow and flourish, even during these particularly difficult times for the industry.

Robert C. Lock

Editor-In-Chief/Founder

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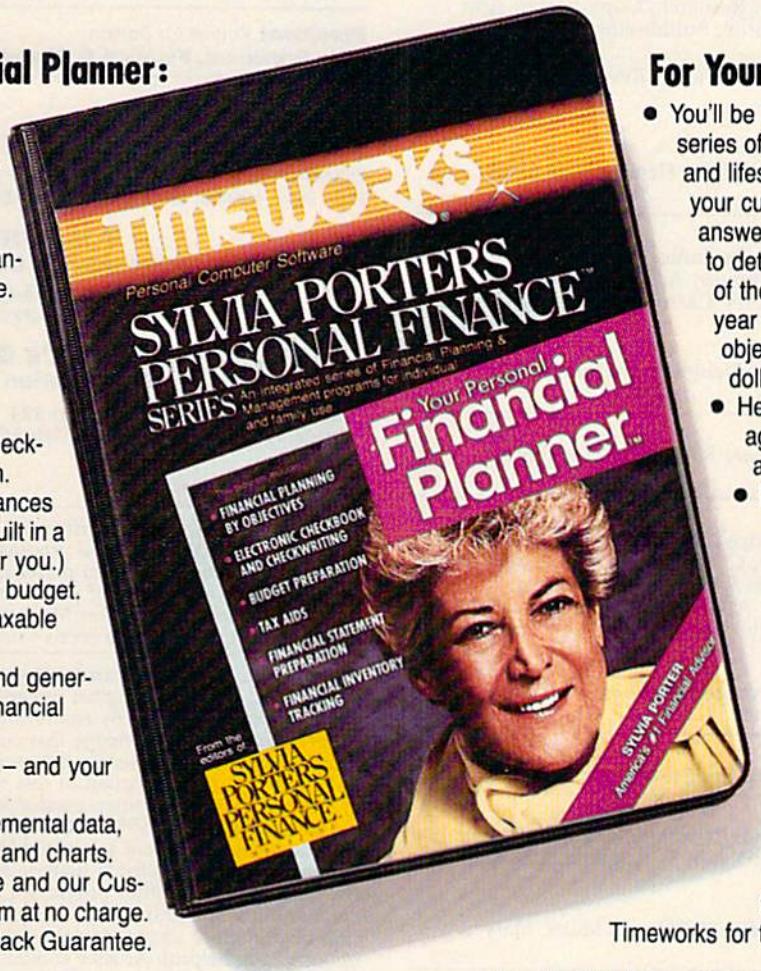

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Do you have a question or a problem? Have you discovered something that could help other Commodore users? Do you have a comment about something you've read in COMPUTE!'s GAZETTE? We want to hear from you. Write to Gazette Feedback, COMPUTE!'s GAZETTE P.O. Box 5406, Greensboro, NC 27403. We regret that due to the volume of mail received, we cannot respond individually to programming questions.

Changing Grays

On my black and white television, my VIC displays black characters on a white screen, while the 64 shows white characters on a black screen. If I buy a 64, is there a way to change the screen to black characters on a white background?

A. R. Brink

On a color TV or monitor, you would see that the VIC's screen is white with blue characters and the 64 is blue with light blue characters. Your black-and-white television displays these colors as white, black, or shades of gray in between. A single POKE to 53281 will change the 64's screen to one of the 16 colors (numbered 0–15) available. For example, **POKE 53281,1** *changes the background to white. To change the character color, hold down either CTRL or the Commodore key and press one of the keys numbered 1–8. Another way to do the same thing is to POKE 646 with a number from 0–15.*

Characters on the VIC screen can have any of the eight CTRL colors, black through yellow, but not the other eight.

Finding Public Domain Programs

Our user group would like to trade information and noncopyrighted programs with anyone who is interested. Can you give us some suggestions on starting a library of public domain programs?

Randolph Scott Zimmer

When a software author puts a program in the public domain, it means people can make copies for themselves or others. User groups often collect public domain programs and offer them at no charge to their members.

First, find a volunteer to be the club librarian. The best place to start in setting up a program library is with your group members. You may find quite a few who have written programs they're willing to share. Or you could sponsor a contest and award prizes to the best programs. Some members may have downloaded programs from a bulletin board system (BBS) or other online information services. You could also correspond with other user groups that have already built up libraries to see how they went about it, or offer to trade public domain disks and newsletter subscriptions with them. Some user groups put their newsletters in the public domain; you can reprint articles from these publications in your own newsletter.

Commodore's national user group coordinator, Pete Baczor, may be able to give you some guidance. He may be reached c/o Commodore Business Machines, 1200 Wilson Dr., West Chester, PA 19380.

The Toronto PET User Group (TPUG), probably the largest Commodore user group in the world, offers associate memberships, which allow groups to order inexpensive public domain software from its huge library. Annual dues for an associate membership are $25. Write to TPUG, Inc. Membership Information, 101 Duncan Mill Rd., Suite G7, Don Mills, Ontario, Canada M3B 1Z3.

Program distribution among members can be handled in several different ways, depending on the size of the group. If your group is large enough to support its own BBS, members can call in and download programs, as well as upload programs that they wish to contribute. This will require some extra maintenance time for the system operator (sysop). Many groups ask members to bring blank formatted disks to meetings and have a copying session before or after the main meeting. Or the group could supply its own disks and prepare them before each scheduled meeting. Orders could be taken at each meeting for the next month's disks.

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128 Compatibility Questions

I have some questions about the 128 and the 1571 disk drive. Will I be able to use single-sided disks with the new drive? Can I use my 1541 as a second drive without hardware or software changes? Does the 1571 work with a 64? I have heard that Commodore had some problems with the early 64s and 1541s and later upgraded them; should I wait until the bugs are worked out before buying a 128 or 1571?

Jeff Knott

You can use single-sided disks, disks containing 64 programs for example, with the 1571. Also, nearly all commercial software for the 64 works fine with the 1571. So far, we have found only one disk that does not load on the 1571 (it does load into 64 mode with a 1541). The problem seems to be the copy-protection method, and the software publisher is working on a new version that will load correctly.

You can use a 1541 and a 1571 at the same time, but they can't both be device number eight. There are two switches on the back of the 1571 that control the device number, and it's quite easily done. And the 1571 does work with a 64, but it won't be able to work at the faster speeds.

We haven't heard of any bugs or mechanical problems with the 1571. There is talk of a planned minor ROM revision for the 128, though. On the first versions, when the CAPS LOCK key is down, the letter Q displays an unshifted Q rather than the ball character (SHIFT-Q). Also, LOCATE and some other graphics commands work with $+x$ and $+y$, but not $-x$ and $-y$ in the "relative to the pixel cursor" option. Neither of these is a serious problem.

Disk Storage

Is it OK to store disks in the box they came in or should they be kept apart? Does a disk containing programs emit any magnetic field that could affect other disks nearby?

R. Gumula

You shouldn't have any problems storing disks together in one box. There's no chance that a disk will scramble data on a neighboring disk.

Fading Away

On a game I am creating, I have an engine sound that is constant; it has to play all of the time. I tried it on the 64 and the sound gradually goes away. On my VIC, I could turn on a sound and it would play through the whole game.

Justin Luton

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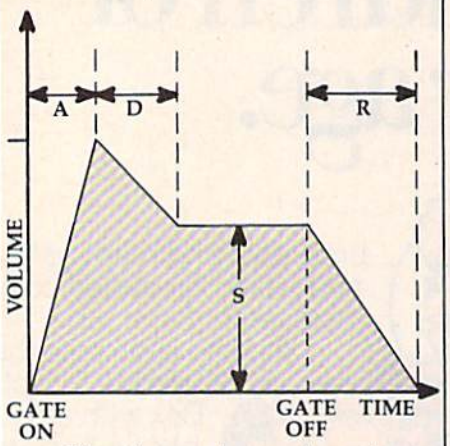
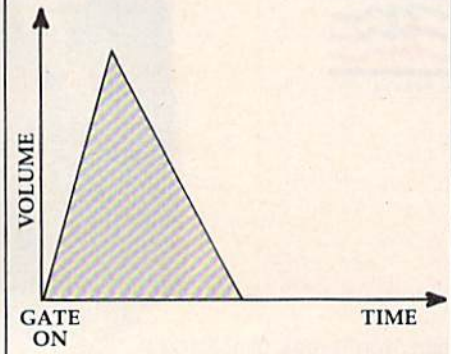
Sound on the Commodore 64 is made up of four parts: attack, decay, sustain, and release (the "ADSR envelope"). The gate bit of a voice controls when the sound is turned on and off. It helps to visualize the ADSR envelope:



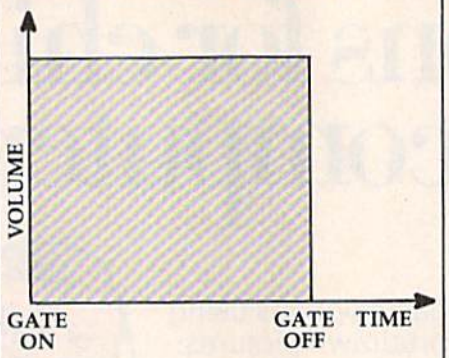
When the gate is turned on, the attack begins—the sound gets louder. It increases in volume gradually or suddenly, depending on the number you POKEd into the attack/decay register. The larger the attack number, the longer it takes to reach the peak. The peak volume is the loudest the sound will be during the cycle; it's determined by the number you POKE into the volume register. Next, the decay begins and the sound gets softer. The length of the decay varies according to the number in that register.

Here's where some people might get confused. Attack, decay, and release are all time periods—how long it takes to complete one phase of the ADSR envelope. Sustain is not a time, it's a volume level, a fraction of the peak volume. The sound you create will continue at the sustain level until you turn the gate bit off. Then the release phase begins and the note gradually (or suddenly) fades.

The key to solving your problem is the sustain value. An envelope with an attack five, decay five, and sustain zero looks like the figure below. The sound peaks and then goes away. A zero sustain means the note will level off at volume zero (no sound).



But if you set sustain at 15 (the maximum) and put zeros in attack, decay, and release, the envelope will act like the tone generator on the VIC. The attack and decay end immediately, and sustain starts at 100 percent of the volume you selected. When the gate is turned off, the release period is zero and the note stops.



Listen To Disk Loads

For anyone interested in hearing "TurboDisk" (July) in action, all you have to do is POKE 54296,15 and turn up the volume. Each beep represents a disk block being loaded, although they go by too fast to be counted. There's a slight pause each time the read/write head moves to the next track and then the beeping resumes. You can also listen to a standard load (without TurboDisk), which is much slower.

Eric Fern

You've discovered something called crosstalk. It's similar to talking on the telephone and hearing snatches of another conversation. As you noted later in the letter, shielding the sound chip would prevent it from picking up signals from disk loads.

Playing Tag

I've been trying to make one character home in on another character on my VIC-20. I think it's called artificial intelligence. Could you explain how it works and maybe include a program?

Mike Baluch

Making one character chase another doesn't require anything as complex as artificial intelligence. It can be done with fairly simple math.

The screen of your VIC has 22 columns and 23 rows. The position of a character can be described by which column and row it occupies—the "x" and "y" coordinates. The top left corner is (0,0) and the bottom right is (21,22). (The same principle applies to 40 and 80 column screens of other Commodore computers.)

The hunter and prey characters each have their own x and y positions, which you would store in a variable. If you subtract the hunter's x-coordinate from the prey's, you'll get a number that tells you how the hunter should move. Say the prey is in column eight and the hunter is in column 15. Subtract to get a result of minus seven. In general, any negative number means the hunter should move left (subtract one column) and a positive number means to move right (add one to the column). The same logic determines whether the hunter should move up or down.

The BASIC program below for the VIC and 64 uses the Kernal plot routine at location 65520 (on all Commodore computers) to place two shapes, an asterisk and a ball, on the screen. To use this routine, POKE 782 with the horizontal position and 781 with the vertical position; then SYS 65520.

On the Plus/4 and 16, eliminate the POKEs in lines 200–210 and change the first SYS to SYS 65520,0,Y,X and the second to SYS 65520,0,B,A. On the 128, make the same changes and add BANK15 at the beginning of 200.

You move your character with the cursor keys. The ball follows closely behind and catches you if you stop. The SGN function in line 180 converts negative numbers to −1, positive numbers to +1, and leaves zero alone. This number is added to the hunter's current position to make it move up or down, left or right.

```
100 X1=10:Y1=10:A1=20:B1=10
110 PRINT"{CLR}"
120 A$=" ":B$=" ":X=OX:Y=OY:A=
    OA:B=OB:GOSUB200
130 A$="*":B$="Q":X=X1:Y=Y1:A=
    A1:B=B1:GOSUB200:OX=X1:OY=
    Y1:OA=A1:OB=B1
140 GETK$:IFK$="{UP}"THENY1=Y1
    -1
150 IFK$="{DOWN}"THENY1=Y1+1
160 IFK$="{RIGHT}"THENX1=X1+1
170 IFK$="{LEFT}"THENX1=X1-1
180 T=(T=0):IFTTHENA1=A1+SGN(X
    1-A1):B1=B1+SGN(Y1-B1)
190 FORA=1TO50:NEXT:GOTO120
200 POKE782,X:POKE781,Y:SYS655
    20:PRINTA$;
210 POKE782,A:POKE781,B:SYS655
    20:PRINTB$;:RETURN
```

New 128 Error Messages

I just bought a Commodore 128 and have a question. If I try to draw a circle without the hi-res screen on, I get a NO GRAPHICS AREA error. I've seen Commodore 64 programs that draw a hi-res scene and then switch it on after it has been drawn. I am writing a game and want to display the instructions while the hi-res screen is being drawn, then enable the hi-res screen. Is this possible?

Phil Gaylord

You can draw on a hidden hi-res screen on the 128, Plus/4, and 16 if you establish a graphics area first. To do that, put the GRAPHIC command somewhere near the beginning of your program. The two statements **GRAPHIC 1: GRAPHIC 0** *are what you need. You might also want to clear the hi-res screen either with a SCNCLR or by adding a ,1 (GRAPHIC 1,1). The GRAPHIC 1 statement turns on*

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the hi-res screen and sets up the graphics area. And GRAPHIC 0 sets the screen back to text. To turn the screen back on, add another GRAPHIC 1 later in the program.

One thing GRAPHIC does is carve out a protected area of memory for the hi-res screen. Try this simple experiment: Turn on your 128 and enter **PRINT FRE(0), FRE(1)** *to see how much memory you have in banks zero and one. Now type* **GRAPHIC 1: GRAPHIC 0** *and then* **PRINT FRE(0), FRE(1)** *again. You should see that bank zero, where programs are stored, has 9K less memory than before. The hi-res screen needs 8K for the bitmap and 1K for color memory.*

BASIC programs are normally stored at (hexadecimal) address $1C00. Setting up a graphics area moves the beginning of BASIC up to $4000, leaving room for the hi-res screen at $2000–3FFF and color memory at $1C00–1FFF.

Can You Strum A 64?

Is it possible to make the 64 sound like a guitar playing a chord? How can I duplicate an open D or open C chord?

Jeremy Baer

The 64's SID chip is capable of playing three voices simultaneously. You can't precisely duplicate the notes of the open guitar chords you mentioned because an open D requires four strings (notes) and an open C five. And even though the SID chip is capable of myriad sounds, it cannot truly simulate an acoustic string instrument like a guitar. Acoustic string instruments have a unique sound quality created by resonance (a sustaining or re-echoing quality caused by sound bouncing within the wooden body of a guitar, for example) and overtones (harmonic sound frequencies higher than the original frequency).

You can play three-note chords with the SID. A D chord contains a D, F♯, and A, and a C chord contains a C, E, and G. You could program each voice to play one of these notes. And you can roughly simulate a strumming sound by very slightly staggering the time intervals between each of the notes played. Here's a short program that plays two chords (to select a chord, delete the REM C MAJOR or REM D MAJOR from one of the DATA statements). We've tried to get as close to an acoustic guitar sound as we could.

```
10 S=54272:FOR X=STOS+24:POKEX
   ,0:NEXT:IFFL=1THENFL=0:END
20 POKES+24,44:POKES+22,96:POK
   ES+21,0:POKES+23,7:POKES+5,
   0:POKES+6,247
30 POKES+12,0:POKES+13,247:POK
   ES+19,0:POKES+20,247:POKES+
   4,16
40 POKES+11,16:POKES+18,16:R=5
   4266:FORX=1TO3:R=R+7:READHF
   ,LF:POKER,HF
50 POKER-1,LF:POKER+3,17:FORD=
   1TO150:NEXT:NEXT:FORX=12TO2
   STEP-1
60 POKES+24,X+32:FORD=1TO100:N
   EXT:NEXT:POKES+24,33:FORY=1
   TO20:NEXT
70 POKES+24,32:FL=1:GOTO10
100 REM C MAJOR DATA 16,195,25
    ,30,42,62
110 REM D MAJOR DATA 18,209,28
    ,49,47,107
```

Get Rid Of READY

I recently purchased an SG-10 printer with a G-Wiz interface. It works great, but I wonder if you can tell me how I can get rid of that "READY." that always appears when it's through printing.

Luis A. Mata

The commands for listing a program to the printer are **OPEN 4,4: CMD 4: LIST**. *If you prefer upper/lowercase listings, change the first statement to* **OPEN 4,4,7**. *Either way, when it's finished, enter* **PRINT#4: CLOSE 4**.

The reason the READY prompt appears is fairly simple. OPEN paves the way for communications to the printer. Usually LIST or PRINT sends characters to the screen, but CMD reroutes all output to the previously opened channel to the printer. When you list a program to the screen, the READY prompt always follows the listing (BASIC treats READY as an error message that means there have been no errors). So when CMD diverts the listing to the printer, it also diverts the prompt.

Don't blame the printer or the interface, blame BASIC. The solution is to alter the way BASIC works. The following program—for the 64 only—changes the error vector so it won't print READY (error messages are disabled as well). After loading and running this program, enter SYS 828 to turn off the prompt and SYS 828 to turn it back on again.

```
10 FORA=828TO853:READB:POKEA,B
   :NEXT:PRINT"{CLR}SYS 828 TO
    TOGGLE"
20 DATA 162,131,160,164,173,85
   ,3,73,1,141,85,3,208,4,162,
   139,160,227,142,0
30 DATA 3,140,1,3,96,0
```

Translating Other Dialects Of BASIC

In many books about printers I've seen the term LPRINT. What does this mean and how can I use it in my programs?

Scott Petoff

Some versions of BASIC include the usual PRINT statement for displaying text on the screen as well as a separate LPRINT statement for sending text to a printer. Printers are sometimes called "line printers," hence the origin of the term LPRINT.

There's no single command like LPRINT in Commodore BASICs, though, so you can't use it in your own programs. To send a line to a printer, you must first open a channel to the printer and then PRINT# the line to it:

```
10 OPEN 1,4,7
20 PRINT"THIS LINE GOES TO THE
   SCREEN"
30 PRINT#1,"BUT THIS ONE ENDS UP
   AT THE PRINTER"
40 PRINT#1:CLOSE 1
```

The three numbers after OPEN are the logical file number, the device number, and the secondary address. The logical file number can be any integer up to 127 and is used after the PRINT# statement to identify which peripheral should receive the information. Commodore printers are usually device number four, and the secondary address of seven means the characters will be printed in upper- and lowercase rather than uppercase and graphics. To print graphics characters, change the secondary address from seven to zero, or just leave it off (OPEN 1,4).

PRINT# can send data to tape or disk files, modems, or printers, making it more versatile than LPRINT, which is limited to printers.

Hidden Commands

I purchased a Commodore 128 a couple of weeks ago and was quite anxious to run some programs on it, so I picked your program "Litter Patrol." I received a SYNTAX ERROR in line 510 because I began the line without spaces, like this: **IFHTANDC=215**. Is the 128 more sensitive to spacing?

Kenneth H. Smith

Your 128 isn't more sensitive; that line would cause trouble on a VIC, 64, Plus/4, or 16. The problem is that you've accidentally placed a hidden command in the line. TAN is a BASIC function that figures out the tangent of an angle. The computer interprets ***HT ANDC*** *correctly, but sees* ***HTANDC*** *as containing the keyword TAN. This type of problem is often difficult to detect because the line looks correct.*

BASIC programs are stored in memory in tokenized form. Each keyword (PRINT, POKE, etc.) is turned into a one or two byte token before it's put into memory. Tokenizing has two advantages. First, a great deal of memory is saved—instead of five bytes for the five letters P-R-I-N-T, only one is needed. Second, when a program is executing, it's much faster for the BASIC interpreter to find one or two byte tokens than it is to find whole keywords.

As soon as you press the RETURN key, the line is tokenized. All keywords are changed to their corresponding tokens and any non keyword data is stored as ASCII text.

Since TAN comes before AND in that line from "Litter Patrol," it is tokenized first. The solution is to break up the line with a space between the T and A.

Here are a couple more examples of

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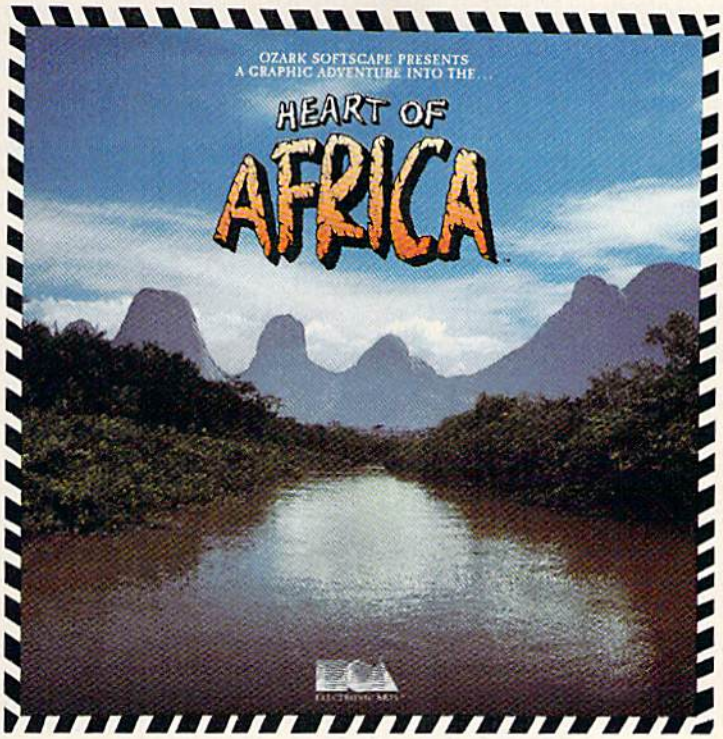

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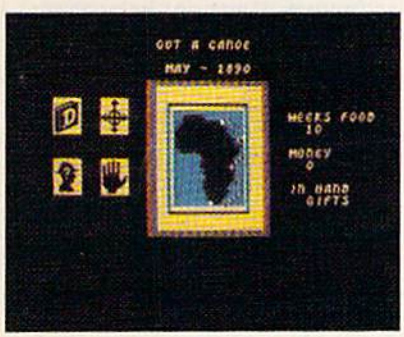

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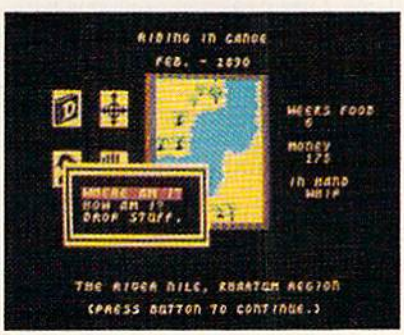

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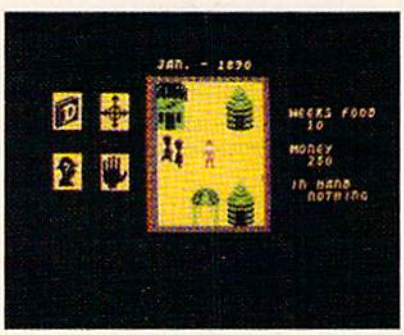

Decipher Native Clues

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*embedded keywords: **HEADER"DISK 1",IF1** contains IF, which confuses BASIC, and **B=TOR127** contains TO (as in FOR J=1 TO 5).*

Emulating BSAVE

How do you save a section of memory to disk as a program file?

Steve Lefcort

Saving a section of memory can be useful for many things. Text screens, hi-res screens, sprite data, machine language, and character sets can all be saved to disk or tape and later loaded by another program.

Many computers have a command to save a section of memory (the Commodore 128 uses the command BSAVE). The 64 does not have such a command in BASIC. But you can use the following short ML program which emulates BSAVE:

```
10 FORA=705TO761:READB:POKEA,B
   :C=C+B:NEXT:IFC<>7580THEN
   PRINT"DATA ERROR"
20 DATA 32,253,174,32,158,173,
   32,130,183,166
30 DATA 34,164,35,32,189,255,3
   2,155,183,169
40 DATA 2,168,32,186,255,32,24
   1,2,165,20
50 DATA 133,251,165,21,133,252
   ,32,241,2,166
60 DATA 20,164,21,169,251,76,2
   16,255,32,253
70 DATA 174,32,158,173,76,247,
   183
```

To save a section of memory type:

SYS 705,"filename",device number,start address,end address + 1

For example, the text screen could be saved to disk with SYS 705,"SCREEN",8,1024,2025. This saves screen memory only; you'd have to handle color memory separately. The screen could then be loaded from a program with the following lines:

```
10 IF A=1 THEN 30
20 A=1: LOAD "SCREEN",8,1
30 REM REST OF PROGRAM
```

Pushing And POKEing

How do you put a character in the very bottom right corner of the screen?

Ryan Wilhm

Whenever something is printed on the screen, the cursor moves to the next position on the screen. So when the cursor is at the last column on the bottom line, printing makes the screen scroll up to make room for more characters. Most of the time this is an advantage, but when you want to create a title screen with a border, this feature can be very annoying.

There are a couple of ways to solve the problem and put a character in the corner. Probably the easiest way is to POKE this location with the character you want. Look at the screen and color maps in one of the appendices of the book that came with your computer. On the 64 and 128 (40-column mode), you would POKE 2024,1 to put the letter A in the corner. Note that you must use screen codes (also listed in an appendix) and not ASCII codes when POKEing to the screen.

Another way to put a letter on the screen at that location is by inserting a character. Whenever a character is inserted, the characters to the right are pushed to the right. The general idea is to print the corner character at the second to the last position, cursor left, and then push it into the corner with the shifted INST/DEL key. This program illustrates this method.

```
10 PRINT"{CLR}";:FORA=1TO24:FO
   RB=1TO40:PRINT"*";:NEXT:N
   EXT
20 FORA=1TO39:PRINT"*";:NEXT:P
   RINT"{LEFT}{INST}*";
30 GOTO 30
```

On the 128, Plus/4, and 16, it's possible to turn off screen scrolling altogether. In direct mode, press the ESCape key and then "M" to turn scrolling off, and ESCape L to turn it back on. Escape has the ASCII code 27, so within a program you would PRINT CHR$(27);"M" to turn off scrolling. One more way to do it is POKE 248,255 (POKE 2025,255 on the Plus/4 and 16). To enable scrolling POKE 248,0 (POKE 2025,0 on the Plus/4 and 16).

---

128 Calculator Mode

I have a numeric keypad that plugs into my 64. I use it to enter programs with a lot of DATA statements by programming one key (the period) to type DATA and redefining the plus key as a comma. But the program that does this on the 64 will not work on my new 128. Any suggestions?

Donnie D. Shanholtz

You could load the program into the 128 and disassemble it with the built-in monitor, but it might take a long time to rewrite it. Here's a better suggestion:

*The 128 already has a built in numeric keypad and the function keys directly above it are redefinable. To make it easier to type in DATA statements, define one function key to print a comma and and one for the word DATA with **KEY 1,","** and **KEY 3,"DATA"**. The same idea can turn your 128 into a calculator. Define one key as PRINT, and define two others as * and / (for multiplying and dividing).*

Sound Effects For PRINT

A while back, you had a program that slows down printing, like the Apple's SPEED command. You suggested that readers who know machine language could add a clicking sound, to make it sound like a typewriter. Well, I don't know machine language. Would you please write it for me?

Masoud Keshmiri

*The following program adds both clicking and speed control to anything that's PRINTed on the 64. It's a short machine language program that goes into the cassette buffer. After typing RUN, you can control the speed at which characters are printed by POKEing location 2. The higher the number, the slower the printing. For the fastest printing, **POKE 2,1**. For extremely slow printing, **POKE2,255**. To make it sound even more like a typewriter, have your own program change printing speeds now and then, maybe every word or two.*

```
10 FORA=828TO898:READB:POKEA,B
   :NEXT:SYS828:POKE2,40:LIST
20 DATA 120,169,93,141,38,3,16
   9,3,141,39
30 DATA 3,169,0,160,23,153,0,2
   12,136,16
40 DATA 250,169,15,141,24,212,
   169,1,141,5
50 DATA 212,88,96,72,138,72,15
   2,72,166,2
60 DATA 160,0,136,208,253,202,
   208,250,169,10
70 DATA 141,1,212,169,32,141,4
   .212,169,33,141
   ,TA 4,212,104,168,104,170,
   04,76,202,241
```

Scratching The Unscratchable

How do I delete a disk file that I've named "*" by mistake? If I follow the normal procedure, the entire disk will be scratched. It cannot be renamed either.

Moshe Politis

*The asterisk is a wildcard, so using **OPEN 15,8,15,"S0:*"** would indeed scratch every file on the disk. (This is one technique for quickly clearing everything from a disk. Another is to reformat the disk without the two-letter ID.)*

*The way to scratch the asterisk file is to use the other wildcard, the question mark. **OPEN 15,8,15,"S0:?"** will scratch every file with a one-letter name. If you have other one-letter files you wish to keep, rename them with a longer name (two or more characters) before the scratch.*

Organizing Files

My reference books don't explain how to use index files with relative files. Could you shed some light on the subject?

George Trout

Relative files are superior to sequential files in some applications because they give you random access to records. To read record 50, for example, you would position the disk pointer and then GET or

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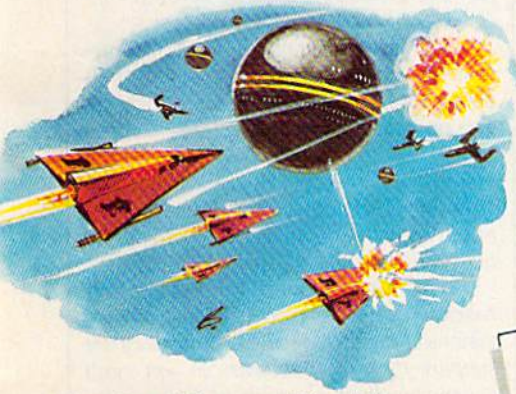

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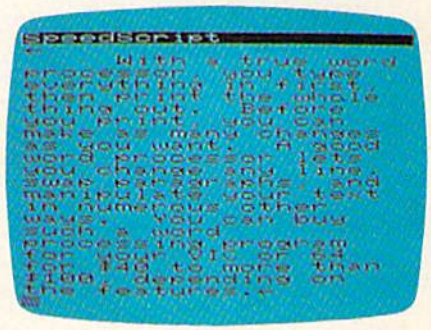

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INPUT the information there. With a sequential file, you'd have to read all of the 49 previous records before reaching the 50th record.

To alphabetize or otherwise sort a relative file, you could read all the records into memory, organize them, and then write them all back to disk in alphabetical order. But sorting that way uses up a lot of memory. It also takes a long time to read the entire file and then write it back to disk. An index file is often a faster way to handle sorting.

As a simple illustration, imagine that you've put four customer records into a relative file:

1. *Smith, shirt, $10*
2. *Jones, shirt, $12*
3. *Farley, shoelaces, $5*
4. *Olson, belt, $20*

Each record contains three fields: name, item purchased, and price paid. To create an alphabetical list of customer names, you would initially read all the names into a string array and create a numeric array of pointers to the string array:

	Before Sort	*After Sort*
A(1)	1	3
A(2)	2	2
A(3)	3	4
A(4)	4	1

The relative file remains scrambled, with Smith, Jones, Farley, and Olson—in that order. But the array holds the index numbers for the sorted list: 3 (Farley), 2 (Jones), 4 (Olson), and 1 (Smith). The four numbers 3, 2, 4, and 1 would then be written to a sequential file. You could create several index files, one for alphabetizing names, one for the subfile of people who have bought shirts, and so on.

This may seem to be a lot of extra work, but it pays off when you're working with large files. Say you've got a list of 1000 names in a relative file and an index file, with 1000 pointers to the records in the relative file. Now you add a new record (number 1001) to the relative file. To update the index file, read the index numbers into an array and do a binary search.

