July 1982
vol 8, no 7
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Focus on Computer Graphics

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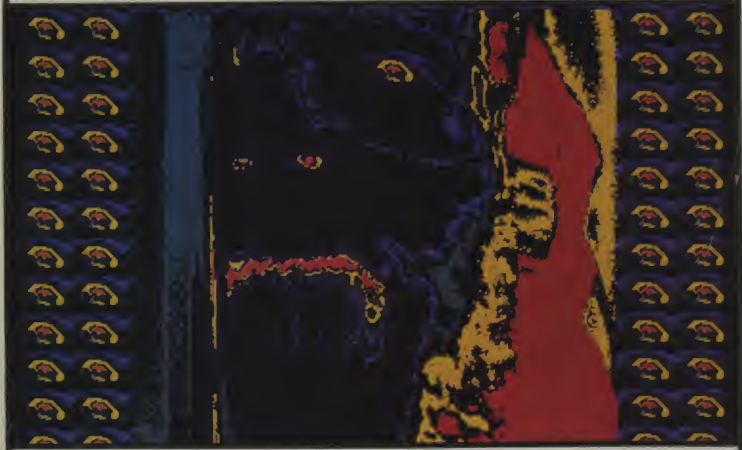

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the cover

The cover is a computer graphic design by Walter Wright. See the Cover Story on page 80 for more information on his technique.

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MEMBER MTA

July, 1982
Volume 8, Number 7

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Likes the Thrust

Dear Editor:

Some praise and a plea...I subscribe to six or seven computer magazines, all of which are good and useful. But I have to write to encourage you and *Creative Computing* to hold to your philosophy (e.g., Eugene Raudsepp's essays, or Ted Nelson on design concepts and such).

No other magazine has the creative, imaginative, and humanistic thrust that yours does. To those of us who are not scientists, engineers, business people, or technicians your commitment to the individual and to imagination—commercially viable or not—is reassuring and an essential counterweight to the dangers this exploding technology brings with its growth.

I hope you'll persist in support of ideas, feelings, and people-oriented speculations on the sane and human possibilities of this new spiritual challenge to civilization.

Ned Davison
1373 Butler Ave.
Salt Lake City, UT 84102

De-bugging the Brain

Dear Editor:

Your excellent article, "Overcoming Blocks and Barriers to Creativity" by Raudsepp (March and April '82), is a significant find in a computer magazine, emphasizing that the revolution is not only technological.

You recognize that we are dealing with an exciting revolution in consciousness. Just as we no longer find slow, limited machinery sufficient, and are evolving everything from the kitchen stove (which, like the wristwatch, talks) to the typewriter (which remembers) to the entertainment industry and the assembly line, the constant study of logic which has made the revolution possible has made us realize that we must improve our internal software: the programs and operating system in the mind. Including Raudsepp's article vindicates your title, *"Creative" Computing.*

Anton Brezinski
6050 Academy Ave.
Riverside, CA 92506

Palpitating, Maybe...

Dear Editor:

Although it would take an article of equivalent length to correct the inaccuracies and errors in detail, I wish to thank *Creative Computing* for Ted Nelson's report on Siggraph/81. Ted clearly got across the intensity of our yearly gathering. I hope he is sent to Siggraph '82 (Boston, July 26-30) as well.

Ted advocated a low-cost Siggraph to his readers. We have a better idea. Anyone can order four hours of the latest computer graphics on videotape from Siggraph (details: T. Defanti, UICC/INFE, Box 4348, Chicago, IL 60680) and hold a local computer graphics extravaganza, thus neatly avoiding the travel and registration costs associated with any large conference.

One thing in Ted's article did confuse me, however. I simply can't understand Ted not identifying with "palpitating blobs"!

Tom DeFanti, Chairman, Siggraph
Association for Computing Machinery
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ROM & Board

Dear Editor:

I read the article on "Text and Graphics" for the Apple and Epson in the February 1982 issue of your magazine. In the article the statement was made that the Epson MX-80 Graftrax ROMs would not work with the 8141 interface. I have found this not to be entirely true.

I bought the Graftrax ROMs to place in my Epson and opted not to purchase the more expensive 8150 interface. I have found that all the features of the ROMs are available with the exception of dot graphics.

This was quite satisfactory to me as I did not purchase the ROMs to use the dot graphics. I mainly do documentation and text processing and did not need graphics but wanted the other features.

If you currently have an Epson MX-80 and want the additional features, but do not need dot graphics you can get by on the 8141 interface.

As a side note I am running a Heath H-89 system. Since HDOS is a device-independent operating system I was able to modify another printer drive and link it into HDOS. This provides me with the ability to handle the features of the Epson and pass all characters to the printer. For any other users of the Heath computers I have this driver available in a multi-unit configuration available for $15.

Raymond H. Thompson
12260 Welcome Drive
San Antonio, TX 78233

Remapping AWACS

Dear Editor:

In the article "AWACS" by John Hitchcock in the May 1982 issue, the author mentioned a problem he had with the map display. As the number representing the planes crossed the map, they erased the portions crossed. This problem is caused by the method used to move the numbers: drawing on top of them with HCOLOR=3 (white) in line 460.

This problem can easily be alleviated by using the XDRAW command, which exclusive-ors the shape with the current display. XDRAWing once draws the shape, and XDRAWing on top of it erases it and restores whatever was on the screen in the first place. The only possible difficulty with this method is that the display will be erased temporarily where the shape is drawn on top of it. However, this is not a difficulty for me; I find the display easier to read with this effect.

The program can be easily modified to use this method. Line 750 should be removed and lines 270 and 460 should be replaced with "XDRAW D%(R,7) AT D%(R,5),D%(R,6)".

Walter R. Smith
3597 Knollwood Hill Dr.
Chattanooga, TN 37415

Back to the Drawingboard

Dear Editor:

Thank you for printing "Graphics Drawingboard" (Feb. 82) by William E. Bailey. The program is useful and imaginative. Mr. Bailey is to be congratulated.

I have modified the program slightly to allow the user to save the "PRINT AT" locations and the ASCII codes generated by the program to a sequential disk file. The file can be used to produce the graphics display without the need to type the locations and codes into a program.

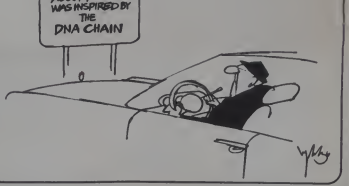
The following modifications to Mr. Bailey's program save the output to disk (I used a TRS-80 Model III).

```
10 I=0:L=4:L2=1:L=400:DIM   LO-1023:HC=191:H
912 NP = NP+1    'COUNT NO. OF "SET" LOCATIONS
914 Z(NP) = I: V(NP) = LO:I
1030 INPUT "(A)dd to Picture  (S)ave  or (E)nd";B$
1040 IF B$ = "E" THEN END
1042 IF B$ = "A" THEN 1050
1045 IF B$ = "S" THEN 2000
2000 CLS: INPUT "FILENAME";F$
2010 OPEN "O", 1, F$
2020 FOR I = 1 TO NP
2030   PRINT #1, Z(I),V(I)
2040 NEXT
2050 CLOSE
2060 END
```

The following program accesses the file created and produces the graphics display. It can be used as a subroutine as well as a stand-alone program. If used as a subroutine, line 20 would probably be eliminated in favor of specifying the file-name in the "OPEN" statement, line 30.

```
 10 CLS
 20 INPUT "FILENAME";F$
 25 CLS
 30 OPEN "I", 1, F$
 40 IF EOF(1) THEN 90
 50   INPUT #1,Z,V
 60   PRINT@Z,CHR$(V);
 70 GOTO 40
 90 CLOSE
```

Rod Rode
9815-98 Ave.
Edmonton, Alta.
Canada
T5X 3A3



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So if you have access to a 48K Apple* with DOS 3.3, and you're hot for some new thrills, Alien Ambush was written for you. But be warned: It just got a lot tougher to survive in space.

Available at finer computer stores everywhere. *Apple is a trademark of Apple Computer, Inc.

CIRCLE 180 ON READER SERVICE CARD

tices...notices...notic

Radio Shack Announces Educational Grants Program

Radio Shack, a division of Tandy Corporation, is committing $500,000 worth of TRS-80 computer equipment to a program designed to encourage and support the successful application of microcomputer technology in U.S. educational institutions.

The **Tandy TRS-80 Educational Grants Program** will award TRS-80 hardware, software, courseware and related products to individuals or non-profit educational institutions whose proposals are selected as providing the greatest benefit to the American educational community.

An impartial Educational Grants Review Board has been established to review submitted proposals and make recommendations for equipment allocation.

An information packet containing a cover letter, TRS-80 brochure, catalog, submission information and a proposal cover sheet will be forwarded in response to initial inquiries.

The first of the quarterly sittings of the Review Board will evaluate proposals addressing "Computer Literacy Among Teachers." Deadline for submissions is June 30. For information regarding proposal content and format, contact: Tandy TRS-80 Educational Grants Program, Radio Shack Education Division, 400 Tandy Atrium, Fort Worth, TX 76102.

Newspaper Syndicate Signs Archibald

Dale Archibald, contributing editor of *Creative Computing* may soon be in your local newspaper.

Archibald recently signed a contract with the Field Newspaper Syndicate to supply a weekly column to newspapers around the country. He said wryly, "I'm joining a select group that includes Ann Landers, Erma Bombeck, Sylvia Porter, The Wizard of Id, and Dennis the Menace."

In his column for Field, he will review all types of software and hardware from the non-technical viewpoint. The column will feature game and other programs (especially those available for a variety of machines), new hardware, simple tips, press release information, and anything else of interest to non-owners and owners alike.

Educational Software Contest

Krell Software has announced an educational software contest, with 90 prizes totaling $30,000 worth of software to be awarded.

There are four general categories: Arts, Humanities and Philosophy; Social Sciences; Math/Natural Sciences; and Logo and other topics.

All entries must be received before December 1, 1982.

For full details on the contest, write: Krell Software Corp., 21 Milbrook Dr., Stony Brook, NY 11790.

Color Graphics for S-100 Computers

David S. Repsher

S-100 bus users, take heart. At long last there is a low-priced, high-resolution color graphics board available for your computer. It is your reward for years of patience.

I had wanted color graphics capability for my Imsai since assembling it in 1976, but I resisted the low-resolution, high priced Cromemco Dazzler. I was envious when the Apple and its imitators appeared on the market.

S-100 users were faced with a price barrier that seemed impenetrable. Some devices had high-resolution capabilities that only NASA could fully exploit. All had price tags that only NASA could afford.

Enter Quest. In an unobtrusive corner of an ad that appears regularly in the pages of this magazine, they offered a color graphics board. If it were any good, I figured, it would be highly touted. But for $100, I decided to take a chance.

For that $100, Quest Electronics (P.O. Box 4430X, Santa Clara, CA 95054) will sell you the Super Color S-100 Video kit. This includes 1K of 2114 static memory — enough to do low-resolution graphics. On-board memory is expandable to 6K with the addition of 10 more 2114 chips with sockets, and two 7805 voltage regulator chips. These may be purchased from Quest or any other parts supplier to give the board a resolution capability of 256H x 192V. Total cost of a 6K color board is less than $200 — remarkable.

Hardware Considerations

Although the board utilizes just 6K of RAM, it occupies an 8K block of memory (dip switch selectable to any 8K boundary). Another option allows a 2758 or 2716 of ROM to occupy the top 2K of the address space of the board. It is only necessary to purchase the ROM and socket to implement this option. Another option allows for on-board RF modulation of the video signal. Quest makes the necessary parts available for $2.50 but advises that it does not advocate violation of any FCC regulations which their use may entail.

Thus, the board may be assembled to produce an RF modulated output to the tuner of a TV or a composite video output to a monitor or external modulator. There are also construction variations depending on whether the board will operate in an 8080/Z80 or an 1802 environment.

I had wanted color graphics capability for my Imsai since assembling it in 1976.

The documentation accompanying the board consists of a bound volume, the first part of which provides assembly instructions for the board and options. These instructions are clear and precise, and assembly presented no problems.

The board itself is clean and well laid out. Its uncluttered appearance reflects both the superior design engineering of Quest and the power of a pair of marvelous chips, the Motorola MC6847 Video Display Generator and the MC1372 Video Modulator.

What The Board Will Do

Because the Radio Shack Color Computer uses the Motorola chip set, a trip to the local Radio Shack will provide a demonstration of the capabilities of the Super Color board. However, if the Color Computer is only a 4K model, only the lower resolutions can be observed.

The various graphics modes available with the Super Color board along with the memory requirements of each are summarized in Table 1. It will be noted that eight colors are available only in the lowest resolution mode (64 x 32). The colors are red, green, yellow, blue, cyan, magenta, orange, and buff.

In this mode, alphanumeric characters may be intermixed with graphic blocks on a character-by-character basis (each character position is divided into 2 x 2 blocks). The characters are formed by a character generator on the MC6847 chip.

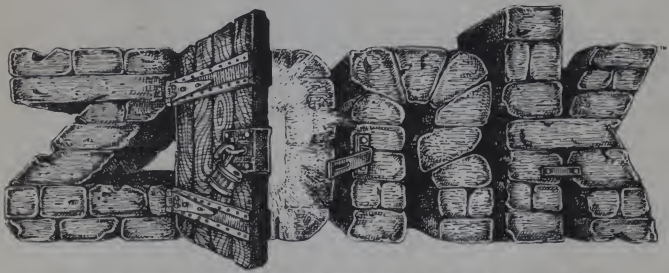
Those modes which display four colors offer the choice of red, green, yellow and blue or buff, cyan, magenta and orange. The two-color modes display buff and black or green and black.

Mode and color group selection is made by writing into one memory address on the board. However, this location, the highest address on the board, is not in RAM. Rather, it accesses a 74LS374 8-bit register.

The outputs of this chip control the mode select inputs of the MC6847 chip. Thus, if the board occupies memory locations E000H to FFFFH, then writing to location FFFFH would select the various display modes. Location FFFFH could not be read since it is not in memory.

David S. Repsher, 1915 Verde Street, Bakersfield, CA 93304.

Many are the doors that lead to the underground.



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A3

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Display Mode	Resolution (H x V)	Number of Colors	Memory Required
Semi-4	64 x 32	8	½K
Semi-6	64 x 48	4	½K
One-C	64 x 64	4	1K
One-R	128 x 64	2	1K
Two-C	128 x 64	4	2K
Two-R	128 x 96	2	2K
Three-C	128 x 96	4	3K
Three-R	128 x 192	2	3K
Six-C	128 x 192	4	6K
Six-R	256 x 192	2	6K

Table 1. The various display modes available with the Super Color board and up to 6K of memory. Note that, for a given amount of memory, resolution may be traded off for more colors.

Locations E000H to F7FFH would then be display RAM. Locations F800H to FFFEH would be the space for the optional ROM.

Criticisms

Having operated the Super Color board for over a month, I have no complaints concerning its performance. In fact, my only criticisms concern the area of documentation.

While the construction manual was lucid, instructions for using the board can best be described as adequate. That is, the necessary information is there but it is difficult to piece together the big picture of just what is happening from what is essentially a collection of tables. I speak as one who has assembled and operated at least 20 S-100 boards and mastered the mysteries of CP/M. However, once the literature is muddled through, the board really is simple to operate.

Nowhere in the manual or Quest's ads is there any mention of the on-board ROM. I suppose a graphics driver routine could occupy this space but a letter to Quest asking for present or future plans for the ROM drew no response.

Neither is there any mention in their catalog or ad concerning the on-board RF modulator. One is only advised of this option in the literature accompanying the board. Then if one desires to implement this option (I did), completion of the board must await the arrival of the parts (about a week).

The most serious deficiency lies in the area of software. The manual includes a software listing in 1802 code for a video editor and listings in 1802 and CP/M-compatible 8080 code for driver routines. All of this code makes use of the alphanumeric capabilities of the color board, such as they are.

Few people will buy this board for its alphanumeric capabilities. A 32 x 16 display is of limited utility. Besides, a 64 x 16 board can be purchased for less than the color board.

This board will be purchased by those seeking a low cost, high quality, high-resolution color graphics board. And if it also has a limited alphanumeric capability, so much the better. Yet, Quest did not see fit to include even one line of code exploiting the graphics capabilities of the board. No demo. No driver routines. And this deficiency is made all the more ironic by the inclusion of the alpha driver routines. A letter to Quest on this matter again elicited no response.

Programming Considerations

Fortunately, programming the board is not difficult. The screen is memory mapped: the lowest memory location of the board corresponds to the upper left corner of the screen. Each successive memory location then corresponds to adjacent horizontal screen positions until the 32nd location. The next memory location displays at the left side of the next line. The number of lines, as well as the number of horizontal pixels controlled by each memory location, is a function of the resolution mode being used.

Again, mode selection is made by writing a byte to the highest (pseudo-) memory location on the board. The board can thus easily be used from Basic using PEEK and POKE statements. Of course, any memory location may also be read. The mode select byte, however, since it is not truly in memory, cannot be read. It can be considered a form of read-only memory.

A Sample Program

The program which follows will allow one to draw on the screen of a color TV using the cursor controls of the keyboard to position a blinking cursor. The program uses the highest resolution mode allowing four colors (128 x 196). The user is prompted on his terminal as to which group of four colors to use.

There is also the option of clearing the screen or not. If the screen is to be cleared, it may be cleared to any of the available four colors.

If one wishes to save the screen on disk, typing an S will transfer the screen memory to lower memory. It is there appended to a

```
                ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
                ;                TITLE: DISPLAY
                ;       COLOR VIDEO DRAWING PROGRAM
                ;  FOR QUEST ELECTRONICS S-100 SUPER COLOR BOARD
                ;       BY       DAVID S. REPSHER
                ;                1915 VERDE ST.
                ;                BAKERSFIELD, CA.93304
                ;
                ;       DEFINITION OF KEY VARIABLES
                ;
                ;ADSTR- STORE CURRENT ADDRESS FOR DISPLAY.
                ;PNTR- RANGES FROM 0 TO 3, POINTS TO POSITION
                ;       WITHIN CHAR TO BE DISPLAYED. 0 IS LEFTMOST
                ;       AND 3 IS RIGHTMOST POSITION.
                ;MASK-  COLOR MASK FOR EACH 2 BIT POSITION. COLORS
                ;       MAY BE 0 TO 3. IF MSBIT IS SET (80H), THEN
                ;       NO COLOR IS DRAWN (MOVE ONLY).
                ;VIDBAS- BASE ADDRESS OF VIDEO BOARD
                ;VIDTOP- HIGHEST ADDRESS OF 8K SPACE OCCUPIED BY BOARD.
                ;        THIS BYTE CONTROLS THE DISPLAY FORMAT.
                ;VIDMID- MIDDLE OF DISPLAY SCREEN.
                ;DISEND- HIGH ORDER ADDRESS BYTE (H REG) OF END OF 6K
                ;        DISPLAY AREA
                ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
E000 =          VIDBAS  EQU     0E000H  ;ADDRESS OF VIDEO BOARD
00F8 =          DISEND  EQU     0F8H    ;PAGE # OF END OF DISPLAY
FFFF =          VIDTOP  EQU     VIDBAS+01FFFH ;DISPLAY MODE CONTROL BYTE
EC14 =          VIDMID  EQU     VIDBAS+0C14H ;ADDR OF MID-SCREN
                ;       THE FOLLOWING ARE BIOS SUBROUTINES
C006 =          CONST   EQU     0C006H  ;CALL HERE FOR KBD STATUS
C009 =          CONIN   EQU     0C009H  ;CALL HERE TO GET KBD INPUT
C00C =          CONOT   EQU     0C00CH  ;CALL HERE TO OUTPUT TO CONSOLE
0003 =          ETX     EQU     03H     ;KEYBOARD REBOOT CHAR
0100                    ORG     100H
```

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valFORTH

ValForth is an improved version of Atari's APX Forth and is upwardly compatible with it. ValForth was written by Steve Maguire and Evan Rosen of Valpar International in conjunction with Patrick Mullarky, the author of APX Forth. Specific improvements are:

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- *All* known bugs have been fixed.

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Utilities: An extensive package of extremely powerful, convenient routines. The [illegible] is too long to [illegible], but includes four powerful CASE-type statements, four types of arrays, two "table" words, STICK [illegible] RND, CHOOSE and SHUFL random routines; SCRMOVE which allows moving a sequence of screens to a new location on the same or different [illegible] with user verify [illegible] prompts, many words supporting string and number [illegible] the keyboard (string handling, too), [illegible] and MSEC delays, etc.

Video Editor: A fast, powerful VIDEO screen editor [illegible] MEMO PAD [illegible] *not* use the slow Atari Operating System [illegible] screens [illegible] supports insert and replace modes and has a [illegible] 5 [illegible] buffer. Makes [illegible] a pleasure. (Requires ValForth)

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With the Player-Missile Graphics package you can create, move, position, color and change images of players and missiles at will with fast [illegible]. Automatic or user-controlled memory allocation options. All three widths are [illegible] ported. Features high-level [illegible] and explained, and interfacing with [illegible] plementation notes with examples are [illegible].

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The Sound Editor allows simple, [illegible] control of all four variables of all four voices possible [illegible] per voice. Any [illegible] ting sound of the Atari can be [illegible] and a tabular readout. (Requires ValForth)

• • •

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The package includes [illegible] Turtle Graphics as in Atari [illegible] has advanced ValForth [illegible] allowing line and point [illegible] and "two-line" [illegible] for [illegible] work [illegible] the [illegible] generated by overflow [illegible]

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CIRCLE 254 ON READER SERVICE CARD

Photo 2A. Demo of graphics capabilities.

Photo 2B. Same as 2A but using different color group.

The Quest super color board.

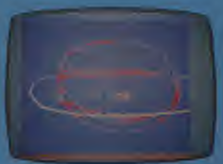

Photo 2C. Changing one bit in control byte...(to 2D)

Photo 2D. ...changes Photo 2C to Photo 2D.

Photo 2E. Poor camera work diminishes display quality

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CIRCLE 247 ON READER SERVICE CARD

loader routine and the user is advised how to save the results as a CP/M .COM file.

Then, to display the picture at any time, one merely types the name of the picture. CP/M then loads the picture and reboots, and the Display program may be loaded. When asked whether the screen should be cleared, the user replies NO and may then continue the picture. This process may be repeated until the picture is done.

Typing a number from one to four will change the color of the cursor. To erase, the background color is selected. Then as the blinking cursor is moved, the other three colors are erased. Choosing color 0 will result in a transparent cursor. This is useful when several areas of different colors must be crossed, since the screen is not changed by the cursor. Typing C offers one the opportunity to change color grouping and to erase the screen.

Program Modification

The program was assembled at location 100H to run under CP/M. My own Super Color board occupies memory locations E000H to FFFFH. If the user's board is addressed at a different location, VIDBAS must be changed to reflect this.

DISEND must also be changed. DISEND is the page location of the board plus 18H. For example, if the board is located at page 50H (occupying locations 5000H thru 6FFFH), then DISEND is 50H+18H=68H. This is the end of the RAM space on the board.

Of course, CONST, CONIN, and CONOT must also be changed to call the user's own BIOS, and the ETX may need changing to reflect the REBOOT character of the user's console. The same may be true of the cursor control characters. The commented assembly listing for the program should serve to explain how it works as well as to point out other areas for possible change or enhancement.

Summary

The Quest Electronics Super Color S-100 board is an excellent piece of hardware. It is easy to program, requiring no complex decoding algorithm. The board performs flawlessly, permitting highly detailed screen graphics on an unmodified TV. It is in the area of software, however, that support is needed. I hope that more potential users of this board will stumble onto Quest's advertisement or this article. Then perhaps a software base or users' group may be created. At the very least, a market will be formed that would make it profitable for the talented pros to enter. Some of the fantastic software that is already out there for the appliance computers might also be translated for use by the board.

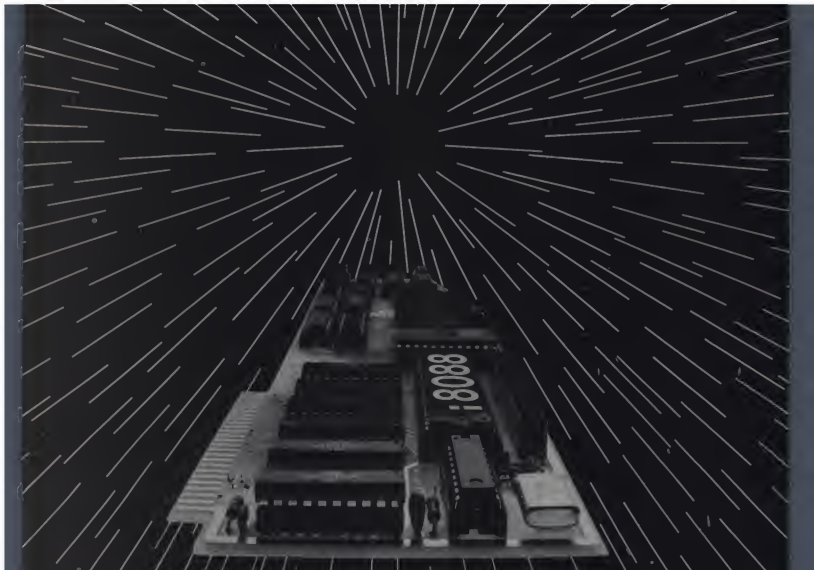
All of the fantastic potential which is the Super Color Board can only be exploited with imaginative software. It has been said, "software makes hardware happen." □

```
                  ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
                  ; THIS ROUTINE WILL NOT BE USED UNLESS A SCREEN IS
                  ; STORED. IT WILL GO ON THE DISK AND DISPLAY THE
                  ; SCREEN WHEN RELOADED AS A COM FILE.
                  ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
0100 C31D01               JMP     START    ;THIS INST WILL BE DESTROYED
0103 2100E0               LXI     H,VIDBAS ;POINT TO SCREEN AREA
0106 110003               LXI     D,300H   ;MOVE PICTURE FROM HERE
0109 1A           X1      LDAX    D        ;GET A BYTE OF PICTURE
010A 77                   MOV     M,A      ;STORE IT IN SCREEN AREA
010B 23                   INX     H
010C 13                   INX     D
010D 7A                   MOV     A,D      ;SEE IF DONE
010E FE1B                 CPI     1BH
0110 C20901               JNZ     X1       ;NO, KEEP GOING
0113 3A1C01               LDA     MODE     ;DONE. NOW GET DISPLAY MODE
0116 32FFFF               STA     VIDTOP   ;STASH IT IN MODE CONT BYTE
0119 C30000               JMP     0        ;ALL DONE. REBOOT
011C 00           MODE    DB      0        ;RESERVED FOR MODE STORE
                  ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
                  ;       PROGRAM STARTS HERE
                  ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
011D 21C102       START   LXI     H,MSG1   ;POINT TO COLOR SELECT MSG
0120 CD8102               CALL    PRINT    ;OUTPUT IT
0123 CD09C0               CALL    CONIN    ;GET A KEYBOARD CHAR.
0126 4F                   MOV     C,A
0127 CD0CC0               CALL    CONOT    ;ECHO IT
012A 79                   MOV     A,C
012B FE41                 CPI     41H      ;IS IT AN ASCII A
012D C23B01               JNZ     STAR2    ;NO. MUST BE A B
0130 3E2C                 MVI     A,2CH    ;YES. SELECT MODE A
0132 32FFFF               STA     VIDTOP   ;TO MODE CONTROL
0135 321C01               STA     MODE     ;TO MODE STORE
0138 C34301               JMP     STAR3    ;GO ON
013B 3E2D         STAR2   MVI     A,2DH    ;SELECT MODE B
013D 32FFFF               STA     VIDTOP   ;TO MODE CONTROL
0140 321C01               STA     MODE     ;TO MODE STORE
0143 219A02       STAR3   LXI     H,MSG0   ;POINT TO 'CLEAR' MESSAGE
0146 CD8102               CALL    PRINT    ;OUTPUT IT
0149 CD09C0               CALL    CONIN    ;GET KEYBOARD RESPONSE
014C 4F                   MOV     C,A      ;PUT IT IN C REG.
014D CD0CC0               CALL    CONOT    ;ECHO IT
0150 79                   MOV     A,C      ;PUT IT BACK IN A
0151 FE4E                 CPI     'N'      ;CLEAR SCREEN
0153 CA8101               JZ      C1       ;NO. SKIP IT
                  ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
                  ;       CLEAR BACKGROUND TO SELECTED COLOR
                  ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
0156 215003               LXI     H,MSG2   ;BACKGROUND SELECT MSG
0159 CD8102               CALL    PRINT
015C CD09C0               CALL    CONIN    ;GET A VALUE FROM ASCII 1 TO 4
015F 4F                   MOV     C,A
0160 CD0CC0               CALL    CONOT    ;ECHO IT
0163 79                   MOV     A,C
0164 3D                   DCR     A        ;MAKE A VALUE FROM 0 TO 3H
0165 E603                 ANI     3        ;STRIP OFF ASCII PART
0167 47                   MOV     B,A      ;BKGD COLOR IN B
0168 4F                   MOV     C,A      ;SAVE IT IN C TOO
0169 07                   RLC              ;MAKE ONE 8 BIT BYTE
016A 07                   RLC              ;OUT OF FOUR 2 BIT CODES
016B B0                   ORA     B
016C 07                   RLC
016D 07                   RLC
016E B0                   ORA     B
016F 07                   RLC
0170 07                   RLC
0171 B0                   ORA     B
0172 47                   MOV     B,A      ;DONE. SAVE IT IN B
0173 2100E0               LXI     H,VIDBAS ;POINT TO VIDEO BASE
0176 70           CLEAR   MOV     M,B      ;PAINT BACKGROUND
0177 23                   INX     H
0178 7C                   MOV     A,H
0179 FEF8                 CPI     DISEND
017B C27601               JNZ     CLEAR
017E 78                   MOV     A,B      ;BACKGROUND BYTE TO A
017F 41                   MOV     B,C      ;INITIAL COLOR MASK TO THE B
0180 4F                   MOV     C,A      ;BACKGROUND BYTE TO C
0181 2114EC       C1      LXI     H,VIDMID ;POINT TO MID SCREEN
0184 229602               SHLD    ADSTR    ;STORE ADDRESS
                  ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
                  ;       PROGRAM SITS HERE BLINKING THE CURSOR
                  ;       WAITING FOR A KEYBOARD COMMAND
                  ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
0187 2A9602       BLINK   LHLD    ADSTR    ;POINT TO CURRENT SCRN POS
018A 78                   MOV     A,B      ;PUT CURRENT MASK IN A
018B A9                   XRA     C        ;COMPLIMENT 2 BITS TO BLINK
018C 77                   MOV     M,A      ;DISPLAY IT
018D CD8C02               CALL    DELAY    ;KILL TIME
0190 79                   MOV     A,C      ;RESTORE ORIGINAL DATA
0191 77                   MOV     M,A      ;DISPLAY IT
```