Find the 500th number on the list—the middle of the alphabetized list. Let's say A(500) is 321 and that record #321 in the relative file is a customer named "Lyons." If the new record is "Stanley" you know that, alphabetically, the new record is in the second half of the list. With one comparison, you've eliminated half the list. It's not necessary to read through the entire list, you just divide the list in half a few times and decide if the name there is too low or too high. (For more on this method, see "Quick Search" in "Hints & Tips," July 1985.)

After about ten comparisons, you might discover that customer 1001 (Stanley) belongs between 731 and 732 on the alphabetical index list. So, you have to move items 732–1000 up a notch in the array: FOR J=1001 TO 732 STEP −1: A(J)=A(J−1): NEXT. Then A(732)=1001 wraps things up.

PRINT In Machine Language

What's the best way to display a large amount of text, like instructions to a game, in machine language? I would think there would be an easier way than loading a number for each letter and storing it.

David DeHaai

There are several ways to display strings to the screen in a machine language program. As you noted, loading a register with a screen code and storing to screen memory is one, but remember that you have to store to color memory as well. You can also load the accumulator with the ASCII value of a character and JSR $FFD2 (the Kernal routine for outputting a character). For long strings, you could use a loop like this:

```
C000 LDY #$00
C002 LDA $C400,Y
C005 JSR $FFD2
C008 INY
C009 CMP #$00
C00B BNE $C002
C00D RTS
```

Put the ASCII values of the characters into memory starting at location $C400 and insert a 0 right after the message. The Y register is both a counter for the loop and an index to the table.

Here's one more ML solution. Frequently when you want to do something that BASIC does very well (like PRINT), it's convenient to use the routine built into BASIC. The STROUT (STRing OUT) routine can be found at these locations:

Commodore 64	*$AB1E*	*43806*
VIC 20	*$CB1E*	*51998*
Plus 4/16	*$9088*	*37000*

Put the text string that you want printed into memory. The string can contain up to 254 characters and must end with a 0. Next, load the accumulator with the low byte of the address of the text string and the Y register with the high byte. Then call the routine with a JSR instruction. This routine can print any of the ASCII characters, including control codes like color changes or cursor controls.

Future Expansion

I've got a question concerning the use of the unimplemented 6502 opcodes in machine language programming. Exactly what do these opcodes do when they are encountered in a program? Does the microprocessor carry out an instruction? I would like to know if anyone has published a list of these opcodes.

Dennis Wilson

The machine language section of the Programmer's Reference Guide *calls some operation codes (opcodes) "Future Expansion," which means they're currently undefined, but may be defined sometime in the future. Nevertheless, if you include them in an ML program, the unimplemented opcodes actually work as instructions.*

When a chip like the 6502 or 6510 fetches an instruction from a machine language program, it keeps track of where it is with an internal register called the program counter (PC). If the PC points to 49152, the number held in 49152 is fed into the processor as an opcode, an instruction to perform an operation. The eight bits of the number trigger switches inside the chip. Similar instructions have similar binary numbers: STA absolute has the opcode $8D, while STA absolute indexed by X is $9D. There's a difference of a single bit. Likewise, STX absolute is $8E, just one bit away from STA absolute (opcode $8D).

The unimplemented opcodes, sometimes called quasi-ops, follow similar patterns, based on which bits are on or off. The number $8F, for example, performs a logical AND of the Accumulator and X register and then stores the result in an absolute (two byte) address. In most cases, quasi-ops make the processor try to do two instructions simultaneously.

The problem with using these opcodes within a program is that newer revisions of the 6502 family of chips may not support these instructions, so you can't depend on them working in future computers. Also, most aren't very useful. It's not likely that someone would need an instruction that ORs the accumulator with the number $EE, ANDs the result with another number, and transfers the result to the X register.

Quasi-ops are sometimes used by software companies as a means of software protection, since standard disassemblers will not translate these instructions properly. A comprehensive list of the unimplemented opcodes is contained in the appendices of Programming the VIC *and* Programming the 64 *(both available from COMPUTE! Books).*

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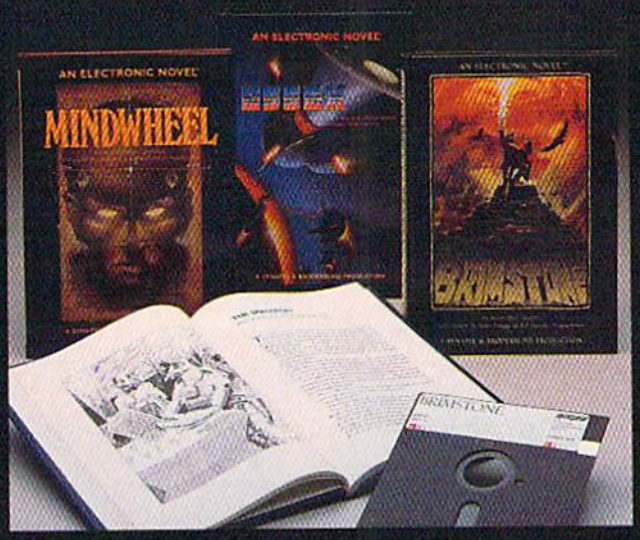

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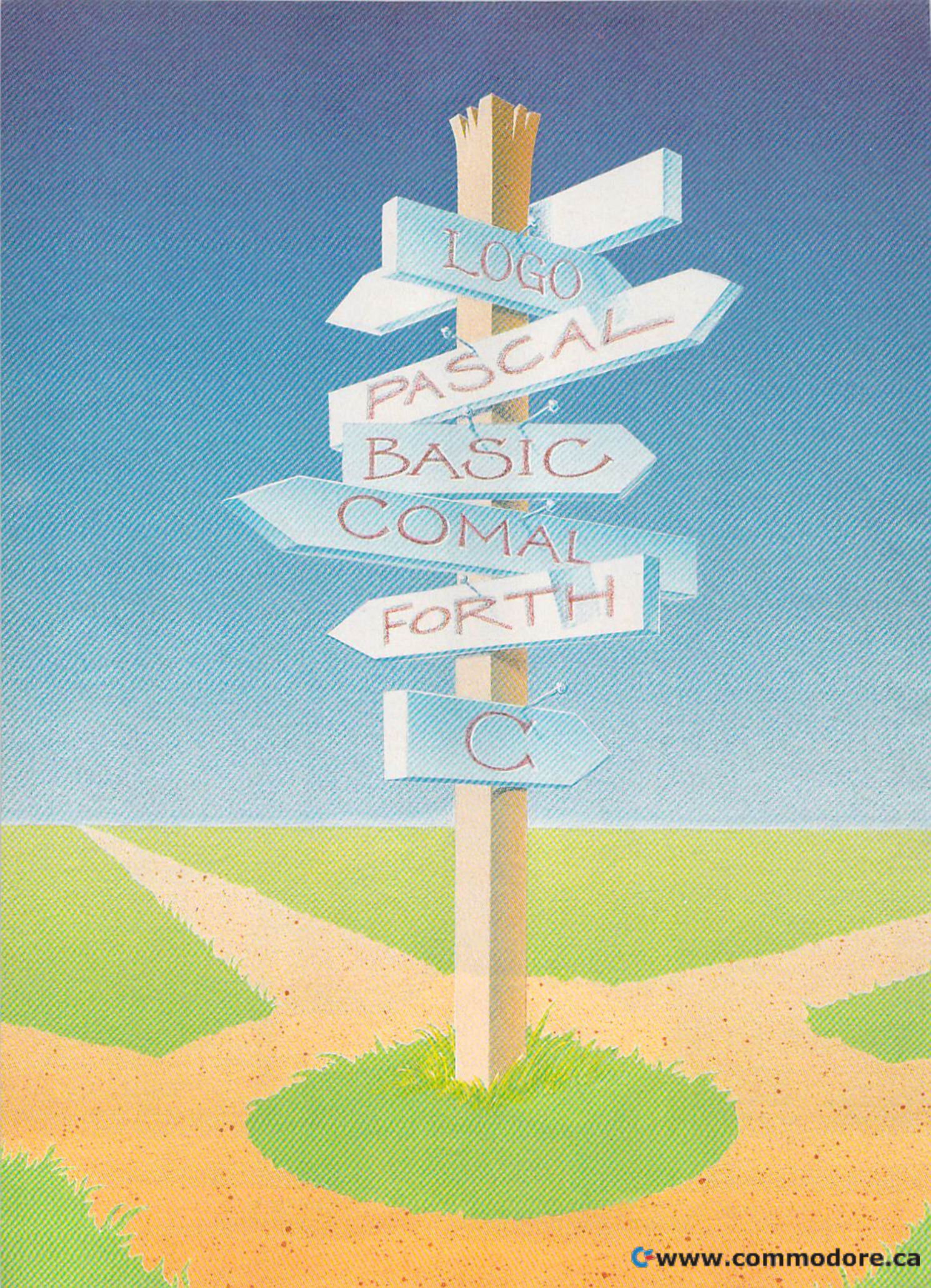

The Commodore 64's Other Languages

Selby Bateman, Features Editor

One of your first discoveries as a Commodore 64 owner is the presence of a programming language called BASIC built into your computer. Each time you turn on the system, BASIC is ready to go—an easy to use, general-purpose programming language. But BASIC is not the only programming path for your Commodore, and often it's not the most efficient. For a few extra dollars, you'll find plenty of other languages that do a lot of things differently—and often, very well.

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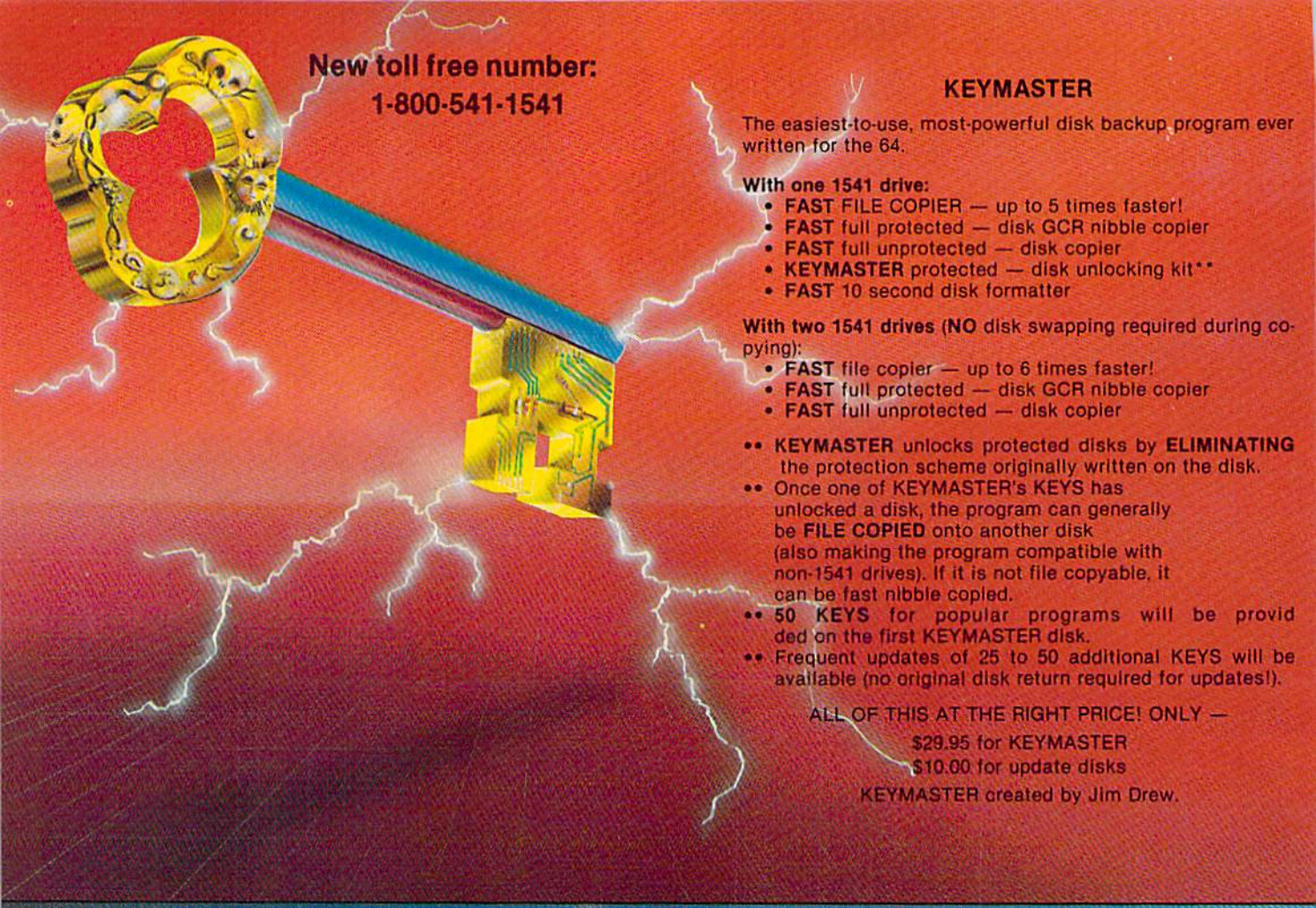

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On-field Football (GAMESTAR)	?	159 sec	66 sec	63 sec	56 sec
EASY FINANCE I (COMMODORE)	?	58 sec	13 sec	13 sec	11 sec

* = Will not fast load — defaulted back to regular load.
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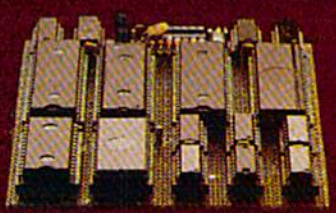

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language easier for people to use. Look at a few testimonials:

"Logo is the most misunderstood language in the history of programming," says author and teacher David Thornburg. "Logo is based on Lisp, the premiere language of researchers in artificial intelligence, and it has all of the capabilities of that language."

"(The C language)...is transportable, and that's one of the reasons it's so popular. It produces very efficient code. Things that you couldn't do with BASIC, you *can* do with C and not have to resort to machine language," says Arnie Lee, president of Abacus Software, which markets *Super C*, among other languages for the 64.

"(Forth) is a language that's optimized for high performance, for programs that need to be especially quick or small," says Martin Tracy, president of MicroMotion and author of *Mastering Forth*. "It's really a developer's language. The novice can rapidly learn it, but it's not as natural as other languages."

"By using COMAL, you get what BASIC should have had; you get the structures that are very useful, and you get a turtle graphics system that you would have bought Logo for—all in one system," says Len Lindsay, president of the COMAL Users Group USA.

"(PROMAL) is the most powerful and innovative programming language and development system available for the Commodore 64," says John R. Segner, president of SMA, creators of PROMAL.

Can all of these endorsements be correct? Is there a *best* language, or are they all equally good?

The answer to that has to do with two general principles which programmers soon learn: What's considered the best programming language depends on what you're trying to program and your own personal programming style. Some languages are better at producing fast-action arcade-type games with colorful graphics, sprites, and music. Other languages may be more appropriate for educational programs and teaching purposes. Still others may be better equipped to handle payroll systems, inventory programs, and related business software. And some programmers prefer a very structured programming environment, such as Pascal, while others like the flexibility of a less structured language. Both factors have a great deal to do with the popularity of a programming language.

For every programming language, you'll find supporters who would never use anything else.

So there's no single best language; some are just better, or more appropriate, for certain types of programs or programming styles. An important consideration in some cases is the time it takes a program to run versus the time it takes to write the program. Certain *benchmark* tests do show measurable differences among languages, usually based on speed and efficiency of operation. But there's a tradeoff; speeding up a program often means spending more time working on it.

For every programming language, you'll find supporters who would never use anything else. There are even user groups for most of the major languages, some with thousands of members. Most of these languages are called high level (some, like Forth or C, are considered mid-level); that is, they are more removed from machine language, and closer to human languages. Your computer doesn't really understand any of these high-level languages. It must interpret them, changing the symbols into machine code, which it then uses directly.

Machine language is not a programming language in the same sense as BASIC or other languages. While it may seem more difficult to learn than most high-level programming languages, machine language is popular because of its power and speed. Although it may take you several machine language operations to accomplish what could be done in BASIC or another high-level language with one command, the computer doesn't have to translate the machine code. It acts on it directly.

The great majority of people who learn to program on their own start with BASIC. After all, it's built into your Commodore, making it immediately accessible. BASIC, which stands for Beginner's All-purpose Symbolic Instruction Code, was created at Dartmouth College in the early 1960s for the express purpose of teaching beginners to program. There are many variations of BASIC now, some built into personal computers and others available on cartridge or disk. If you have a Commodore 64, your computer has Commodore BASIC 2.0; the Plus/4 and the 16 have more commands in a BASIC version 3.5; and the 128 has the richest Commodore BASIC, version 7.0. (For a closer look at these BASICs, see "Exploring 128 BASIC" in the November 1985 GAZETTE.)

BASIC 2.0 doesn't contain commands to let you directly control the excellent graphics and sound capabilities of the Commodore 64. To remedy that, there are programs, either cartridge or disk-based, which extend BASIC by adding new commands. *Simons' BASIC* and the *Super Expander 64* are two of the best known of these extensions. *Simons' BASIC* adds 114 commands to assist with high-resolution graphics, sprites, program debugging, and music and sound effects. If that many new commands seems daunting, try the *Super Expander*, which adds 32 new words to BASIC to aid in programming graphics and sound. Also included are ten different instrument sounds, and a sprite editor. One of the newest and most powerful BASIC extensions for your 64 is Cardco's *S'more*, which brings the 64's BASIC almost to the level of the 128's powerful BASIC 7.0. (See the review of *S'more* elsewhere in this issue.)

Despite the great success of BASIC, not all programmers agree that it's the best language to learn first. David Thornburg, a supporter of the Logo language, has found that his computer science students have

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an easier time learning other languages if they've never been exposed to BASIC. Len Lindsay, a COMAL language supporter, says that BASIC's weaknesses led to the creation of COMAL. And others complain that BASIC has evolved into an unstructured, inefficient language which teaches poor programming habits. Nevertheless, millions of people have learned how to program in BASIC and enjoy its relative simplicity, ease of use, and general-purpose capabilities.

Whatever your final opinion of BASIC, as a Commodore owner you have several other languages available to you. Each of them has a faithful following, some numbering into the thousands. But, you'll have to purchase whatever new language you try, either on disk or cartridge, and then load it into your computer with each use. Most programmers believe that's a small price to pay, considering the enjoyment of learning a new language and the results of programming.

Logo

Logo has become one of the most popular programming languages in the field of education since its development by a team of computer scientists headed by MIT professor Seymour Papert in the 1960s. Papert and his team wanted to create a language which would be easy enough for children to learn, but would be expandable enough to develop power and depth. A part of the language contains easy to use graphics commands, called turtle graphics (so named because the first use of the language controlled the movements of a small robot that resembled a turtle). However, the full Logo language is based on LISP (for LISt Processing), a very powerful high-level language especially suited for text manipulation and analysis and used in artificial intelligence research.

Although most references to Logo emphasize the language's suitability for teaching children with its turtle graphics, Logo supporters point out that the language is really very powerful. "What happened with Logo was that people said, *'Oh, a language for learning—so Logo's for kids,'* " says Thornburg, author of a half-dozen books on Logo. "(Computer dealers) said *'I can go sell that as a kid's language; it's warm and fuzzy.'* But the fact is that Logo is *not* warm and fuzzy. It has a warm and fuzzy component, but Logo is also a *chainsaw*—you can do some pretty extraordinary things with Logo."

Despite the great success of BASIC, not all programmers agree that it's the best language to learn first.

Logo contains a number of commands, called *primitives*, which a programmer uses to create programs. But these primitives can also be combined to create brand new commands, allowing you to extend the language in ways which you can't with a language like BASIC (which offers only defined functions, a limited sort of extensibility). Another aspect of Logo is its modular programming structure, which lets a programmer break down various parts of a program into separate components. This also makes Logo easier for teachers as they try to analyze their students' programs. As a result of this and of Logo's similarity to some advanced languages, some computer science teachers recommend Logo as a first language rather than BASIC.

Commodore Logo is a fairly powerful version of the original Logo, and has commands which let you control the 64's graphics, including its sprites, as well as the SID sound chip and other features. Commodore Logo comes on a pair of disks, one of which contains the language and the other a collection of more than 50 utilities and demonstrations. There is also a 350-page manual.

Logo's widespread use and popularity have encouraged the growth of a variety of user groups throughout the world. A good source of information on Logo is the National Logo Exchange, P.O. Box 5341, Charlottesville, VA 22905.

Pascal

Another programming language which has had a major impact in schools, especially at the university level, is Pascal. Named for French mathematician Blaise Pascal, the language was created in the 1970s by Niklaus Wirth of Switzerland as a medium for the teaching of structured, organized programming.

It has evolved since then into a general-purpose language that's also used extensively for business and scientific programs. Pascal is taught in hundreds of high schools and universities, and the Scholastic Aptitude Test (SAT) advanced-placement test in computer science is based on Pascal. There are several Pascal software packages available on disk for the Commodore 64.

PILOT

PILOT was developed in 1968 at the University of California at San Francisco Medical Center by John Starkweather to serve as a computer-aided instruction (CAI) tool. PILOT (Programmed Inquiry, Learning, Or Teaching) was planned as a programming system for nonprogrammers—sometimes called an authoring system—for development of teaching resources and testing.

It was to be used by teachers and administrators who were not expected to have programming knowledge. Therefore, the language is simple to use and particularly good for screen displays and for the kinds of True-False branching requirements used in testing. Consequently, it's not meant to be as sophisticated in the areas of computation and file-handling. Commodore markets a version of PILOT for the 64.

Forth

As with Pascal, there are several versions of Forth for the Commodore 64. Developed in the 1960s by Charles Moore, Forth was meant to be a jump ahead of the third-generation computers of the time—a "fourth generation" language. "Fourth" reportedly became "Forth" because Moore's IBM computer would allow a maximum of five characters as identifiers.

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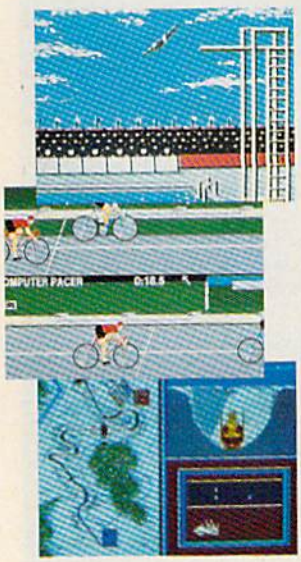

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A Buyer's Guide To Commodore 64 Languages

Language	Publisher	Price	Comments
Ada Training Course	Abacus Software, P.O. Box 7211, Grand Rapids, MI 49510	$59.95	Comprehensive subset of Ada language on disk.
BASIC Lightning	Oasis Software, 377 Oyster Point Blvd., Unit 15, San Francisco, CA 94080	$39.95	BASIC extension and graphics development system on disk.
COMAL 0.14 and COMAL 2.0	COMAL Users Group, USA, Ltd., 6041 Monona Drive, Madison, WI 53716	0.14 Version for $11; 2.0 for $89.95	0.14 Version includes demonstrations and interactive tutorial on disk, plus reference book; 2.0 is full COMAL implementation on cartridge.
C Power	Pro-Line Software, Ltd., 755 The Queensway East, Unit 8, Mississauga, Ontario, Canada L4Y 4C5	$99.95	C compiler; includes book with disk.
C-64 Forth/79	Performance Micro Products, P.O. Box 370, Canton, MA 02120	$69.95	Follows 1979 Forth standard; on disk.
Enhanced Forth	Accelerated Software, Inc., P.O. Box 129, Station A, Scarborough, Ontario, Canada M1K 5B9	Price not available	Follows FIG-Forth standard; on disk.
Forth-64 Language	Abacus Software, P.O. Box 7211, Grand Rapids, MI 49510	$39.95	Forth language, follows 1979 Forth standard and parts of 1983 standard.
Kyan Pascal	Kyan Software, Suite 183, 1850 Union Street, San Francisco, CA 94123	$49.95	Pascal language on disk with tutorial manual.
Logo	Commodore Business Machines, Inc., 1200 Wilson Drive, West Chester, PA 19380	$73.95	Disk-based Logo.
Master Forth	MicroMotion, 12077 Wilshire Blvd. #506, Los Angeles, CA 90025	$100	Follows the Forth 1983 standard; includes graphics system.
Nevada COBOL	Commodore, 1200 Wilson Drive, West Chester, PA 19380	$55.95	For experienced COBOL users; used with Commodore CP/M cartridge.
Nevada Fortran	Commodore, 1200 Wilson Drive, West Chester, PA 19380	$55.95	For experienced Fortran programmers; used with Commodore CP/M cartridge.
PILOT	Commodore, 1200 Wilson Drive, West Chester, PA 19380	$55.95	Educational language on disk.
PROMAL	Systems Management Associates, 3700 Computer Drive, P.O. Box 20025, Raleigh, NC 27619.	$49.95—end-user version; $99.95—developer's version	On disk.
Simons' BASIC	Commodore, 1200 Wilson Drive, West Chester, PA 19380	$34.95	BASIC extension on cartridge.
The Sixty Forth	Elcomp Publishing, Inc., 2174 West Foothill Blvd., Unit E, Upland, CA 91786	$39.95	Forth compiler on disk.
Super C Language Compiler	Abacus Software, P.O. Box 7211, Grand Rapids, MI 49510	$79.95	C compiler on disk.
Super Expander 64	Commodore, 1200 Wilson Drive, West Chester, PA 19380	$29.95	BASIC extension on cartridge.
Superforth 64	Parsec Research, Drawer 1766, Fremont, CA 94538	$59.95	Follows 1979 Forth standard.
Superforth 64 + Artificial Intelligence (AI)	Parsec Research, Drawer 1766, Fremont, CA 94538	$99	Forth language, plus expert systems development module.
Super Pascal	Abacus Software, P.O. Box 7211, Grand Rapids, MI 49510	$59.95	Pascal language development system, also includes graphic toolkit and fast DOS.
UltraBASIC-64	Abacus Software, P.O. Box 7211, Grand Rapids, MI 49510	$42.95 on disk; $39.95 on cassette tape	BASIC extension on disk or cassette tape.
Video BASIC-64	Abacus Software, P.O. Box 7211, Grand Rapids, MI 49510	$39.95	BASIC extension adds more than 50 graphic, sound, and utility commands.
White Lightning	Oasis Software, 377 Oyster Point Blvd., Unit 15, San Francisco, CA 94080	$49.95	Forth language on disk; includes BASIC Lightning.

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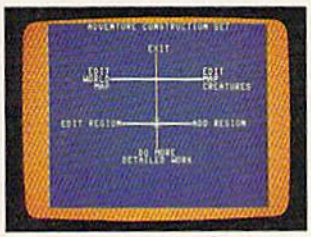

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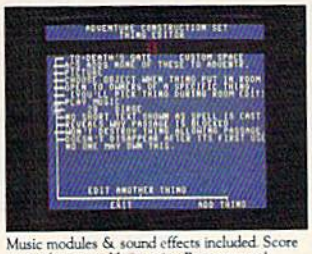

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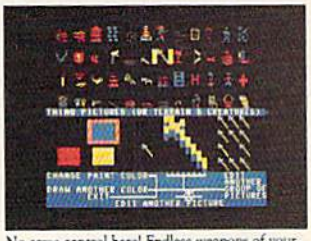

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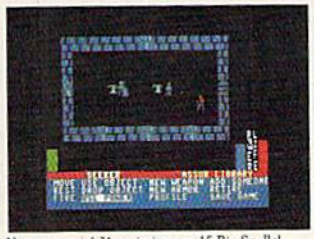

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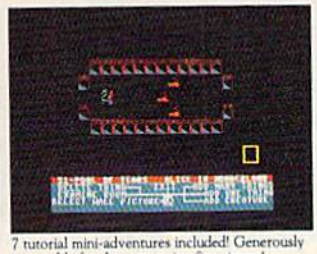

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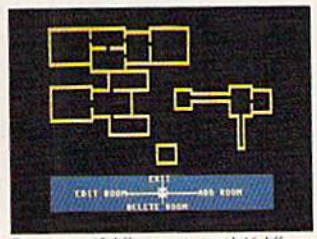

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Like Logo, Forth is an extensible programming language, but with quite a different approach from most languages. It's considered a mid-level language, somewhere between the high-level languages like BASIC and machine language. Forth, like Logo, is extensible. Words from its command vocabulary can be used to define other words which in turn become part of the vocabulary. You're essentially writing your own computer language based around Forth. Like Pascal, Forth separates programming into structured modules.

First used to control the movements of a large telescope, Forth's development over the years has resulted in several different standards. Each standard represents a different stage of evolution in the continuing growth of Forth.

The popularity of Forth is probably best expressed in FIG, the Forth Interest Group, a California-based non-profit support organization which has a membership of over 5,000 Forth users worldwide. For more information, contact FIG at P.O. Box 8231, San Jose, CA 95155. A FIG hotline is staffed to answer Forth-related questions at (408) 277-0668. And the FIG Tree is an on-line computer database which offers Forth information through your computer at (415) 538-3580. (Once connected by modem, hit the RETURN key twice to start.)

COMAL

When Borge Christensen of Denmark created COMAL (COMmon Algorithmic Language) during the early 1970s, he was seeking to replace BASIC as the major programming language in schools and homes. He reportedly wanted to keep the interactivity of BASIC but add to it the structure of Pascal. The resulting language has continued to gain popularity in both Europe and in the U.S., especially in schools. COMAL is generally regarded as a language easy to learn and use, with a structured form that makes teaching the language less confusing. The editing capabilities are extensive, and programming is modular.

The most popular versions of COMAL are for Commodore computers since the language is particularly suited for the Commodore's features. Two versions are available for the 64, the earlier COMAL 0.14 on disk and the fully implemented COMAL 2.0 on cartridge, both from the COMAL Users Group USA, Ltd., 6041 Monona Drive, Madison, WI 53716.

C

Created in 1972 by Dennis Ritchie, the C programming language has become very popular, especially within the last few years. Its power and transportability from one computer to another have made it the language of choice for much of the applications programming for Apple's Macintosh, Atari's 520 ST, and Commodore's new Amiga. (See "C: Language of the Future?" in the October issue and "Horizons: Another Look at C," elsewhere in this issue.) But there are also at least a couple of versions available for the Commodore 64 as well. It's popular among software developers for two reasons: C programs usually run faster than programs written in other languages (except machine language), and once a program has been written, it can be translated fairly easily to run on other machines.

PROMAL

PROMAL (PROgrammer's Micro Application Language) is a recent addition to the languages available for the 64. This high-level language is structured in ways similar to C and Pascal, and emphasizes simplicity, power, and speed. Created by Systems Management Associates (SMA), PROMAL is meant to appeal to a wide range of programmers who have at least a working knowledge of BASIC or another high level language. In addition to the "end-user" version of PROMAL, there's a developer's version for those who wish to create professional quality programs and market them.

In addition to the languages already mentioned, there are several other packages for the Commodore 64 which you may wish to investigate. Commodore sells versions of two programming languages used primarily in business and science, *Nevada COBOL* (COmmon Business Oriented Language) and *Nevada FORTRAN* (FORmula TRANslator). COBOL and FORTRAN were both created in the 1950s, the former to handle business programming tasks and the latter as an aid to scientists and engineers. The Commodore 64 versions are aimed at experienced programmers, and must be used with the CP/M (Control Program for Microcomputers) cartridge. According to Commodore, both the COBOL and FORTRAN disks are compatible with CP/M 3.0, which is built into the 128.

Also for the 64, Abacus Software sells a package called the *Ada Training Course*, an introduction to a programming development system used extensively by the Department of Defense. Although it would be impossible to implement the entire Ada system on a 64, the package is useful for its structured programming techniques and its introduction to Ada and to compilers (utility programs which translate high-level language into machine code).

Although there are literally hundreds of different programming languages and variations of languages, those available for the Commodore 64 will give you an excellent introduction into the major categories of programming languages and development systems beyond BASIC.

For more specific information on languages for your 64, see the accompanying chart, "A Buyer's Guide to Commodore 64 Languages."