Color Board, continued...

```
0192 CD9C02           CALL    DELAY    ;KILL TIME
0195 CD0600           CALL    CONST    ;KEYBOARD INPUT?
0198 C49E01           CNZ     READ     ;IF SO, GET IT
019B C38701           JMP     BLINK    ;IF NOT  KEEP BLINKING
             ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
             ;        GET A COMMAND AND EXECUTE IT
             ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
019E CD0900  READ     CALL    CONIN    ;GET A KEYBOARD CHAR.
01A1 FE03             CPI     ETX      ;REBOOT?
01A3 CA0000           JZ      0        ;IF SO, JUMP ZERO
             ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
             ;        SEE IF ITS A MOVE COMMAND
             ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
01A6 FE1A             CPI     1AH      ;UP ARROW?
01A8 CA1702           JZ      UP
01AB FE0A             CPI     0AH      ;DOWN ARROW?
01AD CA2402           JZ      DOWN
01B0 FE08             CPI     08H      ;LEFT ARROW?
01B2 CA3102           JZ      LEFT
01B5 FE1C             CPI     1CH      ;RIGHT ARROW?
01B7 CA4802           JZ      RIGHT
             ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
             ;        SEE IF ITS A COLOR CHANGE COMMAND
             ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
01BA 219902           LXI     H,MASK   ;POINT TO 2 BIT COLOR CODE
01BD FE31             CPI     31H      ;COLOR "1"?
01BF C2C701           JNZ     R1       ;IF NOT, TRY AGAIN
01C2 3600             MVI     M,0      ;STORE COLOR 1 IN MASK
01C4 C35B02           JMP     PLOT     ;PLOT THE NEW COLOR
01C7 FE32    R1       CPI     32H      ;LIKEWISE
01C9 C2D101           JNZ     R2
01CC 3601             MVI     M,1
01CE C35B02           JMP     PLOT
01D1 FE33    R2       CPI     33H      ;AND AGAIN
01D3 C2DB01           JNZ     R3
01D6 3602             MVI     M,2
01D8 C35B02           JMP     PLOT
01DB FE34    R3       CPI     34H      ;AND AGAIN
01DD C2E501           JNZ     R4
01E0 3603             MVI     M,3
01E2 C35B02           JMP     PLOT
01E5 FE30    R4       CPI     30H      ;MOVE TRANSPARENT?
01E7 C2ED01           JNZ     R5
01EA 3680             MVI     M,80H    ;MOVE, NO PLOT CODE

01EC C9               RET
01ED FE43    R5       CPI     'C'      ;CLEAR THE SCREEN?
01EF CA1D01           JZ      START    ;IF SO, GO DO IT
             ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
             ;        SAVE THE SCREEN AT 300H FOR DISK STORE
             ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
01F2 FE53             CPI     'S'      ;SAVE THE SCREEN?
01F4 C0               RNZ              ;INVALID CHAR, GET ANOTHER
01F5 219003           LXI     H,MSG3   ;PRINT SAVE INSTRUCTIONS
01F8 CD8102           CALL    PRINT
01FB 2100E0           LXI     H,VIDBAS ;GET BASE OF VID BRD
01FE 110003           LXI     D,300H   ;DESTINATION OF DISPLAY
0201 7E      S1       MOV     A,M      ;GET A SCREEN BYTE
0202 12               STAX    D        ;STORE IT
0203 23               INX     H        ;POINT NEXT
0204 13               INX     D
0205 7A               MOV     A,D      ;SEE IF WE RE DONE
0206 FE1B             CPI     1BH      ;DONE 6K?
0208 C20102           JNZ     S1       ;NO, KEEP GOING
             ; ERASE THE JUMP INST AT LOC. 100H TO NOPS
020B 210001           LXI     H,100H   ;POINT AT INSTRUCTION
020E AF               XRA     A        ;MAKE A 0
020F 77               MOV     M,A      ;MAKE A NOP
0210 23               INX     H        ;POINT NEXT
0211 77               MOV     M,A      ;DO IT AGAIN
0212 23               INX     H
0213 77               MOV     M,A      ;AND AGAIN
0214 C30000           JMP     0        ;DONE, REBOOT
             ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
             ;        ROUTINES TO MOVE CURSOR ON SCREEN
             ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
0217 2A9602  UP       LHLD    ADSTR    ;MOVE CURSOR UP 1 LINE
021A 11E0FF           LXI     D,-32    ;NEGATIVE BIAS IN D
021D 19               DAD     D        ;ADD IT TO H REG
021E 229602           SHLD    ADSTR    ;SAVE UPDATED SCREEN ADDR.
0221 C35B02           JMP     PLOT     ;NOW DRAW IN NEW LOCATION
             ;
0224 2A9602  DOWN     LHLD    ADSTR    ;MOVE DOWN 1 LINE
0227 112000           LXI     D,32     ;BIAS FOR 1 LINE
022A 19               DAD     D
022B 229602           SHLD    ADSTR
022E C35B02           JMP     PLOT
             ;
```



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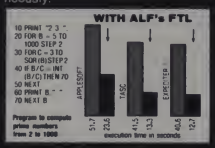
FTL is the easy way to speed up your Applesoft programs. You can run all your Applesoft programs with *no* changes, and without 'compiling' them. Plus, FTL doesn't reduce your available memory. The key is ALF's AD8088 Processor Card, which adds a fast, 16-bit computer to your Apple. FTL, the Formula Transfer Link, sends Applesoft formulas (*, /, ↑, LOG, EXP, COS, SIN, TAN, and ATN) to the card for fast processing. FTL runs programs that compilers won't, like programs with embedded assembly language. But FTL is compatible with most Applesoft compilers, so you can use **TASC** or **Expediter II** *and* FTL for even faster execution!

ALF's dependable Processor Card easily meets Apple's 2 watt power recommendation. The Apple's 6502 processor runs at full speed while the Processor Card runs programs from its on-board memories. Several AD8088's can be used simultaneously.



FTL is just one use for the powerful AD8088 Processor Card. There's a Multiple Event Timer (MET) for timing critical routines in your programs, with resolution to 50 µS for scientific applications. Coming soon are **MS-DOS** (the IBM Personal Computer's DOS), **CP/M-86**, and a fast 3-D high-res graphics card that connects through the AD8088's versatile expansion port.

$345 is the suggested price for the AD8088 Processor Card with FTL and MET. An Apple II with Language Card (or 16K RAM Card) and disk drive is required. See your local Apple dealer, or write for more information.

ALF

A L F Products Inc 1448 Estes Denver, CO 80215 (303) 234-0871

Color Board, continued...

```
0231 3A9802     LEFT    LDA     PNTR    ;GET 1 OF 4 CHAR PNTR
0234 B7                 ORA     A       ;SEE IF IT IS LEFTMOST POS
0235 C23F02             JNZ     L1      ;NO
0238 2A9602             LHLD    ADSTR   ;YES. SO GOTO NEXT CHAR
023B 2B                 DCX     H       ;MOVE LEFT 1 CHAR
023C 229602             SHLD    ADSTR   ;SAVE NEW ADDR.
023F 3D         L1      DCR     A       ;DOWN COUNT POINTER
0240 E603               ANI     3       ;MASK OFF 6 MSBITS
0242 329802             STA     PNTR    ;STORE NEW POINTER
0245 C35B02             JMP     PLOT    ;GO MOVE THE CURSOR
                ;
0248 219802     RIGHT   LXI     H,PNTR  ;GET CHAR. POS. PNTR.
024B 7E                 MOV     A,M

024C 3C                 INR     A       ;INCREMENT 1 TO RIGHT
024D E603               ANI     3       ;MASK OFF 6 MSBITS
024F 77                 MOV     M,A     ;STORE NEW POINTER
0250 B7                 ORA     A       ;SEE IF INC TO NEXT POS
0251 C25B02             JNZ     PLOT    ;NO, DISPLAY IT
0254 2A9602             LHLD    ADSTR   ;YES, GET OLD ADDRESS
0257 23                 INX     H       ;POINT NEXT POSITION
0258 229602             SHLD    ADSTR   ;NOW DROP DOWN AND DISPLAY IT
                ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
                ; THIS ROUTINE DISPLAYS BYTE AT NEW CURSOR POSITION
                ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
025B 3A9902     PLOT    LDA     MASK    ;GET CHAR COLOR CODE
025E 07                 RLC             ;SHIFT LEFT
025F DA9E01             JC      READ    ;MSBIT SET SO MOVE TRANSPARENT
0262 0F                 RRC             ;RESTORE THE ACCUM.
0263 219802             LXI     H,PNTR  ;GET CHAR POS PNTR
0266 46                 MOV     B,M     ;PUT IT IN B REG
0267 4E                 MOV     C,M     ;AND C REG
0268 04                 INR     B       ;ADD BIAS
0269 0C                 INR     C
026A 0F         P1      RRC             ;SHIFT MASK # OF POSITIONS
026B 0F                 RRC             ;SPECIFIED BY B REG.
026C 05                 DCR     B
026D C26A02             JNZ     P1
0270 47                 MOV     B,A     ;MASK IS IN POSIT., STORE IT
0271 3EFC               MVI     A,0FCH  ;ONE'S MASK TO ACCUM.
0273 0F         P2      RRC             ;SHIFT MASK # OF POSITIONS
0274 0F                 RRC             ;SPECIFIED IN C REG.
0275 0D                 DCR     C
0276 C27302             JNZ     P2
0279 2A9602             LHLD    ADSTR   ;ONE'S MASK NOW POSITIONED IN ACC.
027C A6                 ANA     M       ;BRING IN BITS NOT BEING CHANGED
027D B0                 ORA     B       ;OR IN THE BITS TO BE CHANGED
027E 4F                 MOV     C,A     ;SAVE CURRENT BYTE IN C
027F 77                 MOV     M,A     ;DISPLAY NEW BYTE
0280 C9                 RET             ;DONE, GO BLINK
                ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
                ; OUTPUT A MESSAGE UNTIL A BLANK IS ENCOUNTERED
                ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
0281 7E         PRINT   MOV     A,M     ;FETCH CHAR FROM MSG
0282 B7                 ORA     A       ;IS THIS A BLANK?
0283 C8                 RZ              ;IF SO, DONE
0284 4F                 MOV     C,A     ;MOVE CHAR TO C FOR OUTPUT
0285 CD0CC0             CALL    CONOT   ;SEND IT TO CONSOLE
0288 23                 INX     H       ;POINT NEXT
0289 C38102             JMP     PRINT   ;DO IT AGAIN
                ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
                ;       THIS ROUTINE KILLS TIME
                ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
028C 110030     DELAY   LXI     D,3000H ;LOAD DELAY TIME IN D
028F 1B         D1      DCX     D       ;DOWN COUNT TIMER
0290 7A                 MOV     A,D
0291 B3                 ORA     E       ;D+E EMPTY?
0292 C28F02             JNZ     D1      ;NOT DONE
0295 C9                 RET             ;DONE, GO BACK
                ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

                ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
0296            ADSTR   DS      2
0298            PNTR    DS      1
0299            MASK    DS      1
029A 0D0A0A0A0AMSG0     DB      0DH,0AH,0AH,0AH,0AH
029F 444F20594F         DB      'DO YOU WISH TO CLEAR THE SCREEN? ',0
02C1 0D0A0A0A47MSG1     DB      0DH,0AH,0AH,0AH,'GROUP A COLORS:  (1)GREEN,'
02DF 2028322959         DB,     ' (2)YELLOW, (3)BLUE AND (4)RED.
02FE 0D0A0A4752         DB      0DH,0AH,0AH,'GROUP B COLORS:  (1)WHITE,
031B 2028322941         DB      ' (2)AQUA, (3)PURPLE, AND (4)ORANGE
033D 0D0A0A454E         DB      0DH,0AH,0AH,'ENTER A OR B -  ',0
0350 0D0A0A0A  MSG2     DB      0DH,0AH,0AH,0AH
0354 5748494348         DB      'WHICH BACKGROUND COLOR DO YOU WISH?
0377 0D0A20454E         DB      0DH,0AH,' ENTER 1, 2, 3 OR 4 -  ',0
0390 0D0A0A5245MSG3     DB      0DH,0AH,0AH,'READY FOR SAVE 25 XXXX.COM'
03AD 0D0A0A00           DB      0DH,0AH,0AH,0
03B1                    END     100H
```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The story of Herrera's success began with his son's sight problems. Young Steve Herrera had been born with severe cataracts in both eyes and, naturally, his father was concerned. Herrera reasoned that the boy's learning abilities could be seriously affected by growing up in a world he could not see.

Having just purchased an ATARI 800 Home Computer, it occured to Herrera that this could be the perfect tool for testing Steve's vision. So he wrote a program simply displaying the letter "E" in various sizes.

Success! It turned out that 2-year-old Steve could see even the smaller "E's" without special lenses. Herrera was first relieved, and then intrigued when he discovered that not only could his son see the "E's," but he would happily play with the computer-generated letters for hours. So Herrera added a picture of an elephant to go with the "E," and then more letters and pictures. Thus, "My First Alphabet" was born, a unique teaching program for children two-years and older consisting of 36 high resolution pictures of letters and numbers.

Herrera submitted the program to the ATARI Program Exchange, where it became an instant best-seller. ATARI was so impressed with the outstanding design, suitability and graphic appeal of "My First Alphabet," that the program is being incorporated into the ATARI line of software.

In addition to his grand prize winnings of $25,000 in cash and an ATARI STAR trophy, Herrera also automatically receives royalties from sales of his program through the ATARI Program Exchange.

But Fernando Herrera wasn't the only software "star" that ATARI discovered. Three other ATARI STARS were awarded at the ASAP awards ceremony for software submitted to the ATARI Program Exchange and

judged by ATARI to be particularly unique and outstanding.

Ron and Lynn Marcuse of Freehold, New Jersey, teamed up to write three winning entries in the Business and Professional category for home computers: "Data Management System," "The Diskette Librarian" and "The Weekly Planner."

Sheldon Leeman of Oak Park, Michigan, captured an ATARI STAR for his exceptionally well-engineered "INSTEDIT" character set editor.

Greg Christensen of Anaheim, California, became our youngest ATARI STAR winner at the age of 17. Christensen designed the clever "Caverns of Mars" game program, which also will be incorporated into the ATARI product line. Greg designed the program in 1½ months after owning his ATARI Home Computer for less than a year.

Every three months, ATARI awards ATARI STARS to the writers of software programs submitted to the ATARI Software Acquisition Program and judged first, second and third place in the following categories: Consumer (including entertainment, personal interest and development); Education; Business and Professional programs for the home (personal finance and record keeping); and System Software.

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Fernando Herrera had a great idea that made him a star. ATARI would like to give you the same opportunity.

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Beware The Perilous Plums

David Lubar

creative computing
SOFTWARE PROFILE

Name: Snake Byte
Type: Game
System: 48K Apple, Disk Drive
Format: Disk
Language: Machine Language
Summary: Interesting game for all ages.
Price: $29.95
Manufacturer:
Sirius Software
10364 Rockingham Dr.
Sacramento, CA 95827

Snakes and apples are a combination that goes a long way back. Throw in a couple of nasty plums, a collection of rooms, and a timer, and the result is a challenging game. At the start of *Snake Byte*, the player selects a game with one, two, or no perilous plums. These plums bounce around each room, and are deadly if they contact the head of the player's snake. This snake moves around the room, eating apples. Whenever an apple is eaten a new one appears. This continues until ten apples have been ingested. If the player takes too long, penalty apples appear.

When the player eats ten apples without being killed, he moves into the next room. Each room after the first contains some obstacle or obstacles. The second room contains a long horizontal line, the third has a cross, and the fourth a large set of lines in the shape of a capital E. Since the snake can't survive any collision, these obstacles increase the difficulty of each room.

While it might not seem too difficult to scoot around a room eating apples and ducking plums, there is one extra problem the player must face. When the snake enters a room, its body is fairly short. Each time the snake eats, it grows longer. By the tenth apple, the snake is much longer than the room. Only convolutions and other snakey actions can prevent a collision. And, though the plums lack intelligence and just bounce around the screen without aiming for the snake, they always seem to be somewhere near where you want to go. A beginner can survive longer by playing without plums, but someone who has begun to master the game will want to try his luck and skill against one or two plums. While a game with no plums is easier than a fruitful game, the presence of plums adds bonus points, thus allowing a higher score.

The game uses the keyboard for control,

with one set of keys for up, down, left, and right, and a second for clockwise and counterclockwise movement. Though the program defaults to the standard I,J,K,M sequence, this can be changed by the user. The game responds quickly to the keys, which is especially important when making a tight turn or going after an apple on the edge of a room. After a while, players will probably develop certain strategies, such as using part of the body of the snake to corral the plums, or looping back and forth to decrease the area blocked by the snake. But even with strategy and reflexes, it will probably be quite a while before most players make their way through all the rooms. While *Snake Byte* doesn't offer massive waves of attacking aliens or flights through space, it is a fun and challenging game, both for young people and adults. □

Talking Games for the TRS-80

Owen Linzmayer

Until a few months ago, if you wanted to give your TRS-80 the gift of speech, you had to purchase an expensive voice synthesizer, but not any more. Two new games on the market produce voices through the cassette port, these are *Robot Attack*, an arcade game from Big Five, and *Forbidden Planet* adventure from Fantastic Software.