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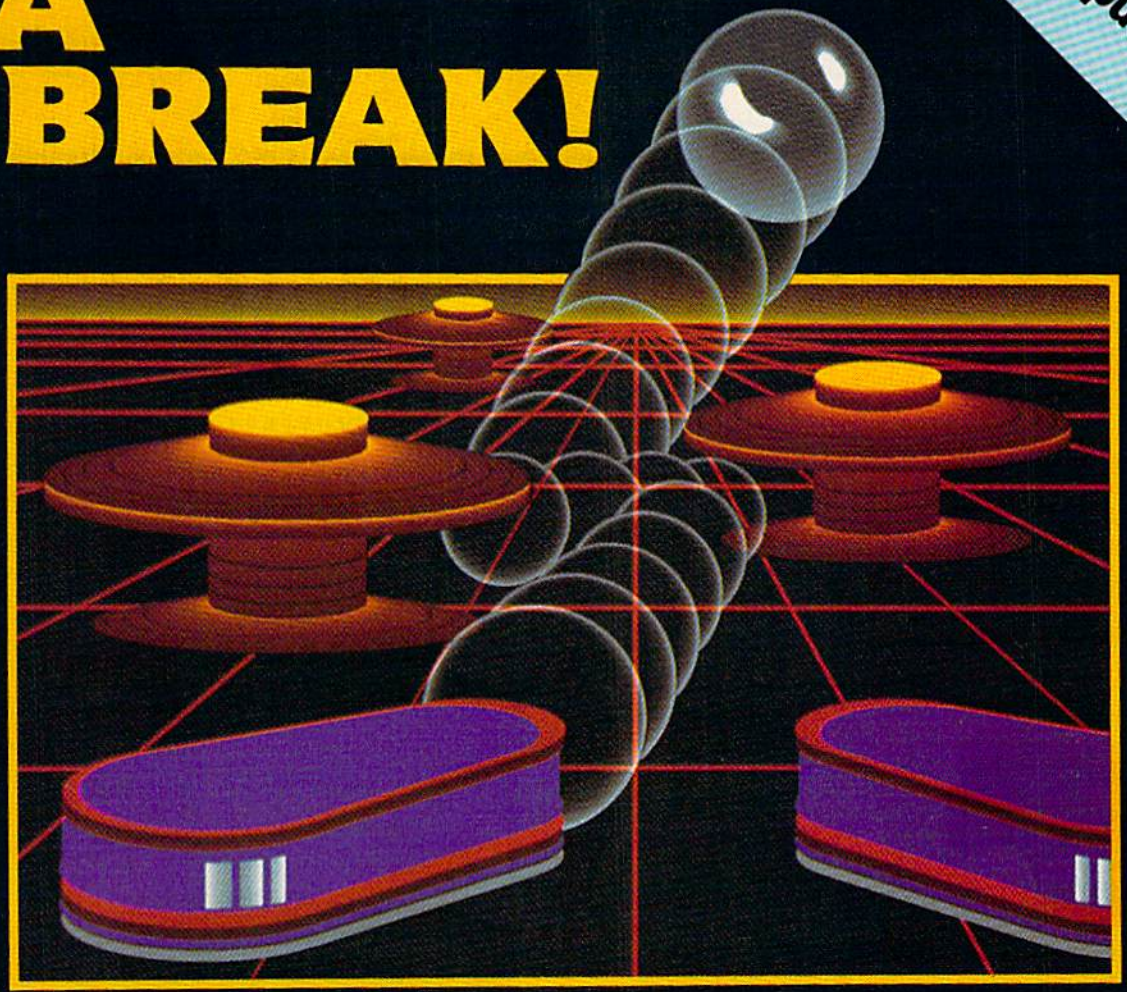

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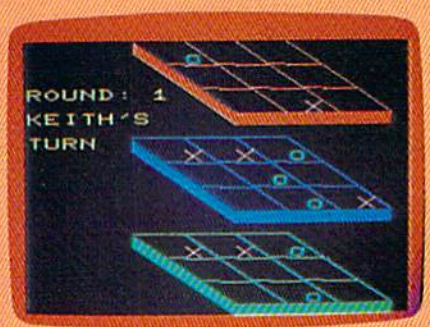

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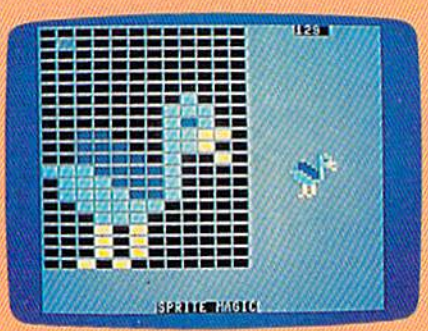

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35AD02

The Natural Approach to Computer Languages

Selby Bateman, Features Editor

How would you like to converse with your computer just as you do with another person? No special programming languages with unfamiliar commands, statements, and symbols—simply conversational English. Researchers in the fields of artificial intelligence, expert systems, and robotics are working toward that goal. They're still a long way from achieving it, but the results so far are changing the way we think about and use computers.

At an automated factory, a plant manager uses ordinary English phrases to type in the day's orders to a roomful of computer-controlled robots. He keys in quotas, suggests adjustments for several specialized robotic arms, and reprograms the work assignments of a group of the machines. The factory's computer system translates the English commands into machine code, asks for clarification on one order, and soon the robots are at work.

At a nearby hospital, a doctor races to diagnose a sick child, using a computer-based expert system. Engaging in a written dialogue with the computer, she types in the symptoms and notes relevant factors in the youngster's medical history. The diagnostic program replies with a battery of related questions and then suggests several diagnoses for the physician to consider.

In a schoolroom across the city, a computer quizzes a student on a history lesson, then answers questions that the student asks. Spotting a weakness in one area of the student's understanding, the computer program suggests several readings to be completed before the next lesson.

In these situations, individuals with no programming background are communicating with computers in ordinary English as they direct actions, solve problems, and search for answers. The examples represent three of the most promising areas of advancement in using ordinary English language to communicate with computers—industrial robotics, expert systems, and interactive databases. Such scenes may well be common within a few years thanks to recent developments in artificial intelligence research and the continuing improvements in computer hardware and software.

While natural language research has gone on for more than 40 years, the subject remains a complex and controversial one. The complexities of human language, including the use of common sense and context to differentiate meaning, continue to elude researchers seeking to codify those rules within a computer system. In fact, there are those who believe that a true natural language for computers will always stay beyond reach. Others feel that natural languages will one day be the dominant method of computer-human communication.

New menu-driven user interfaces, with easy to understand symbols, or icons, are being implemented extensively to help the average person use computers in applications ranging from 24-hour money machines to information kiosks and library catalog systems. New-generation computers like the Apple Macintosh, the Atari ST, and the Amiga from Commodore feature graphics-based interfaces rather than text-based operating system commands which intimidate many beginners.

But a real natural language must go beyond menus and icons. It should allow interactive conversations between the user and the computer system. And that has proven far more complex than researchers initially thought.

One of the first efforts in natural language research came just after World War II, when computer scientists built machines to translate one language to another. A translation machine looked up each word in a built-in dictionary, found what was supposed to be its foreign language equivalent, and then altered the syntax of the message to correspond to the new language.

But the limitations of such a primitive syntax-based system soon became apparent. For instance, the English-language phrase "The spirit is willing but the flesh is weak," when translated to Russian by one of the early machines, reportedly became "The vodka is strong but the meat is rotten."

Undaunted, a handful of scientists at Stanford, Yale, M.I.T., Cal Tech, and a few other universities developed artificial intelligence research centers to carry their efforts beyond the early attempts. They've continued their work, and their debate, through the years.

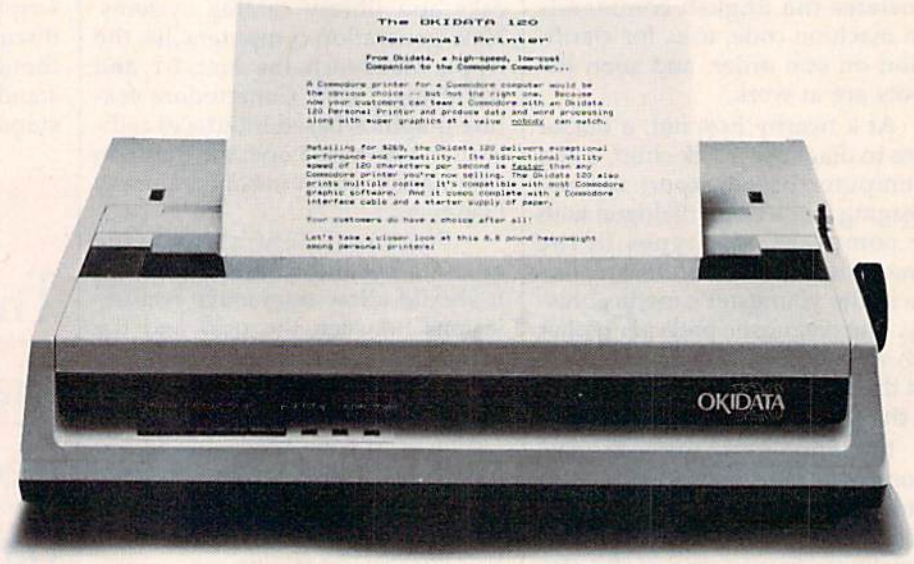
Computer pioneer Joseph Weizenbaum developed one of the most publicized natural language simulation programs at M.I.T. in 1966. Called *Eliza*, the program seemed to understand English statements and questions. The software was written in an extension of the Fortran programming language, called Slip. Other versions, some watered down from the original, were later written in Lisp and also in BASIC.

Weizenbaum reportedly centered the original *Eliza* on two components of operation: a parser, which breaks down each sentence to determine word meaning, and a script system, or a list of rules for discussing particular subjects. Although the program didn't understand English, it seemed to understand based on a simple technique of template, or pattern, matching. *Eliza* was only a trick, not an example of a true natural language at work. Weizenbaum never meant to suggest that it was an example of artificial intelligence, and the publicity given to the program at the time surprised him.

The promise is that millions of people may one day be able to control computer environments through ordinary language.

Versions of *Eliza* are still available for the Commodore 64. And a new program, *Racter* from Mindscape, Inc., for the IBM PC, Apple II, and Macintosh computers, goes even further along the same lines by generating poems and prose monologues in addition to what seems to be an interactive dialogue with the user.

Left Brain.



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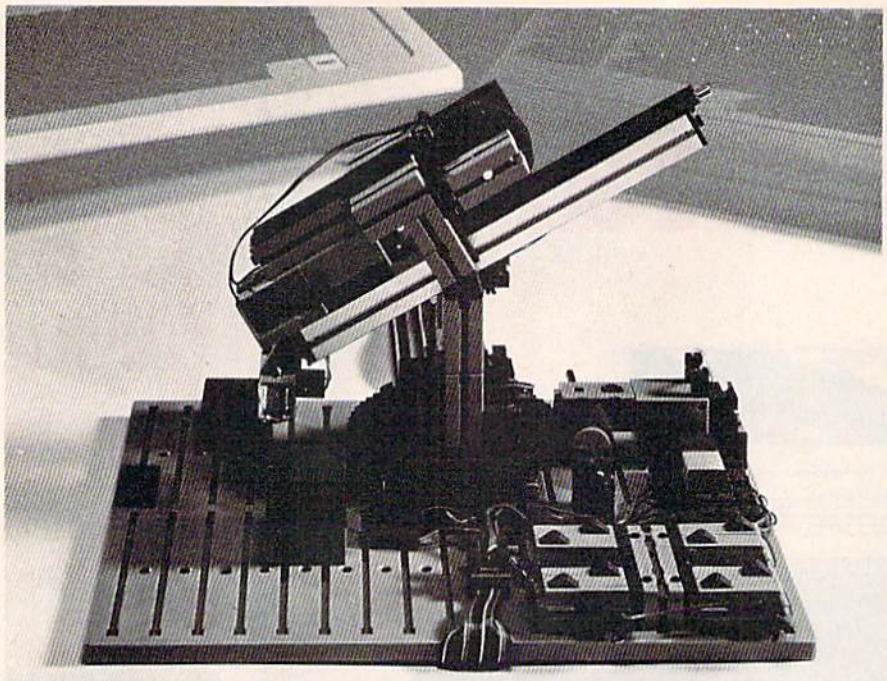

Using a natural language called PaRCL, Commodore 64 owners program this FischerTechnik robotic computer kit.

Natural language research has evolved along several different lines over the years, moving away from the idea that a natural language can be based primarily on defining words and changing a sentence's syntax. To really work, a natural language must not only be able to handle the words, grammar, and syntax of human language, but also the meaning as it shifts from the context of one application to the context of another. It must also be able to distinguish metaphors, logical connections between statements, the plausibility of statements, and hundreds of other factors. To do all of that, some researchers believe it may require a mammoth knowledge base of the way the world works and thousands of rules. It may also require a computer program which can generate its own rules—learning as it goes along.

Limited though they may be, commercial natural language systems have been on the market since the late 1970s. Their purposes and levels of use vary greatly, however, from robotic controllers to "smart" databases. The promise behind such research is that millions of people who have no desire or aptitude for learning formal computer languages may one day be able to control computer environments through ordinary language.

For example, by the early 1990s, more than 100,000 robots are expected to be used in U.S. factories, according to estimates by the Robot Institute of America, an industry support association. Can some or most of those robotic workers be controlled by people who don't know computer programming?

"That's pretty much the trend coming out of the laboratories presently in robotics applications," says Allen Amaro, chief executive officer of Parsec Research in Fremont, California. "They want the average operators to be able to control the robotics configurations. And in order to do that, you have to have a natural language front end."

Amaro's company has recently been involved in just such a natural language robotics project, one that Commodore 64 (and Apple II and IBM) owners can take part in as well. The FischerTechnik computer robotics kit is a $199 package of precision electromechanical parts, computer software, and interface which lets you build and program your own robotics experiments.

The robotics laboratory is offered with a new natural language program, called PaRCL (pronounced "parkul"), with which you program your robotic experiments. The system gives nonprogrammers a chance to learn the basics of robotics through hands-on activity. Teachers can use the system to teach everything from simple programming to robotic fundamentals. And engineers will find a variety of sophisticated options which follow in miniature many industrial robotic operations.

"We're presently manufacturing the interface for FischerTechnik of West Germany," says Amaro. "But in addition to that, we've written the software. The original product they're releasing uses BASIC. What we've done is transform the whole system into what is not only a very powerful educational tool, but the language we're using is presently being introduced into the robotics community industrywide."

Based on the programming language Forth, PaRCL uses English words written in a simple syntax. With the 249-piece construction set and the PaRCL language, you build ten different projects and learn to use reversible motors, gears, digital and analog inputs, outputs, position sensors, lamps, and switches. A dual-axis robot arm simulates industrial processes physically and in the operating language.

The robotics kit is being marketed through retail stores in the U.S. by Fischer America, a division of Fischer International, which has extensive experience with industrial robotics. The system is also available directly through Parsec Research (P.O. Box 1766, Fremont, CA 94538).

One of the most practical applications in natural language development is the area of computer databases. Originally found on mainframe systems, newer microcomputer database programs have been developed that let nonprogrammers create the environment they need for virtually any type of database. That is, you type in your query, in English, and the database translates the words into a computer language, gets the answer, and displays it on the screen. If you wish to redefine or restructure the database, the system lets you do that without having to know a computer language.

The most powerful natural language systems are still tied to mainframe or supermini computers, especially to those with large database

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—James Levy, Chairman/CEO Activision, Inc.

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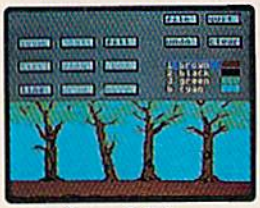
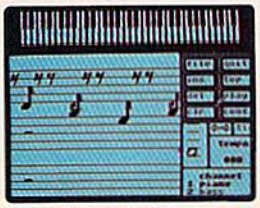


SceneMaker

SpriteMaker

SoundMaker



MusicMaker

The Editor

"(GameMaker is)...designed for everyone who has ever wanted to build his own computer game, but never had the time to learn assembly language."

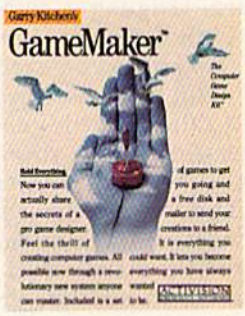
—Ric Manning/Louisville Times

There's no question! Now is the time to turn that great game idea of yours into a real piece of computer software. With GameMaker, Garry Kitchen brings you the single most powerful computer game design tool ever offered. But he didn't stop with just power. He put all the tools of his trade together and then made them more accessible than ever before for owners of the Commodore 64/128 and the Apple II series computers. GameMaker includes these incredible tools:

SceneMaker. Create the background scenes for your game. Either use scenes that have been pre-programmed or create scenes of your own.

SpriteMaker. Create the characters or objects that move in your game. Use full animation to make them life-like. You can select from many pre-programmed sprites or you can create almost any kind you can imagine.

SoundMaker. Smashing, blasting, singing, whooshing and a whole lot more can be created, or you can select from a variety of commonly-used effects already created for you.



MusicMaker. A little musical introduction for your creation? How about some background music or a grand finale? You can create it all.

The Editor. This is where you bring together all the components you created with SceneMaker, SpriteMaker, SoundMaker, and MusicMaker. All the commands needed to make a game program are listed for you. Just choose the ones you want to use, put them in order, and presto! Your new game is off and running.

The Design Contest.

If you've always thought you had some great ideas for games (and you know you have), there's never been a better time or a better way to get them on a disk. Because you can enter the GameMaker Design Contest, and, if your game is judged to be the best, we'll publish it! And that will make you a published software designer. Has a nice ring to it, doesn't it? Published...Software...Designer. Design the most exciting and creative computer game you can imagine and send it to us. All the rules and information for this unique contest are in specially-marked GameMaker packages. Gentlemen—and ladies—start your minds.

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A Language Of Convenience:

Keyboard Macros

As a computer user, you may have seen certain commercial productivity programs available which use templates, or preprogrammed forms. There are form letters for word processors, budget forms for spreadsheets, address file forms for databases, and so on. A growing number of programs offer these preset templates to free you from having to set up your own.

In most cases, templates can be customized even further to suit your personal needs. And many of the commercial templates let you achieve customized forms without having to alter the actual code in which the original template is written. It can be done with a few keystrokes.

Related to customized templates are much more powerful and flexible tools, *macros*, which have gained popularity as many high-end commercial programs become more complex. But the term itself originated in the world of computer programming.

Machine language programmers often use shortcuts called *macroinstructions* (or "macros" for short) to speed up their programming. A macro is a preprogrammed group of assembly language microinstructions. By using macros, a programmer avoids writing and rewriting often-used routines. Simply plug in the name of the appropriate macro and the assembler automatically inserts the proper code.

A different sort of macro is built into the Commodore 128 and Plus/4. Press the f3 key and the word DIRECTORY appears. A disk directory automatically prints to the screen. You could type DIRECTORY yourself, but why press nine keys (plus RETURN), when a single key does it all? Programmable keys can save a lot of typing time.

This approach is also being used regularly in sophisticated application programs to save repetitive or time-consuming steps. For example, *Lotus 1-2-3*, a popular integrated productivity package for IBM and other MS-DOS computers, offers users the option of setting up keyboard macros. Frequently repeated procedures or commands can be assigned to one or two keystrokes. Thereafter, when that procedure is needed, you have a shortcut to save you time.

The problem for many people in setting up macros on *Lotus 1-2-3* is that the system is not a simple one to get used to. The options are plentiful, and the result is that making macros can become like learning a small programming language. In fact, numerous magazine articles—and even books—have been devoted to explaining the advanced customizing features of *1-2-3*. Other productivity software such as *SuperCalc*, *VisiCalc*, and *dBase II* also have macro capabilities. They're generally easier than *1-2-3* to use with macros, but not quite as powerful.

With macros, even a nonprogrammer can customize a piece of software in many ways. Let's say that your word processor has a four-step, eight-keystroke command sequence to redefine the margins—top and bottom, left and right. A macro might be programmed to do that for you with one or two keystrokes. If you also want to have the right edge of your text justified, that could be added to the same macro. With the right software, almost any word, phrase, sentence, paragraph, or larger combination of characters can be made into a macro.

Or, suppose you regularly log on to one of the major telecommunications services like CompuServe. Rather than go through the log-on procedures of dialing the number, giving your identification number and then your password, a macro can be made to do all of that with one keystroke.

The popularity of these keyboard enhancers is reflected in the number of stand-alone macro makers now on the market. Products like *SuperKey*, *ProKey*, *SmartKey*, *Keyworks*, and others are in growing demand, especially in the business environment where repetition of procedures is necessarily frequent. The programs are usually loaded into the computer prior to the loading of an application, such as a spreadsheet. They reside in memory behind the application program, providing keyboard shortcuts to just about any function you need.

systems. And these commercial natural language packages still cost thousands of dollars. One example is the Artificial Intelligence Corporation's (Waltham, Mass.) *Intellect* program, which lets you ask questions of a database system in ordinary English, then converts the query into the program's language. Another commercial natural language system is *Themis* from Frey Associates of Amherst, New Hampshire, a program which allows you to add words easily to its base vocabulary in addition to supplying a natural language interface.

Some of the most optimistic expectations for the development of natural languages come from Japan's Fifth Generation computer project. This massive government-backed effort to move beyond today's so-called fourth-generation computers includes a strong component of natural language research. The goal is to have systems which will contain as many as 20,000 rules and a hundred million data items from which to draw. It's hoped that these computers will be able to make inferences from their knowledge bases, fill in gaps between logical statements, create their own data indexes from external sources, and differentiate among different possible meanings within the same sentence constructions. But much more work must be done before any of these capabilities are achieved.

Despite the setbacks and slow progress associated with natural language interfaces for computers, hardware and software manufacturers realize the long-range importance of advances in this field. In order to involve the bulk of the population in computing, the machines themselves must become easier to use, less intimidating, and more productive. And one of the most important steps in attracting these people is more plain talk between computers and humans.

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The New MLX

Enhanced Machine Language Editor For The Commodore 64

Ottis R. Cowper, Technical Editor

This significantly improved version of COMPUTE!'s GAZETTE "MLX" utility will help you enter machine language program listings without typos. It's more foolproof than the old MLX and is easier to use, too—especially for beginners. The new MLX is required to enter all Commodore 64 and 128 (in 64 mode) machine language programs published in COMPUTE!'s GAZETTE, beginning in this issue.

Since its initial publication in the December 1983 issue of COMPUTE!'s GAZETTE, our "MLX" machine language editor has helped thousands of readers type in dozens of ML programs with a minimum of problems. MLX detects most common typing mistakes as they're made. However, your growing appetite for high-quality programs is leading us to publish longer and longer listings. Lengthy programs demand a more efficient entry system, so this month we're introducing a new MLX with important enhancements:

• A much more compact format. With each line of a new MLX listing, you enter eight bytes of data with 18 keystrokes, as opposed to only six bytes of data in 21 keystrokes when using the original MLX. This means you can enter machine language programs with 40 percent less typing.

• A more sophisticated checksum scheme. Transposition errors that could slip past the original MLX are caught by this version. Typing mistakes are now virtually impossible.

• A buffer (reserved area of memory) that holds the data you enter instead of direct storage in memory. This means that you'll never again have to worry with those bothersome POKEs that were sometimes necessary to reconfigure memory before using the old MLX.

Hexadecimal Checksums

Type in and save a copy of the new MLX. You'll need it for all future machine language programs in COMPUTE!'s GAZETTE, as well as ML programs in our companion magazine, COMPUTE!, and COMPUTE! books.

When you're ready to enter an ML program, load and run the new MLX. It asks you for a starting address and ending address. These addresses appear in the article accompanying the MLX-format program listing you're typing. If you're unfamiliar with machine language, the addresses (and all other values you enter in MLX) may appear strange. Instead of the usual decimal numbers you're accustomed to, these numbers are in *hexadecimal*—a base 16 numbering system commonly used by ML programmers. Hexadecimal—hex for short—includes the numerals 0–9 and the letters A–F. But don't worry—even if you know nothing about ML or hex, you should have no trouble using the new MLX.

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Mitey Mo turns your Commodore 64 into a telecommunications giant. It's the best-performing modem with upload/download.

Mitey Mo is being hailed as "the best price/performance communications package available." Its software has received the endorsement of the U.S. Commodore Users Group, which gives a money-back guarantee to members. It is truly the industry standard, and no wonder. It's the most user-friendly modem you can buy—it will take you online faster and easier than anything else.

Mitey Mo opens up a world of practical and exciting uses for your C-64. It lets you send and receive electronic mail, link up with community bulletin boards, play computer games with people in distant places, tap into library resources, and much more. All at your convenience.

Until Mitey Mo, Commodore's 1650 Automodem was the obvious choice when you went looking for a modem for your computer. Like Mitey Mo, it has "auto answer"—it receives data while unattended. And both modems are "auto dialers"—you dial right on the computer's keyboard. But that's about where the similarity ends.

Mitey Mo can dial up to 9 numbers sequentially. But suppose you dial a number and find it's busy. Mitey Mo has "auto redial"—it hangs up and redials immediately until it gets through. With the other modem you have to redial each time—and somebody with auto redialing can slip in ahead of you.

Mitey Mo is menu driven. It lists the things you can do on the screen. Select a number and you're on your way. Since Automodem isn't menu driven, you'll be hunting through the manual a lot.

With Mitey Mo, your computer's function keys are programmable—you can save yourself plenty of keystrokes. Not so with the other modem. And only Mitey Mo lets you store data to review or print it later.

Mitey Mo has just one switch, the Smart 64 software does the rest. With the other modem you'll have to remember to check three switches, otherwise you may be answering when you mean to be originating.

Mitey Mo is half the size of the other modem. The very latest technology allows miniaturization and increased reliability, as well. Mitey Mo is so reliable, we gave it a full three-year warranty. The other modem gives 90 days, then you're on your own.

Not only will you find Mitey Mo mighty useful, you'll find it mighty reasonably priced. When you buy it, you'll get $15 of CompuServe access time and 2 hours of PlayNet free, as well. See your dealer or call us directly to order your Mitey Mo.

MODEM FEATURES	MITEY MO	COMMODORE AUTOMODEM
Auto Dial/Answer	YES	YES
Auto Redial	YES	NO
Smart 64 Software	YES	NO
Function Keys Programmable	YES	NO
Upload/Download Text & X-Modem	YES	NO
VT-52/VT-100 Emulation	YES	NO
Menu Driven	YES	NO
28K Software Buffer	YES	NO
Easy-to-Use Manual	YES	NO
Bell 103 Compatible	YES	YES
Multiple Baud Rates	YES	YES
Cable Included	YES	YES
Single Switch Operation	YES	NO
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After you enter the starting and ending addresses, MLX offers the option of clearing the workspace. Choose this option if you're starting to enter a new listing. If you're continuing a listing that's partially typed from a previous session, don't choose this option.

It's not necessary to know more about this option to use MLX, but here's an explanation if you're interested: When you first run MLX, the workspace area contains random values. Clearing the workspace fills it with zeros. This makes it easier to find where you left off if you enter the listing in multiple sittings. However, clearing the workspace is useful only before you first begin entering a listing; there's no need to clear it before you reload to continue entering a partially typed listing.

When you save your work with the new MLX, it stores the entire contents of the data buffer. If you clear the workspace before starting, the incomplete portion of the listing is filled with zeros when saved and thus refilled with zeros when reloaded. If you don't clear the workspace when first starting, the incomplete portion of the listing is filled with random data. Whether or not you clear the workspace before you reload, this random data will refill the unfinished part of the listing when you load your previous work. The rule, then, is to use the clear workspace feature before you begin entering data from a listing, and not bother with it afterward.

At this point, MLX presents a menu of commands:

```
Enter data
Display data
Load data
Save file
Quit
```

You no longer have to remember SHIFT command keys as in the original MLX. Instead, just press the letter of a menu option. These commands are available only while the menu is displayed. You can get back to the menu from most options by pressing RETURN with no other input.

Entering A Listing

To begin entering data, press E. You'll be asked for the address at which you wish to begin entering data. (If you pressed E by mistake, you can return to the command menu by pressing RETURN.) When you begin typing a listing, you should enter the starting address here. If you're typing in a long listing in multiple sittings, you should enter the address where you left off typing at the end of the previous session. In any case, make sure the address you enter corresponds to the address of a line in the MLX listing. Otherwise, you'll be unable to enter the data correctly.

After you enter the address, you'll see that address appear as a prompt with a nonblinking cursor. Now you're ready to enter data.

To help prevent typing mistakes, only a few keys are active while you're entering data, so you may have to unlearn some habits. The new MLX listings consist of nine columns of two-digit numbers—eight bytes of data and a checksum:

```
C000:A9 0C 8D 15 D0 A9 FF 8D 17
C008:3B 63 8D 3C 63 A9 01 8D C6
C010:01 58 A9 00 8D 33 63 20 7D
C018:0B C5 20 C1 CB A9 FF 8D 43
```

You *do not* type spaces between the columns; the new MLX automatically inserts these for you. You *do not* press RETURN after typing the last number in a line; the new MLX automatically enters and checks the line after you type the last digit. The only keys you need for data entry are 0–9 and A–F. Pressing most of the other keys generates a warning buzz.

To correct typing mistakes before finishing a line, use the INST/DEL key to delete the character to the left of the cursor. (The cursor-left key also deletes.) If you mess up a line really badly, press CLR/HOME to start the line over.

The RETURN key is also active, but only before any data is typed on a line. Pressing RETURN at this point returns you to the command menu. After you type a character of data, the new MLX disables RETURN until the cursor returns to the start of a line. Remember, you can press CLR/HOME to quickly get to a line number prompt.

Beep Or Buzz?

After you type the last digit in a line, MLX calculates a checksum of the line number and the first eight columns of data, then compares it with the value in the ninth column. The formula (found in lines 370–390 of the MLX program) catches almost every conceivable typing error, including the transposition of entire numbers that the original MLX could miss. If the values match, you'll hear a pleasant beep, the data is added to the workspace area, and the prompt for the next line of data appears (unless the line just entered was the last line of the listing—in which case you'll automatically advance to the Save option). But if MLX detects a typing error, you'll hear a low buzz and see an error message. Then MLX redisplays the line for editing.

To edit a line, move the cursor left and right using the normal cursor controls. (The INST/DEL key now works as an alternative cursor-left key.) You cannot move left beyond the first character in the line. If you try to move beyond the rightmost character, you'll reenter the line.

To make corrections in a mistyped line, compare the line on the screen with the one printed in the listing, then move the cursor to the mistake and type the correct key. During editing, RETURN is active; pressing it tells MLX to recheck the line. You can press the CLR/HOME key to clear the entire line if you want to start from scratch, or if you want to get to a line number prompt to use RETURN to get back to the menu.

Other MLX Functions

The Display data option lets you review your work. Unlike the original MLX, the new MLX calculates and displays checksums for each line. Thus, a quick way to check your typing is to compare the reverse video checksums on the screen with the data in the rightmost column of the printed listing. If the values match, you can be confident that the line is entered correctly.

When you select D, you'll be asked for a starting address. (As with the other menu options, pressing RETURN at this point takes you back to the command menu.) When entering an address, make sure it corresponds to the address of a line from the listing. Otherwise, the checksums will be meaningless. You can pause the scrolling display by pressing the space bar. (MLX

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finishes printing the current line before halting.) To resume scrolling, press the space bar again. The display continues to scroll until the ending address is reached, then the menu reappears. To break out of the display and return to the menu before the ending address is reached, press RETURN.

The Save and Load menu options are straightforward. First, MLX asks for a filename. (Again, pressing RETURN at this prompt without entering anything returns you to the command menu.) Next, MLX asks you to press either T or D for tape or disk. If you notice the disk drive starting and stopping several times during a load or save, don't panic; MLX opens and reads from or writes to the file instead of using the usual LOAD and SAVE commands, so this behavior is normal. Disk users should also note that the drive prefix 0: is automatically added to the filename (line 750), so this should *not* be included when entering the name. (This also precludes the use of @ for Save-with-Replace, so remember to give each version you save a different name.)

Remember that MLX saves the entire workspace area from the starting address to the ending address, so the save or load may take longer than you might expect if you've entered only a small amount of data from a long listing. When saving a partially completed listing, make sure to note the address where you stopped typing so you'll know where to resume entry when you reload.

Error Alert

MLX reports any errors detected during the save or load. Tape users should bear in mind that the Commodore 64 is never able to detect errors when saving to tape. The new MLX also has three special load error messages:

• INCORRECT STARTING ADDRESS. This means the file you're trying to load does not have the starting address you specified when you ran MLX. If you feel certain you're trying to load the right file, exit and rerun MLX, being careful to enter the correct starting address.

• LOAD ENDED AT *address*. This means the file you're trying to load ends before the ending address you specified when you started MLX. If you feel certain that you've loaded the right file, exit and rerun MLX, being careful to enter the correct ending address.

• TRUNCATED AT ENDING ADDRESS. This means the file you're trying to load extends beyond the ending address you specified when you started MLX. If you feel certain that you've loaded the right file, exit and rerun MLX, being careful to enter the correct ending address.