Robot Attack

The object of *Robot Attack* is simple: you are stranded on an alien space station and you must destroy as many robots as you can before they kill you. Escape is impossible and death inevitable.

At the beginning of the game you are in charge of four men; an extra man is awarded every 5,000 points. You maneuver the men, one at a time, through an infinite series of partitioned rooms. As you travel from room to room, enemy robots try to do you in, either by shooting or ramming your man. Your only defenses against these mechanical monsters are your laser gun and superior intelligence.

By pressing the four arrow keys in various combinations, you can make your man run in eight directions. Up and down movements are the slowest, left and right are somewhat faster and the diagonals are the quickest. Using diagonal movement is a handy way to dodge enemy fire and outrun the Fiendish Flagship which appears if you tarry in one room too long.

To shoot your laser pistol, just aim in any direction and press the space bar. Only three of your shots are allowed on the screen at a time. Any robot hit by a shot is instantly blasted into space trash, but alas, you cannot harm the Fiendish Flagship.

Your intellect is almost as powerful a weapon as your laser gun. The robots, after all, can only do what they have been programmed to do. After playing a few games, you learn some of their habits, and begin to be able to predict what they will do when you make a specific move. Using what you know, you can cause the robots to run into themselves, and the electrified walls, and even shoot other robots. It is possible to clear a roomful of enemies without firing a single shot!

If you manage to destroy everything in a room, you are awarded 10 bonus points for every robot that was in the room when you entered. Just because you have cleared a room, don't think for a moment it will stay that way. The master security computer has been programmed to re-stock each room after you leave it.

Have I forgotten anything? Let's see, oh yes, the voices. The voices are terrific! Robot Attack has crisp, understandable voices which add a new dimension to game playing.

The cassette version of *Robot Attack* has a vocabulary of about a dozen words, the disk version has three times as many. Incidentally, if you've ever wondered what Bill Hogue sounds like, it is his voice that talks to you throughout the game.

In conclusion, *Robot Attack* is an excellent TRS-80 adaptation of the popular arcade game. It is somewhat slower than other Big Five games, but stands strong among them.

Forbidden Planet

You wake up in a plastic container aboard a malfunctioning star-cruiser. The ship's alert wails in the background, frantically you race around trying to find the right objects to repair the ship. Once you have fixed the cruiser you must crash-land it on a strange "forbidden planet"

creative computing
SOFTWARE PROFILE

Name: Robot Attack
Type: Arcade game
System: TRS-80 Model I or III, 16K cassette, 32K disk
Format: Cassette or tape
Language: Machine
Summary: Excellent talking arcade game
Price: Cassette $15.95, disk $19.95
Manufacturer:
Big Five Software
P.O. Box 9078-185
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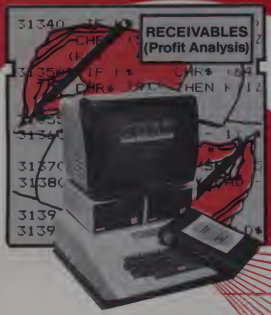
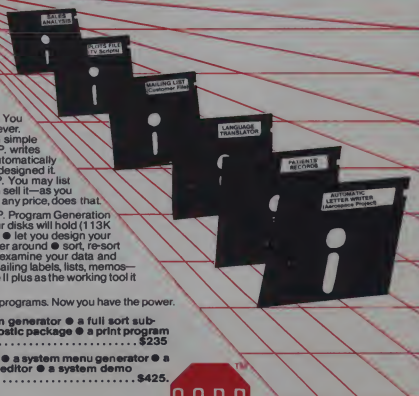


Apple II Plus with [illegible] drives, Applesoft in ROM, 48K.



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Creative Computing SOFTWARE PROFILE

Name: Forbidden Planet
Type: Text Adventure
System: TRS-80 Model I or III, 48K
Format: Disk only
Language: Machine
Summary: Talking adventure
Price: $39.95
Manufacturer:
Fantastic Software
P.O. Box 27734
Las Vegas, Nevada 89127

filled with angry ogres, caves, modern cities, radioactive lakes and much more.

This is the scenario for the first talking TRS-80 adventure, *Forbidden Planet*.

Forbidden Planet is a machine language program written by William Demas, the co-author of Scott Adams' Adventure #12, and is sold by Fantastic Software. Adams' style is evident throughout the program, from the split screen to the immediate response time. If I didn't know better I would have sworn that *Forbidden Planet* was Adams Adventure #13.

The program is a text-oriented adventure; you input commands in a verb/noun format, try to unlock mysteries, find treasures, fight battles and survive to enjoy it all. *Forbidden Planet* is exciting, sometimes frustrating, fast moving, challenging and just plain fun. It boasts a vocabulary of over 140 words plus 50 or so spoken words.

Don't be misled into thinking you are "talked along" the adventure. Only key phrases or clues are spoken, therefore if the computer talks, you had better listen carefully to what it says.

If you want, you can toggle the voice on or off in the middle of a game. The voice in *Forbidden Planet* isn't a drab monotone robot voice, but rather, a lively emotional human voice. The voice quality is good but slightly harsher than that of *Robot Attack*. Even so, every word is audible and comprehensible.

The space setting used in this program isn't novel, but Demas has added many original twists to the adventure. Even experienced adventurers will find *Forbidden Planet* very difficult to solve.

There is a variety of ways to die in the first 20 or so locations, and, needless to say, survival is tough. Anyone who enjoys a challenging adventure will find this program a delightful array of puzzles and obstacles waiting to be solved and overcome.

Forbidden Planet is a handsome addition to any collection of computer adventures and is worth the $39.95 price. □

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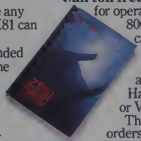

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Blowing Up the Screen

Dale Archibald

Creative Computing
SOFTWARE PROFILE

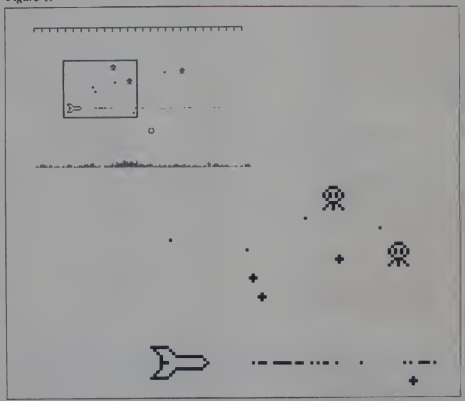
Name: Zoom Grafix
Type: Graphics printer
System: Apple II or II Plus, Applesoft in ROM, 48K; Atari 800 in works
Format: DOS 3.3
Language: Machine and Applesoft
Summary: Simple, fast graphics with enlargement feature
Price: $39.95, $10 for a backup.
Manufacturer:
Phoenix Software, Inc.
64 Lake Zurich Dr.
Lake Zurich, IL 60047

Graphics printing programs come in handy for reviewers who need to illustrate articles with screen photos. Some programs allow you to hit reset in mid-move, and store an image in memory. With a graphics program, you can then print that image out as an illustration.

Programmers use graphics programs to see how their graphics look onscreen, or to send printouts with press releases. Businesspeople use them to make hard copies of charts and graphics.

Zoom Grafix by Dave Holle takes you a step past simply copying the screen image. It allows you to select any part of the image and blow it up. For example, if you were to freeze *Torax* (Figure 1), you could print out an image of just one of the attacking monsters rather than the entire screenful.

Figure 1.



If you wanted to print the ghoulie normal size, you would select SIZE: 1 HIGH x 1 WIDE. Four times normal would be SIZE: 4 HIGH x 4 WIDE. You could make it wider than normal or higher than normal just by using 2 x 4 dots, or 4 x 4 dots.

Using *Zoom Grafix*, you can drive any of several graphics printers. With some, however, if you want to print wider than the paper, you lose the right side as the program compensates.

You can expand a graphic several sizes with *Zoom Grafix*. You simply print out one section at a time, then glue all the printouts together. For business, you could expand a graph or chart to use at meetings.

But the zoom feature isn't the only good thing about the program. It also shows you what the graphic is in its memory. It will print either hi-res screen 1 or 2. It will print white on black or black on white. It has a blinking "window" that lets you frame—and see—the exact area to be printed on your graphic; and you can change the area if your previous selection doesn't suit you.

Dale Archibald, 1817 Third Ave. N., Minneapolis, MN 55405.

Zoom Grafix, continued...

Printers

Once you have selected your printer and interface, you can store it on disk *after* you have tested your configuration. (Configurations can be changed at any time for different printers.)

The printers that are on the menu to operate with *Zoom Grafix* are the Anadex 9000, 9001, 9500 and 9501; Diablo; Epson MX-70, 80, and 100; IDS 225, 440, 445, 460 and 560; MPI 88G; NEC PC-8023; Prowriter; Qume Silentype; Spinwriter; Starwriter; and Xerox. Phoenix promises it will accommodate others in the future with optional updates.

Interfaces on the menu include the Apple Centronics, parallel, serial, and Apple III RS-232; Centronics CCS 7710, 7720 and 7728; Epson APL; Grappler; IS EP-12 PKASO; K-T; MC CPS parallel and serial; MPI Auto-Plot; SSM AIO parallel and serial; Tymac; and Versacard parallel and serial.

It is a very thoughtful program, with good error-trapping. It is, however, a bit slow to load. This, it seems, is because it takes up all but about 1K of memory in the Apple. Once it has loaded, it seems to operate very rapidly.

It is a very thoughtful program with good error-trapping.

When booted, if your printer isn't turned on, the program is supposed to stop with WAITING FOR THE PRINTER signalling the reason. It didn't on the version I tested (an early one). Instead, it goes through the sequence and all the questions, then hangs up when it should begin printing. That just means turning my MPI-88G on and tapping the paper advance switch to get it chugging.

There are other parts of the menu for printing in addition to positive or negative selection, size of zoom, and horizontal or vertical printing.

Zoom Grafix also lets you set: the zoom window from 0,0 to 279, 191; left margin; print width (automatically set for the machine you use, but you change this if you are using narrower paper); delay to set the time the printer should rest after each row, so it doesn't overheat; printer change; and line- or formfeed.

It is a simple, mostly self-explanatory program. Questions are answered in the 10-page instruction book. Non-bootable disks will be replaced free for the first 90 days after purchase, then for $5 after that with the return of the original. □

Awaken the Artist in Your Apple

Ame Choate Flynn

creative computing
SOFTWARE PROFILE

Name: Special Effects

Type: Apple Graphics

System: 48K Apple II, joystick, paddle or graphics tablet

Format: DOS 3.3

Language: Applesoft and Machine Language

Summary: Highly recommended

Price: $39.95 joystick or paddle, $69.95 graphics tablet

Manufacturer:
Penguin Software
830 4th Ave.
Geneva, IL 60134

Apple Graphics have come a long way in the past year. The resolution hasn't changed, neither have the ubiquitous six basic colors; but graphics software utilities have enabled the Apple to approach state-of-the-art computer graphics.

Large expensive computer graphics systems allow for creation of real-time, on-the-spot art and animation. They usually have unlimited color capability and let you draw directly without pre-planning your x and y coordinates. You can choose from a selection of "brushes"—a specific one for every type of line—load the brush with color and have it reproduced on the screen.

With *Special Effects* by Mark Pelczarski the Apple computer comes very close to emulating main-frame computer graphics systems costing as much as $250,000 for only $39.95.

Ame Choate Flynn, TechniGraphics, 111 Hicks St. #17B, Brooklyn Heights, NY 11201.

The utility can be divided into three basic parts: creating a picture, modifying one you already have, and animating and working with it in either an immediate mode or within your own programs.

Creating A Picture

The "Brush" or "Paint" module gives you a choice of 96 brushes or shape tables that take the place of your cursor. These shapes range from the smallest dot to lines to an air-brush splatter effect.

You can load the brush with any one of 107 colors or color patterns and move the brush/cursor around the screen with the paddles.

You can stand back from your work and make it do things you never believed possible.

Unlike the more formalized coloring book type of picture creation, where you draw some lines and fill with color, *Special Effects* allows you to put color next to color with no need for a black or white border.

The irregularly shaped air brushes allow for highly sophisticated shading and modeling. As an artist, this aspect of the utility gives me the freedom that I have come to expect with oils or acrylics, but not with my computer.

Mr. Pelczarski has made it very easy to move around the module; brushes and the color palette are displayed on page two so you can move back and forth easily from the select mode to your painting on page 1. He has even included a "Magnifying Mode" which lets you magnify the area around the cursor two or four times and turn individual pixels on or off to make them black or white.

Modifying A Picture

Using the "Conversion Module," you can take a picture you have created using other software or with a graphics tablet, and convert it into the *Special Effects* format; or conversely, take a *Special Effects* picture, convert it, and use it with the tablet.

In this module there is also a "Font Converter" which allows you to take fonts from *DOS Toolkit* or *Higher Text* and use them in the character generator in *The Complete Graphics System*. These are basic utilities which keep non-programmers from total frustration and having to remember if a picture is a Pic. TITLE (tablet) picture or a TITLE.Pic (*Special Effects* or *The Complete Graphics System*) picture.

Simply having fun with a picture is sometimes difficult; you tend to take your "art" too seriously. With the "Graphics Tricks" module you can stand back from your work and make it do things you never believed possible, all with the press of one or two keys. "Picture Flips," for example, give you a mirror image of your graphic—left on right side, top on bottom, etc. The graphics you wind up with may look very different from what you started with, but I guarantee you will have a great time.

"Color Trick" changes selected colors to other colors. You are given a "negative image" or mirror image of the picture with the colors changed. These tricks and flips are easy to get in and out of, and I

Special Effects, continued...

could have used them at the Rhode Island School of Design when my 2-D teacher said "Do it again—different."

Animation

The last options in this module are to move or animate your pictures. You can take a rectangular portion of the picture and move it to any portion of the picture on page one. You can move parts of pictures from page two to page one at different times giving you quite sophisticated animation. You use the paddles to define the portion of the picture you wish to move, and scroll it onto the page in an up or downward direction.

"Programmers Notes" tell how to use this option in your own programs and move parts and pieces in and out of the screen easily and effectively. I used it in a demonstration disk recently and it stopped the show.

Another way of moving a picture onto page one or through a picture on page one is to spiral it with a delightful routine that starts in the middle of the screen, and "spirals out" your picture from page two.

The "Packing Module" eliminates the old limitation of only 13 or so 34-sector pictures on a disk. Using a look-ahead table, you can squeeze down most pictures to a length of only 7 to 20 sectors depending on their complexity.

With this module you can pack a picture, unpack a picture or create a string of packed pictures. You can string from three to ten pictures together, and load them into HIMEM.

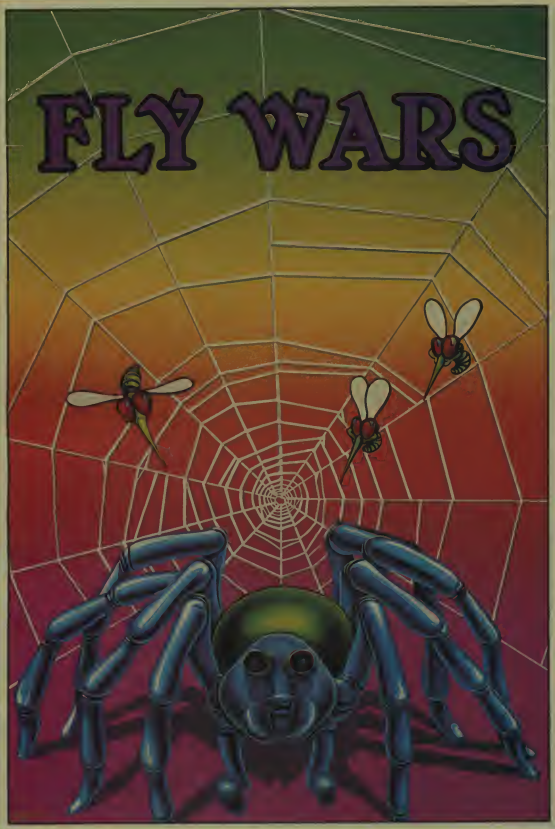
With the "Viewstring" module, a short program, you have quick (less than 15 seconds) access to all pictures in the string. They are all stored on page two, and you just call them out when you want them. I have used this for animation by modifying each picture in the string slightly and playing them out at two or three second intervals.