The Quit menu option has the obvious effect—it stops MLX and enters BASIC at a READY prompt. Since the RUN/STOP key is disabled, Q lets you exit the program without turning off the computer. (Of course, RUN/STOP–RESTORE also gets you out.) If you choose this option, MLX asks for verification. Press Y to exit to BASIC, or any other key to return to the menu. After quitting, you can type RUN again and reenter MLX without losing your data, as long as you don't use the clear workspace option.

The Finished Product

When you've finished typing all the data for an ML program and saved your work, you're ready to see the results. Unlike the original MLX, this version keeps the data in a temporary holding area rather than in its final resting place in memory, so you must always save the finished program with MLX and then reload it from BASIC with a standard LOAD command.

The instructions for loading the finished product varies from program to program. Some ML programs are designed to be loaded and run like BASIC programs, so all you need to type is LOAD *"filename"*,8 for disk or LOAD *"filename"* for tape, and then RUN. (Such programs usually have 0801 as their MLX starting address.) Others must be reloaded to specific addresses with a command such as LOAD *"filename"*,8,1 for disk or LOAD *"filename"*,1,1 for tape, then started with a SYS to a particular memory address. (On the Commodore 64, the most common starting address for such programs is 49152, which corresponds to MLX address C000.) In either case, you should always refer to the article which accompanies the ML listing for information on loading and running the program.

An Ounce Of Prevention

By the time you finish typing in the data for a long ML program, you'll have several hours invested in the project. Don't take chances—use our "Automatic Proofreader" to type the new MLX, and then test your copy *thoroughly* before first using it to enter any significant amount of data. (Incidentally, the new MLX is included on this month's COMPUTE!'s GAZETTE DISK.) Make sure all the menu options work as they should. Enter fragments of the program starting at several different addresses, then use the Display option to verify that the data has been entered correctly. And be sure to test the Save and Load options several times to ensure that you can recall your work from disk or tape. Don't let a simple typing error in the new MLX cost you several nights of hard work.

See program listing on page 136.

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If you have been looking very long, you have probably discovered that there are just too many claims and counter claims in the printer market today. There are printers that have some of the features you want but do not have others. Some features you probably don't care about, others are vitally important to you. We understand. In fact, not long ago, we were in the same position. Deluged by claims and counter claims. Overburdened by rows and rows of specifications, we decided to separate all the facts — prove or disprove all the claims to our own satisfaction. So we bought printers. We bought samples of all the major brands and tested them.

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We wanted to find that printer which had all the features you could want and yet be sold directly to you at the lowest price. We didn't want a "close-out special" of an obsolete product that some manufacturer was dumping, so we limited our search to only those new printers that had the latest proven technology. We wanted to give our customers the **best** printer on the market today at a bargain price.

The Results Are In

The search is over. We have reduced the field to a single printer that meets all our goals (and more). The printer is the SP-1000 from Seikosha, a division of Seiko (one of the foremost manufacturers in the world). We ran this printer through our battery of tests and it came out shining. This printer *can* do it all. Standard draft printing at a respectable 100 characters per second, and with a very readable 12 (horizontal) by 9 (vertical) character matrix. This is a full bi-directional, logic seeking, true descender printer.

"NLQ" Mode

One of our highest concerns was about print quality and readability. The SP-1000 has a print mode termed Near Letter Quality printing (NLQ mode). This is where the SP-1000 outshines all the competition. Hands down! The character matrix in NLQ mode is a very dense 24 (horizontal) by 18 (vertical). This equates to 41,472 addressable dots per square inch. Now we're talking ***quality*** printing. It looks like it was done on a typewriter. You can even print graphics using the standard graphics symbols built into your computer. The results are the best we've ever seen. The only other printers currently available having resolution this high go for $500 and more *without* the interface or cable needed to hook up to your computer.

Features That Won't Quit

With the SP-1000 your computer can now print 40, 48, 68, 80, 96, or 136 characters per line. You can print in ANY of 35 character styles including 13 double width and 3 reversed (white on black) styles. You not only have the standard Pica, Elite, Condensed and Italics, but also true Superscripts and Subscripts. Never again will you have to worry about how to print H_2O or X^2. This fantastic machine will do it automatically, through easy commands right from your keyboard. Do you sometimes want to emphasize a word? It's easy, just use **bold** (double strike) or use *italics* to make the words stand out. Or, if you wish to be even more emphatic, underline the words. You can combine many of these modes and styles to make the variation almost endless. Do you want to express something that you can't do with words? Use graphics with your text — even on the same line. You have variable line spacing of 1 line per inch to infinity (no space at all) and 143 other software selectable settings in between. You can control line spacing on a dot-by-dot basis. If you've ever had a letter or other document that was just a few lines too long to fit a page, you can see how handy this feature is. Simply reduce the line spacing slightly and ... VOILA! The letter now fits on one page.

Forms? Yes!
Your Letterhead? Of Course!

Do you print forms? No problem. This unit will do them all. Any form up to 10 inches wide. The tractors are adjustable from 4 to 10 inches. Yes, you can also use single sheets. Plain typing paper, your letterhead, short memo forms, labels, anything you choose. Any size to 10" in width. In fact this unit is so advanced, it will load your paper automatically. Multiple copies? Absolutely! Use forms (up to 3 thick). Do you want to use spread sheets with many columns? Of course! Just go to condensed mode printing and print a full 136 columns wide. Forget expensive wide-carriage printers and changing to wide carriage paper. You can now do it all on a standard 8½" wide page, and you can do it quietly. The SP-1000 is rated at only 55 dB. This is quieter than any other impact dot matrix printer that we know of and is quieter than the average office background noise level.

Consistent Print Quality

Most printers have a ribbon cartridge or a single spool ribbon which gives nice dark printing when new, but quickly starts to fade. To keep the printers output looking consistently dark, the ribbons must be changed quite often. The SP-1000 solves this problem by using a wide (½") ribbon cartridge that will print thousands of pages before needing replacement. (When you finally do wear out your ribbon, replacement cost is only $11.00. Order *#2001.)*

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When shopping for a printer with this quality and these features, you could expect to pay around $500 or more. *Not now!* We sell this fantastic printer for **only $259.95! You need absolutely nothing else to start printing — just add paper.**

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Be sure to specify the order # for the correct version printer designed for your computer.

Commodore C-64 & C-128, Order #2200, cable included

IBM-PC and compatibles, Order #2100, plus 8' cable #1103, $26.00

Standard Parallel with 36 pin Centronics connector, Order #2400, no cable

We also have interfaces and cables for other computers not listed. Call Customer Service at 805/987-2454 for details.

Shipping and insurance is $10.00 — UPS within the continental USA. If you are in a hurry, UPS Blue (second day air), APO or FPO is $22.00. Canada, Alaska, Mexico are $30.00 (air). Other foreign is $70.00 (air). California residents add 6% tax. The above are cash prices — VISA and MC add 3% to total. We ship the next business day on money orders, cashiers' checks, and charge cards. A 14-day clearing period is required for checks.

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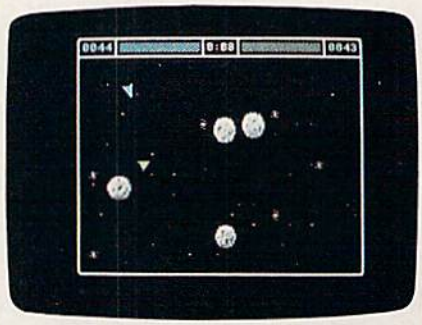
or send order to:

APROTEK
1071-A Avenida Acaso
Camarillo, CA 93010

Space Arena

Bryan Files



The blue spaceship (upper left) has scored a hit, causing the other ship to careen out of control into the path of an asteroid.

This engaging two-player game, which could have been titled "Indirect Aggression" for its unique design, features superior graphics and playability. For the Commodore 64 and 128 (in 64 mode). Two joysticks are required.

In a distant galaxy, a fierce war between two great empires has reached a stalemate. The cost to both civilizations has been high with no gain to either side. With the assistance of the Timelords, the two sides have agreed to settle the dispute in a controlled environment—a Space Arena.

Enclosed in this arena are four asteroids and a ship representing each side. Both ships are equipped with photon blasters, which have the ability to push objects without damaging them. A ship is destroyed only by a collision with an asteroid. The highest score within a given time determines the victor. One point is given each time a pilot hits the opposing ship with a photon blast. If the enemy's ship is destroyed by running into an asteroid, 20 points are awarded.

In "Space Arena," two people compete with their joystick-controlled ships. The movement is much like the classic arcade game *Asteroids*. Rotate the ship by moving the joystick left or right. Push the joystick forward to activate the ship's thrusters, and press the fire button to release a photon blast. Remember that you have no brakes; to slow down, you must turn the ship around and thrust in the direction you're moving. Game options include speed (1–3, where 1 is the slowest and 3 the fastest) and time limit (1–5 minutes).

There are two basic strategies to playing Space Arena. You can try to push your opponent into an asteroid, or push the asteroids into your opponent. The effect of photon blasts on asteroids is much less than on ships because the asteroids are heavier. A single photon blast can send a ship flying across the screen, especially if the ship has to turn around before being able to slow down. On the other hand, if your opponent is faced with several fast moving asteroids, he may crash into one on his own.

Typing It In

Space Arena is written entirely in machine language, so you must use MLX, the machine language entry program that appears regularly in the GAZETTE (a new, time-saving version of MLX appears beginning this month—see "The New MLX" elsewhere in this issue). When you run MLX, answer the initial questions as follows:

Starting Address: C000
Ending Address: CFB7

After entering the program, save a copy on tape or disk. To load the game, type LOAD "*filename*",8,1 for disk, or LOAD "*filename*",1,1 for tape, where *filename* is the name you used to save the program. To run it, type SYS49152.

If you'd rather not type in the program, send a blank tape or formatted disk, a self-addressed, stamped return envelope, and $3 (U.S. funds) for each copy. Outside the U.S., please don't send stamps but include the extra cost of postage. Please indicate that you want a copy of Space Arena. Send it to:

Bryan Files
404 Eastbrook Lane
O'Fallon, MO 63366

See program listing on page 130.

CAN WE TALK?

You Bet We Can!

Announcing The VOICE MESSENGER and EASY SPEECH For The Commodore 64 and 128.

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Welwyn/Currah along with Rist, Inc. are without a doubt the most innovative developers of computer speech technology. The VOICE MESSENGER and EASY SPEECH system was designed for all possible applications: educational, entertainment, business and home utility. And can immediately be put into use with most dedicated, menu-driven and pre-existing software including: Infocom's™ "Adventure Series", the CBS™ "Success with Math" educational series, and many, many more.

TALK IS CHEAP! (Inexpensive, anyway)
The VOICE MESSENGER and EASY SPEECH system is available at a suggested combination retail price of under $70.00, or may be purchased separately.

To find out how you can turn your Commodore 64 or 128 computer into your best friend, or to locate a store location nearest you call: (313) 547-8300; or write: Welwyn/Currah, 104 West Fourth Street, Suite 208-9, Royal Oak, Michigan 48067.

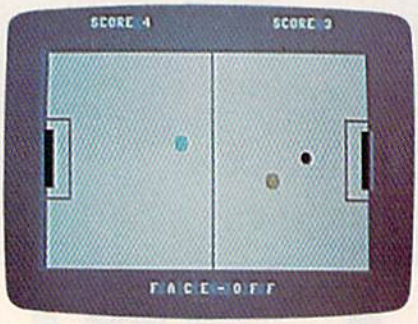
Welwyn CURRAH

Face-Off

Kevin Mykytyn and Mark Tuttle

Do you like fast action and competition? Whether you play against a friend or your computer, this colorful simulation of Air Hockey offers both. For the Commodore 64 and 128 (in 64 mode). A joystick is required (two joysticks for two-player game).

If you've played Air Hockey, you already know how to play "Face-Off." Based on ice hockey, Air Hockey pits two players against each other, each trying to shoot a puck into his opponent's goal while



The player on the right has missed blocking the puck, which is headed straight for the goal.

defending his own goal. A center line splits the playfield. Neither player is allowed to cross this line. The object of the game is simple: The first player to score five goals wins.

Typing It In

Face-Off is written in BASIC, although a large portion of the game is in machine language (in the form of DATA statements). Type it in using "The Automatic Proofreader," elsewhere in this issue. After you've finished entering the program, save a copy on tape or disk. To play the game, load it and type RUN. You'll see a message (READING DATA—PLEASE WAIT) and after a brief pause, you'll see a prompt, 1 OR 2 PLAYERS. Press 1 or 2 (it's not necessary to press RETURN). The one-player game pits you against your computer; the two-player game is for two human opponents and requires two joysticks.

Next, you're prompted to select the speed (1–3). Speed 1 is the slowest and 3 is the fastest. (It is suggested that you play your first game at the slowest speed, although speed 2 is probably the one you'll choose after playing a few times.) If you selected a two-player option, the game begins after you've selected a speed. If you chose the one-player option, there's one more prompt to answer: Skill Level (1–9). This determines the intelligence of the computer-controlled player. If you choose 1, the computer plays a pretty easy game. At 9, it's very wily. With a speed of 3 and a skill level of 9, the computer is next to impossible to beat.

When the game begins, you see a red puck, a cyan player on the left, and a yellow player on the right. The cyan player controls the puck to start. Contact with the puck starts the game. (Notice that the puck gradually slows down if it's not hit.) After each goal scored, the player scored against gets control. (You can knock the puck into your own goal, which awards a point to your opponent.) A total of nine pucks are placed per game. If you wish to change the number of pucks, change the value in line 510.

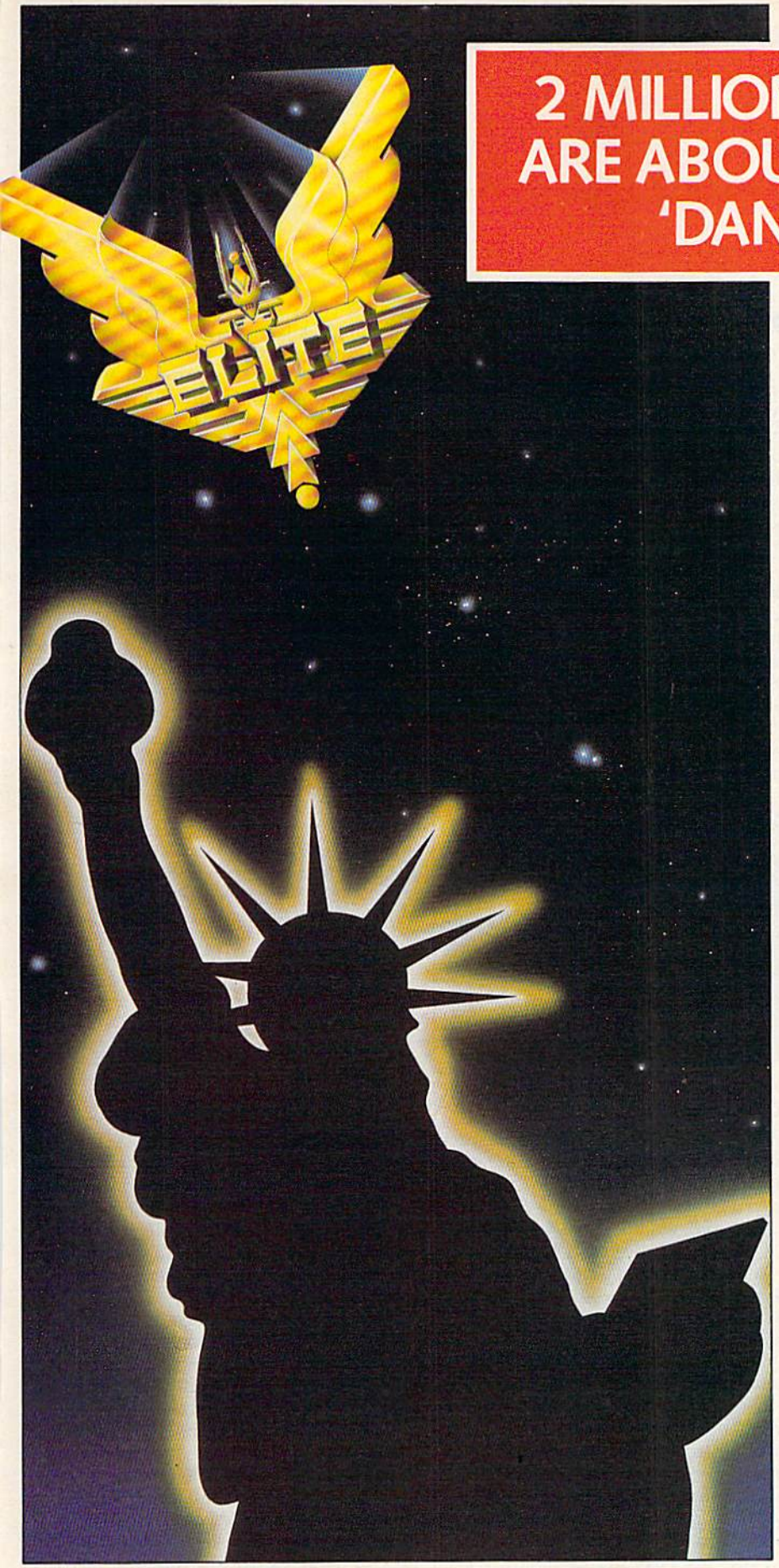
One Player Or Two?

When playing against the computer, plug a joystick into port 1. You control the yellow player, on the right.

You can move anywhere up to the center line. (At slower speeds, one strategy is to play along the center line, like rushing the net in tennis. This keeps the puck in the computer player's territory most of the time if you can react quickly enough.) Current scores for each player are posted at the top of the screen. After nine pucks are used, the game is over. You're then prompted to press the fire button to play again, then to press up on the joystick to change play options or down to play with those of the previous game.

The two-player game has the same rules. The cyan player, on the left, must use a joystick plugged into port 2.

See program listing on page 135.



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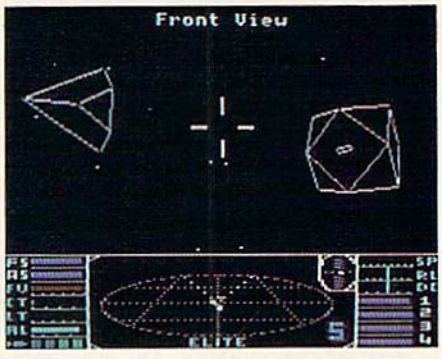

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SoundChaser Keyboard And *MacMusic*

The SoundChaser-64 is a rugged, full-size, four-octave musical keyboard, interfacing with the Commodore 64's cartridge port, and designed for serious applications. Although at $199 it is not inexpensive, it's one of the *best* Commodore 64 musical keyboards on the market and well worth the price. In addition, the SoundChaser is driven by quality software. (Be advised, however, that the software may not work properly on some of the earliest model 64s.)

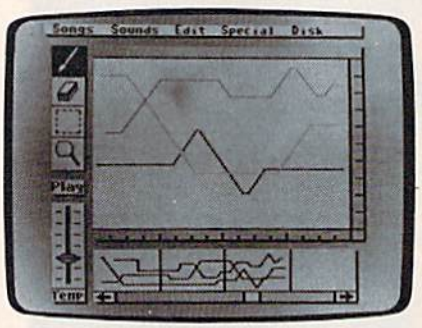
The disk accompanying *SoundChaser* includes an instructional program which clearly explains the Monophonic and Polyphonic (three-voice) play modes. (Written documentation is a scant three pages, one of which is installation instructions.) In polyphonic mode, the voices all have the same characteristics (waveform, envelope, etc.); there is a modest selection of variable parameters and five preset instruments. Monophonic mode permits substantial—even total—modification of 13 preset sounds. Unfortunately, there is no way to save new voicings. This is a considerable drawback, particularly given the absence of other software for SoundChaser. I hope that a Load/Save option for voicings will be added in the future.

The monophonic voices are a veritable tutorial on how to get expressive sounds from the SID chip. Richness is largely dependent on two-oscillator near-unison detuning, filter and oscillator modulation (LFO and ADSR). Sync and ring modulation are also implemented. Limitations include: the same ADSR for filter and amplitude enveloping, a shallow depth of LFO modulation (three half-steps maximum), and no pulse LFO.

Both monophonic and polyphonic modes offer excellent keyboard response: no delay, and rock-solid decoding. The three voices of polyphonic mode correspond to the two lowest and the highest keys pressed. Overall, SoundChaser software is intuitively accessible, particularly to those with analog synthesizer experience.

The *MacMusic* program will indeed, as its liner states, "make your C-64 into a musical Macintosh"—complete with joystick instead of mouse. (The 64 keyboard isn't used at all.) Here are icons, pull-down menus, boxes (windows), clicking, and dragging, and "cut/paste/copy/erase/paint/magnify" options inspired by *MacPaint* and *Music Construction Set*.

The well-designed hi-res screen is coupled with an innovative "visual music" notation which combines a vertical musical keyboard graphic (for pitch) with a horizontal beat/time-line. Three color-coded voices are drawn/brushed (edited/erased) within this time/space block—an effective method for those untrained in music theory and traditional notation.



MacMusic

I must confess to some difficulty and frustration in trying to use the joystick as a mouse (a real mouse would be easier). Otherwise, *MacMusic* is simple to learn and operate. The short manual is well-written, clear, and concise.

Ten current pop songs are included, as well as a choice of 13 instruments (bearing little resemblance to their names). While you are offered a menu of ten scales in any key, a major limitation of the current version of *MacMusic* is that you cannot create or modify instruments. (The "canned" instruments are nowhere near the quality of SoundChaser's.) Although the program liner suggests that additional sounds may be loaded (a pull-down menu includes a "Load Sounds" option), *MacMusic* itself does not have this capability. (Perhaps this is a future development to which the liner refers—"*MacMusic*'s upward compatibility," "continually expanding its features.")

Although early Passport/Hal Leonard literature announced *MacMusic*'s compatibility with the SoundChaser keyboard, *MacMusic* does *not* use SoundChaser. Indeed, *MacMusic* is now described as "the ultimate stand-alone composing program." Unfortunately, joysticks are no substitute for organ keyboardists. The value of both SoundChaser and *MacMusic* would increase if they were made compatible. In particular, the ability to enter musical data through the superb SoundChaser would make the innovative and well-designed *MacMusic* a much more flexible and viable arranging tool.

—Art Hunkins

SoundChaser-64
Passport Designs, Inc.
625 Miramontes St., Suite 103
Half Moon Bay, CA 94019
$199

MacMusic *for Commodore 64*
Hal Leonard Publishing Corporation
(with Passport Designs, Inc.—Passport Musicsoftware)
8112 W. Bluemound Rd.
Milwaukee, WI 53213
$49.95

S'more

The *S'more* cartridge changes a 64 into a new, more powerful computer, one with more memory and a much improved BASIC. Most of the additional commands are the same as, or similar to, the commands found in the 128's BASIC 7.0. You could say that *S'more* transforms a 64 into a mini-128.

When you first turn on a 64 with *S'more* installed, the screen has a cyan border, a white background, and a dark gray cursor, which is much more readable than the 64's default blue on blue. The power-up message announces that you have 61183 bytes free, half again as much as a normal 64. The best part, though, is that there are more than 50 new commands. Plus, you have access to several dozen new variables and arrays for handling the SID chip, the CIA chips, screen and color memory, and other memory addressing tasks.

S'more abounds in programming aids. NUMBER renumbers a program; DELETE removes a range of lines from a program; FIND shows you where certain variables, numbers, or strings are located; CHANGE performs a search-and-replace; DEC and HEX$ make translations between decimal and hex easy; and DUMP shows current variable definitions. KEY can program the function keys with commonly used statements. Turn on TRACE mode to follow the execution of a program. If you make a programming error, EL, ER, and ERR$ tell you the line number with the mistake, the error number, and the error message. TRAP lets you set up error-handling routines within a program and, if you wish, RESUME to a line number after an error has occurred.

Several new and enhanced disk commands have been added. MERGE adds a program on disk (or tape) to the one currently in memory. LOAD and SAVE have been modified to default to disk. You can enter RUN "*program name*" to load and run a program from disk. RECORD simplifies access to relative files. No longer is it necessary to go through the OPEN 15,8,15 ritual to send disk commands; you just type DISK, followed by the usual command for scratching, initializing, or whatever. When the drive light starts blinking, you can read the error channel with PRINT DS$.

S'more supports DO–LOOPs (including WHILE, UNTIL, and EXIT), which are more flexible than FOR–NEXT loops. And IF-THEN statements can be followed by ELSE. There's PRINT AT, for locating the cursor before printing, and PRINT USING, for formatting output. Keyboard input is improved by new commands like INLINE, INFORM, and GETKEY. There are many more commands and features; *S'more* has nearly all of the 128's program control keywords and programmer's utilities (and some very useful ones that aren't available in the 128), but it lacks the new commands for sprites, hi-res graphics, and music.

The cartridge comes with a well-written 129-page manual, which includes an explanation and at least two programming examples for each new command. As a bonus, there's a disk with programs written in *S'more* BASIC for programmers to study and use. The manual notes that the disk should be backed up—it's not copy-protected—or, if you prefer, you can send $3 to Cardco for a backup. Included is a version of the popular public domain machine language monitor *Micromon*, a mailing list program, and more. There are also several interesting hi-res pictures on the flip side (although you have to remove the *S'more* cartridge to get the program to work).

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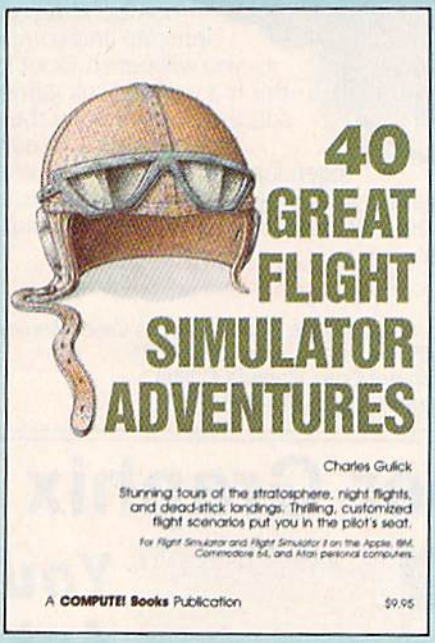

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The new keywords add punch to BASIC and the additional memory is certainly welcome. *S'more* is a valuable addition to any programmer's library.

—Todd Heimarck

Cardco, Inc.
300 S. Topeka
Wichita, KS 67202
$69.95 (cartridge, disk, and manual)

Stunt Flyer

Sierra's new action software, *Stunt Flyer*, puts you in the cockpit as you learn the skills of piloting a stunt plane. With a little practice, you'll be doing slow rolls, hammerheads, half-loops, Immelmans, and even the outside-inside Cuban 8. As a beginner, you can watch an airshow to see how the pros do their stunts, before starting to fly your own plane. Since all the pilots are experts, don't expect to be able to do the stunts as well as they do. You'll have to become a bona fide ace for that.

Practice makes perfect. First, get familiar with your airplane, a *Pitts Special* biplane, the most maneuverable of all stunt planes. Then start to practice your stunts. The 47-page manual shows you how to accomplish each maneuver, operate the controls, and take part in a stunt-flyer competition. It also covers the basic principles of aerodynamics and shows you how to put together individual moves to create an aerobatics sequence.

Start with the easy maneuvers, like the slow roll. You'll get the hang of it before long. Don't be discouraged at first about crashing. Unlike real flying, you can always get up and walk away from your mistakes.

The most enjoyable thing about *Stunt Flyer* is the competition part of the program. After some practice, you can compete in various stunts, watch what you did, and receive a score. If your flying is up to par, you'll hear the spectators below applaud your efforts. If not—well, at least they don't boo and hiss.

Stunt Flyer is for those who like excitement in their software. There won't be any dull moments. The stunts are not easy to master, but that's the challenge. Once you've improved, you can save the results of your compulsory sequence score and freestyle flight to a "competition" disk and send the disk to Sierra. The company is offering a $1000 prize to the best *Stunt Flyer* pilot, something that makes this piece of software pretty realistic.

—David Florance

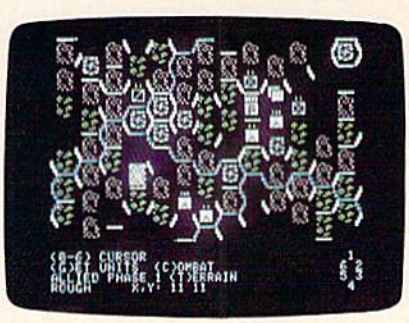
Sierra On-Line, Inc.
P.O. Box 485
Coarsegold, CA 93614
$24.95 (disk)

Operation Market Garden And *Kampfgruppe*

Strategic Simulations, Inc., has built its reputation on strategy war games for home computers. The company is prolific in the field, with games to simulate battles from many different historical periods. But the sheer number of SSI titles causes its own problem: How does the company prevent all these games from seeming alike?

One of the problems is that wargamers themselves are very unwilling to experiment. We expect certain things from our games—things like hexagon maps and lots of numbers—and if we don't find them we insist that the game prove they weren't needed. SSI has shown that it understands its audience. Most SSI games use formats the player will find familiar, while a few attempt to break new ground. *Operation Market Garden* and *Kampfgruppe*, two of SSI's latest releases, reflect these two concerns.

The subjects of the two games are the first hint of the traditional. *Operation Market Garden* deals with the campaign for a bridgehead in Arnhem, Holland, in September 1944. The largest combined-arms airborne operation in history, the Arnhem campaign was the Western Allies' most notable defeat. *Kampfgruppe* simulates small-unit battles on the Russian front, where the Soviets and Germans were repeatedly involved in action. It demonstrates the changes in equipment and tactics by both sides throughout the war. Both the Arnhem campaign and tactical Russian-front battles are traditional wargame topics.



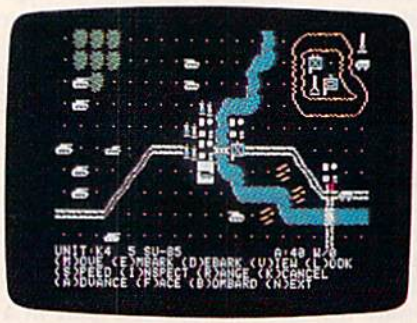
Operation Market Garden

Of the two game-systems, though, *Operation Market Garden* is the more traditional. It uses a hexagon-covered terrain map and battalion-sized units with lots of numbers. It employs a rigid play sequence, where one side moves and fights and then the other side moves and fights. The detailed manual includes maps showing the progress of the historical campaign, and charts demonstrating how the computer calculates combat. The game is superbly done, but it's also completely without surprise.

Operation Market Garden demonstrates SSI's concern for the evolution of proven game systems. There is little innovation, but there is nothing out of place, either. The game uses well-tested movement, combat, and supply systems to simulate the campaign with respectable accuracy. It forces the player to use both strategic planning and tactical finesse. And it does it all without raising the gamer's ire. A thoroughly solid effort.

Kampfgruppe illustrates SSI's other major concern—the innovative wargame system. The game map is divided into squares, not hexagons. The squares do not appear on the screen, so the map has a more natural appearance, and is easy to read. Units can move in eight directions instead of six. The game includes four historical scenarios and an easy-to-use scenario generator. A wide variety of armored, artillery, and infantry weaponry is available to the players. None of these features is innovative in itself, but in the context of a swift-moving system, they are nicely done.

What is new is the way you, the player, control your battle units. Effectively, you order your units to move twice. A unit will follow its first order, then, unless you have changed it, its second order. If you alter the orders, it will obey, but only after a short (but often crucial) delay. The delay system forces you to make a plan and stick to it, or suffer some degree of chaos. Units fire automatically at enemy units; you can control the range at which your units fire, but not the actual target. This procedure is both unusual and realistic.



Kampfgruppe

Kampfgruppe allows you to play a very specific leadership role. Rather than command individual units, you can give orders to those units' headquarters. This system both reduces the time-consuming problem of moving each unit and adds a further degree of realism. In effect, you give general rather than specific orders, of the type actually given by higher-level commanders. The game allows you to switch to a unit-by-unit command if you wish, but you will use this option less frequently as you begin to master the game.

Both *Operation Market Garden* and *Kampfgruppe* are encouraging for the company's followers. Thoroughly designed efforts like *Operation Market Garden* are always welcome in the wargame hobby, while new directions like *Kampfgruppe* are necessary if the hobby is to grow. What SSI seems to need now is a computer with greater graphics and computing capabilities. With the new generation of personal computers now appearing, SSI's games should soon offer even better graphics, easier play, and greater realism.