Documentation

The *Special Effects* disk is copy-protected, but you can use the pictures and subroutines created with it in your own programs. Mark Pelczarski has even listed the addresses and lengths of the subroutines so you can put them on your own disk, and his well-written documentation makes them easy to use.

Good documentation is a major part of any piece of software, and using the well-designed booklet is a delight. Each module is fully described with the options that are available to the user, and there is even a short reference guide in case you forget what a particular command means.

I highly recommend *Special Effects* to anyone who wants to take advantage of the Apple color graphics capabilities, and have fun at the same time. □



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Fly Wars requires a 48K Apple II or II+ computer with one Apple disk drive and is playable with keyboard or Sirius' Joyport and Atari-type joystick.

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Sacramento, California
(916) 366-1195

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Cyclod

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The craziest game yet from the masters of crazies at Sirius. Cyclod requires a 48K Apple II or II+ with one Apple disk drive and is playable with keyboard, Apple-compatible joystick, or Sirius' Joyport and Atari-type joystick.

Sirius Software, Inc.
Sacramento, California

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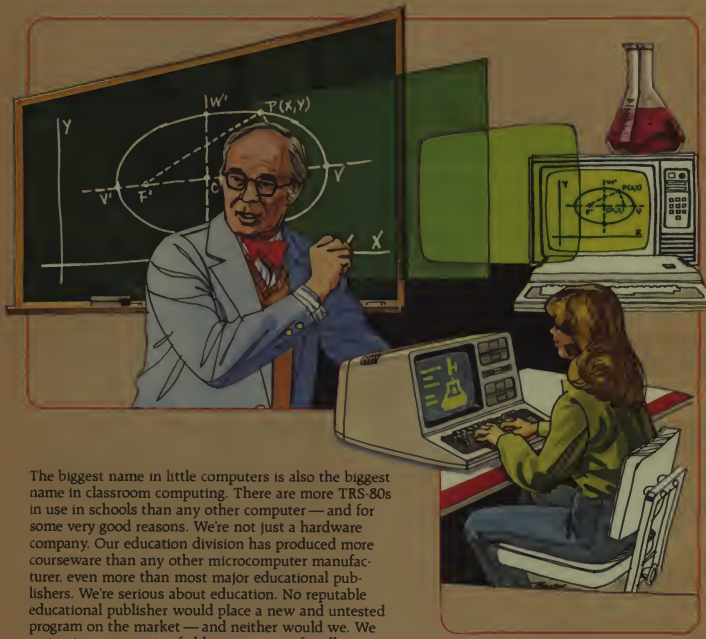

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Four High-Res Text Generators for the Apple

A Comparative Review

Andrew Berentes

An Introduction To Hi-Res Text Generators

The Apple computer brought high-resolution graphics within the reach of most computer owners. Soon after serious hi-res programming is begun, however, most programmers become frustrated by the fact that the Apple makes no provision for mixing text with high-resolution graphics. For many applications, this is a severe disadvantage, so it is not surprising that several solutions have appeared on the market.

It is now possible to purchase any of a dozen or so packages which will allow the mixing of hi-res graphics and text. One approach, used by ROM Plus from Mountain Computer involves the installation of a new piece of hardware. This is a useful, if somewhat expensive approach.

The other method, the one which this article will discuss, involves the use of a software-based high-resolution character generator.

The software approach has several advantages, when compared with hardware-based text generators. First, of course, is lower cost. One software-based character generator can be had almost for free, and even the most sophisticated cost well under $50. In my case, this permits me to own several different generators and to choose the best one for a particular application.

Andrew Berentes, Campus View House 405, Bloomington, IN 47401.

But there are other advantages of software generators. For example, once a program is written to use a particular generator, both the program and generator may be moved to another computer through use of a disk or tape.

With a hardware character generator, if you want to trade programs that use hardware generated hi-res text you are out of luck unless everyone owns the hardware.

Incidentally, all of the packages I will discuss include fully transportable lower case and do not require a lower case adapter.

Because software-based character generators are more numerous than the hardware-based types, the variety of special features is much greater. One of the generators I will discuss has especially powerful features for animation. Another allows the creation of large characters and the manipulation of the standard font in many effective ways.

When fonts — a font is any set of characters — reside in RAM instead of in ROM, they may be easily modified, and, in fact, entire fonts may be created with very little trouble. One of the packages discussed comes with 21 fonts ready to go. With a character set in ROM, changing the characters is more complicated and more expensive.

Using Hi-Res Generators

Hi-res character generators all operate in a similar way. They are designed so that normal PRINT commands will control the placement of characters on the hi-res page. Essentially, the hi-res generator hooks into the normal print machinery; when a particular character is printed on the text page the hi-res generator takes that as a cue to draw a predefined shape on the hi-resolution screen. Thus the generator gets its position cues from the cursor position and the instruction for which character to draw from the character that is printed on the text page.

But wait a minute. No one says that just because an A is printed on the text page, an A must be drawn on the hi-res page. In fact, hi-res generators allow the user to redefine characters so that, while normal letters are printed on the text page, the hi-res page may be getting Greek alphabetic characters.

This allows the creation of special symbols for special purposes. These symbols might include normally unavailable mathematical symbols, a Japanese syllabary, or the graphic symbols you need for your new Star Trek game.

So, one of the first things you should look for in a hi-res character generator is an easy way to design your own char-

acters. Fortunately, most packages include a program which allows the user to define characters in a grid and then stuff them back into the font.

This process is still time consuming, since every character has at least 56 points to be considered. Still, it is not all that difficult, and it is usually faster than defining shape tables to do the same job.

Another helpful feature in a hi-res generator is a command which disables normal screen scrolling. Because part of the screen is often taken up by graphics, we often want to use every available text line. A major frustration is that line 24 of the screen is difficult to use because the screen tends to scroll up following a print to that line.

The usual result of scroll defeat is that when a carriage return is issued in line 24 the cursor returns home without clearing the screen. The ability to disable screen scrolling is available in some form in three of the generators discussed in this article.

Animation in Hi-Res

Among the most sophisticated applications for hi-res generators is character animation. With this process, characters are defined such that, when printed in blocks, large shapes are drawn. These shapes may then be animated with PRINT statements. For those of us who do not choose to do animation in assembly language, these character animations can often be made to operate must faster than would be possible with shape tables. Certainly, the figures are easier to create.

The ultimate animation technique is nondestructive animation. With this technique it is possible to move a shape over a background object without erasing parts of that object. We owe this capability in the Apple to the fact that there are two hi-resolution screens.

The background is stored on the unseen page, called the secondary page. When the characters to be animated are printed, they are overlaid on that secondary page. The result is transferred to the primary page, which is the one seen by the viewer.

I have found advantages to each, and I use one or another as appropriate for my current purpose.

Thus, the background is stored on the secondary page, and can be reinstated on the primary page when the character has moved. While this may sound complicated, with one of the hi-res generators discussed, it is quite easily implemented. An excellent demonstration of this is RIBBIT, found in the DOS Tool Kit.

Related functions allow the generator to overlay characters. Thus it is possible to underline or to create composite characters fairly easily. This feature, used in a slightly different manner, allows the generator to print on a background, choosing either black or white as the print color to make the print visible.

The Hi-Res Character Generators

In working with these four character generators I have found advantages to each, and I use one or another as appropriate for my current purpose. So, my goal here is not to recommend one over the others, but to illuminate the features of each so that you can choose the one most appropriate to your applications.

As one further aid to choosing the best generator for you, note that all except *Screen Machine* include demonstration programs. These programs vary in complexity and serve to show the scope of hi-res generator applications in general as well as the features of any particular generator.

I would strongly recommend that you seek out each of these programs and view their demonstrations before making a final purchase. Another interesting illustration of hi-res text is "Apple Pie" by N. R. McBurney II *(Creative Computing*, August 1980).

You will notice that there are really two *High-Resolution Character Generators*, both from Apple. The latest, found in the DOS Tool Kit, is called *HRCG* in the manual. I have used that name to distinguish the new program from the original which was published in the Contributed Software Bank.

(Note: Very similar programs come with *Pascal Animation Package* and *Pilot Animation Package* from Apple. —Ed.)

Hi-Res Character Generator may usually be copied onto your disk at an Apple dealer. *HRCG* must be purchased along with several other programs in the DOS Tool Kit.

Screen Machine is available in a tape version which is fully compatible with DOS. It is manufactured by Softape and may be ordered directly from them. I have noticed that it is now being published on disk, but I have no experience with the disk version.

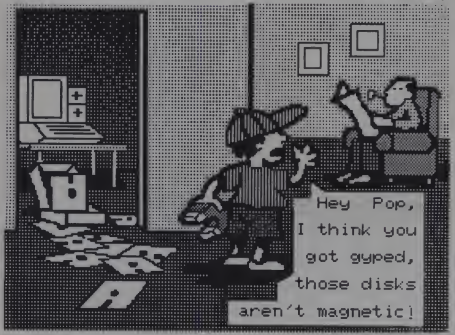
Higher Text is distributed nationally by Synergistic Software and is available also through the A.P.P.L.E. users group to members only. The version reviewed was obtained from A.P.P.L.E., and may differ from the version as distributed by Synergistic.

A Word of Warning

I should mention something here before moving on. The memory locations from $300 to $3FF (768 to 1023 decimal) are quite popular locations for small machine language programs, such as the standard Applesoft tone generator.

Be aware that they are commonly used by the character generators also. Memory maps are provided by *Higher Text* and by *Screen Machine*, detailing their $300 page usage; these should be consulted before you try to use this memory range.

Magnetic — **Robert Cavey**



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	Hi-Res Char. Generator	Screen Machine *	Higher Text	HRCG
Number of Characters in Font	128	96	96	96
Fonts Available Under Program Control	1 normally more are possible	1	3 or more depending on available memory	1 to 10
DOS Compatibility	3.2 or 3.3	3.2 or 3.3	3.2 or 3.3	3.3 only
Use with Cassette	Yes (moderately easy)	Yes (very easy)	No	No
Minimum Memory Required	1.25 K (1 font)	1.75 K (1 font)	6.1 K (3 fonts)	2 K (1 font)
Machine Memory Required	16 K	24 K	32 K (48 K preferred)	32 K
Location in Memory	Any available space	Above HIMEM (Applesoft)	Decimal 3072 to 8191	Above HIMEM
Method of Control	POKEs	POKEs and CALLs	POKEs, Control Characters	Control Characters
Non-Destructive Animation	No	Yes	Yes	Yes (very convenient)
Colored Text	No	No	Yes	No
Enlarged Text	No	No	Yes	No
Text Scroll Disable	Yes (No normal scroll)	Yes (Also normal scroll)	No	Yes (Also normal scroll)

*Cassette version

High-Resolution Character Generator

The original *High-Resolution Character Generator* has been available for some time. It is in Volume 3 of the Apple Software Bank Contributed Programs, which I obtained, along with the rest of Volume 3, for a copying charge. Even if you must pay more than I found necessary, however, you will get a bargain, since Volume 3 also contains such well-known programs as *File Cabinet, Apple Vision, Airfoil,* and *Internal Combustion Engine Simulation.*

creative computing
SOFTWARE PROFILE

Name: Hi-Res Character Generator (from Apple's Contributed Software, Volume 3)

Type: Graphics Utility

System: Apple II (or Apple II Plus), 16K, Disk or Cassette

Format: Disk or cassette

Language: Machine Language

Summary: Best buy. It works and it's almost free.

Price: Usually free, see text.

Manufacturer:
Apple Computer, Inc.
10260 Bandley Dr.
Cupertino, CA 94017

High-Res Character Generator is the most compact of the four generators considered in this article. It has two parts: a program, which requires 256 bytes of memory, and a character table, which uses 1K.

Further, these components may be located in almost any free area in memory. The combination of small size and relocatability makes *High-Res Character Generator* the only one of the four that can be used with a 16K system.

The documentation may be a little difficult to find. (My dealer doesn't normally have it.) I have, therefore, included a basic guide to the use of the package in this article.

You will notice that it uses POKEs to enter commands, but the required commands are relatively few in number. The serious user would be well advised to assign variables to 972, 973, and 974 so that, to turn on, say Inverse printing, you would do a POKE MODE, INVRS rather than POKE 973,255. This will make the user's job much easier.

Unlike the other packages, *High-Res Character Generator* has no command to enable lower case printing. Instead, this is accomplished within the context of the Basic program. To learn the procedures, list the Hi-Res Demo which is included with the generator.

The Demo is heavily documented and contains lines which may be lifted verbatim and used in your program. The algorithm is not difficult to understand and is well worth a few minutes of study.

It is possible, if a little inconvenient, to design your own character fonts. This is accomplished by plotting characters on a grid and translating the grid points into hexadecimal code.

The procedure is elaborate and time-consuming, but not terribly difficult if all the steps are followed carefully. Up to 256 characters may be put into memory without too much trouble; and more can be added with a little work.

If you wish to create characters, you will find instructions in the Contributed Programs, Volumes 3-5.

Hi-Res Character Generator is compact, inexpensive, and fulfills the most common requirements of a character generator quite well. It can be used easily with any memory size, with Integer Basic or Applesoft, and with cassette or disk-based systems. You may never need anything more elaborate than *Hi-Res Character Generator.*

Screen Machine

Screen Machine was my first hi-res text generator for a very good reason. It was and still is the only one I know of that is every bit as convenient when used with a cassette based system as when used with a disk drive.

Most hi-res programs require that a

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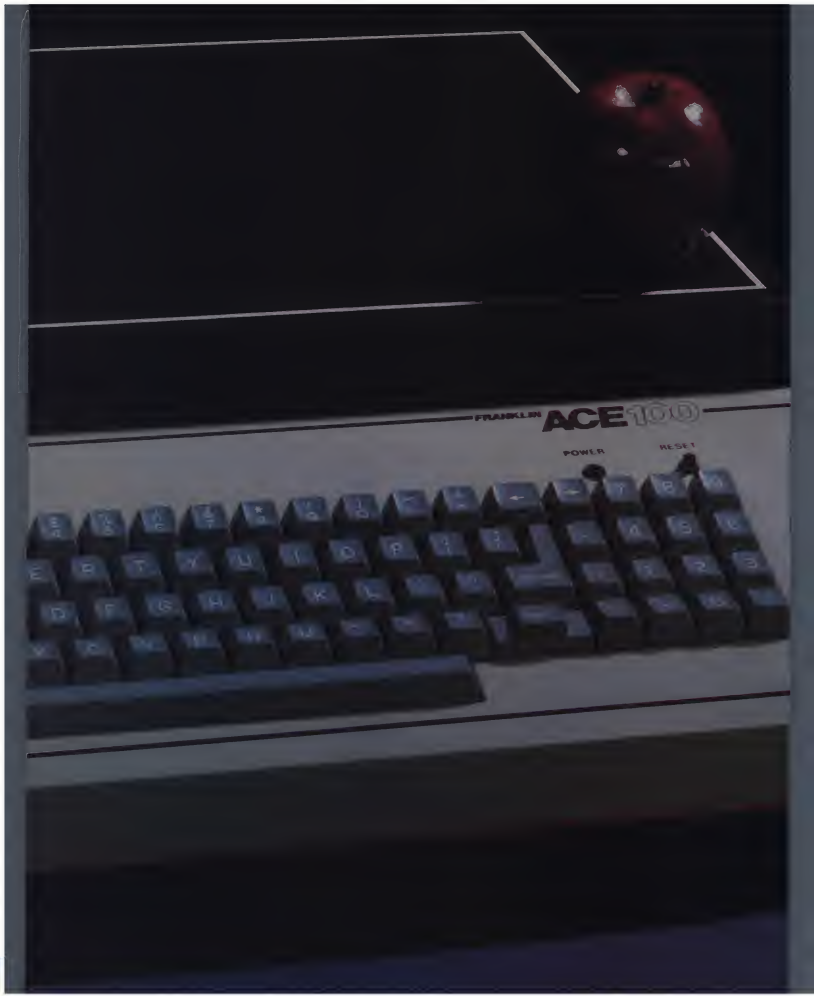
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About Embedded Control Characters

Control characters are used by *Higher Text*, *Screen Machine*, and *HRCG* to control various generator functions. This has several advantages over the use of POKEs. Control characters require less memory when stored in programs and can be made more mnemonic, that is to say, more meaningful and easy to remember.