—*Neil Randall*

Strategic Simulations, Inc.
883 Stierlin Rd., Bldg. A-200
Mountain View, CA 94043
Kampgruffe *($59.95)*
Operation Market Garden *($49.95)*

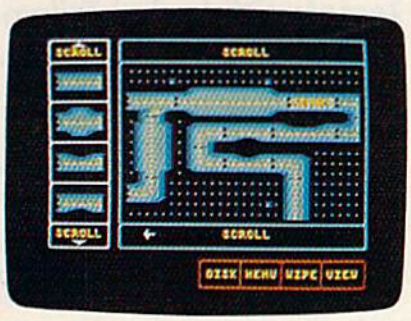
Fast Tracks: The Computer Slot Car Construction Kit

That's Tom Sneva up ahead on the pole. Bobby Rahal is outside on the first row. Rick Mears is inside on the second row, and here I am, starting in fourth, on the outside of the second row. The green flag will be out any second. Rahal is probably going to accelerate hard and try to beat Sneva into the turn. I'll just go with him and try to take the lead coming out of the second turn. There's the flag! Hit it hard now!

You'll probably never be sitting on the starting grid at the Indianapolis 500 with Mears, Sneva, and Rahal, but *Fast Tracks: The Computer Slot Car Construction Kit* will put you on the toughest slot car tracks around against the toughest and smartest drivers you'll ever care to see.

The predesigned tracks are tricky enough. But they can get even trickier as you design your own race course and try to post the fastest time possible. Tight turns, narrow one lane straightaways, overpasses, and oil slicks make the course extremely demanding. Try to pass at the wrong time, and you'll find yourself being bumped and spinning off the track. Your 64 is not Mr. Nice Guy. Given the chance, it'll push you off the track every time. Don't hesitate to bump back—you can gain two seconds for every car you force off the track.

Fast Tracks includes more than 20 different track sections for designing your own race course. The track sections are easy to position for your own racing layout. Just use your joystick to place the pieces. After completing your track, the computer provides the landscaping and you're ready to race. Build a really tough track, then challenge your friends to beat your time on your track.



The most innovative feature of *Fast Tracks* is an option that allows you to make a disk copy of your track and give it to a friend who can then load it and run it, without having to own a copy of *Fast Tracks*. The program even gives you credit for designing the track. Your friends can experience the challenge of attempting to beat your best time, lacking only the ability to modify or design a track of their own.

An additional disk may be purchased from Activision which includes several other tracks, including a Bobby Rahal signature track. Here's a chance to experience a race against one of the best. Try to beat Rahal's time around his own track.

Activision has also announced a "Dream Track" contest. Create the most difficult and complex track imaginable, then send it to Activision. The winner, selected by Bobby Rahal, will receive an all-expense paid trip for two to the 1986 Indianapolis 500.

—George Miller

Activision
2350 Bayshore Frontage Rd.
Mountain View, CA 94043
$29.95

Keys to Responsible Driving

Learning how to drive is a rite of passage in America. Almost every teenager takes some sort of driver's education course in high school. *Keys to Responsible Driving*, a package from CBS software, is an interesting addition to this education.

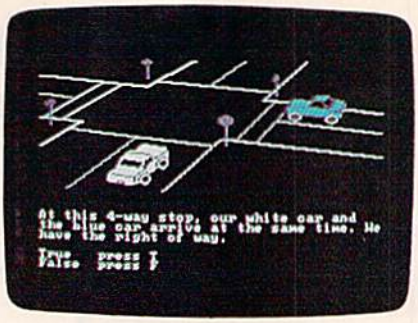
This isn't a driving simulation—that's left for the the open highway. Instead, this self-paced question and answer program presents the general rules of the road, letting you move through each chapter of instruction at your own speed. Defensive driving is stressed throughout the program, and graphically displayed situations put you in the driver's seat. You react, and your answers, whether right or wrong, are evaluated.

Do you know what the sign for a slow-moving vehicle is? Just how safe or unsafe is mixing alcohol and automobiles? Answers to these questions, and scores of others, are included in this program. Screen after screen shows you the proper way to make a U-turn, or parallel park. What are the steps you need to keep in mind when making a

right turn—or a left turn? *Keys to Responsible Driving* tells you.

A pre-test and post-test show you what you know before you begin, and what you've learned after you're finished. Scores are even kept in a record file which you can access at any time. Separate chapters cover such things as handling and maneuvering a car, road signs, city driving, highway driving, turning and changing lanes, as well as outlining the dangers of driving under the influence of drugs or alcohol.

Two disks and a *Guide to Safe Driving* booklet are included in this package for the Commodore 64. Reviewed by



such organizations as the National Safety Council, the American Automobile Association, and Allstate Insurance Company, the only thing that *Keys to Responsible Driving* doesn't include is a driver's license.

—Gregg Keizer

CBS Software
One Fawcett Place
Greenwich, CT 06836
$79.95 (disk)

also worth noting

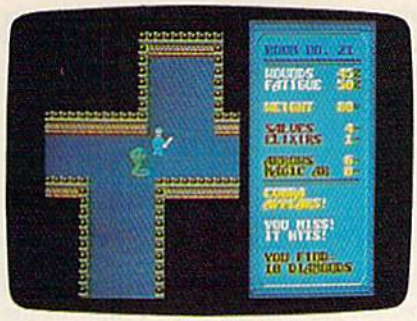
Cadpak-64 (Enhanced Version)

Subtitled a "Computer Aided Design Package with Dimensioning," *Cadpak-64* is a very good program for the creation of high-resolution pictures and graphics designs on the Commodore 64. The package lets you use either a light pen or the keyboard to create the images, and supports numerous dot-matrix printers, both color and black-and-white. A major plus for *Cadpak* is its ability to produce accurately dimensioned output at every stage of the design process. Documentation is very comprehensive, although it can be a bit confusing at times because of the two different input methods covered. That shortcoming is more than compensated for by the excellent tutorials on the disk. *Cadpak* is a typically thorough effort from Abacus, and will be of interest to anyone wishing to create, store, and print hi-res pictures.

Abacus Software
P.O. Box 7211
Grand Rapids, MI 45910
$39.95

Temple Of Apshai Trilogy

For those as yet unfamiliar with the popular Apshai series of fantasy adventure programs for the Commodore 64, this new release from Epyx should be of great interest. Even those who've played one or more of the three games included in the trilogy may want to invest in this combined package. Epyx has taken *The Temple of Apshai*, *The Upper Reaches of Apshai*, and *The Curse of Ra*—all previously released separately—and placed them on one disk. The colorful graphics have been noticeably improved, the game play is faster, and the accompanying manual is informative and clear. An Apshai Command Card provides a quick reference to all



the options within the game as well. There are 12 levels, 568 rooms, and 37 different monsters for you to conquer.

Select a character, imbue him or her with varying levels of strength, constitution, dexterity, intelligence, intuition, and ego. Then set forth. If you create an adventurer you particularly like, you can save the character for use in later games. The program will record all of the pertinent information—experience, fatigue, treasure, weapons, and strength—and let you take that character to any of the three games. There is even a provision for you to bring to the Apshai trilogy a character or characters created on other computer game systems. This is a classic series of computer games made even better.

Epyx Computer Software
1043 Kiel Court
Sunnyvale, CA 94089
$27

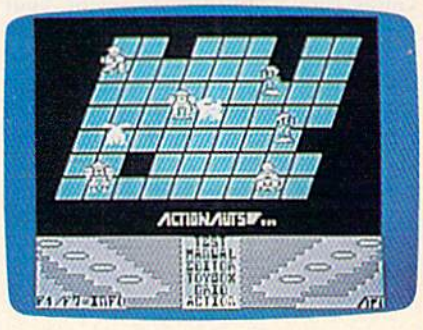
Decision in the Desert

This World War II combat simulation blows the sands of North Africa across your computer's screen as you become a German or British general fighting for your army's survival. Five scenarios cover the first two years of the war in the desert, from O'Conner's raid against the Italians in 1940 to the final assault on the El Alamein position in 1942. You command one army's divisions, regiments, and air squadrons while the computer controls the other.

Sending orders to your units through the keyboard or joystick, you move, attack, and defend on a variety of terrain, from the fortress of Tobruck to the ridges of Alam Halfa. Plunge too far behind enemy lines, and you could get cut off from your supplies, endangering your army and tempting defeat. But take no risks—become a Rommel or Montgomery in name only—and the enemy could pummel you from all sides.

In this strategic-level game, you decide where to attack, and when. Whether to press your Italian infantry forward, even though they've suffered severe casualties, or husband your last reserve of armor for that final counterattack which could swing the battle. Periods of frantic movement and combat are interspersed with relative calm, just like in the real desert war. You can select options within each scenario, set the level of computer competence, even display only those enemy units you've brushed against. *Decision in the Desert* may not put sand in your face, but it's the closest you'll come from this side of the screen.

MicroProse Software
120 Lakefront Dr.
Hunt Valley, MD 21030
$39.95



Actionauts

Software designer Rob Fulop calls his *Actionauts* a set of computer toys rather than a game. And, as such, the program is an engaging experiment in creativity. You play with a "gravity grid" and a group of programmable screen characters. These figures move around on the grid in any fashion you choose. The program's editor lets you use a joystick or the keyboard to instruct your set of Actionauts on what to do. Start with a simple game of tag (the user's manual shows you how) and then move on to more complex constructions.

Actionauts is a special program in that it's *freeware*—copyrighted software which is intended to be copied by anyone who wants to use it. Fulop's company, Advanced Program Technology (APT), is sending copies of *Actionauts* to user groups across the country. The company requests that those who use the program send in $3 to become registered users and to get a copy of the manual and a subscription to the "Actioneer" newsletter. If you can't get a copy at your local user group, you can order the entire package from ATP for $10. But note: Freeware is still copyrighted software, not public domain material.

Fulop, formerly a computer game designer with Atari and Imagic, was responsible for such programs as *Missile*

Command and *Demon Attack*. He's brought the same talents to *Actionauts*, which is an inventive package at an unbeatable price.

Advanced Program Technology (APT)
467 Hamilton Ave., Suite 1
Palo Alto, CA 94301
Free (through user groups)
$3 for documentation
$10 individually through APT

The Original Boston Computer Diet

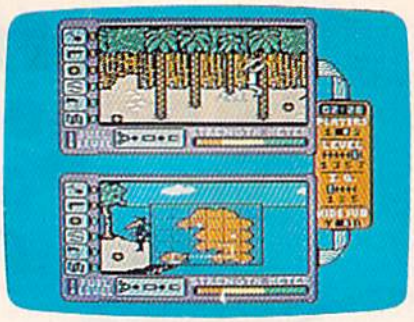
No one ever said dieting is easy. But Scarborough's *Original Boston Computer Diet* for the Commodore 64 can at least make the process easier and more enjoyable. The program will also get you started on a balanced, nutritional approach to weight loss rather than a fad diet that might be unhealthy and could be unproductive in the long run. Developed by Dr. Leighton Read of the Harvard Medical School and several other medical researchers, the *Boston Diet* focuses on meal planning, food reporting, goal setting, and solid nutritional advice. The program counts calories for you, offers feedback on the nutritional balance of your diet, and even has built-in "counselors" who help guide your efforts. The 97-page manual contains short chapters on health, fitness, and proper diet. A separate Food Reporting and Meal Planning Guide shows you how to set up your own schedule.

This is an easy-to-use, flexible, and informative computer diet program. Although only one person can use the package at a time, after you've purchased the program you can buy additional disks for only $10.

Scarborough Systems, Inc.
25 N. Broadway
Tarrytown, NY 10591
$49.95 (disk)

Spy Vs Spy II: The Island Caper

Don't expect to master the elements of espionage in one sitting with First Star Software's *Spy vs Spy II: The Island Caper*. The action is fast, the dangers many, and your opponent unscrupulous. *The Island Caper*, for the Commodore 64, uses the same *Simulvision* format—a split-screen feature for two players or one player against the computer—used in the first *Spy vs Spy* game. In this sequel, you and the opposing spy are trapped on a tropical island while searching for the parts to a missile. Find and construct the missile before your opponent, and you can leave the island on a submarine. Wait



too long, and the still-active volcano will end the search for you.

Like its predecessor, *The Island Caper* features excellent color graphics and sound. The treacherous island and its surrounding waters come equipped with quicksand, coconut bombs, swords, sharks, snare traps, and even punji pits. As you search, you set booby traps for your opponent while avoiding the island's natural hazards and the traps set for you. The split screen effect lets you see everything the other spy is doing at the same time that he can see you. At the upper levels of play, there may be more than one island to search. Playing against the computer, you'll have to become very fast and tricky to win. Playing against another person, with simultaneous two-player action, is even more fun.

First Star Software
18 E. 41 St.
New York, NY 10017
$29.95 (disk)

Star Rank Boxing

This well-designed one- or two-player game for the 64 allows you to create your own boxer, train him, then work your way up through the ranks.

Pre-fight training is important to fine tune your boxer for the upcoming contest. Spend too little time on road work, and you'll find your boxer tiring early in the fight.

With a joystick, you select punches as you fight any of 19 ranked boxers in bouts against the computer, or select a "dream match" against a friend. Excellent animation and graphics, with effective use of sound make *Star Rank Boxing* an interesting addition to any game collection.

Gamestar, Inc.
1302 State St.
Santa Barbara, CA 93101
$29.95 (disk)

Halley's Comet

This new package, a series of programs written by Eric Burgess, Fellow of the Royal Astronomical Society, is intended to help amateur astronomers keep track of Halley's comet, especially during its 1986 appearance. It could also be useful for instructors, as it includes a short teacher's guide in addition to the 12-page user's manual.

The on-screen introduction to the programs sums up their features rather nicely:

This program helps you to find and to observe Halley's comet. It shows where the comet can be seen among the stars of the constellations. It tells you what time the comet rises, is highest in the sky, and sets, for any day you choose, anywhere on earth. It plots the sky from any location for any time and date, and shows the comet relative to stars, naked eye planets, sun and moon. It shows earth and comet moving in their orbits, and their positions at any date. It provides physical details of the comet and its historical passages through the inner solar system. The program is optimized for the apparitions of 1759, 1835, 1910, and 1986.

This kind of program is not for everyone. Some of its material is fairly dry, and the time plots could be confusing without interpretation. However, this software does an excellent and accurate job, and uses the 64's features to full advantage.

Science & Technology Software Service
13361 Frati Ln.
Sebastopol, CA 95472
$49.95

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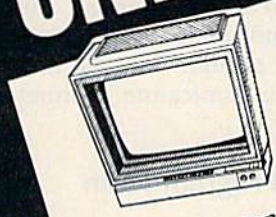

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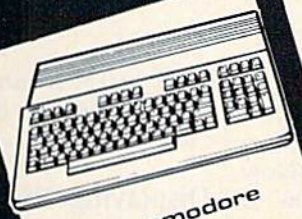

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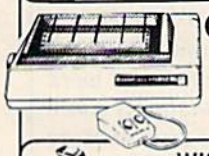

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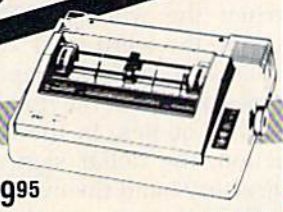

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BASIC magic

Using That New Disk Drive You Got For Christmas

Michael S. Tomczyk

Congratulations—you just got a new disk drive for Christmas. Now you're trying to figure out how to use it. Don't panic—we're here to help get you started, with a beginner's introduction to disk drive commands for your Commodore 128, 64, Plus/4, 16, and VIC-20.

First, some terminology. Floppy disks are technically floppy *diskettes*, but they're usually called "disks" or "floppies."

You can buy all sorts of programs on disk, the most popular being word processors, spreadsheets, databases, games, and educational programs. If you buy a commercial program in a store or through the mail—such as a word processing program on disk—what you usually get is a disk and a manual or instruction sheet explaining the commands associated with that program.

But disk drives aren't just for commercial programs. You can also save your own programs—ones that you write—on disk, regardless of the "language" they're written in—BASIC, machine language, Logo, and so on. You can also save data files—which are different from program files. An example of one is a text file, a document created with a word processor.

Using A Preprogrammed Disk

First, we'll assume your computer and disk drive are already connected and both turned on, and we'll also assume you're using a single disk drive (as opposed to a dual drive—two drives in one unit).

A disk can be damaged (or the information on it scrambled) if you bend it, overheat it, or touch it with a magnet.) Never leave disks lying around exposed where dust can collect. Disks are relatively fragile and should be handled carefully.

Insert a preprogramrned disk, perhaps the one that came with the 1541 or 1571, into the drive. Turn the locking lever or push-down device to secure it.

Displaying The Directory

Now let's see what's on the disk. All disks contain a listing or directory of the programs or data files on that disk. To call up the directory on your screen, type the following and press RETURN:

```
LOAD"$",8
```

When the word READY appears, type the word LIST and the directory will appear, displaying the names of each of the files on the disk within quotes. In the loading instruction, the dollar sign stands for "directory" and the number 8 is the disk drive *device number*. Incidentally, if you leave out the number 8, the computer will think you're using a tape recorder instead of a disk drive and will tell you to PRESS PLAY ON TAPE.

Also, if you're using a dual disk drive you can address directories in, say, drive number 1, like this:

```
LOAD"$1",8
```

REM: *If you have a Commodore 128, Plus/4, or 16, you can use a shortcut command to get a directory. Just type DIRECTORY and press RETURN. The 128 also has the CATALOG command, which works exactly like DIRECTORY. An even shorter shortcut is to press the f3 function key, which is preset to print DIRECTORY.*

Printing The Directory

You can print your disk directory on your printer for filing or reference purposes by using the following commands:

```
LOAD"$",8
OPEN 4,4:CMD 4
LIST
PRINT#4:CLOSE 4
```

OPEN 4,4 tells the computer you're going to be working with the printer. CMD 4 directs subsequent commands to the printer, so the LIST command sends the directory listing to the printer. The last line closes the communication channel to the printer.

Loading A Program From Disk

To load the first program on a disk (the one at the top of the directory), type the following and press RETURN:

```
LOAD"*",8 or
DLOAD"*" (Plus/4, 16, and 128 only)
```

The computer will whir as it searches for the program and loads it. When the word READY appears, the program is loaded.

To start the program, type RUN, press RETURN, and the program begins. RUN works with BASIC programs. To run machine language programs, you usually have to use a different command:

```
LOAD"*",8,1 or
BLOAD"*" (Plus/4, 16, and 128 only)
```

and then type something like SYS 49152 instead of RUN.

REM: *You can use an asterisk (*) to load the first program from any disk. Most major programs like word processors and spreadsheets have only one program on the disk, so using the asterisk gives you a shortcut.*

If there's more than one program on the disk, load the program you want by name, like this:

```
LOAD"program name",8 or
DLOAD"program name" (Plus/4, 16, and 128 only)
```

where *program name* is the name of the file as listed in the directory. When the word READY appears, type RUN and press RETURN.

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Using A New Blank Disk

One of the best uses for your disk drive is storing programs that you write. Since the blank disks you buy in a store come *unformatted*, you have to *format* each one before you can put information on it. The reason the disks don't come already formatted is that they can be used by many different disk drives which store information in different patterns on the disk. Formatting a disk means preparing it for use by your particular brand of disk drive. In doing this, you must give the disk a *disk name* and an *identification (ID) number*. Examples of these are: "MAGIC, M2". In this example, "MAGIC" is the disk name and "M2" is the ID. The ID can be any two letters or numbers. (Consult your disk drive manual for more specific information.)

To format a blank disk, insert the disk into the drive and type:

```
OPEN 1,8,15,"N:disk name,id":CLOSE 1
```
or
```
HEADER "disk name",id (Plus/4, 16, and 128 only)
```

Now your disk is formatted and ready to accept programs or data you want to store on it.

A word of caution: This procedure can also be used to erase and reformat an old disk, but if you do that, *any previous information stored on the old disk will be completely erased and lost*, so be careful not to erase a disk you want to keep. Also, be sure to use a different name and ID for each disk. This way each disk has a unique identity—and will prevent any confusion later.

Saving Your Own Program On Disk

OK, so you've formatted your blank disk and want to save a program or data file on it. With your disk in the drive, type the following program (or any program of your own):

```
10 PRINT "HOW MANY K WILL
   YOUR"
20 PRINT "DISK HOLD?"
30 INPUT K
40 PRINT "YOUR DISK WILL HOLD"
50 PRINT "APPROXIMATELY"
   K*1024/60/56
60 PRINT "PAGES OF TEXT."
```

This program calculates approximately how many pages of text can be stored on one disk, assuming each page will contain 60 characters on each line, and 56 lines of text. One page of 8½ × 11-inch typing paper can hold 60 lines total, but only 56 lines are used because of the top and bottom margins. A disk formatted on the 1541 drive can hold about 165K of information. A disk formatted with the HEADER command on a 1571 drive can hold twice as many kilobytes of memory because the 1571 can use both sides of the disk.

To save this program on a formatted disk, type the following and press RETURN:

```
SAVE"TEXTCALCULATOR",8 or
DSAVE"TEXTCALCULATOR" (Plus/4, 16, and 128 only)
```

The program is automatically saved on the disk. To check it, try listing the directory (LOAD"$",8 and LIST). To retrieve the program in the future, insert the disk in the drive and type: LOAD "TEXTCALCULATOR",8 or DLOAD "TEXTCALCULATOR".

The program is now stored on your disk with the name you gave it between the quotation marks in the SAVE command. You can use any program name you like, as long as it's 16 characters or less. But don't try to give the same name to two different programs on the same disk, the disk drive won't allow it (if you saved two programs under the name SPACEGAME and later tried to load one of them, the disk drive would have no way of knowing which program of that name you wanted to load).

Erasing A Program From A Disk

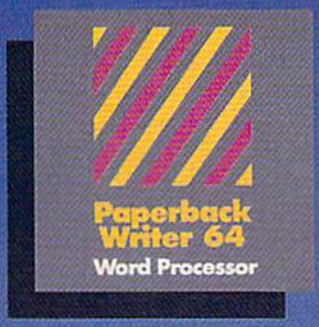
You can use the S (SCRATCH) command to erase an unwanted program from a disk. For example, to erase the program we just created, type:

```
OPEN 1,8,15,"S:TEXTCALCULATOR"
  :CLOSE 1 or
SCRATCH"TEXTCALCULATOR"
  (Plus/4, 16, and 128 only)
```

Check the directory to see if it's gone.

This should help get you started with your new drive. Again, your disk drive manual contains a lot of useful information. Once you're used to the techniques we've discussed here, study your disk drive manual. You'll find your drive is the most important device you use with your computer.

Solutions!



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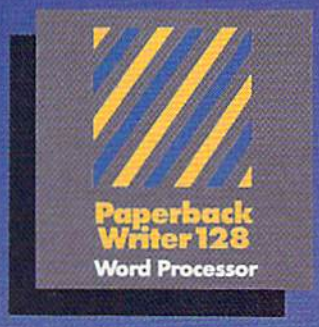

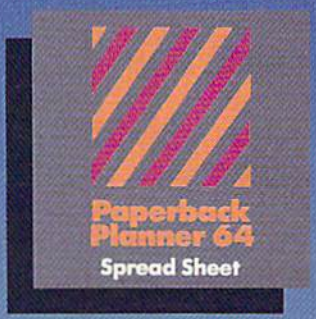

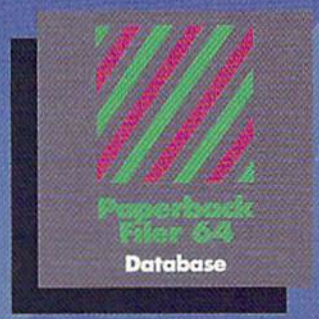

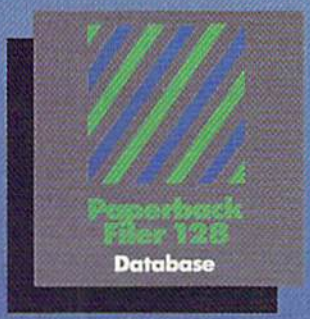

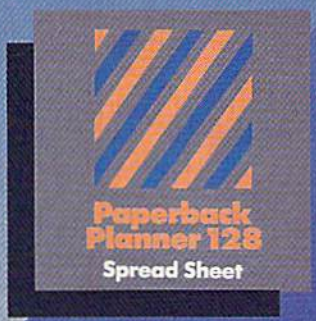

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More Control Over BASIC

David Whittaker

Putting information into DATA statements and then READing through them is one way of handling lists, whether they're numbers to be POKEd into memory or information to be stored in arrays.

The READ-DATA combination is *sequential*, which means the computer starts at the first DATA statement and moves forward, reading each item in sequence. It's like a sequential file on tape or disk—you have to read the individual pieces of data in order. The seventeenth variable written to a file is always the seventeenth when you read the file. A Datassette has a rewind button which allows you to go all the way back to the beginning if you wish to reread the file. The RESTORE command is a similar sort of rewind button for DATA statements. It sets the pointer to DATA statements back to the beginning.

You may encounter situations where you want to start rereading from the middle of DATA statements. The 64 doesn't allow you to RESTORE to a line number (although the Plus/4, 16, and 128 do—you can enter RESTORE 50, for example).

The following short machine language program is the answer. Add it to the beginning of your program and you'll have access to any line of DATA:

```
3 FOR H=685 TO 709:READ A:POKE
  H,A:NEXT
4 DATA 32,158,173,32,247,183,3
  2,19,166,165,95,56
5 DATA 233,1,176,2,198,96,133,
  65,165,96,133,66,96
```

When you want to RESTORE to a specific DATA statement, add SYS(685)xx to the program, where xx is a line number or a numeric expression.

Here's another BASIC improver. It allows you to GOTO an expression.

```
6 FOR H=710 TO 718:READ A:POKE
  H,A:NEXT
7 DATA 32,158,173,32,247,183,7
  6,163,168
```

Put it at the start of a BASIC program and when you want to send the program to a calculated line number, enter SYS(710)xx, where xx is a numeric expression that returns a valid line number within your program.

VARPTR For VIC And 64

David Pancoast

Some BASICs have a function called VARPTR, which allows you to find the location of a variable in memory. It may not sound like a particularly useful command, but there are some situations in which it's handy.

BASIC itself has to find variables and their addresses, so it's not surprising that there's a built-in ROM routine you can call on. Try running the following program on a 64:

```
10 A=2: VP=0
20 SYS 45195A
30 VP = PEEK(780)+256*PEEK(782):
   PRINT VP
```

VIC owners should substitute SYS 53387A in line 20. To find the location in memory of a variable, put the variable name directly after the SYS. After the SYS, locations 780 and 782 hold the low and high bytes of the variable's address.

In this example, we're finding the location of the numeric variable A. If you're trying to pinpoint an array variable, be sure to predefine all nonarray variables (like VP) before you SYS to the VARPTR routine. Defining brand new simple (nonarray) variables moves all array variables up a few bytes in memory.

You can see a variable's name in the two bytes before the pointer (VP−2). If the example above returned a value of 2111 for the variable A, you could enter PRINT PEEK (2111−2) to find a value of 65 (the letter A is CHR$(65)). POKE a 66 there and the variable A would disappear from the program, replaced by the new variable B.

All simple variables use two bytes for the variable name and five for the definition. Integer variables take up two of five bytes, string variables fill three of five (length plus a pointer to where the string is actually located), and numeric variables use all five bytes (in floating point format).

How does knowing the address of a variable help you with programming? First, it's very helpful when you're passing information to machine language (ML) programs. If you know where a variable resides, you can POKE the information into memory, telling your ML routine where the value of that variable can be found.

And if you're investigating floating point operations, finding a variable allows you to test different numbers—try adding one to the value in the first byte of the variable pointer with POKE VP, PEEK(VP) +1 just to see what happens to the value of the variable.

Advanced BASIC programmers might want to devise a fast sorting routine that swaps pointers rather than switching values (to avoid the delays caused by dynamic strings and garbage collection). Just remember that new variables push array variables up in memory, so you'd need to declare all variables before starting the sort.

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machine language for beginners

Blanketing Memory

Richard Mansfield
Senior Editor

When you want to fill the screen with a particular color or a special background, or otherwise blanket a section of memory with a particular number, you need to send a large number of contiguous bytes. It's easy to send up to 256 bytes by using a Y offset like this:

```
10 *= 864
20 .S
30 .O
40 SCREEN = $0400
50 LDY #0
60 TYA
70 LOOP STA SCREEN,Y
80 DEY:BNE LOOP
90 RTS
```

Line 10 sets the start address to 864. After you assemble it, you can test this little routine by typing SYS 864. Line 20 causes the assembler to print the results on screen and line 30 POKEs the program into memory. (These are conventions used by the LADS assembler from my *Second Book of Machine Language*. Other assemblers will differ.)

Line 40 defines the address of the screen on the 64. Line 50, the start of the program proper, puts a zero into the Y register, and line 60 transfers the zero to the Accumulator so we can print the @ symbol—which has a code value of 0—on the screen. Then in line 70 we start a loop which puts the zero into the SCREEN address *plus whatever number is in the Y register*. This addressing mode is signified by NAME,Y and is very useful for this kind of repetitive task.

Since we set Y to zero in line 50, the first time through the loop we will store a @ character into address $0400 (SCREEN + Y), but we then DEY which makes Y become 255. It's important to realize that the Y and X registers and the Accumulator (like any other single byte) can only count up to 255. If you LDY #255:INY you will cause Y to go up past 255, which resets it to zero. Likewise, if Y holds a zero and you DEY, it then holds 255. The next DEY will make it 254 and so on down.

Since we're filling the first 256 bytes of the screen with @, it doesn't matter whether we start with byte 0 and INY upwards or fill downwards from 255 to 0 using DEY. In our example, we're going down until DEY causes Y to once again hold a zero which will drop us through the BNE in line 80 and we RTS (ReTurn) from this Subroutine.

To fill the entire screen, however, we need more than a single STA SCREEN,Y:

```
10 *= 864
20 .S
30 .O
40 SCREEN = $0400
50 LDY #0
60 TYA
70 LOOP STA SCREEN,Y
80 STA SCREEN+256,Y
90 STA SCREEN+512,Y
100 STA SCREEN+768,Y
110 DEY:BNE LOOP
120 RTS
```

This is essentially identical to the first program, but we've added some additional target zones in lines 80, 90, and 100. Since line 70 will fill the screen from bytes zero to 255, we can fill the second block using SCREEN+256 and the third block with SCREEN+512. You can continue adding 256-byte chunks to SCREEN to fill as large an area as you wish. However, for really big jobs, there's an easier way:

```
10 *= 864
20 .S
30 .O
40 SCREEN = $0400
60 LDA #<SCREEN:STA LOOP+1:LDA
   #>SCREEN:STA LOOP+2
70 LDY #0
80 TYA
90 LOOP STA $FFFF,Y
100 DEY
110 BNE LOOP
120 INC LOOP+2
130 LDX LOOP+2
140 CPX #$08
150 BCC LOOP
160 RTS
```

In this case, we're going to adjust the target address in line 90 on the fly. In line 60 we stuff the starting address of the screen into the FFFF's on line 90 (notice that the STA $FFFF,Y never really happens, because the FF's are just temporary place holders until the screen address can be stored there). We set this up by loading the Accumulator with the *low byte* (using the #< command) of SCREEN and storing it into the low byte of the target value, then putting the *high byte* of SCREEN into the high byte on line 90. Don't worry about how this is done. If you need to set up such a pointer, just define the target (line 40) and initialize the pointer as we do in line 60, storing the low-byte directly before the high-byte.

The loop between lines 90–110 sends our @ character to the address that has been stuffed into the 0000 we originally typed, plus the value of Y. So, as we did in the first two programs, we can fill a 256-byte chunk of the screen at a time by counting down the Y register with DEY. The only difference this time is that we're not sending bytes to SCREEN, we're sending to a replaced set of FF's in line 90. The advantage of this is that we can easily adjust this address to make it point to the next higher 256-byte chunk simply by raising the high byte (the two F's on the left in FFFF). The high byte of a pointer address represents multiples of 256; the low byte represents single bytes. This is similar to ordinary decimal numbers like 12. If you raise the "high digit," you get 22, then 32, then 42, etc. If you raise the "low digit," you get 13,14,15...etc.

So, in line 120 we INC the high byte. In the instruction STA $FFFF,Y the STA instruction takes up one byte (that would be the address of LOOP). The low byte is FF

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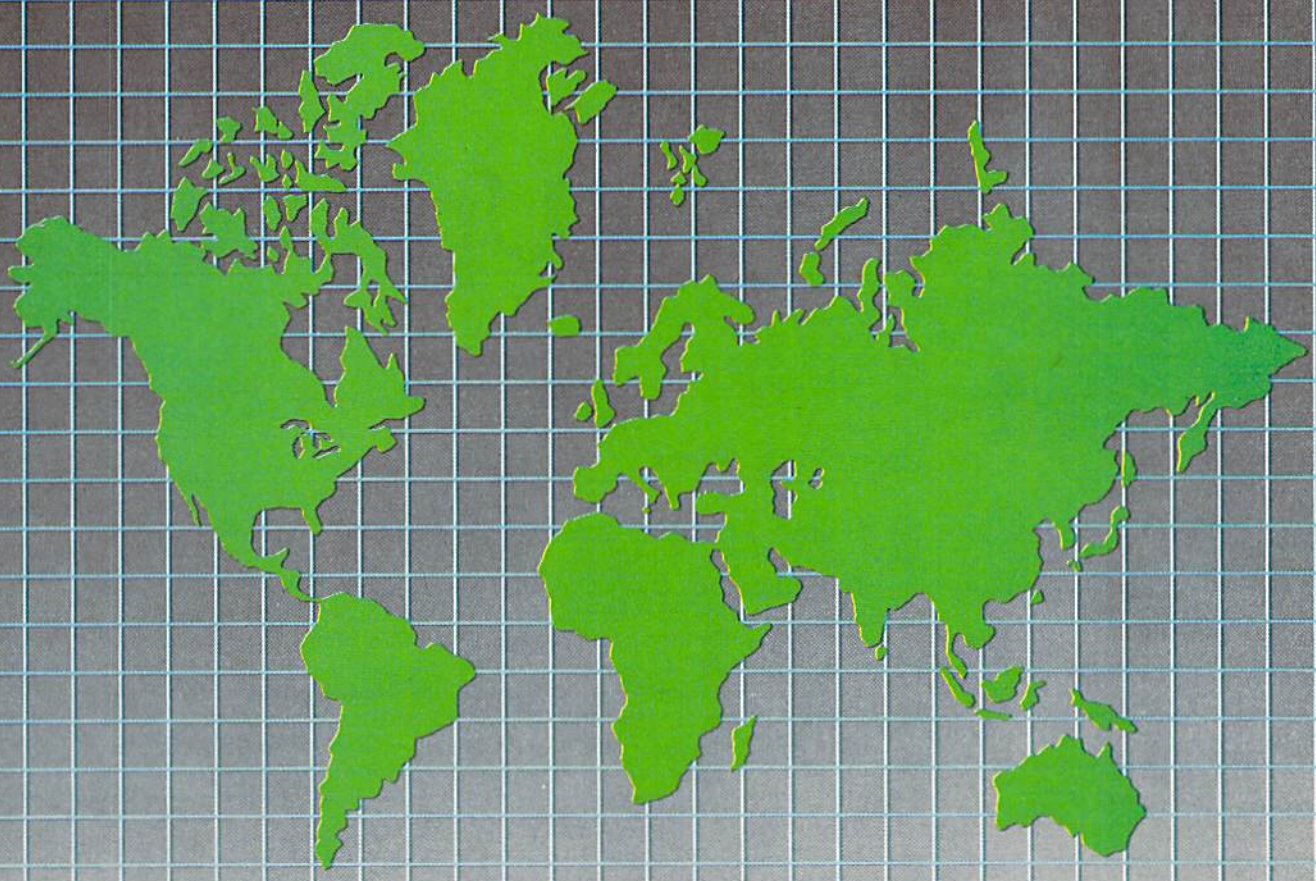

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and the high byte is the second FF, located at LOOP+2. (Addresses are stored backwards from the way we would read them. Thus, 04 00 that we read becomes 00 04 when stored in the computer.)

We then need to see if we're finished, if we've filled everything we wanted to fill. We load the X register (which is otherwise not being used in this routine) with the high byte of the pointer and then compare it to 8. Take a look at line 40. You can see that we started out with a high byte of 04 and a low byte of 00. So, if we want to fill four 256-byte chunks, we look at the pointer to see if the high byte has been INCed up to 8. BCC means branch-if-less-than, so until the high byte reaches 8, we'll branch back to LOOP and continue filling.

User Group Update

When writing to a user group for information, please remember to enclose a stamped, self-addressed envelope.

Send typed additions, corrections, and deletions for this list to:

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User Group Notes

The Commodore Computer Club of Pine Bluff has a new address: P.O. Box 1083, Pine Bluff, AR 71603.

The Atlanta C-64 User's Group is now the Commodore User's Group of Atlanta (CUGA), Donald Schwab, 633 Clairmont Circle, Decatur, GA 30033.

The address for the Gold City User Group has been changed: P.O. Box 257, Ft. Knox, KY 40121.

The Alliance Commodore Computer Club also has a new address: c/o Eugene Hansen, 726 W. 16th St., Alliance, NE 69301.

Another new address is for the Commodore Users Group of Massena (COMA): c/o Star Tech Systems, 69 Main St., Massena, NY 13662.

The Chillicothe Commodore Users Group can now be reached c/o Robert May, 213 Terrace Dr., Chillicothe, OH 45601.

The new address for the VIC-UPS Computer User Group is: P.O. Box 178, Nedlands, W. A. 6009, Australia.

A new users group is forming in Zurich, Switzerland. For more information, write: P.O. Box 130, CH-8062, Zurich, Switzerland.

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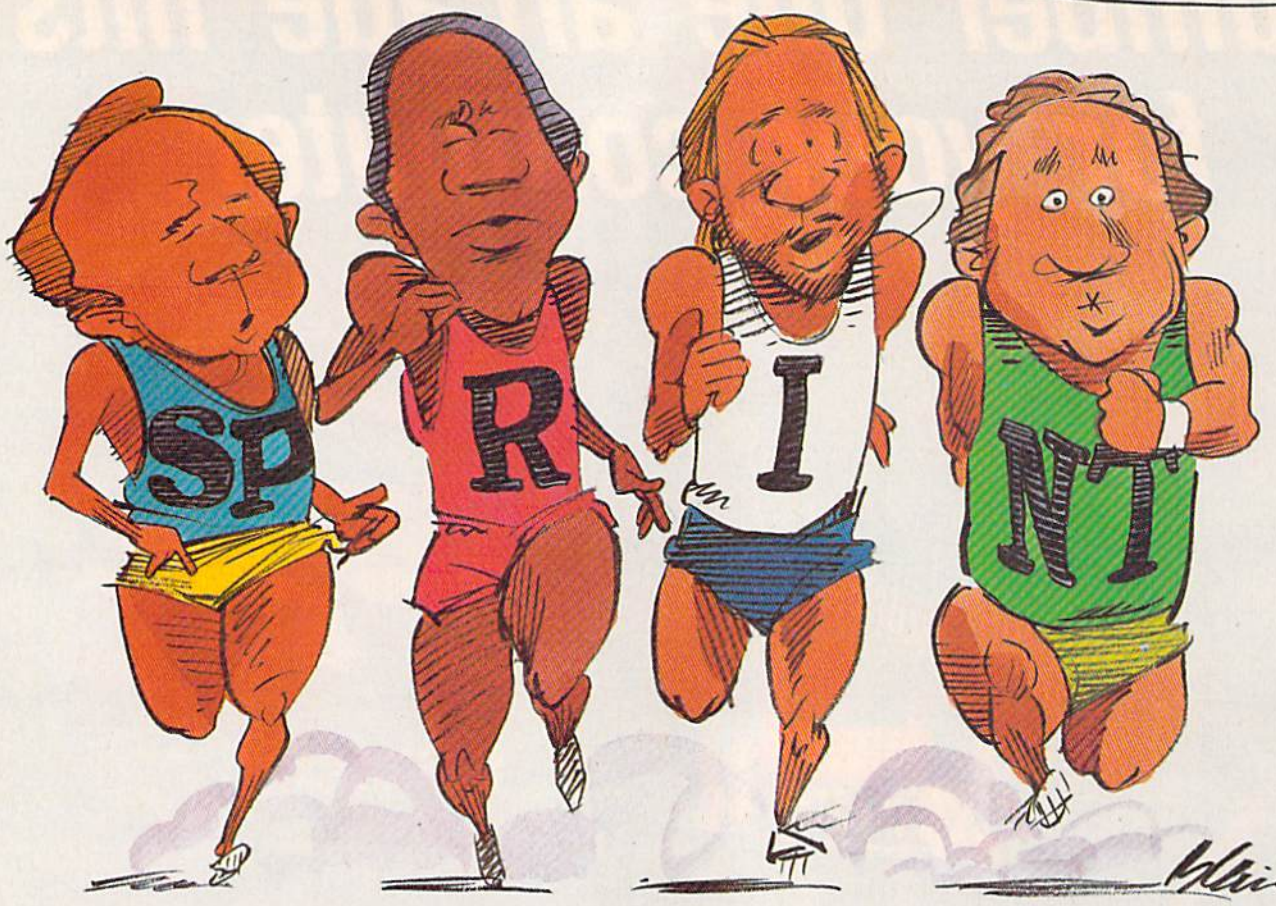

A Compiler For The 64

Robert A. Stoerrle

Here's a BASIC compiler that can make your programs execute up to 50 times faster! Written in machine language, and extremely easy to use, "Sprint" supports most Commodore BASIC commands, statements, and functions. For the Commodore 64 and 128 (in 64 mode). A disk drive is required.

What's the chief complaint when it comes to Commodore BASIC? Speed, or more precisely, the lack of it. Yet the language itself is not what earns BASIC its reputation as painstakingly slow; it's the way that it's implemented. BASIC is *interpreted*. Most faster languages are *compiled*.

Whether a program in a high-level programming language is interpreted or compiled, each statement has to be translated into the machine language of the computer. With an interpreter, this has to be done every time the statement is executed. This slows down execution speed considerably. However, a compiler translates the entire program once—before execution. So, when you run the program, it executes much faster than a comparable interpreted program.

"Sprint" is a BASIC compiler that supports a subset of BASIC statements available on the 64. It supports most of the Commodore statements, including LET, FOR, NEXT, IF, POKE, PRINT, READ, DATA, and INPUT. It supports integer numbers (but no fractions), numeric and string variables, and one-dimensional numeric arrays. Sprint also supports a wide range of functions, including LEFT$, RIGHT$, MID$, PEEK, STR$, and VAL.

Typing In The Program

Sprint is written entirely in machine language and must be typed using the new version of MLX (elsewhere in this issue).

After loading MLX, run it. When prompted for the starting and ending addresses, enter these values:

Starting Address: 8000
Ending Address: 9737

Since Sprint is a very large program (almost 6K of pure machine language), you may want to type it in more than one sitting. Be sure to follow the instructions in the MLX article to save your work between sittings, and always load up your previous work before typing further.

Once the program has been typed in and saved, it can be loaded by the following statement.

```
LOAD"SPRINT",8,1
```

To run it, type:

```
SYS 32768
```

Using Sprint

The first step, of course, is to write the BASIC program you wish to compile. You can do this with the normal BASIC built into your 64. If you wish, you can test the program on the interpreter first by running it. This will not always work, as Sprint has a slightly different syntax for certain keywords.

When you're ready to compile the program, save it on disk (Sprint compiles a program from disk, not from memory). Load Sprint and type SYS 32768. You'll be prompted for the filename of your BASIC program. When you enter it, Sprint will proceed to compile your program. As the program is compiled, each line will be listed to the screen, followed by any error messages for the line. Note that you can stop the compiler simply by pressing the STOP key. If the compilation finishes with no errors, you can simply type RUN to execute the compiled program. However, if there are errors, you'll have to load the original BASIC program (the source program) and make the necessary changes.

Sprint compiles programs starting at the beginning and continuing straight to the end; it does not follow GOTOs or GOSUBs, or evaluate IF/THEN statements. Because of this, you can't have conditional DIMs (IF...THEN DIM...) or conditional FORs. Sprint is a two-pass compiler—it scans the program twice. Once a program has been compiled, there's no need for the compiler to be in memory in order to run the program; Sprint programs are self-sufficient.

After the source program is compiled, the object program (the resulting code) will reside in memory as if it were an ordinary BASIC program. You can run and save it, but if you type LIST, you'll see:

```
10 SYS 2061
```

This is another advantage of using a compiler—people can't easily LIST or modify your program. Editing can only be done on the source program.

Constants, Variables, And Expressions

Sprint works much the same as regular Commodore BASIC. However, there are some differences you should keep in mind when you're writing a program.

Constants are data values used in BASIC programs, such as −1, 4353, and "HELLO". Sprint supports two types of constants: integer and string. Integer numbers are limited to −32768 to 32767. However, numbers greater than that are allowed in POKE, PEEK, and SYS statements. String constants are characters enclosed in quotes. The closing quote may be omitted if it's at the end of a line.

Sprint supports both numeric and string variables. Variable names may be of any length, but must not contain any *reserved words* (words that are significant to the compiler, such as POKE and THEN). Only the first 15 characters are looked at, however. Integer variables may be terminated by a percent sign (%) if desired, but all regular numeric variables are assumed to be integers anyway, since there are no floating point numbers. String variable names must be terminated with a dollar sign ($).

Strings are limited to ten characters, unless specified otherwise. If you want to include more characters, DIMension the string, as if it were an array, to the maximum number of characters it will hold. The maximum number of characters allowed in a string is 253.

In addition to integer variables, Sprint supports one-dimensional integer arrays. Subscripts may range from 0 to 126. Arrays that are not DIMensioned are assumed to consist of 11 elements, numbered 0–10. The format for assigning, reading, and dimensioning integer arrays is identical to that for interpreted BASIC, except that the subscript of a variable may not be another subscripted variable or an expression. It must be an integer constant or integer variable.

Numeric expressions in Sprint may contain integer constants, variables, arrays, functions, and operators. The operators supported by Sprint are +, −, *, /, as well as the logical operators AND and OR, and the relational operators =, <, etc. *Parentheses are not permitted.* Unlike interpreted BASIC, expressions are evaluated strictly left to right; there is no operator precedence. To get around this, you must break up the expression into several smaller expressions, and then put the results of these back together. For example, this expression:

```
SUM = A + X*Y + B + I*J
```

becomes the following.

```
Q1 = X*Y:Q2 = I*J:SUM = A+Q1+B
+Q2
```

Strings can be compared using the relational operators as in regular BASIC. They can also be *concatenated* (one string appended to the other) using the plus sign. Note that the result of a string expression must not be longer than the number of characters allocated for the string.

When an expression is assigned to a variable, the LET may be omitted.

Sprint Keywords

ABS	INPUT	RESTORE
AND	LEFT$	RETURN
ASC	LEN	RIGHT$
CHR$	LET	READ
DATA	MID$	RND
DIM	NEXT	SGN
END	OR	SPC
FOR/TO/STEP	PEEK	STR$
GET	POKE	SYS
GOSUB	POS	TAB
GOTO	PRINT	VAL
IF...THEN...	REM	

Statements

A complete list of the keywords available in Sprint appears in the "Sprint Keywords" table. Most keywords function the same as in regular BASIC, except for the following:

• DATA. The DATA statement has one small idiosyncrasy: Items that include spaces must be enclosed in quotes, or the item will be READ as if it doesn't contain a space (YOU ARE becomes YOUARE.)

• DIM. The DIM statement can only be used to declare one-dimensional numeric arrays. Multi-dimensional arrays are not permitted, nor are string arrays. A string is dimensioned to the maximum number of characters it will hold, like an array of numbers representing each character of the string. Only integer constants are allowed between the parentheses of variables in a DIM statement.

• FOR. This statement functions the same as in Commodore BASIC, but its syntax is somewhat more particular. The TO value, and

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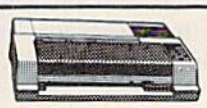

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the STEP value, if specified, must be either integer constants or integer variables. Expressions are not allowed. Also, every FOR statement must have one, *and only one*, matching NEXT statement.

• GET. In Sprint, the GET statement can be followed only by a string variable. This shouldn't be a problem, as numeric GETs are prone to errors because of non-numeric keystrokes, and the VAL function can be used to change the string to a number.

• IF. This statement functions a bit abnormally when AND or OR is used. Because expressions are evaluated without operator precedence, the following statement will not work:

```
IF A=B AND C=D THEN...
```

It would be evaluated as if it were

```
IF (A=B AND C) = D THEN...
```

To get around this, you can use the following modification.

```
X = A=B:Y = C=D:IF X AND Y
  THEN...
```

The result of the comparison A=B, which is −1 for true or zero for false, is assigned to variable X. The result of C=D is assigned to Y. Now X and Y can be substituted for those comparisons in the IF statement.

• INPUT. Each INPUT statement can assign input to just one variable. In addition, all characters, except leading and trailing spaces, typed on the screen, are assigned to the variable. This includes commas, colons, and quotes.

Functions

Sprint supports most Commodore functions that do not require floating point numbers. The arguments of functions must be constants or variables, not expressions. Also, note that functions may not be nested. For example, ABS(RND(0)) is illegal. The following functions work differently in Sprint than in regular BASIC:

• RND. The RND function always returns a number ranging from −32768 to 32767, no matter what its argument is. To scale the number down to size, you can divide, using the equation.

```
Z=32767/upper range:N=RND(0) AND
  32767/Z
```

The AND is necessary to insure that no negative numbers result. Sprint gets its random numbers from voice 3 of the SID chip.

• MID$. This string function has two forms in Commodore BASIC: MID$(v$,x) and MID$(v$,x,y). Only the latter form is supported by Sprint.

• ASC. In Commodore BASIC, using this function on a null ("") string results in an error. This does not occur in Sprint. Instead, a value of zero is returned.

Error Messages

Sprint has many error messages which make it easier to debug programs. However, only certain types of errors can be flagged during compilation. Sprint catches errors such as data type mismatches, NEXT without FOR, and so on. Errors such as overflowing numbers and running out of DATA items cannot be flagged during compilation because they occur during execution of the actual compiled program. In these cases it will be harder, but not impossible, to debug programs.

Sometimes, an error earlier in the program leads to another error later on. For example, if there is an error in a FOR statement, the compiler will act as if that FOR does not exist. Because of this, the corresponding NEXT statement will cause a NEXT WITHOUT FOR error message. You'll have to use your judgment to weed out these extraneous messages. Note that you should *never* attempt to execute a program with even a single error in it.

See the Sprint Error Messages table for more details.

How Fast Is Sprint?

I ran several test programs through the compiler to determine the speed of Sprint. Results varied according to the type of program. The compiled test programs ran 15 to 50 times faster than Commodore BASIC. A program to sort 100 numbers took over two minutes in Commodore BASIC, but the same program compiled by Sprint executed in only five seconds!

For demonstration purposes, I've included a sample program. Type in Program 2, "64 Doodler Demo," and run it, noting the speed with which it executes. Now, save, compile, and run it again. Notice the difference?

See program listings on page 127.

Sprint Error Messages

BAD FILE—Sprint only reads program files. This error results if the filename of a sequential file is entered. This error may also happen if program line has more than 80 characters or a read error occurs.

DISK ERROR—The disk error channel is checked prior to each pass. If there is an error, it is displayed and compilation is aborted.

DEVICE NOT PRESENT—The disk drive is not connected to the serial bus, or it is not turned on.

NOT SUPPORTED—A statement that is legal in Commodore BASIC but illegal in Sprint was used.

ILLEGAL FUNCTION USE—A function was used where a statement should have been used.

ILLEGAL STATEMENT USE—A statement was used where a function should have been used.

NON-EXISTING LINE—A GOTO or GOSUB attempts to branch to a program line that does not exist.

SYNTAX—A misspelled keyword, extra parenthesis, and so on.

TOO MANY FORS—It is unlikely that you'll ever encounter this error, as up to 19 FOR/NEXT loops can be nested.

NEXT WITHOUT FOR—A NEXT statement attempts to end a loop which does not have a corresponding FOR statement.

TYPE MISMATCH—Numeric data was used where string data was expected, or vice versa.

COMPILATION ABORTED—Either the STOP key was pressed or an irrecoverable error has occurred (file not found, and so on).

MISSING COMMA

MISSING PARENTHESIS

MISSING SEMICOLON

MISSING EQUAL SIGN

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The Fast Assembler

Yves Han

Here's a truly amazing machine language assembler for the 64 and 128 (in 64 mode). "Fast Assembler" supports multiple statement lines, labels, and macro-like "include" files. It can assemble to memory or to disk. Written very compactly, it occupies only about 2600 bytes, leaving the rest of memory for your source code. It also adds to the BASIC editor several new features useful to both BASIC and machine language programmers.

Symbolic label-based assemblers are the most convenient way to write machine language (ML) programs. The instructions are entered as *source code* and later assembled into object code (the actual ML program—the numbers in memory). And rather than using memory locations, you can name routines with meaningful labels. It's as if you could enter GOSUB JOYSTICK in BASIC.

Saving Memory By Using The BASIC Editor

You write your ML programs for "The Fast Assembler" (FA) with the 64's BASIC editor. You save to tape or disk as you would a BASIC program, and listing it to a printer is exactly the same as listing BASIC.

The FA is an extension of the BASIC interpreter especially designed for writing programs in machine language. Writing it as a BASIC extension kept the program short (under 2600 bytes) because many subroutines of the BASIC interpreter could be used. Some modifications have been made to BASIC to make writing programs easier. To do this, the BASIC ROM had to be copied to its matching RAM.

Even if you don't write programs in machine language, you can still use the assembler because of the new features added to BASIC and the extra BASIC commands. The assembler will execute a BASIC program just like normal BASIC would.

Typing Instructions

You'll need a copy of "The New MLX" program (appearing this month for the first time) to type in Fast Assembler. First type in MLX and save a copy or two. When you run it, answer the prompts as follows:

Starting Address: 0801
Ending Address: 1220

After entering the FA, save it on tape or disk. To start up FA, first load it as if it were a BASIC program (don't use a secondary address of 1, just type LOAD *"filename"*,8 for disk or LOAD-*"filename"* for tape). Then type RUN. The enabling SYS is built into the first line of the program. The screen will clear, and a message will appear at the top of the screen, indicating FA has been enabled. You can now start programming—in BASIC or machine language.

BASIC Modifications And Enhancements

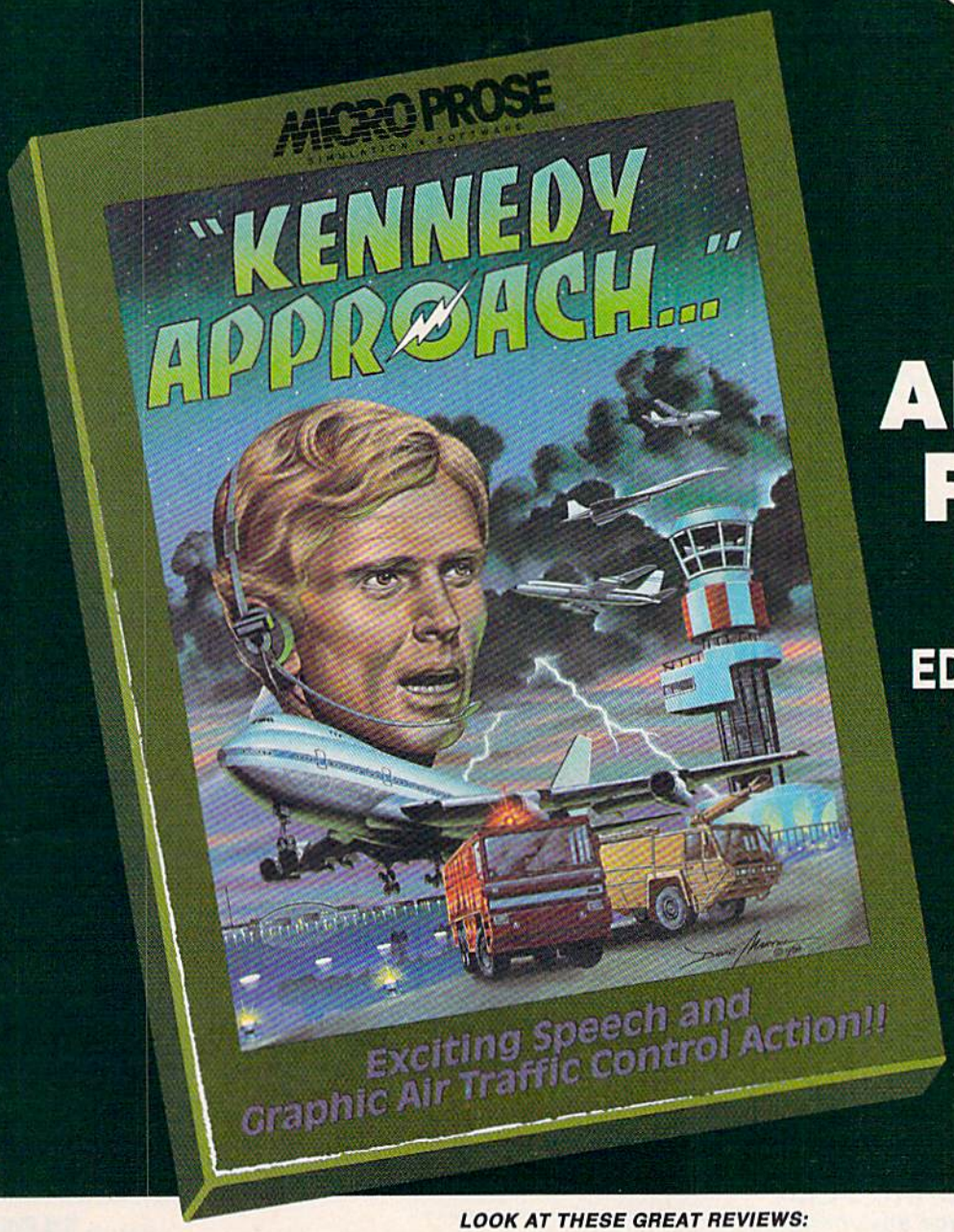
The following changes have been made to the BASIC interpreter:

• **Structured listings.** Spaces between the line number and the first character on the line are not deleted. This makes it possible to indent lines and make listings easier to read.

• **List pause.** You can freeze a listing by holding down the SHIFT key or pressing SHIFT-LOCK. Listing can be continued by releasing the SHIFT key.

• **ASCII translations and hexadecimal/binary numbers.** In arithmetic expressions, you can use hexadecimal and binary numbers. Hexadecimal numbers should be preceded by "$" and binary numbers by "%". You can also use a character preceded by a single quote ('A is the same as ASC("A")). You can also use this to find the value of a BASIC token. For example, PRINT 'END will print the value 128, which is the BASIC code for END. If you put a space between the quote and the character, the ASCII value of the space will be taken instead of the character.

• **Variable and function names.** The rules for variable and function names have been changed a little bit. Instead of the first two, the first eight characters are recognized. FA recognizes NUMBER1 and NUMBER2 as separate variables, while ordinary BASIC would consider them the same variable



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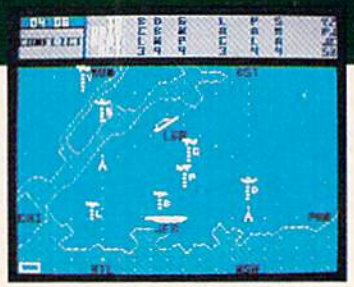

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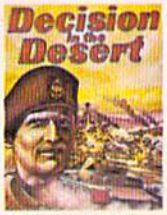

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(NU). Variables may contain but not be equal to BASIC/assembler commands or mnemonics: LAND is a legitimate variable name, even though it contains the keyword AND. But variable labels starting with TI or ST (reserved keywords) are not automatically set to zero the first time you use them. An exception to the eight character names is that only the first two characters of array variables are significant.

• **Keywords.** Because variable and function names may contain keywords, FA has to be able to decide whether a keyword is a keyword or part of a variable or function name. So the assembler recognizes a keyword if it's followed by a space or nonalphabetic character. For example, in PRINT "OK" the keyword PRINT will be recognized as a PRINT command, but in A$="OK":PRINTA$, the keyword PRINT is recognized as part of the variable name PRINTA$. You would have to insert a space (PRINT A$) if you wanted to print the variable A$.

• **REM and DATA.** Capital letters in REM and DATA lines are listed as capital letters and not as tokenized BASIC keywords. For example, **10 rem AB** lists as it is entered and not as **10 rem atnpeek** as normal BASIC would do.

New BASIC Commands

AUTO *step value*

This command turns automatic line numbering on and defines the step value between the line numbers. To enter AUTO mode, type AUTO followed by the step value and press RETURN. Then enter a line with a line number. The next line number prints automatically. To leave auto mode, move the cursor to an empty line and press RETURN. To turn automatic line numbering off altogether, enter AUTO only.

You can also use this command to delete part of a program. Turn automatic line numbering on with a step value of one. Type the number of the first line you want to delete and press RETURN. Keep pressing RETURN until you've reached the end of the section you want to delete. Instead of pressing RETURN again and again, you can enter **POKE 650,128** and hold RETURN down until you've reached the last line to be erased.

OLD

If you accidentally type NEW, you can restore your program with this command. It can also be used if you've installed a reset button. If you've assembled a program and are testing it, sometimes your computer locks up. Use the reset button and then enter SYS 4408 to restart the assembler and type OLD to restore the source program. If your program has not destroyed the assembler or the source program, everything will be there.

Semicolon (;)

This has the same function as the REM statement. It need not be separated with a colon from the preceding command. For example:

```
10 X=0:REM SET X TO ZERO
```

is the same as

```
10 X=0;SET X TO ZERO
```

The semicolon in the commands PRINT and INPUT is not treated as a REM statement but as a separator.

Using Labels As Variables And Addresses

Label names follow the same rules as variable names. They can be used in arithmetic expressions like normal variables. You can define a label in two ways:

You can place the label name just before the command to which you want to refer. If more commands are on the same line, you must separate the label from the commands with a colon.

Or you can label the current program counter: **LABELNAME=***. The asterisk (*) is a special variable which gives the value of the program counter. The counter is the address where the next instruction or datum will be placed. You can only read the variable *. You cannot assign a value to it with the statement *=expr.

Here's an example of using labels to mark routines in a program (don't type this in, it's only a fragment of a program):

```
50 JSR DISPLAY1; JUMP TO LABELED SUBROUTINE (LINE 90)
60 LDA $FF: BNE SKIPIT ; CONDITIONAL BRANCH AHEAD TO SKIPIT
70 TYA
80 SKIPIT: LDX #4: STA $8000,X: RTS; TARGET OF BRANCH IN 60
90 DISPLAY1=* ; THIS LABELS THE CURRENT PROGRAM COUNTER
100 ;
110 LDA #65: JSR $FFD2: RTS
```

Remember that in the lines above, the semicolon marks the beginning of a comment which, like a REM, is ignored by FA. The technique in line 90 is valuable if you think you may be adding some code at the beginning of the routine. As listed, the subroutine called DISPLAY1 starts with LDA #65, but later you could go in and add some lines between 90 and 110.

Three Passes To Assemble

Three passes are required to assemble source code (what you write) into object code (an executable ML program that the computer can follow). But FA doesn't do it by itself. You have to insert a loop that repeats three times with BASIC commands:

```
10 FOR PASS=1 TO 3
.
. (Insert source code)
.
90 NEXT PASS:END
```

If you use an invalid addressing mode such as LSR (expr),y you'll see ILLEGAL ADDRESSING MODE ERROR. Mnemonics can only be used in program mode—that is, in a program you execute with RUN. If you enter a mnemonic in direct mode, you'll see ILLEGAL DIRECT ERROR.

Also note that for Immediate Addressing, the argument can be an actual number or an arithmetic expression with a value in the range 0–255. Or you can substitute a string expression, in which case the assembler takes the ASCII value of the first character as the argument. If the string length is zero, the argument becomes zero.

Assembler Commands

Assembler commands which write data to the output device can only be used in program mode, otherwise you'll get ILLEGAL DIRECT ERROR. All assembler commands must be included in every pass.

ORG *address,mode,device,name*

This command must be used at the start of each pass. It does several things. First, it sets the origin (ORG), the memory address for the beginning of the ML program. It assigns an initial value to the program counter. It also sets the assembler mode, which should be zero on the

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first two passes and one on the third and last. ORG also sets the output device and filename (if necessary).

Not all arguments are necessary. Also permitted are:

```
ORG
ORG address
ORG address,mode
```

Default values for the arguments are:

```
address = 49152 (=$C000)
mode    = 0
device  = 0 and no name
```

If you use a mnemonic or assembler command before you've used the command ORG, you'll see UNDEF'D LOCATION COUNTER ERROR.

The address assigns a value to the program counter. Usually, you use more than one pass to assemble the source program. Only during the last pass should the object code be written to memory or to the output device. Mode tells the assembler when the last pass is reached. Zero means it's not the last pass, so no object code should be produced, and there's no range checking for arguments and no checking for too large branches.