At the very least, it is easier to type a control character than a POKE sequence, and, since some functions require several commands, this advantage becomes more important as the user undertakes more complex projects.

Often control characters are used individually—to clear a screen for example. Control characters are typed while holding down the CTRL key. In this case it is often advantageous to use variables to represent the control characters. For example, with *HRCG* the variable C$ might be set equal to a Control-P, which is the command to clear the hi-res screen.

The least obscure way to do this in Applesoft is through the CHR$ function, a feature which is unfortunately lacking in Integer Basic. Thus, in Applesoft we would use the line

900 C$ = CHR$(16) : REM CTRL-P

to make the above mentioned assignment (the numbers to use may be found on pages 138, 139 of the Applesoft Reference Manual.)

The use of REM statements is virtually essential if this technique is not to cause trouble during some future debugging operation. Of course, it would be possible, and in fact necessary in Integer, to make the assignment directly like this:

900 C$ = "": REM CTRL-P

You will notice that something is missing, namely the Control-P. It was typed between the quotation marks, but it is completely invisible in the listing. This brings us to the big headache in using control characters.

Unfortunately, the Apple does not display control characters on the text screen. This is more than just a nuisance, for it makes the standard Apple editor worse than useless for working with control characters.

When the cursor is used to copy characters while editing, it can copy only those characters which actually appear on the text screen. Since control characters do not appear, they are not copied and are deleted whenever a line is edited. And, of course, the user does not know about these deletions until his program bombs for no apparent reason.

What is needed is an editor which will both make the control characters visible and permit lines containing them to be modified.

The first solution I encountered was Program Line Editor (PLE), which gets my vote for the most useful programming utility ever created for the Apple. Its talents deserve an article by themselves, but one is particularly important here. PLE incorporates a line-based editor which is infinitely easier to use than the cursor based editor native to the Apple.

One feature of this editor is that control characters are displayed in inverse during the editing process. Thus, once a suspect line is identified and accessed by the editor, it may be edited without any of the side effects mentioned.

Incidentally, one other nice feature of PLE is that it permits the entry of lower case from the Basic environment, that is to say, without the need to have a character generator up and running; this can be quite an advantage. PLE is compatible with Integer and will make all of your Basic programming ten times easier.

Unfortunately, PLE does not make control characters visible in listings. For this we turn to the Applesoft Programmers Aid (APA), which is included with *HRCG* in the DOS Tool Kit. APA has many features, but the one of importance here causes all control characters to be shown on the screen whether they appear in listings, catalogs, or whatever.

These control characters appear as inverse figures on the video screen. Once a line is listed along with its embedded control characters, the line may be edited with the standard Apple editor. Although this is slow when compared to PLE, there is a great advantage to having all control characters in a listing made visible instead of having to go into an editing mode to visualize them.

Unfortunately, APA requires DOS 3.3 and Applesoft, so Integer Basic users are left with PLE. Also unfortunately, the control characters still do not appear in printed listings.

Tape users will notice that these are both disk-based utilities. However, the problem of control characters is considerably less severe with *Screen Machine* — which uses only two control characters — than with *Higher Text* or *HRCG*, and it is non-existent with *Hi-Res Character Generator*, so the disadvantage is not really that severe.

creative computing
SOFTWARE PROFILE

Name: Screen Machine

Type: Graphics Utility

System: Apple II (or Apple II Plus)

Format: Disk (DOS 3.3)

Language: Machine Language

Summary: Easy to use; does the basic jobs

Price: $29.95

Manufacturer:
Softape
10432 Burbank Blvd.
N. Hollywood, CA 91601

control program and a character table be loaded somewhere out of the way in memory. With disk systems this is accomplished easily by BLOADing the generator into the required location.

Screen Machine works in a different way. The control program and character table are contained in a prefix, a unit which can be appended either to Integer or Applesoft programs. The prefix becomes a part of the program and is saved and loaded with the same operation as the program.

When the program is run for the first time, the control program relocates itself into an appropriate section of memory. Thus, one program may be created which will run conveniently on either disk or cassette systems without modification.

The first step in using *Screen Machine* is to create the prefix. When *Screen Machine* is run, it presents the character font editor. The user is shown a full upper and lower case font along with a variety of punctuation marks and special symbols.

At this time any special characters which may be needed are defined through use of a 7x8 grid. Within this grid, points are turned on or off to create the characters. When a character is finished it is stored back into the character font.

It is possible to assign that new character to any letter, number, or special symbol, or to give it a hexadecimal assignment. With a hexadecimal assignment, a normally unavailable character such as a "[" (hexadecimal $5B) can be used, permitting all standard characters to remain avail-

able. In Applesoft, the CHR$ function may then be used to print that character. In Integer, a function like CHR$ is provided by *Screen Machine*.

When the character set is completed, it is output to tape or disk in the form of a prefix which contains everything needed to print hi-res text. Then a Basic program is created to use the prefix.

While the program is being created, the prefix may be run directly from disk or tape, but when the program is fully debugged, it is joined with the prefix so that they may be loaded in one operation.

While the prefix is running within the program, all functions are controlled by CALLs and POKEs. This is made more convenient by assigning variables to the addresses to be used; thus CALL HM would be used instead of CALL 897 to clear the background and home the cursor. I have written an initialization subroutine which I append to any program which will use *Screen Machine*. Since I use the same variable names in every program, I pretty much know them by heart.

It is possible to perform nondestructive character animations with *Screen Machine*, since either page may be used as the primary or secondary page. This is a little more difficult to do with *Screen Machine* than with the Apple *HRCG*, but animation is at least available to the tape user.

Among the things *Screen Machine* does not offer is colored text. All text is either normal or inverse — black and white. This is not a fault of *Screen Machine*, but is a symptom of the Apple hi-res system. Actually the only package that does offer colored text is *Higher Text*, which does so only for enlarged fonts.

All things considered, *Screen Machine* is an impressive package. It is low in cost, usable with tape or disk, and provides versions for both Integer and Applesoft. The most severe limitation is the fact that the user is limited to having one font available.

This means that, if a great many special characters are needed, something must be given up, such as lower case. However, the ease of use and compact size of *Screen Machine* still recommended it for a great many hi-res text applications.

Higher Text

Perhaps the most distinctive features of *Higher Text* are its versatile text modes and its colored text. *Higher Text* is the only package of the four that allows enlarged text, which may in turn be printed in up to nine colors. Just about anything you would want to do with a text generator is possible with this remarkable piece of software.

Fonts are created in two basic flavors: standard size (7 x 8 dots, 40 x 24 characters on screen) and large font size (14 x 16 dots, 20 x 12 characters on screen).

creative computing
SOFTWARE PROFILE

Name: Higher Text II
Type: Graphics Utility
System: Apple II
Format: Disk (Apple DOS 3.2)
Language: Machine Language
Summary: Does it all.
Price: $40
Manufacturer:
Synergistic Software
5221 120th Ave. S.E.
Bellevue, WA 98006

In addition, the standard size fonts may be manipulated in various ways. They may be wide (20 x 24 characters), tall (40 x 12 characters), or expanded (20 x 12 characters).

You may be wondering why there are both expanded and large font characters when both are the same size. Expanded characters are merely enlarged versions of the standard character set, and can contain no more detail than exists in a 7 x 8 matrix.

Large font characters are defined in a 14 x 16 matrix and can thus be far more detailed. This is best illustrated by the sample fonts included in the package, such as a very impressive Old English. Conceivably, large characters could be created for animation purposes by using the large font.

Wide, expanded, and large font characters may be printed in colors. Expanded and large font characters have four new colors in addition to the standard Apple six: pink, yellow, aqua, and blue violet are created by mixing standard colors on alternate lines of the screen, and while they tend to be a bit fuzzy, they are welcome relief from the normally limited Apple palette.

Additionally, the user may select text on a colored background. While it is not easy to display colored text on colored backgrounds due to the idiosyncratic way in which the Apple creates its colors, various combinations of white, black, and colored text and backgrounds may be used effectively. A helpful chart is provided and makes it easy to select combinations of text and background colors which will work well together.

Most functions are controlled by embedded control characters, a feature which causes special problems during program development. It would be nice to be able to write programs while *Higher Text* was in effect. Because a standard Apple displays lower case characters as nonsensical punctuation marks, this ability would allow the user to see the lower case characters as recognizable text instead of mishmash.

Unfortunately, when you type a control character into a Basic line, it takes immediate effect. Suddenly, your listing is in big, purple letters and your entire line will not fit on the screen.

Additionally, listings within *Higher Text* are monotonously slow. So the solution seems to be to write in a normal Basic environment, perhaps with the aid of Program Line Editor. This is regrettable, but probably unavoidable.

A nice touch is that *Higher Text* modifies the normal bell sound produced by the Apple speaker. When *Higher Text* is operating, the bell is both more interesting

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Using High-Resolution Character Generator

The complete generator has two components, the Hi-Res Character Generator and the Character Table. These must be loaded, either from disk or tape, into some unused section of memory. Cassette users should consult the new Reference Manual pp. 46-48 for a discussion of tape saves and reads in the monitor.

Tape users may obtain copies of the two components by proceeding as follows. If you are unfamiliar with disk, get some help.

1. BLOAD HI-RES CHARACTER GENERATOR, A$6000
2. CALL 151 (You are now in monitor)
3. Follow the saving procedures on page 46 of the Reference manual, using the following command: 6000.60FF.W.
4. Stop but do not rewind your tape.
5. Reenter Basic (Press RESET with Autostart ROM)
6. BLOAD CHARACTER TABLE,A$6000
7. CALL 151
8. Save to tape with the following command: 6000,64000.W.

Hi-Res Character Generator may be loaded beginning at any address which is an even $100, and requires 256 bytes. The documentation suggests loading it at $6000 (that is 24576 decimal, right above Hi-Res page 2).

From disk, just BLOAD HI-RES CHARACTER GENERATOR, A$6000. From tape, drop into monitor (CALL 151), prepare your tape, and type 6000.60FF R. Before you press Return, start your tape. When you hear the first beep the load is complete.

The suggested location for the Character Table is $6800. You can do a BLOAD CHARACTER TABLE,A$6800 from disk. From tape type 6800.6C00 R and proceed as you did with the Generator.

Now you must tell the program where to find itself. To do this, POKE 54 with the decimal equivalent of the low byte of the starting address of the Generation; this is always 0, to POKE 54,0. POKE 55 with the high byte of the Generator address. This is $60 in our example, which is 96 in decimal, so we POKE 55,96.

Next, at least 1 character must be printed, so let's PRINT " ". Finally, 972 is POKEd with the high byte of the address for the Character Table. For our example, this is $68 or 104 decimal. The whole sequence is as follows:

```
POKE 54,0
POKE 55,96
PRINT" "
POKE 972,104.
```

From here on, anything you print will appear on Hi-Res page 1, which, of course must be turned on.

A few more commands will come in handy:

```
POKE 973,255 sets inverse printing,
POKE 973,0 returns to normal text,
POKE 973,1 exclusive-ors new text
           with the background,
PRINTing a Control-L will clear the
           screen (Home no longer works),
POKE 974,64 prints on Hi-Res page 2,
POKE 974,32 prints on Hi-Res page 1.
```

To turn off *Hi-Res Character Generator* execute a PR#0 and a TEXT command. The Generator is restarted with POKE 54,00 and POKE 55,96.

and more pleasing. A key click feature may also be engaged to provide auditory feedback for each key press.

Now for a bit of bad news. You will notice in the comparison chart that *Higher Text* is quite a large program. To be sure, this bulk includes three fonts, but if you only need one, a great deal of memory goes to waste. To take full advantage of the package, you need a 48K machine, although a 32K machine can function to a limited degree.

The other bit of bad news is bad only for Applesoft users. *Higher Text* is not a relocatable program as are *Screen Machine* and *HRCG*. As a consequence it is designed to load at $7fd which overlaps with the beginning of program storage for Applesoft at $801. Thus, the Applesoft program must be moved upward in memory to make room for *Higher Text*.

Ordinarily this is no easy matter, but fortunately, a utility is provided to do the job. The program LOMEM: relocates the Applesoft program in residence, and resets all of the memory pointers to new, correct values. *Higher Text* is loaded into the space vacated by the program. This can all be accomplished either from within a Basic program or by an EXEC file.

If I could own only one text generator, *Higher Text* would be my choice. It does everything, perhaps not as conveniently as the more specialized packages, but it does them. It also does things which others cannot do at all.

Perhaps the only serious lack is its inability to print characters upside down, on their sides, or as mirror images, a feature which I don't use too often anyway. (Actually, I understand that this has been incorporated in the recently introduced *EZ Draw 3.3* from Sirius Software, which includes *Higher Text* as its text generator.) This is a minor omission, however. I own few pieces of software that please me more than does *Higher Text*.

HRCG

This is a second text generator from Apple. This time it appears in the DOS Tool Kit. Actually, the Kit includes a coordinated trio of programs which add up to a complete text and animation system.

The second program of the group is the Applesoft Programmer's Assistant (APA) which, among its other talents, makes the embedded control characters of *HRCG* visible in listings. Finally, Animatrix is used to create characters for *HRCG* fonts and for character animation.

HRCG has the best-designed command structure of the four generators. Only control characters are used in the program, and the letters chosen for each command are generally easy to remember. The command set is exceptionally powerful and convenient, making *HRCG* the easiest of the four generators to operate.

HRCG is a versatile text generator in that as many as 10 fonts may be loaded at one time; 21 fonts are provided with the Tool Kit. The current font is program selectable. Thus, some of the complex demonstration programs provided with DOS Tool Kit use as many as three fonts in addition to the normal text font. This is possible, but far less convenient with

creative computing
SOFTWARE PROFILE

Name: HRCG (from Apple's DOS Toolkit)
Type: Graphics Utility
System: Apple II Plus (or Apple II with 64K), DOS 3.3
Format: Disk (Apple DOS 3.3)
Language: Machine Language
Summary: Easiest to use; best for animation.
Price: $75
Manufacturer:
Apple Computer, Inc.
10260 Bandley Dr.
Cupertino, CA 94017

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CIRCLE 182 ON READER SERVICE CARD

Hi-Res Text, continued...

Higher Text and *Hi-Res Character Generator*.

Where *HRCG* really excels is with animation. The demonstrations provided are nothing less than stunning. This versatility arises from the powerful command structures and from the convenience of Animatrix. Animatrix creates a series of characters that fit together to form a large figure. All of the information needed to print that figure may be placed into a single string which may be printed by a single PRINT statement.

This is possible by virtue of three block printing commands. After the initial print location is determined by HTABs and VTABs, printing a Control-B declares the top and left margins of a block. After the first line is printed, a Control-C moves the cursor down one line and left only as far as the first space in the block. This can be repeated as many times as necessary to complete the block, which is terminated by a Control-D. Thus, for each line there is a saving of an HTAB and a PRINT statement.

Since so many Basic commands are eliminated, an *HRCG* block print runs much faster than the equivalent process on, say, *Higher Text*. The resulting animations are stunningly fast for what is essentially a Basic program. They are so fast that they often must be slowed down by timing loops. In fact, this is the really big reason to prefer *HRCG* over *Higher Text* for some purposes. This is probably the only really fast way to animate using Basic.

Animatrix deserves special mention since it is the most convenient font editor I have used. The overall effect is one of a large grid in which grid characters may be placed in up to five rows of seven. Thus, it is possible to see a large animation shape as a total entity, both enlarged and as it will appear on the hi-res screen.

It is also possible to link together several of the cells in the large frame, so that the same character can be created in several cells at once. I have used this to create a rolling ball, first creating four featureless balls, and then adding different detail to each one to create an animated sequence.

With the large grid, it is possible to see an entire alphabet as it is created, so it is easy to achieve stylistic consistency from character to character.

Another reason for my love of Animatrix is that the editing cursor is controlled by the same paddles, resulting in very fast character design. A joystick makes the process almost effortless and as close to fun as a tedious job is likely to come.

Because of its efficiency, I have often designed characters on Animatrix and then transferred the designs to *Higher Text*. While similar characters may be designed within *Higher Text* or *Screen Machine*, the process is far less convenient.

Now for the bad news about *HRCG*. In order to make the program usable with different memory configurations, it was made relocatable. Thus, it is loaded in at the top of memory — wherever that may be. The procedure for doing so is fairly involved — especially when additional fonts are loaded — and is not very well documented.

In fact, to find out how to load additional fonts, you must look to the remarks in the demonstration programs (LOADHRCG is probably best) for instructions. If you don't have a printer, locate one and make a printed listing of one of these programs; this is so essential that such a printed listing should have been provided with the documentation.

While you have the printer fired up, it would be extremely useful to get a printed listing of the program RIBBIT also. Then use APA to list the control characters to the screen. You can then fill in the control characters on your printed listing and learn a great deal about *HRCG* in the process. These listings will be invaluable reference pieces.

Of course, once you have figured it all out, you can write up a standard initialization subroutine based on LOADHRCG and use it in all of your programs.

My complaints concerning *HRCG* include the difficulty involved in loading it, its lack of variable size and colored characters, and its lack of colored background control. Adding color and size control would have increased the size of the program, however, reducing the number of fonts that could be stored at one time and probably slowing it down.

Where *Higher Text* was designed for maximum versatility, *HRCG* excels where clean control structures are important. Aside from loading, *HRCG* is very easy to use and requires little mucking about with POKEs and CALLs to hard-to-remember machine locations. It is, therefore, a genuine pleasure to use. Although it is limited in some ways, everything *HRCG* was designed to do it does extremely well.

Conclusion

While writing this article I have gone back to look through the manuals dozens of times. Each time I do, I find some feature of one of the generators which I have failed to include. So I rewrite a paragraph to include that feature, only to find another lurking in some corner of the manual.

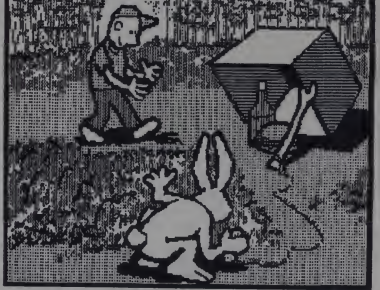
In other words, these are, without exception, well-designed packages which have tremendous potential for the innovative user. Whichever one you obtain you will find it a powerful and valuable aid to your programming creativity. □

In addition to the utility programs described in this article, many larger packages include hi-res text generators. These packages include slide show editors, plot programs, general graphics packages, languages and even word processors.

Here is a *partial* list of such programs: *Executive Briefing System* (Professional Software Technology), *Screen Director* (Business and Professional Graphics), *100 Color Drawing System* (Penguin Software), *E.Z. Draw 3.3* (Sirius Software), *Apple Pilot* (Apple Computer), *GraForth II* (Insoft) and *Screen Writer II* (Online Systems).

Look for in-depth reviews of all these programs in this and other issues of *Creative Computing*. — MC

Free Lunch **Robert Cavey**



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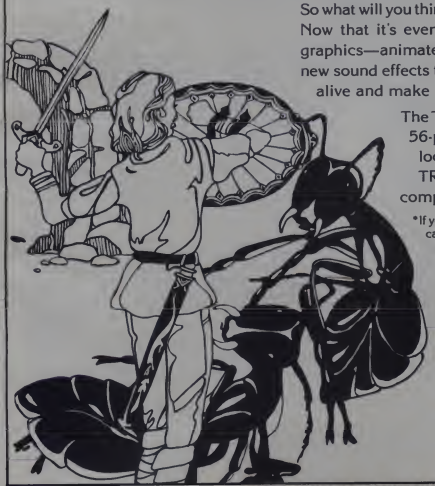

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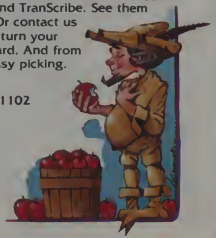

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A Graphic Language That's Downright Forthright

Michael Coffey

creative computing
SOFTWARE PROFILE

Name: GraForth II

Type: Graphic Language

System: Apple II (or Apple II Plus) 48K One Disk Drive

Format: Apple 16 Sector Disk (DOS 3.3 compatible)

Language: Machine Language

Summary: Good value for graphics programmers

Price: $75

Manufacturer:
INSOFT
10175 Barbur Blvd.
Suite 202B
Portland OR

Paul Lutus has put together quite a bag of tricks for all you Apple II graphics programmers. If you've been trucking along with Apple Basic or Pascal, you will appreciate the completeness of this new package. If you are a newcomer to the field, you will be dazzled by the three-dimensional animation made possible by *GraForth*.

GraForth is more than just a utility package: it is a language for conversing with your computer about graphics. What's more, you can customize *GraForth*, extending and modifying it until you have devised your own personal language for your personal computer.

Conversational Graphics

The first thing you want to do with any graphics package is make pictures. In *GraForth II*, you can immediately begin typing commands that draw on the screen. Without much preparation, you can plot points of several colors, draw lines and clear the screen. Each graphics command affects the screen immediately. Soon, you learn how to erase individual lines, create colored rectangles and reverse the colors on the screen.

Turtle Talk

As you continue to experiment, you will find yourself playing with "Turtle Graphics" commands. Turtle graphics is just another way of drawing lines and pictures on the screen.

Apple Basic, like many systems, forces you to use Xs and Ys to draw pictures. In addition to X-Y graphics, *GraForth II* provides a picture drawing technique called "turtle graphics," in which an invisible electronic turtle moves around the screen, leaving a trail as it goes.

You tell the turtle where to go by telling it when and how far to move and when and how much to turn. By putting together a series of "MOVE" and "TURN" commands, you create pictures.

Character Building

Let's say you want to make a moving picture that contains many small, moving objects. "Character graphics" was designed for you. With character graphics, you draw each of your little objects in advance and save them in a "character set."

Once you have built a character set, you can print your objects on the screen just as if they were letters or numbers. Through rapid repeated printing and unprinting, you can create the illusion that your objects are scooting about on the screen.

Computer Graphics of the Third Kind

Computer people have a saying that goes "It's hard to make things easy." Most 3-D graphics programs serve as profound arguments to support that slogan. Indeed, the most difficult section of *GraForth II* is the 3-D section.

GraForth excels at drawing and moving 3-D images. It can make them expand or shrink or stretch in three directions. You can put up to 16 different 3-D images on the screen at one time and make them all move.

With some practice, you may be able to make animated rocks or daggers or lips zoom in at the viewer. You could also animate scientific things like molecules or body organs.

You will probably experience some difficulty creating your own images to animate. It just isn't easy to draw a three-dimensional object on a flat surface.

The 3-D editor in *GraForth II* does a better job than most programs because it lets you see what you are creating while you are doing it.

Great Caesar's Ghost

Normally, *GraForth II* translates your typed lines into funny bits so that the computer can execute them quickly. A text

editor makes the computer remember your lines the way you typed them, so that you can look at them again and change them. The editor can also record your text creations on disk.

GraForth II comes with a text editor and can also use the output of many other editors (including some of the most popular word processors).

The *GraForth II* editor uses line numbers (a la Basic) and can automatically number and renumber your lines as you type them. Automatic renumbering sounds neat but you will have a hard time adapting to it, *especially* if you also use Basic.

Intra-line editing is exactly as built in by Apple, with one enhancement: an "insert one space" command. Cursor control is exactly as built in by Apple: you must master a confusing collection of "pure cursor move," "destructive backspace" and "retype" commands.

In a 48K Apple, the *GraForth II* editor can hold on to between 50 and 100 lines of text. With 64K, you get 300 to 600 lines.

Personalizing the Language

In *GraForth II* you can use abbreviations, compound words, jargon and slang more or less as you do in English.

If you don't like to type the word "ERASE," you can establish the letter "E" as an abbreviation for "ERASE." As a result, you would never have to type "ERASE" again.

If you would rather say "DISPLAY" than "PRINT," you can establish "DISPLAY" as an alias for "PRINT." When you find yourself typing the same group of commands repeatedly, you can establish a new word to use in place of that group of commands. All programming in *GraForth II* is done through this process of word defining.

GraForth vs. Forth

Many micro hackers enjoy a language called Forth. In their eyes, Forth is very similar to a good assembly language. They may also appreciate the ability of Forth to run on many different computers. If you use a standard Forth, you should be able to develop Forth words on one computer and use them on another.

GraForth II is not a standard Forth. Practically none of the features I've described would be found in standard Forth. Furthermore, *GraForth II* uses error handling, disk management and input output techniques that conform to no known standards. Unless you are a professional programmer, you need not worry about Forth standards.

What's Missing

GraForth II does almost everything that a graphics language should do. It cannot, however, calculate fractions or very large numbers. Consequently, you would have trouble with scientific plotting. It does nothing to simplify the use of a printer. You can print text if you are clever (or very experienced with the Apple). You can print graphics only if you are really on the ball and have spent some extra money on a "graphics dump" program.

GraForth II also lacks a ready means to use paddles or joysticks. You can forget about other add-on hardware unless you are totally comfortable with ROM calls, PEEKs and POKEs.

Compared to Other Languages

Look both ways before choosing a language for your personal computer. Among the many languages available, Basic, Pascal and Logo predominate.

GraForth vs. Logo: Logo is considerably easier to learn than GraForth. It offers an adequate full-screen editor and the ability to invent new words.

Logo offers fewer graphic features than GraForth but does include both X-Y graphics and turtle graphics. Optional features for Logo will probably be offered in the near future. Look for in-depth reviews of Logo systems for the Apple II in other issues of *Creative Computing*.

GraForth vs. Basic: Applesoft Basic comes free with the Apple II Plus, so it has a price advantage over GraForth. You get the built in X-Y graphics features. You also get more convenient arithmetic facilities, including floating point numbers (for fractions and large numbers) and algebraic notation (e.g. A=B+C).

Three-dimensional, character and turtle graphics can all be added by purchasing utility software, but you must choose utilities carefully, because some are quite difficult to use.

If you really enjoy Applesoft Basic, you should probably stick with it. After all, Applesoft is understood and supported by more software authors than any of the other languages mentioned here.

GraForth vs. Pascal: Pascal offers some degree of compatibility with other computers. Apple Pascal comes with an adequate full-screen editor, but it costs more than any of the other languages mentioned here.

Standard features of Apple Pascal include X-Y and turtle drawing. Apple publishes 3-D and character graphics options for Pascal and Fortran. The packages are called *Applegraphics II* and *Pascal Animation Tools*, respectively.

Do You Want It

If you really want to produce high quality 3-D animation, buy GraForth II. For 2-D animation, all the languages are equally good. If you just want to experiment and learn about graphics, get Logo or stick with Basic. If you are very curious about Forth or about computer languages in general, buy this one because it is fairly easy to learn. □

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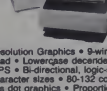

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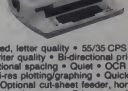

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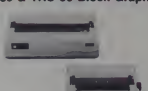

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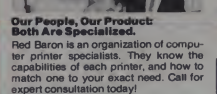

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Pilot for the Apple

Mike Smith

creative computing
SOFTWARE PROFILE

Name: Apple Pilot

Type: CAI Authoring and Playback

System: Apple II Plus, 48K, Disk Drive (two drives required for authoring)

Format: Machine Language

Summary: Extensive, colorful and interesting

Price: $150.

Manufacturer:
Apple Computer Inc.
10260 Bandley Dr.
Cupertino, CA 94017

In the development of lessons for Computer Assisted Instruction (C.A.I.), the number of things that the instructor needs to do, most of the time, is limited. The three major things are

- Inform the student.
- Accept his response to that information.
- Move to a different part of the lesson depending on whether the student reacted in an expected or an unexpected way.

Everything else is mere "computational detail" and should be performed by the computer.

Now that is rather idealistic. Authoring languages, of which Pilot is an example, attempt to allow the person unfamiliar with those computational details to develop useful and sophisticated courseware for use in the classroom. In addition, such languages can be used to advantage by the person familiar with computers and offer the ability to develop graphics or sound effects to be used in conjunction with programs not written with the authoring language.

The authoring languages on the market achieve the removal of the computational details with varying degrees of success. This review deals with the Apple implementation of Pilot. Although many of the comments are specific to advantages/disadvantages of *Apple Pilot*, I hope that people interested in purchasing other versions, e.g. PET or Atari Pilot, will be helped by knowing what one person feels should be in a Pilot implementation.

The Apple paddles can be used in developing graphics.

In the upcoming issues of *Creative Computing*, I will present an implementation of Pilot that converts Pilot statements into Basic commands. I am very familiar with the language, and therefore feel justified in making certain criticisms of *Apple Pilot*.

I have spent four years as a junior/senior high school teacher in physics and mathematics, and am currently teaching courses in computer engineering at the university level. I am interested in the development of Computer Aided Instruction and in the simulation of various effects in the classroom. My interest in Pilot arose when I found that in order to develop Basic lessons for use in the classroom, I had to spend an exorbitant amount of time.

This development time was in addition to my regular classroom load, and although I had been a programmer for 15 years, I was looking for a method to cut down lesson development time. *Apple Pilot* appeared to be a step in that direction.

Equipment

Apple Pilot comes as a system diskette (uncopyable but with a back-up), a demonstration lesson diskette and two fairly detailed *Apple Pilot* reference books. A student using prepared lessons requires an Apple II Plus with 48K of memory together with a single disk drive. Although not necessary, a color monitor can be used to good effect to display the graphics.

A teacher (lesson author) needs a second disk drive to prepare a lesson. There has been no effort made to enable the teacher with only one drive to develop a lesson. As *Apple Pilot* makes very extensive use of the disk drives, this disadvantage can be a blessing in disguise.

The Apple paddles can be used in developing graphics and to allow the student to interact with the program. However, as all the graphics commands can be implemented from the keyboard, the absence of paddles is not a problem.

A printer can be used to provide a listing of the Pilot program during lesson develop-

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CIRCLE 237 ON READER SERVICE CARD

ment. Unfortunately, there are no commands to allow a Pilot lesson to use a printer. This is a definite disadvantage as there are many times when students need hard copy information.

Through the use of the graphics screen, both upper and lower case are provided without a lower case adapter. Control-Z acts as a shift key, and Control-A acts as a shift-lock key. The shift key appears not to be implemented. However, connecting the shift key to the game paddle port allows normal typewriter use of the shift key. Shift-p gives P and control-shift-p gives @. No mention of this possibility is made in the manual; it is almost as if the Apple programmers didn't realize that they had included it.

No changes to the files on the Apple diskette are needed to get this modification to work. (Don't try this yourself unless you know exactly what you are doing. Get the dealer to do it so you can use the shift key, keep the use of the game paddles and avoid baked Apple.)

Although the *Apple Pilot* is implemented in part from Apple Pascal, neither knowledge of Pascal nor the Pascal language card is required to use it. However, if you do have access to a language system, you will find that you can perform many functions using the Pascal operating system. With the language system you can use *Apple Pilot* to advantage in customizing character sets, e.g. scientific or foreign language, for use in place of the Pascal SYSTEM.CHAR.

The fact that the *Apple Pilot* makes no use of the language card has both advantages and disadvantages. The most obvious advantage is that you cut the cost of implementing an *Apple Pilot* system by $300 or so per student computer. That is quite a saving on a classroom set of computers.

The major disadvantage is that *Apple Pilot* is rather cramped for memory space. This results in heavy disk drive use and very little space to store variables within a Pilot program. It would be nice if the teacher could at least down load the EDITORs onto the card as this would reduce the time required to reload them to make corrections in the programs.