On the final pass, you should set the mode to one, which signals the last pass, when object code is written to the output device.

Finally, you set the device number of the output device and a string expression which contains the filename if the object code is not written to memory. Zero means the output device is memory. Be careful not to write to memory locations where the assembler is placed ($0801–$121B) or where the BASIC interpreter is placed ($A000–$BFFF).

A device number in the range 8–11 means the output device is a disk drive. If mode is equal to one, the assembler will open a PRG file with the name specified in the argument name. The logical file number will be eight.

BYTE *expression,expression,...*
This command writes numbers or characters to memory or the selected output device. It can have one or more arithmetic or string expressions separated by commas. Arithmetic expressions must give a positive value less than 256. The value will be placed in one byte. Each character of a string expression will be placed in one byte.

WORD *expression,expression,...*
This has the same function as BYTE except that values of arithmetic expressions must be positive and less than 65536. The value will be placed in two bytes in low/high format.

INCLUDE *name,device*
This command assembles a file from disk and inserts the resulting object code into memory or the output device. The file must be a normal PRG file and may not contain BASIC commands which cause a branch to another line or stop the program. Also not permitted are the BASIC commands DEF, RETURN, CLR, NEW, and the assembler commands SEND and INCLUDE.

The file is opened with a logical file number of nine. The file is closed when the end of the file is reached. The name is the filename you're including, and the device number can be 8–11 (use 8 if you have a single drive). If you have only one disk drive and you assemble to disk, the file(s) for the command INCLUDE must be on the same disk to which you assemble.

All variables and labels are *global*, which means you can pass parameters to INCLUDE files so they can work like macro-instructions. Let's say you're writing a program that needs to access several different disk files, and there are several points in the program that use the Kernal routines SETLFS, SETNAM, and OPEN. You could write the source code that performs these Kernal calls and save it to disk under the program name "OPEN" to be used later. Then, in the main program, use INCLUDE "OPEN" ,8. When the source code is compiled, the series of commands from the OPEN file are automatically inserted in the proper place in the object code.

SEND *stringexpr*
The command SEND may be used only if the object program is written to disk. It's used to link object code to a BASIC program. *Stringexpr* must contain a BASIC line with line number. If you forget the line number, you'll get MISSING LINE NUMBER ERROR. If you want to send more than one line, you must use SEND for each line, and you have to send the lines in the right order. You must send the lines before the actual object code is written to disk. The address in the ORG command must be the start of BASIC RAM (2049).

UNSEND
If you load a program which consists of both BASIC and ML, the interpreter has to know where the BASIC part ends. UNSEND places a mark which the computer recognizes as the end of the BASIC part.

Example Programs

```
100 FOR PASS=1 TO 3:PRINT "PAS
    S"PASS,
110 ORG $C000
120 IF PASS=3 THEN ORG $C000,1
130 START: LDX #0
140 LOOP: LDA TEXT,X:PRINT TEX
    T,
150 BEQ EXIT
160 JSR $FFD2
170 INX
180 BNE LOOP
190 EXIT: RTS
200 PRINT *
210 TEXT: BYTE "EXAMPLE 1",0
220 NEXT PASS:END
```

Lines 110 and 120 show how to use the command ORG. In every pass, line 110 sets mode 0. But in pass three, line 120 sets mode 1. The object code will start at 49152 (hexadecimal $C000). Line 200 prints the current value of the location counter (*).

You can assemble the program with the command RUN. The program will give the following output:

```
PASS 1    0       49165
PASS 2    49165   49166
PASS 3    49166   49166
```

The first column is the pass number. The second column is the value of the label TEXT in the instruction LDA TEXT,X in line 140. The third column is the value the label should have when the source code is assembled. You can see that only in pass three are these values equal to each other. This is because the assembler defaults to zero-page addressing. In pass one, TEXT has a value less than 256 so zero-page addressing is assumed. This means a two-byte instruction instead of three. The value assigned to TEXT will be too low, as you can see in pass one. In pass two, this value, which is too low, will be used in assembling line 140. The assembler decides not to use zero-page addressing, so TEXT is assigned the

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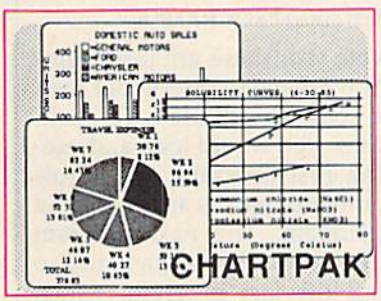

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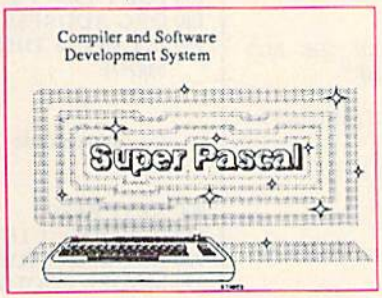

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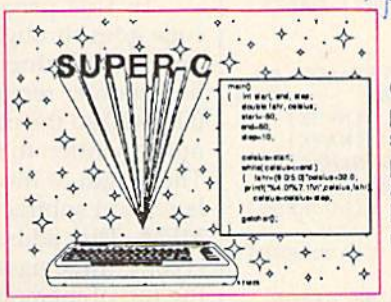

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correct value. In pass three, the correct value replaces the previously incorrect values during assembly.

```
5   ;EXAMPLE PROGRAM 2
6   ;
10  PRINT CHR$(147)
11  DEF FN H(X)=INT(X/256)
12  DEF FN L(X)=X-256*FN H(X)
20  PRINT:PRINT" LOADER MAKER"
30  PRINT:PRINT" ENTER THE NAM
    E OF THE PROGRAM THAT"
40  PRINT" HAS TO BE LOADED BY
    THE LOADER."
50  INPUT" >";NAME$
60  PRINT:PRINT" ENTER THE NAM
    E OF THE LOADER."
70  INPUT" >";N$
80  PRINT:PRINT" ENTER THE ADD
    RESS TO EXECUTE THE"
90  PRINT" PROGRAM."
100 INPUT" >";ADDRESS:ADDRESS=
    ADDRESS-1
105 ;
110 FOR PASS=1 TO 3
115 ;
120 ORG 2049
130 IF PASS=3 THEN ORG 2049,1,
    8,N$
135 ;
140 SEND "10 SYS"+STR$(LOADER)
150 UNSEND
155 ;
160 LOADER: LDA #8:TAX:LDY #1
170         JSR $FFBA
180         LDX #FN L(NAME)
190         LDY #FN H(NAME)
200         LDA #LEN(NAME$)
210         JSR $FFBD
220         LDA #FN H(ADDRESS)
    :PHA
230         LDA #FN L(ADDRESS)
    :PHA
240         LDA #0:JMP $FFD5
250 NAME:   BYTE NAME$
255 ;
260 NEXT PASS:CLOSE 8:END
```

The above example program shows how to use the commands SEND and UNSEND to write a program that includes a SYS within a BASIC line.

The main routine at 160–250 illustrates how to load another program from an ML program. Note that the lines up to 100 are BASIC; they prepare the variables and defined functions for use in the source code. If you assemble the program with the command RUN, you'll get a program that can load another ML program from disk and execute it. The object code will be written to disk.

In line 140, the command SEND writes a BASIC line to the output device by which you can load and run the program as if it were a normal BASIC program. Line 150 marks the end of the BASIC part of the object code.

The INPUTs in lines 50, 70, and 100 permit you to enter the parameters for the object program when the source program is assembled. In this way you can make different object programs with one source program.

Another advantage of writing the assembler as a BASIC extension is that you can assemble a program to the top of memory. Use the following construction to do this:

```
100 POKE 56,PEEK(56)-4:CLR
110 TOPOFMEM=PEEK(55)+256*(PEEK
    (56)+4)
120 ADDRESS=0:MODE=0
130 FOR PASS=1 TO 3
140 ORG ADDRESS
150 IF PASS=3 THEN ORG ADDRESS,
    MODE
      .
      .
      . Source code
      .
      .
900 NEXT PASS
910 IF MODE=1 THEN END
920 ADDRESS=TOPOFMEM-*
930 MODE=1:GOTO 130
```

In this program, the source code goes through six passes. During the first three passes the location counter remains at zero. Mode 0 is used so the object program will not be written to the output device. The length of the program is calculated and subtracted from TOPOFMEM. This address is used in the second three passes to assemble to the top of memory. MODE is set to one so the assembler will write the object code to the output device during the sixth pass (actually pass three of the second time around). Line 100 is used to reserve 1K at the top of memory for the object program.

Large Programs

If your source program won't fit into memory, you can split your program and use the command INCLUDE. For example:

```
10 FOR PASS=1 TO 3
20 ORG ADDRESS
30 IF PASS=3 THEN ORG ADDRESS,1
      .
      . Part 1 of source code
      .
90 INCLUDE "PART 2",8
100 INCLUDE "PART 3",8
110 NEXT PASS:END
```

The labels and variables used in the INCLUDE files will be global variables, which means you can use them in arithmetic expressions everywhere in the program.

Another possibility is chaining the programs, but then you can't use a FOR-NEXT loop for the passes. You must use another way to define the passes. For example:

```
FIRSTPROGRAM
10 PASS=PASS+1:IF PASS=4 THEN
   END
20 ORG ADDRESS
30 IF PASS=3 THEN ORG ADDRESS,1
      .
      . Source code
      .
90 LOAD"SECONDPROGRAM",8
SECONDPROGRAM
      .
      . Source code
      .
90 LOAD"FIRSTPROGRAM",8
```

Note that these are just examples. You'd have to insert your own source code as indicated. To chain programs, you would load and execute the first program. It controls the number of passes and loads the next program. The next program loads the following program and so on until the last program, which must load the first again.

Editor's Note: As a bonus, the source code for the entire FA itself will be included on the GAZETTE DISK *for those who want to study it or make modifications to it.*

See program listing on page 132.

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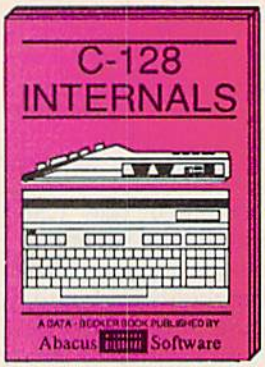

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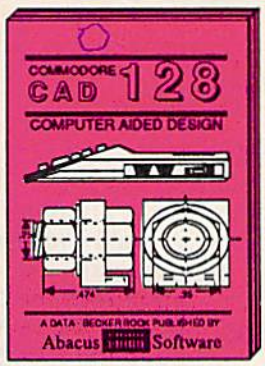

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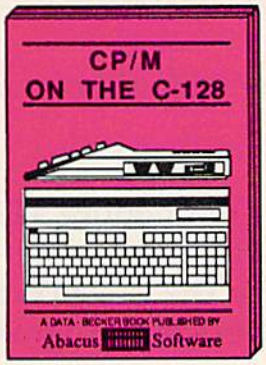

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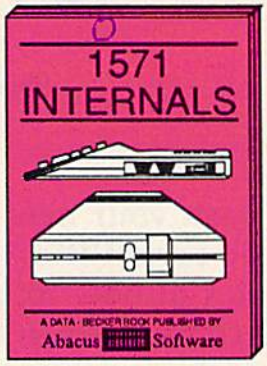

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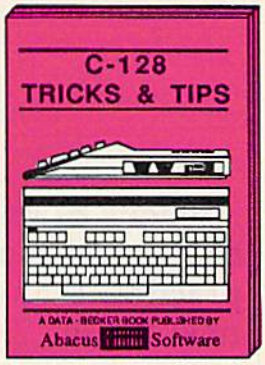

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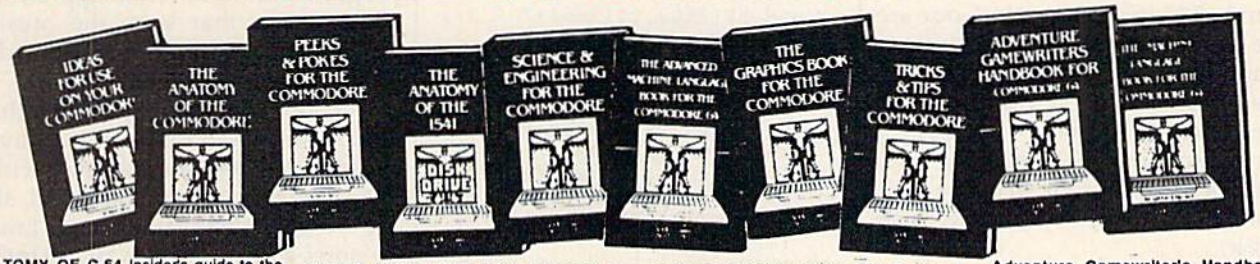

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Programming Music and Sound On The 128

Philip Nelson, Assistant Editor

Anxious to unleash your new Commodore 128's sound and music capabilities? Here are some practical examples of how to use the powerful new BASIC 7.0 commands in working programs.

One of the Commodore 128's most welcome features is its ability to make music and sound effects with simple BASIC commands. Gone are the days when it took hours of programming and multiple POKEs to create sound on a Commodore computer. Since your *128 System Guide* explains the basics of each command, we'll look at some programs that actually put them to work.

Musical Keyboard

The first program, "Musical Keyboard," is lots of fun to use and also demonstrates how arrays can simplify your programs. It defines four rows of keys on the 128's keyboard as musical keys, giving you two separate one-octave keyboards. By pressing keys 0–9 on the numeric keypad, you can switch to any of the 128's ten predefined instrument voices.

```
10 GOSUB 60
20 GETKEY A$:X=PEEK(212)
30 IF T$(X)<>"" THEN PLAY T$(X
   ):PRINT "{HOME}"SPC(7)"TUNE
   :"MID$(T$(X),2)
40 IF P$(X)<>"" THEN PLAY P$(X
   ):PRINT "{HOME}"P$(X)"
   {2 SPACES}"
50 GOTO 20
60 DIM P$(256),T$(256):FOR J=1
    TO 3:SOUND J,0,0:NEXT
70 PLAY "U15 X0 T7 S":TEMPO 15
80 READ K,P$:P$(K)=P$:IF P$<>"
   DONE" THEN 80
90 READ K,P$:T$(K)="T"+P$:IF P
   $<>"DONE" THEN 90
100 PRINT CHR$(147)SPC(10)"
    {RVS}{2 DOWN}MUSICAL KEYBO
    ARD{OFF}":PRINT SPC(12)"4
    {SPACE}5 6 7 8 9"
110 PRINT SPC(11)"E R T Y U I
    {SPACE}O":PRINT SPC(12)"D
    {SPACE}F G H J K"
120 PRINT SPC(11)"X C V B N M
    {SPACE},":PRINT "{HOME}"SP
    C(7)"TUNE:"MID$(T$(70),2):
    RETURN
130 DATA 23,03C,18,03#C,20,03D
    ,21,03#D
140 DATA 31,03E,26,03F,28,03#F
    ,29,03G
150 DATA 39,03#G,34,03A,36,03#
    A,37,03B
160 DATA 47,04C,14,04C,11,04#C
    ,17,04D
170 DATA 16,04#D,22,04E,19,04F
    ,25,04#F
180 DATA 24,04G,30,04#G,27,04A
    ,33,04#A
190 DATA 32,04B,38,05C,256,DON
    E
200 DATA 81,0,71,1,68,2,79,3,6
    9,4,66,5
210 DATA 77,6,70,7,65,8,78,9,2
    56,DONE
```

Think for a moment how you would structure a musical keyboard program like this. It requires that you read the computer's keyboard, detect the pressing of certain keys, and translate those keypresses into musical notes. One way to do this would be with a long series of individual IF tests (IF A$="X" THEN PLAY "O3C" and so on). But that would be slow and inefficient. This program takes a different approach, using arrays that store the music data and simplify the keyboard-scanning process as well.

Take a look at lines 60–90, the setup portion. Both of the arrays (P$ and T$) are dimensioned with 256 elements, enough to hold all the possible keyscan values. Line 80 stores a PLAY string (O3C, O3#C, etc.) in each element of the P$ array that corresponds to the keyscan value (23, 18, etc.) of a key that we'll use to make music. Line 90 creates a similar array for selecting different instruments with the numeric keypad keys. (Actually, these two arrays could be combined into one, but we want to display the instrument data separately.)

After the setup portion is complete, the program loops continuously through lines 20–50. The statement X=PEEK(212) returns the value of the last key pressed. (Location 212 performs the same function as location 197 on the 64 and VIC-20. The statement FOR J=1 TO 1E9:PRINT PEEK(212):NEXT

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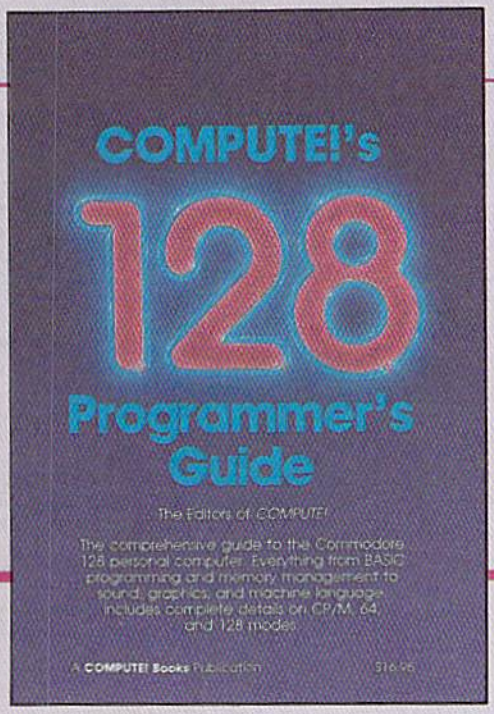

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lets you see the keyscan value of any key.) Lines 30–40 use the keyscan value as an index into the T$ and P$ arrays. The IF statements in these lines will be true only for those array elements in which we placed data: Every other element in the arrays is empty, containing nothing but a null string (""). Note that the arrays make it possible to use a short, efficient working loop that doesn't slow the program as a multitude of IF statements would.

Since this program uses PLAY to make the actual notes, you may wonder why there's a SOUND command in line 60. The statement FOR J=1 TO 3:SOUND J,0,0:NEXT immediately silences all SOUNDs that may be in effect from a previous program (or your own experiments). When you're setting up a sound program, it's prudent to reset sound and music parameters to a known state to avoid unwanted residual effects. If you fail to take this precaution, previous sound commands (FILTER, etc.) may prevent your sounds from working properly. Of course, pressing RUN/STOP–RESTORE resets most sound parameters, but that's not a very elegant solution. Thus, line 70 ensures that various TEMPO and PLAY parameters are set as needed in this program (filter off, maximum volume, etc.).

Although PLAY can generate as many as three notes at once, the 128's BASIC can only read one key at a time. So this keyboard is necessarily monophonic. Machine language routines are necessary to create a polyphonic (chord-playing) keyboard.

128 Soundmaker

"Soundmaker" is the shortest of the example programs, but it creates the most complex effects, using all three of the 128's voices simultaneously. Type in Soundmaker and save it to disk or tape (pay close attention to the punctuation in line 60). When you run the program, it spends a few seconds in preparation, then invites you to press any key.

```
10 GOSUB 70
20 GETKEY A$:V=V+1:IF V=4 THEN
    V=1:PRINT
30 W=INT(RND(1)*4):DI=INT(RND(
   1)*3):FRQ=K(T(ASC(A$)))
40 MI=INT(FRQ/(8*(V*W+1))):S=I
   NT((FRQ-MI)/((INT(RND(1)*10
   )+1)*(MI/100)))
50 SOUND V,0,0:SOUND V,FRQ,100
   ,DI,MI,S,W
60 PRINT "SOUND"V"{LEFT},"FRQ"
   {LEFT},"100"{LEFT},"DI"
   {LEFT},"MI"{LEFT},"S"{LEFT}
   ,"W"{LEFT},":GOTO 20
70 FOR J=1 TO 3:SOUND J,0,0:NE
   XT:VOL 15:DIM K(256),T(256)
   :FOR J=1 TO 255:T(J)=J
80 K(J)=J*150:NEXT:POKE 2594,1
   28:PRINT CHR$(147)SPC(10)"
   {DOWN}{RVS}128 SOUNDMAKER
   {OFF}"
90 PRINT SPC(10)"PRESS ANY KEY
   ":PRINT:RETURN
```

Whenever you press a key, the 128 executes a new SOUND command and displays it on the screen for reference. As you'll soon discover, SOUND can create a dazzling variety of effects. All three voices are used, in 1-2-3 order, so if you keep pressing keys, you'll hear as many as three different sounds at once. The duration of each sound is limited to 100. If you want to hear individual sounds, wait until the current sound is done before pressing a key.

Note the difference in the way that SOUND and PLAY handle volume. SOUND does not produce any sounds at all unless you have previously set the volume to some non-zero value with VOL (line 70). PLAY, on the other hand, sets volume for itself with the U symbol, and pays no attention to VOL commands.

The frequency of each sound is determined by the ASCII value of the key you press. Keys with high values (like Z, ASCII 90) create higher pitched sounds than those with lower values (like the space bar, ASCII 32). Pressing SHIFT pitches the entire keyboard higher. The waveform and sweep direction for each sound are selected at random, while the minimum frequency and step value are held within reasonable ranges.

Song Player

This program demonstrates a simple way to encode and play music on the 128. "Song Player" lets you enter PLAY strings under program control, adding them to the program as DATA statements with the dynamic keyboard method. After entering your music, you can replay it at any time or resave it along with the program. Pay special attention to the punctuation in lines 60 and 190, which cause the program to modify itself.

```
10 J= 1000
20 CH$=" 0123456789#$.XVOTUWHQ
   ISRMABCDEFG":PLAY"X0 U15 O4
    T7 I"
30 PRINT"{CLR}{2 RIGHT}{RVS}12
   8 SONG MAKER":PRINT"
   {2 DOWN}{2 RIGHT}{RVS}E
   {OFF}NTER{2 SPACES}{RVS}P
   {OFF}LAY{2 SPACES}{RVS}Q
   {OFF}UIT"
40 GETKEY A$:IF A$<>"E"ANDA$<>
   "P"ANDA$<>"Q" THEN 40
50 IF A$="E" THEN 120
60 IF A$="Q" THEN PRINT"{CLR}1
   0 J="J:POKE 208,2:POKE 842,
   19:POKE 843,13:END
70 REM---SONG PLAYING ROUTINE
80 RESTORE:PRINT "{DOWN}PLAYIN
   G SONG. PRESS ANY KEY TO QU
   IT."
90 GET A$:READ P$:IF A$=""ANDP
   $<>"FINI" THEN PRINT P$:PLA
   Y P$:GOTO90
100 PRINT "{DOWN}END OF SONG.
    {SPACE}PRESS ANY KEY.":GET
    KEY A$:GOTO 20
110 REM---MUSIC ENTRY ROUTINE
120 POKE 208,0:PRINT "{CLR}ENT
    ER MUSIC DATA (29-CHARACTE
    R MAXIMUM)"
130 PRINT "TYPE 'MENU' TO EXIT
    "
140 P$="":INPUT "{8 SPACES}";P
    $:IF P$="MENU" OR P$="" TH
    EN 20
150 X=0:FOR M=1 TO LEN(P$):FOR
     K=1 TO LEN(CH$)
160 IFMID$(P$,M,1)=MID$(CH$,K,
    1)THENX=X+1
170 NEXT K,M:IF X<LEN(P$) THEN
     PRINT"ILLEGAL MUSIC DATA"
    :PRINT P$:GOTO 130
180 PRINT "{CLR}";J;"DATA ";P$
    :PRINT "J="J+1":GOTO 120"
190 POKE 208,4:POKE 842,19:POK
    E 843,13:POKE 844,13:END
999 REM---MUSIC DATA STARTS HE
    RE
63999 DATA FINI
```

The music entry routine permits you to enter as many as 29 PLAY symbols at one time (blank spaces are acceptable, although PLAY ignores them). Consult the *128 System Guide* for an explanation of the various PLAY symbols. Before adding the PLAY string as a DATA statement, the program checks every character in the string to make sure it is legal. If you enter a character that the PLAY command does not understand (Z, for instance), the program signals an error and lets you try again. Note that while the program can tell whether a character is a legal PLAY symbol, it does not check for correct PLAY syntax: You are still responsible for arranging the symbols in meaningful order. For example, the string "XU$#" contains legal PLAY

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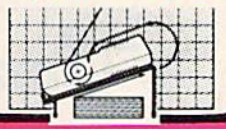

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characters but causes an error when you try to PLAY it. If the PLAY string is accepted, the screen flashes briefly as the program adds the string as a DATA line, then the entry prompt reappears. You can return to the main screen by entering MENU or typing RETURN without entering any characters.

Music data is added beginning with line 1000. Successive DATA lines are entered as 1001, 1002, and so on up through 63998. Do not delete or renumber line 63999; it contains a string that marks the end of the music data. When you exit the program by pressing Q, it automatically modifies line 10 to let you resave the program complete with the new data. The next time you load and run the program, all the data will be there. Since this program modifies itself as it runs, don't renumber it or alter any lines unless you understand exactly how the dynamic keyboard processing works.

As short as they are, these program examples demonstrate a number of handy sound and music techniques. It's often preferable to use variables rather than literal values in sound commands. SOUND VOC, FRQ, DUR is just as valid as SOUND 1, 11000, 100—and considerably easier to understand. And replacing literals with variables lets you change the sound dynamically, just by redefining the variable. Since the computer can often look up a variable faster than it can interpret a literal, variables can also speed up a program somewhat.

PLAY accepts variables, too, so PLAY A$ and PLAY A$(23) work just as well as PLAY "C D E F". You may also concatenate PLAY strings and use other string operations such as MID$, LEFT$ and so on:

```
10 PLAY "X0U15S":P$="CDEFGAB"
20 FOR J=ASC("1") TO ASC("6"):
   FOR K=1 TO 7
30 PLAY "O"+CHR$(J)+MID$(P$,K,
   1)
40 NEXT:NEXT
```

PLAY accepts nearly any string construction that PRINT can handle. However, you may not separate PLAY strings with a comma or semicolon. One final reason to put strings into variables is that it simplifies debugging. If you're not sure what a PLAY statement is doing, simply PRINT the string on the screen to see what it contains.

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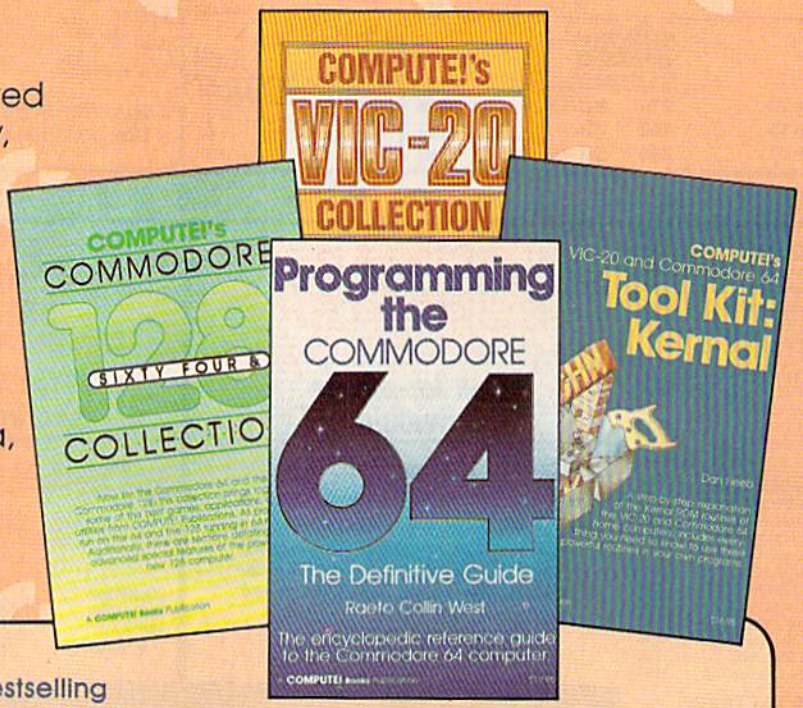

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BASIC Backup

John R. Hampton

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When you're writing a new program or making changes to an old one, it's important to remember that all your typing is stored in random-access memory (RAM), and a simple thing like a power failure could instantly erase it all. Therefore, it's a good idea to periodically save your work.

If you're like me—and a lot of other programmers—time becomes unimportant when you're lost in the depths of creation, and it's easy to let hours slip by without realizing it. What's needed is a small reminder. That's what "BASIC Backup" provides.

Saving Programs Or Cooking Eggs

BASIC Backup runs in the background, not interfering with the program you're working on. It gives you a programmable timer and an easy way to save programs. You can set it for any time from 1–255 minutes, and then go on programming without thinking about BASIC Backup. For example, if you set it for 15 minute intervals, it waits 15 minutes and then starts flashing the border colors. A blinking border is hard to ignore, in fact it can be very annoying. To stop it, you can reset the timer and continue programming or you can press a few keys to save the program in memory. The timer is there to remind you to make another backup but can be used to time almost anything. I've even used it while cooking hard-boiled eggs.

BASIC Backup is a machine language wedge that's POKEd into memory by BASIC. After you've typed in the program and saved it, type RUN. When it's finished, the READY message will return. You should then type NEW to reset pointers. Now BASIC Backup is ready to use.

This utility can be used whenever a program is not running by holding down the CTRL key and pressing f1. This pauses the timer and displays current values for several parameters:

FILENAME: the name of the program most recently saved

DISK/TAPE: press D or T

VERIFY: an option to have the save verified; press Y or N

INTERVAL: the number of minutes between saves; enter 1–255

REMAINING: the number of minutes left before Backup gives notice (no input)

OVERDUE: the number of minutes beyond the assigned Backup notice (no input)

You can enter new values for the first four of these, or just press RETURN over the values currently displayed.

After entering new values—or keeping the current ones—you're given a chance to do a backup. Press C to continue, to start saving the program. On disk saves, BASIC Backup looks at the filename you entered and attempts to scratch a program by that name before starting the save. Scratching before saving is preferable to the sometimes unreliable Save-with-Replace option.

By pressing RUN/STOP at the prompt, or when entering any parameter, you can return to BASIC immediately. This way you can enter the utility simply to view the time remaining, or to change one of the parameters.

When you exit the utility and return to BASIC, the timer will continue from where it left off if you didn't enter an interval. Otherwise, it will be restarted using the new interval, or stopped if you entered OFF. You can then resume your programming, or CONTinue the program that was running.

When the timer finishes counting down, it will signal you by flashing the screen's border colors twice every second. The flashing will continue even if a BASIC program is running, and will not stop until you reenter the utility to reset or stop the timer by pressing CTRL-f1. If you don't define a new interval for the timer, the flashing will continue when you return to BASIC.

If you should have to reset your BASIC program by pressing RUN/STOP–RESTORE, you'll disable Backup. It can be restarted by typing in and running this short BASIC program (you may want to add these lines to the program in memory):

```
10 POKE 56334, PEEK(56334) AND 254
20 POKE 788, 167:POKE 789, 2
30 POKE 56334, PEEK(56334) OR 1
```

Backup uses memory from addresses 679 to 767 for its interrupt routine, so your BASIC program cannot use these 89 bytes. The main portion of the utility resides underneath BASIC ROM, and should not interfere with your programs.

See program listing on page 139.

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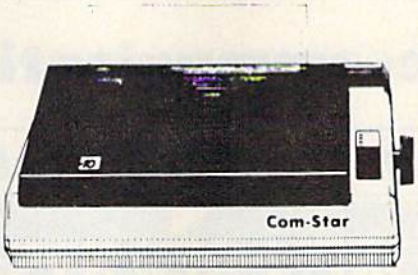

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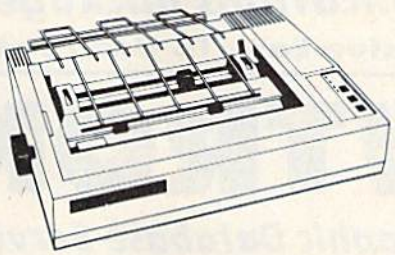

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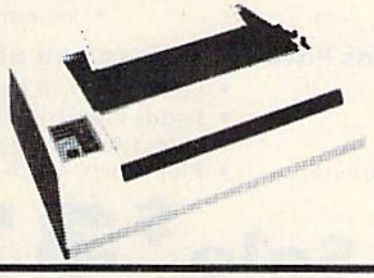

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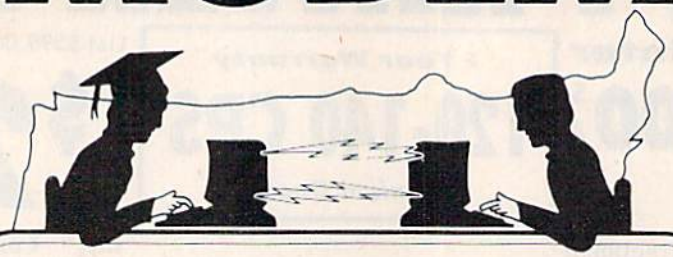

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The Printmaker

Manu Gambhir

This clever program converts a screen you design with keyboard graphics into a BASIC routine—and appends it to your program. For the 64, Plus/4, 16, VIC-20, and 128 (in 64 mode).

Wouldn't it be nice if you could spend your time designing a screen and not have to worry about writing the program to produce it? "Printmaker" lets you do just that. It automatically creates code in the form of PRINT statements from whatever is on the screen and appends these lines to the program in memory. The PRINT statements include color control codes and REVERSE ON/OFF codes to reproduce the screen exactly as it was created.

Printmaker is very easy to use. It's written in machine language, but as a BASIC loader. There is only one rule to follow: The top line of the screen may not be used.

Designing A Screen

Type in the appropriate version of Printmaker for your computer, and be sure to save a copy before running it the first time because the BASIC loader erases itself from memory. To use it, just load and run. The program is POKEd into a safe location (49152 on the 64, 15872 on the Plus/4 and 16, and 7168 on the unexpanded VIC), out of the way of BASIC. Now you can begin writing your BASIC program, or you can load a BASIC program to which you wish to append your screen.

At this point, you're ready to create your design on the screen using keyboard characters. All characters—numbers, letters, graphics—are legal. Colors are available, too. (Plus/4 users should note that only the 16 primary colors will work with Printmaker. Luminance levels will not be translated to PRINT statements.) To move about the screen, use the cursor keys. (If you mistakenly hit the RETURN key, the computer will attempt to enter the current line as a BASIC statement.)

The entire screen (apart from the first line) will be encoded in PRINT statements. Since the last character position on the screen, the bottom right location, is included, the screen (and your display) will scroll up one line when you run the BASIC program. If you wish to avoid this effect, delete the last character (even if it's a space) in the final PRINT statement created by Printmaker. If your screen design calls for a character in this position, it can be POKEd there in the BASIC program following the final PRINT statement.

When you've completed your design, press the HOME key to get the cursor in the upper left corner of the screen. Then type:

SYS 49152,I (for the 64 and 128 in 64 mode)
SYS 7168,I (for the VIC)
SYS 15872,I (for the Plus/4 and 16)

where I is the increment by which you want the lines numbered. Any number from 1–255 is allowed. Printmaker will append the new lines automatically to your program. For example, if your BASIC program ends with line 850 and you design a screen with Printmaker and SYS with an increment of 10, the appended code will begin with line 860 and proceed with 870, 880, and so on.

After typing the SYS, the cursor reappears and the screen (minus the top line) is appended to your program in the form of PRINT statements. Type LIST to see the results.

See program listings on page 133.

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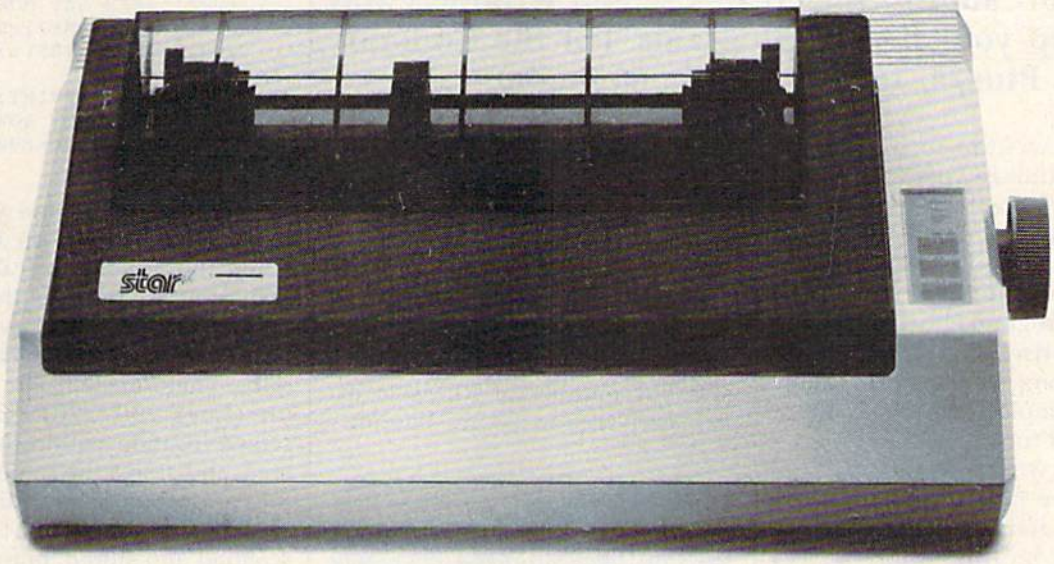

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BASIC Windows

Wayne Arnett

This short subroutine creates screen windows and livens up your BASIC programs. For the Commodore 64, Plus/4, 16, and 128 (in 64 mode).

Programs written in BASIC are sometimes dull and predictable, but they don't have to be. You don't need high-speed graphics and polyphonic sound in, say, a recipe filer, but you shouldn't fall asleep using the program either. Including a few surprises in your programs can go a long way toward making even the simplest ones more entertaining and fun to use.

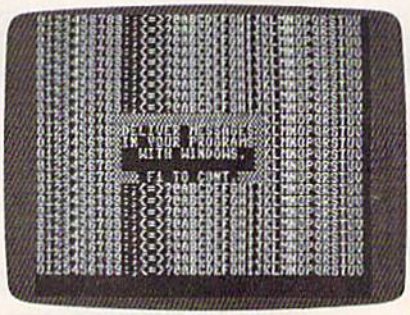
Screen windowing is a trick you should have in your programming repertoire, and it's easy to include in most programs. Windows are message boxes superimposed on a small area of the screen. But they don't disturb the contents of the rest of the screen.

Windows can present mini-menus to guide a user through a program without switching back and forth between full-screen displays. You can use them to flash scores, time elapsed, or a funny comment to keep the kids interested in that math program they've been yawning over. Any brief message your program delivers to the screen can be presented in a window. When it's no longer needed, it can just disappear, leaving the original text in its place.

Superimposing a bright window border and contrasting colors onto the screen has far more visual impact that squeezing a few words into whatever display space is available. And it's much less disruptive to your program than clearing the screen, printing a message, and then reprinting the original display.

The Universal Window

"BASIC Windows" is a short program which can be included as a subroutine in most BASIC programs. There are three main modules, and each can be tailored to your specific needs. The program is only 26 lines long, and it contains a generous number of REMs to explain each section. BASIC Windows



Screen windows can enhance your program presentation.

puts a 5-line by 18-character window in the center of the screen. If you want your window to be a different size, or you want to place it elsewhere on the screen, you'll need to make some adjustments to the program. The height and width of the window can be changed by setting variables H and W in line 100 to the number of rows and columns, respectively. The position of the window is specified in the next line. Set variable R to the row number (1–25) and variable C to the column number (1–40). The B$ array defined in lines 140–190 contains the message in the window. Each element of the array (starting with element 0) contains one row of the message. Substitute your own message, making sure that the number of characters in each row equals the width specified in line 100. Lines 200–210 fill the screen with characters for testing purposes; be sure to delete these lines before transferring the subroutine to another program.

The program runs as listed on the Commodore 64. Plus/4 and 16 owners should substitute these lines:

```
90 KEY 1,CHR$(133):COLOR 0,5,4
230 M=3031+40*R+C:REM UPPER LE
    FT CORNER OF WINDOW
250 POKE205,R-1:PRINT:PRINT"
    {UP}";:REM SET ROW NUMBER
270 S(I,J)=PEEK(M+J):NEXT:POKE
    202,C-1:PRINTB$(I):M=M+40:
    NEXT
350 POKE205,R-1:PRINT:PRINT"
    {UP}";:REM SET ROW NUMBER
360 FORI=0TOH-1:POKE202,C-1:PR
    INTC$(I):NEXT
```

Most of the time you don't know what will be on the screen when the window is called; since you want to retrieve the original display after the window is erased, the area that's to be overwritten has to be "memorized." The first module (lines 230–270) PEEKs each screen location within the window area, and stores the screen codes in the S array (defined in line 120).

As each horizontal line is scanned and stored, one line of the window is printed in its place. For a variety of messages, you can design the window in several different versions, and call whichever one you need (scorebox, reminder, etc.). Try different colors, or let your program choose them randomly. You can even use one color for the border and another for the message by including color changes within the PRINT statement.

As soon as all five lines of the window are printed, part two of the subroutine (starting at line 290) begins converting the stored screen codes into printable strings (the C$ array).

The third module waits until the f1 key is pressed. Then it reprints the characters that were covered by the window to their original place on the screen. The original text color is also restored in line 340. At this point, there's no evidence that a window ever appeared on your screen.

See program listing on page 140.

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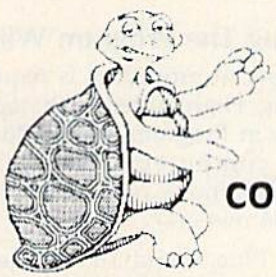

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REM Highlighter

Don A. Ellis

If you headline routines in your programs with REMs, here's a short and clever utility that helps you find important sections of code more quickly. It highlights REMs on your screen and your printer. For the 64, 128 (64 or 128 mode), Plus/4, 16, and VIC.

Trying to find the REMark statements in a crowded program listing as it scrolls by is difficult, particularly after a few late-night hours in front of the screen. Like many other programmers, I use asterisks (***), but that's only marginally effective. Blank REM lines inserted to set off the comments and identify program routines work better, but use up both screen space and memory.

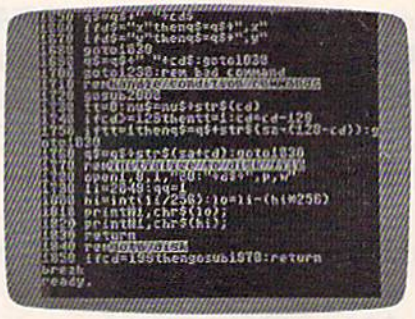
A Better Solution

"REM Highlighter" automatically *tweaks* another program, at no cost to memory, so that REM statements on separate lines will be displayed in reverse, standing out sharply. The adjusted program may be saved normally, and this version will retain its reversed comments when reloaded.

There are three disk versions of REM Highlighter: Program 1 for the 64 and 128 (in 64 mode), Program 2 for the 128 (128 mode), and Program 3, the VIC version. Plus/4 and 16 users should type in Program 1 but make this substitution (because the keyboard buffer is in a different location):

```
6 N=239:P=1319:COLORØ,7,4
```

and change the values of variables N and P in line 28. Change N from 198 to 239 and P from 631 to 1319.



REM Highlighter is handy for handling routines in your programs. It works on your screen and your printer.

This utility is very easy to use. Load and run Highlighter and enter the name of the program you wish to tweak. If you're using disk, that's all there is to it. If you're using tape, the process is a little less automatic, but still simple (see below for details).

Be sure to enter the program exactly as in the listing; it depends on precise screen layout to function, so the spacing is tight. Common keyword abbreviations must be used; when you see an underlined character, it means to enter it with the SHIFT key held down. Save a copy before using the program because the program in memory destroys itself when it's done its work.

The disk version uses the dynamic keyboard technique. It POKEs keystrokes into the keyboard buffer, so that when the program ends, the computer is fooled into thinking that certain keys have been pressed. REM Highlighter first loads the program to be modified, so REM Highlighter itself is overwritten (and lost). But several lines of BASIC (63994–63999) have been left on the screen. The 13s in the keyboard buffer are carriage returns, so the computer prints RETURN over lines, adding them to the program just loaded. The final line tells the program to GOTO 63995, and the program obliges by jumping to the highlighter routine. When it's finished, blank lines numbered 63994–63999 are printed on the screen. The dynamic keyboard is again used to press RETURN over the lines, erasing them from memory. You're left with the program with reversed REMs. You can now save back to disk.

Using The Program With Tape

A special procedure is required for using Highlighter with tape. First type in Program 4 and adjust it for the computer you're using (no modifications are necessary for VIC or 64 owners):

Plus/4 and 16: In line 63993, change the value of N to 239 and change P to 1319.

128 (128 mode): In line 63993,

change N to 208, change P to 842, and change the PEEKs into 43 and 44 to PEEK(45) and PEEK(46). Also, add the BANK0 command to the beginning of 63993.

It's necessary to append Highlighter to the program you wish to tweak. To accomplish this:

1. Load the program you wish to be highlighted.

2. Clear the screen; in direct mode, enter the following line exactly (use abbreviations, no spaces):

```
?43;pE(43),44;pE(44):a=pE(45)+pE(46)*
  256-2:c=int(a/256):b=a-c*256:pO43,
  b:pO44,c
```

For the 128, use this line:

```
print45;peek(45),46;peek(46):a=peek(4624)
  +peek(4625)*256-2:c=int(a/256):
  b=a-c*256:poke45,b:poke46,c
```

3. Load REM Highlighter.

4. Using the values displayed (by step 2), POKE 43 and 44 with their original values again. On the 128, POKE 45 and 46 instead.

5. Type RUN 63993.

How It Works

The routine in lines 63994–63998 works its way through your program in memory, examining each line to see if it starts with REM; if it does, and if the line has comments on it as well, the last space before the comments is POKEd with 18 (the code for reverse printing). Since only one byte is examined in each non-REM line, and only a few in others, the process is very fast for BASIC; most programs will take less time than they take to load. When the end of your program is reached, line 63999 erases all the new lines, and you're left with your original program—except now you can see the highlighted REMs.

The affected lines save properly as we've noted, and signal the printer as well as the screen; so you can also print copies with reversed comments. You'll also notice that any affected line appears one space shorter since the 18 is a signal only and takes up no display space. But they will not withstand other attention: If you change a line with a REM, or even press RETURN over one of them, the BASIC interpreter will not see the POKEd 18 and the reversed display will not reappear.

See program listings on page 138.

Disk Disassembler

Jeff Babuschak and Richard Rager

This useful utility disassembles machine language programs from memory or disk. The disassembly can be routed to the screen, to a printer, or to a disk file. For the 64 and 128 (in 64 mode).

In BASIC, when you enter something like 20 PRINT "HELLO", the computer transforms the English-like commands which people can understand into numbers it will use later when the program is run. PRINT, for example, is not stored in memory as five letters, but as the single number 153 (the *token* for PRINT). When you type LIST, the numbers are converted back into letters that spell out the command.

Machine language (ML) programs are similar: The numbers in memory are *operation codes*—opcodes for short—and each opcode has a corresponding *mnemonic*—an abbreviation that's easier to remember than the number. For example, the opcode 169 followed by a 5 is equivalent to the instruction LDA #5 (written as a mnemonic).

To create a machine language program, you need an assembler. It converts the mnemonics into the opcodes—the runnable ML program. (See "Fast Assembler" elsewhere in this issue.)

A disassembler is just the opposite: It's a program that allows you to list ML programs. It translates the numbers in memory or on disk into readable abbreviations for ML commands.

Follow The Menu

Apart from a short ML routine POKEd into the cassette buffer, "Disk Disassembler" is written entirely in BASIC. There are no special instructions for typing it in or running it. After saving a copy to disk, just type RUN.

You can disassemble a program from memory or from disk. You can also create a source file for making your own modifications to a program. The resulting program (PRG) file is compatible with the "Fast Assembler," *PAL, LADS* (from *The Second Book of Machine Language*, published by COMPUTE! Books), and other assemblers that use source files in program format. You'll have to make a few changes before assembling, like adding a line that gives the origin (the ORG command in Fast Assembler, or the *= command in LADS), for example.

In some cases, disassembling from disk has a slight advantage over disassembling in memory since "auto boot" programs take control of the computer by tampering with memory pointers.

Once you run the program, you'll be asked what kind of disassembly you want, from RAM or from disk. If you choose RAM, you enter a starting and ending address. For disk disassembly, you must name the ML file to be disassembled. Next, you answer the following questions:

1. List Hold—prints enough to fill the screen and then pauses the listing and offers an escape.

2. Screen—sends disassembly to screen.

3. Save to Disk—sends disassembly to disk to create a source file.

4. Print—sends disassembly to printer (check to see that your printer is turned on).

5. Hexadecimal—prints numbers in hexadecimal. If your answer is no, the numbers will appear in decimal.

When answering these questions, you are not limited to one device. You can have all the devices working at the same time, with one exception. When using the List Hold command, you *cannot* send the disassembly to disk at the same time because the saving process would be slowed down entirely too much. (The program will refuse to allow both List Hold and Save To Disk options.)

The Problem Of Messages

Disk Disassembler attempts to disassemble every single byte in the ML program, which sometimes leads to some strange results. Let's say a file contains a simple message like " HI", a space and the letters H and I. This message would be stored in memory as the ASCII numbers 32, 72, 73 (hexadecimal $20, $48, $49).

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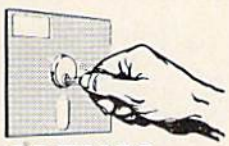

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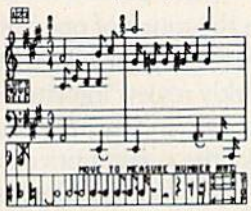

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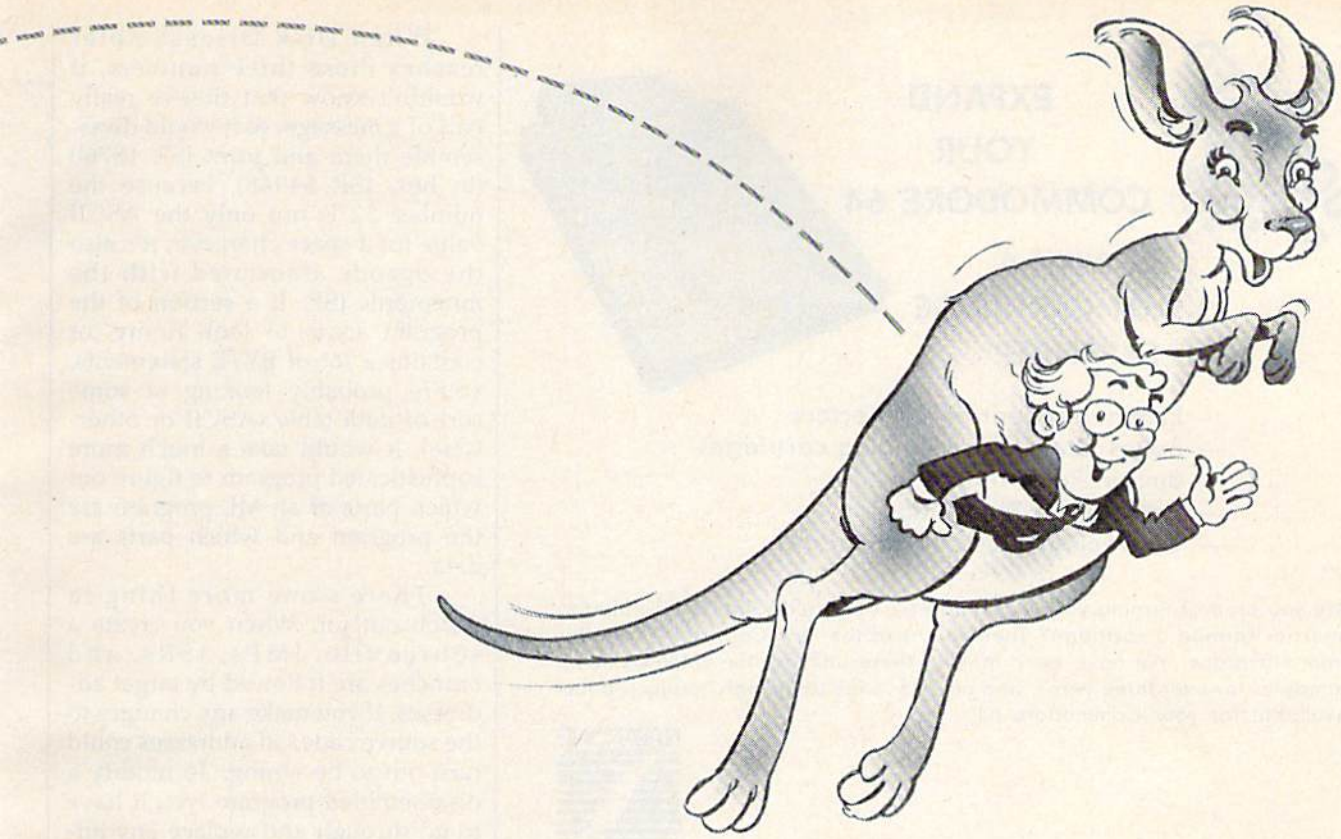

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When Disk Disassembler reaches those three numbers, it wouldn't know that they're really part of a message, so it would disassemble them and print JSR 18760 (in hex, JSR $4948), because the number 32 is not only the ASCII value for a space character, it's also the opcode associated with the mnemonic JSR. If a section of the program starts to look funny, or contains a lot of BYTE statements, you're probably looking at some sort of data table (ASCII or otherwise). It would take a much more sophisticated program to figure out which parts of an ML program are the program and which parts are data.

There's one more thing to watch out for: When you create a source file, JMPs, JSRs, and branches are followed by target addresses. If you make any changes to the source code, all addresses could turn out to be wrong. To modify a disassembled program, you'll have to go through and replace any addresses with labels and then place the labels at the appropriate line.

See program listing on page 125.

Off-Screen Trace

Brent Dubach

BASIC programmers will appreciate this testing and debugging utility. It traces program execution line by line and displays the trace on an alternate screen so there's no interference with your program display. It also allows you to control the speed of the execution. For the Commodore 64 and 128 (in 64 mode).

Tracing the path of program execution is helpful when you're debugging a program. Most TRACE commands in BASIC languages print executing line numbers on the same screen as the program being traced. While acceptable for some programs, in others this approach so disrupts formatted text output that it loses much of its debugging value. For example, in programs that use a high-resolution graphics screen, tracing execution becomes awkward since the normal text screen cannot be seen so long as the program has the machine in the hires graphics mode.

Here's a trace utility for the Commodore 64 that avoids these problems by setting up its own display screen. Your own program output is not disturbed, and the trace information can be seen at the touch of a key. And the line displayed is the line *after* the line which has just been executed.

How To Use The Trace

Since "Off-Screen Trace" is written entirely in machine language (ML), you'll need to use MLX to type it in (see "The New MLX," elsewhere in this issue). When prompted for the starting and ending addresses, respond with the following:

Starting address: 8800
Ending address: 8AFF

Be sure to save a copy before running the program.

Although Off-Screen Trace is written in ML, you don't need to know anything about ML in order to use it. Once in memory, the trace program is activated by a **SYS 34816** command and deactivated by **SYS 34970**. These commands should be issued only in direct mode and not from within a program. If you want to trace only a part of the program, you may use RUN or GOTO followed by the line number at which you want to begin and then either a STOP command or the STOP key to halt execution. Tracing may be turned off at any time after it has been switched on. *Be sure, however, that you do not follow a SYS 34816 with another SYS 34816 without deactivating tracing in between.* If you do this, you'll need to turn the machine off and back on and start all over.

Once Off-Screen Trace is activated, pressing CTRL-O (for Other screen) will allow you to see a separate trace display that shows the line numbers in which statements are being executed. Pressing CTRL-O again returns you to whatever output screen your program is using. This keypress is not "debounced" by the program and therefore has a very light touch. Use a quick, crisp keypress to toggle between the two displays.

Controlling Execution Speed

Because of the overhead involved in tracing execution, programs always run more slowly while being traced. This utility allows you to control the speed of execution with the space bar. It allows statements to be executed only when it sees that the space bar is held down. By holding it down, you can keep the program executing at maximum speed, and you can also step through statements one at a time with a quick single press of the space bar. Regardless of which screen is in view at the time you press the space bar, your own program screen will be reinstated before the next statement in the BASIC program is executed. Another CTRL-O will retrieve the updated trace display.

Instead of an unstructured sequence of line numbers, the trace display shows executing line numbers in an outline format that reflects the organization of your program. Each time a GOSUB is encountered, the trace display is indented two spaces. With each RETURN it is moved two spaces to

the left of the left margin. Thus, you can easily tell by monitoring the line number display whether your program is entering and exiting subroutines as you intended.

Memory Considerations

The program uses memory at the top of the range normally available for BASIC program text and variables. In addition to memory for machine language itself, memory is needed for the separate display screen and for saving certain important information when toggling between displays. When activated with SYS 34816, the trace program protects itself and its display screen from incursions by BASIC by setting 33792 as the top of memory available to BASIC. This still allows BASIC programs that need almost 32K of memory and leaves all the typically used sprite and machine-language areas available. You should note that some of this range of memory is the same as that used by "MetaBASIC," so you should disable "MetaBASIC" before loading and using this trace facility.

See program listing on page 138.

computing for families

Smart Power Tools: A Peek Inside The Black Box

Fred D'Ignazio, Associate Editor

The microcomputer industry has an inferiority complex. And no wonder. Since microcomputers were introduced a decade ago, they have evolved at an amazing pace. Yet this pace has not been enough to silence the host of critics—consumers, educators, and the media—who demand that the computer be *powerful* yet also *easy to use*.

This is not a simple task! The industry has tried to respond to these criticisms by manufacturing "powerful" computers that are also "user friendly."

One legitimate way to measure the power of the computer is to measure the power of its software. You can do this by adding up the number of useful commands, options, and functions of the software. For example, the giant super power-tool program *Symphony* from Lotus contains hundreds of functions and commands. But is *Symphony* easy to use? Not according to many disgruntled consumers, educators, and reporters.

As a result, *Symphony* is a dinosaur. It will soon be extinct, along with its whole generation of super-power tools.

When the microcomputer industry produced *Symphony*, it erred on the side of power while neglecting ease of use. Now the industry is headed in the other direction. For the short term, the industry has backed away from producing any more "super power tools" like *Symphony* and is splitting up the power tools into smaller, more manageable, and easier to use, programs. And there's lots of excitement about mini-power tools—little "pop-up" programs—that a user can call on, even in the middle of another program.

But this strategy cannot last. It sacrifices power for ease of use, so it's only a temporary solution. The critics don't just want ease of use, or just power. They want both—at the same time.

Is This Possible?

It is, with software now on the drawing boards: programs known as *smart power tools*. These will be so user-friendly and intelligent that a child can operate them. In less than five years, computer tools' power, complexity, and richness will be completely masked from the user. The tools will edit our prose, reshape our ideas, organize our information, and manipulate our numbers, all with almost no supervision by us. Microcomputer companies will have satisfied their critics at last.

But we will have sacrificed something even greater—*control*. To be so easy to use, smart power tools will have to take control over the problems we want solved. The human's job will be reduced to pushing buttons. We will respond to the computer's questions and feed the computer the information it needs. Then the smart computer tool will do all the rest.

In my opinion, this loss of control is unacceptable. The sacrifice is too great. And I, for one, don't want to make it.

I'm worried about the *automation of human thinking* that such power tools will represent. If people are accustomed to having computer programs do their thinking for them, they'll lose the habit of thinking for themselves. This has at least two harmful effects. First, if people don't carefully scrutinize the computer's *black box thinking*, who's to say that the answers it gives are correct? Second, people will be sacrificing their own standards of thinking for the computer's standard. In many cases, this may lead to an improvement. But over time it will lead people to become *numb* to what is good thinking and what is bad. We could end up like the piano player in *Catcher in the Rye*, who was so accustomed to people applauding his virtuosity for so long the he grew deaf to his own playing, which became mechanical and mediocre.

As Easy To Use As A TV

I'm even more worried about children in school. Courses on word processors, databases, and spreadsheets will soon replace courses in programming, computer literacy, and computer fundamentals, in most schools. Like the rest of us, the children are being told that computers should be more powerful yet "as easy to use as a TV." As future consumers and office workers, they're not supposed to settle for anything less. And they won't have to. They're a primary market for the new smart power tools.

But what happens to the children's thinking skills when the tools don't just do arithmetic or word processing, but also organize thoughts, correct spelling, solve word problems, and group facts, figures, and ideas?

I may sound like an alarmist, but I think that for our own sake—to preserve our thinking skills and to stay in control of our computers—*we must continue to program computers*.

I don't mean programming in BASIC or Logo. I mean programming in the larger sense of the word: thinking through a problem, task, or process, step by step, precisely and in considerable detail, until we thoroughly understand what is going on and have made sure that it goes on correctly.

At this level, programming isn't just an obsolete computer skill. It's the same as thinking. And thinking is a human skill, one that we must continue to cultivate, even in a world full of smart power tools.

simple answers to common questions

Tom R. Halfhill, Staff Editor

Each month, COMPUTE!'s GAZETTE *tackles some questions commonly asked by Commodore users and by people shopping for their first home computer. If you have a question you'd like to see answered here, send it to this column, c/o* COMPUTE!'s GAZETTE, *P.O. Box 5406, Greensboro, NC 27403.*

Q. I've noticed that some commercial software disks do not have the little notch on their edges, yet they contain a program on the disk. How do the software companies write to a "write-protected" disk?

A. As you know, the lack of a write-enable notch (or its equivalent, a notch covered with tape) prevents a disk drive from writing to a disk. But most software publishers these days don't duplicate their disks one by one with a disk drive. It would take far too much time, and they'd have to pay someone to sit at a computer all day shoving disks in and out. Instead, they use bulk copiers, or subcontract the job to a duplication company that uses bulk copiers. These copiers resemble office photocopy machines. Basically, you just insert a master disk into one slot, stick a blank disk into another slot, and press a button. In seconds, the machine copies the master disk onto the blank disk.

Of course, there's a little more involved to it in practice. Bulk copiers are designed to duplicate many different kinds of disks—Commodore, Apple, Atari, IBM, or whatever—so they have to be adjusted for the proper format. High-volume copiers usually have automatic feeders that handle whole stacks of blank disks at a time, collators to sort the finished copies, and devices which slap on the paper labels. But essentially, bulk copiers do for floppy disks what photocopy machines do for sheets of paper. They aren't foiled by the lack of write-enable notches on the blank disks, and they even apply copy-protection schemes as they copy.

If all this makes it sound like a bulk copier would be a handy machine to have around, keep in mind that they cost several thousand dollars—without frills.

Q. What advantage is there to daisy-chaining two disk drives together?

A. Two-drive computer systems are generally more convenient to use than one-drive systems. For example, if you often find yourself making backup copies of entire disks—or copies of numerous files on disks—there are two-drive copy programs that speed up the process considerably. You can insert the source disk in one drive, the target disk in the second drive, and then run the copy program. By copying from drive to drive, it duplicates the entire disk or the files you specify without the frequent disk-swapping required on a single-drive system.

Two-drive systems also make it easier to maintain backups as you're working. With a disk inserted in each drive, you can periodically save copies of important data files, documents, or programs by alternating from drive to drive.

Or suppose you're a programmer who likes to keep a disk of utilities handy as you work. With a two-drive system, one drive can hold the disk with your assembler, compiler, renumbering utility, etc., while the other drive contains your work disk. Then you don't have to swap disks whenever you need to load a certain utility or save the current copy of your program.

You can do practically anything with a one-drive system that you can with a two-drive system, so it's mainly a question of convenience. The benefits must be weighed against the cost.

Q. I currently own a Commodore 64 with a Datassette. I've been thinking about purchasing a disk drive. Recently I saw a TV show about laser discs. Laser discs are supposed to be faster than floppy disks and able to hold much more data, plus they are said to be almost indestructible. The people on the show said the laser discs would be on the market soon. Do you think I should go ahead and buy a floppy disk drive, or wait for the laser discs?

A. The laser discs you're referring to are probably CD-ROMs, which stands for *Compact Disc–Read Only Memories.* CD-ROMs are based on audio compact disc technology and have recently been adapted for personal computers. They are indeed much faster than floppy disks and hold immense amounts of data.

At this point, however, CD-ROMs are not a replacement for a floppy disk drive. As their name implies, CD-ROMs are *read-only*—the computer can read data from the disc, but can't save new data or erase the disc. Like phonograph records, CD-ROMs are manufactured with their information permanently pressed into the surface. They're intended for such applications as storing databases and programs which don't require frequent updating. For instance, one of the first CD-ROMs to be announced is Grolier Inc.'s *Academic American Encyclopedia.* Engineers are working on read/write laser discs, but it will be a couple of years before they become available at consumer prices.

For more information see "CD-ROMs: The Ultimate Database" in the November 1985 issue of COMPUTE!'s GAZETTE.