It is rather annoying that the system diskette is uncopyable. The lesson diskettes can easily be copied. If only the teacher is developing lessons using the system diskette, there is little likelihood of crashing the system diskette, as *Apple Pilot* is written in a very user helpful and protective way.

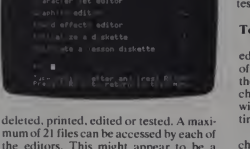
However, Pilot is such a simple language to learn and the Apple implementation of the sound and graphics editors so pleasant to use, that students should be allowed to develop their own programs. Students are frequently very hard on disks and a copyable master disk should be available.

The Pilot System

The *Apple Pilot* system is divided into six parts. The text editor, graphics editor, character editor, sound editor, and lesson duplicator are available only to the courseware developer. The Run-Time system is available to both student and developer.

Developing a Lesson

After booting the system (authoring) disk, the teacher is presented with a menu of editors. After choosing the required editor, a second menu appears. This allows the various types of files to be created.



deleted, printed, edited or tested. A maximum of 21 files can be accessed by each of the editors. This might appear to be a serious limitation, but in practice, except for a back-up disk, you would not want a large number of lessons on one disk.

An important part of developing a Pilot lesson is designing the lesson on paper before entering the text. The sound and graphics parts of the lesson need not be developed until later; the Run-Time system is able to cope with the absence of these files. This means that the teacher can map out the skeleton of the lesson without worrying about embellishments until much later on.

One big plus with this version of Pilot, is that the courseware developer does not have to be concerned with the formatting of the text on the screen. In Basic programs, you must be sure that words are not split onto two lines. In *Apple Pilot* this is automatically taken care of. Even if you develop a lesson and then decide to cram the text into one half of a screen, using the other half for graphics, all the formatting is done for you.

Once the lesson has been saved on the disk, you can RUN it from the editor. Running the lesson this way has several advantages over testing the program as though you were a student. A student never gets to see the error messages as the Run-Time system inwardly digests them. Running the program from the editor causes all errors to be displayed on the screen. In addition you can more quickly edit the files by recalling the editor into memory at this time. It is a shame that the editors cannot be stored in the language card as this would further reduce the recall time.

In Basic, when your program crashes, you simply retype the offending line and rerun the program. This version of Pilot is a little different. The Pilot program, unlike a Basic program, does not exist in memory. Instead, it resides as a series of commands in a file on the disk. The Run-Time system pulls small portions off the disk and does what is required. This means that you can't just change a line, you must go back and change the file on the disk using the editor. This is the reason that it makes good sense to plan your lessons in advance.

In developing a lesson, you can include a GOTO option which allows you to jump to a certain part of a lesson and test it without having to go through the earlier parts. The secret in good CAI is to test, test and then test again.

Text Editor

Apple Pilot has a fairly comprehensive editor. It allows the addition and deletion of text, moving around inside the file and the replacement or changing of specific character strings. For people unfamiliar with editors or computers, it will take some time to get used to all the commands.

A nice feature is that after making a change, you can type Control-C and recover the original file—useful when you make mistakes. In addition, before you leave the editor, you are asked how you want to save the file. You can save it under either the old name or a new name, or throw it away.

The use of the command tx: allows the character set to be changed. This means that the keyboard can be programmed to type special characters instead of the normal letters. This is very useful for introducing scientific or foreign language symbols into your lessons. However, since the text editor uses the text screen rather than the graphics screen, these new characters are not displayed while you are in the text editor. This is a great shame as it makes animation much more difficult.

Again, because the text editor uses the text screen, all letters are shown in upper case, with the true upper-case letters shown in inverse. The shift key modification mentioned earlier still works. No information on how to incorporate a lower-case adapter is available in the documentation.

If many back-up copies of files are kept, you will quickly have more than 21 text files on a disk. Because of a peculiarity of the editor, you can access only the first 21 access files. The others are safe on the disk, you just can't edit them. If you find yourself in this situation, there are three possible solutions:

Delete unwanted files. A useful solution only if the files are unwanted. A better solution is to have one disk on which you

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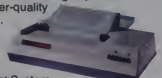

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develop a lesson. Then you can transfer the completed lesson. (But when is a lesson ever complete?)

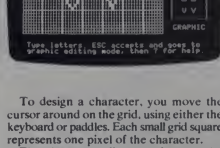
Call early versions of the files into memory and save them under a different name, then delete the old files. This has the effect of putting early files high on the disk. The other files move down the disk into a place where you can access them. This is a useful procedure only if you do it infrequently.

Access the files through a Pascal language card. Users of the language card will recognize the text editor as being similar to the Pascal Text Editor, except in two areas. First, the screen is limited to 40 characters. If you go past 40 characters, the cursor automatically moves down to the next line. That might be a useful option in Pascal. Second, the function of the Control-C and Escape keys in accepting/rejecting text changes are reversed in operation in Pilot compared to Pascal. Whether it is possible to change the Pilot start-up options to alter this is not documented.

Character Editor

The character editor allows the design of special characters.

Upon entering the editor, you will find a screen divided into three areas: a grid of 35 boxes show the character you type on the keyboard and the real-size special character you have developed.



To design a character, you move the cursor around on the grid, using either the keyboard or paddles. Each small grid square represents one pixel of the character.

The character editor was found to be lacking in one area. There is no simple way of "pulling the plug"—erasing a character back to a blank. If you make a mistake, you must erase it dot by dot.

Graphics Editor

Graphics can be entered into a lesson in two ways. They can be called by graphics commands imbedded in the text or as pictures developed by the graphics editor. For graphics more complex than a few simple lines, it is better to use the editor. The other method means that you don't see the effects of the graphics until you run the lesson.

For complex graphics, correcting errors can become very time-consuming. Second, when the lesson is run every time a graphics command is issued, a graphics interpreter is downloaded from the disk into the memory (another place where a language card could be used to advantage). If many graphics commands are entered, this can really slow down the lesson.

The editor itself allows the production of complex figures in a fairly simple way. Once you are familiar with the commands and have developed a plan of attack, the pictures appear very quickly. I like to use the editor to develop "slides" for use in lessons and lectures. A HELP function is included to provide information on-line about the commands.

The editor uses a rubber band cursor. The cursor is placed at a starting part of the screen from which it can be moved by using the paddles and/or keyboard. Connecting the starting point and current cursor position there is a line which stretches and

The editor uses a rubber band cursor.

shrinks as the cursor is moved. It is as though there were a rubber band connecting the starting and current points of the cursor. This makes it very easy to position your graphics correctly.

Boxes can be placed on the screen very quickly. Using the rubber band cursor you position the opposite corners of the box, press B and get a box filled with the required color. Pressing F gets you a frame rather than a filled box. Open and closed circles can be produced in a similar way.

Complex shapes can be made by moving the cursor about the screen. Moving the cursor into the middle of a shape and typing A will cause an area to be filled with color.

Typing E causes the last set of graphics commands to be removed and the graphics screen updated. This updating of the graphics should be an option. If you want to remove the last two sets of commands, you must remove one set, wait for the screen to be redrawn, and then erase the second set and wait again. For complex graphics this wait can be very frustrating.

Commands can only be erased from the end back. If you find that something you drew early in the graphic is no longer to your liking, everything drawn after it must go.

Moving the cursor to a point and typing T allows the entry of text on the graphics screen. This is independent of the text placed in the text window by the text editor commands.

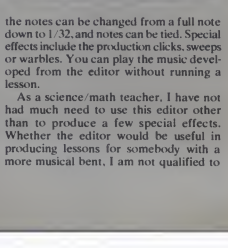
The graphics, once produced, can be stored in two ways. A picture can be stored as a series of commands or as the whole picture (Quick Draw). When the command form is called from a lesson, the picture is redrawn element by element. With a Quick Draw picture, the whole picture appears on the screen at once. The main disadvantage of Quick Draw pictures is the fact that they eat up disk space very quickly, occupying 17-20 blocks on the disk compared to the 1-4 blocks that the command files occupy.

The main problems with the graphics editor are the erasing problem and the fact that there is no way to use a graphics tablet to draw the graphics. I have found a reasonable, although unsatisfactory compromise. I make a drawing of the object on a clear piece of plastic. I then place this in front of the monitor and use the paddles to trace the shape on the screen. It works, but a graphics tablet would be much nicer.

Sound Editor

Sound can be introduced into a lesson by using either sound commands imbedded in the text or the sound editor. Imbedded commands suffer from all the disadvantages mentioned for imbedded graphics commands.

The sound editor has a HELP function to detail the commands available. It permits notes to be produced over a range of four octaves (plus an additional F). Notes can be natural, sharp or flat. The duration of



the notes can be changed from a full note down to 1/32, and notes can be tied. Special effects include the production clicks, sweeps or warbles. You can play the music developed from the editor without running a lesson.

As a science/math teacher, I have not had much need to use this editor other than to produce a few special effects. Whether the editor would be useful in producing lessons for somebody with a more musical bent, I am not qualified to

say. However, the following limitations might be important:

The notes are not displayed on the staves but in the form

C 4 1/4 T

which means the note of C in the fourth octave for 1/4 of a note, tied to another note.

You are limited to one note at a time; no chords are allowed. This is rather a shame as even in science it would be nice to demonstrate the effect of two notes beating together.

Features of Apple Pilot

In my upcoming series of tutorials and articles, I will describe the Pilot language. *Apple Pilot* has the equivalent of most of the commands mentioned in those articles. The rest of this review will be devoted to describing the special features of *Apple Pilot*.

The presence of the graphics editor is a real plus. Graphics and special characters can add to the content and interest of a lesson, if used correctly. The documentation provided on Pilot is good. Examples are plentiful and a person unacquainted with the language can prepare satisfactory lessons with the documentation. However, there are no additional references which would enable users to extend their knowledge and application skills.

The Accept and Match commands have several useful options. The student answer can be modified automatically to all upper and lower case. Unnecessary blanks can be removed and numbers rescued from within a sentence. For example, the number 5 will be recognized from within "There are 5 things there, computer."

The Match instruction can be made to look for one or several character strings with or without allowing for spelling mistakes. It can be made to distinguish between the "no" in "none" and the "no" in "known" (one starts the word). The number of attempts that a student has made at a certain answer is stored automatically by the program.

In addition, it is possible to preset the time allowed for a student to answer. This permits checking on whether the student needs some help.

A very useful command, ap:, places a series of cross hairs on the screen. The student can move the cross hairs with the paddles to point things out. This feature is nicely demonstrated in the Legends program on the demonstration Lesson diskette. However, if you don't have the paddles connected, you will not see the demonstration.

There are file handling commands included in *Apple Pilot* which can be used to store student responses and scores for later analysis. I have not made much use of these, as I felt that they were rather clumsy. If you were building a large series of lessons and needed to keep track of overall student performance they might be useful.

Because of memory restrictions, there is only limited space for storing variables in the program (600 characters including the answer buffer). The names of the variables are limited to one letter and one number. This means that the student name must be stored in a variable of the form N1$ rather than NAME$. This leads to poor programming style.

Your local dealer will know very little about Pilot.

Assuming that the system needs variables of two characters only, there was no need to restrict the user to those characters. A look-up table would have provided the best of both worlds.

In addition to strings, numerical variables can be manipulated. A number of system variables are kept. These include the last answer, the numerical value of the last answer and the number of times the last question has been attempted. Variables defined in one Pilot lesson can be carried over into the next lesson if required. This is a very useful feature to ensure continuity in a series of lessons.

A very useful compute command, c:, allows mathematical formulae to be calculated. Certain string modifications can be made, including capitalization of a string, capitalization of the first letter, replacement or deletion of characters in a string. Surprisingly, changing a string into lower case is not an allowed function. The calculation power of the Compute function seems rather slow. The production of random numbers for use in a simulation seems to take forever.

In addition, calculations cannot be done via the equivalent of DO-loops. This is probably not a problem for people unfamiliar with computers, but for experienced programmers it is definitely a fustrating disadvantage. IF-THEN loops can be produced but also take a long time to run.

Considering the fact that there are so many user friendly features in this version of Pilot, it is very surprising that it is necessary to define strings before they can be used. Again, this is probably due to memory space restrictions.

The program does its best to recover from errors. If a graphics or sound file is not available, the student lesson continues regardless. The program responds to control-C, reset and fatal errors by rebooting the system HELLO program. There is no way of disabling this feature.

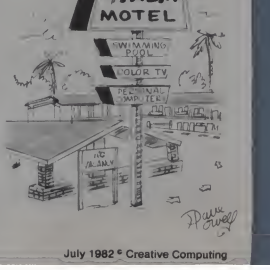
Conclusion

Overall, this is a useful program and can be put to good use by both the experienced and inexperienced courseware developer. There are many useful HELP functions within Pilot, and the program is, in general, very user friendly. Considering the cramped memory, a teacher will be limited by his own imagination, rather than by this implementation of Pilot.

My only real criticisms concern support and documentation. There are no additional references on Pilot and no information at all for the experienced programmer who wants to include parts of Pilot with his lessons to make modifications to the language.

Your local dealer will know very little about Pilot and letters to Apple requesting more information will not even receive a courtesy postcard to say "contact your local dealer and stop bothering us."

Your best bet is to form a group of Pilot users, and share software. And please, if you have useful ideas, write them up and send them to *Creative Computing* so we can all share. Everybody hates re-inventing the wheel. □



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The Case Against Pilot:

The Pros and Cons of Computer-Assisted Instruction Languages and Authoring Systems

Paul F. Merrill

The advent of low-cost microcomputers has created a new surge of interest in educational applications in the computer. This new interest is creating a growing demand for quality computer-assisted instruction (CAI) courseware. Most microcomputers which have been introduced in the last few years come with Basic, a general purpose language. Although Basic is considered to be a beginner's language, many feel that it is impractical to expect teachers, with no computer experience, to learn Basic in order to develop CAI courseware.

Since the advent of CAI many individuals and organizations have attempted to develop specialized computer languages which would enable instructors with little computer background to develop CAI courseware. These attempts have fostered such CAI languages as Coursewriter, Planit, Tutor and Pilot.

In an effort to get even further away from computer languages, others have developed authoring systems such as Ticcit and Bell and Howell's recently introduced Courseware Development System for microcomputers.

These authoring systems may be distinguished from CAI languages by their lack of operation or command statements and their use of built-in logic and presentation forms or files. Rather than putting together a series of commands, the author fills in presentation forms such as rules, questions, examples, possible answers, feedback, helps, etc.

CAI languages and authoring systems may simplify the author's task by using one or more of the following techniques: 1) Reduce the domain of possible commands and strategies; 2) Provide commands and strategies which meet the specific needs of instructional applications; 3) Provide commands or routines which perform higher level tasks. Most of the languages and systems mentioned above use a combination of these techniques. However, some languages emphasize one technique over another.

The simplicity of Pilot was achieved by reducing the number of commands in the language.

Dr. Paul Merrill, College of Education, Instructional Science Dept., W-160 STAD, Brigham Young Universiy, Provo, UT 84602.

Pilot

One of the first special purpose CAI languages available for microcomputers was Pilot (Apple Computer Inc. recently announced Pilot for the Apple II). Pilot has gained popularity because it is relatively easy to learn and is designed specifically for educational applications.

The simplicity of Pilot was achieved by reducing the number of commands in the language. Most versions of the language have approximately ten commands. Some of the more powerful versions have several additional commands for graphics, tone generation, and special functions. The principle commands in Pilot include: Type, Accept, Match, Compute, Jump, and Use.

The Type command provides for the display of text and values of numeric and string variables on the screen. The Accept instruction causes the computer to pause and wait for the student to enter a response. The response is edited according to specified rules and stored in a system variable. The response may then be compared with possible correct and incorrect answers supplied by the author using the Match command.

The Compute command provides for the assignment of numeric and string values to variables and the evaluation of arithmetic expressions. The Jump instruction enables the sequence of command execution to be altered by branching to a specified

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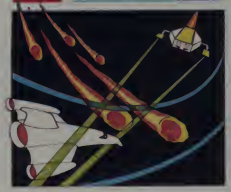

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Table 1. Comparison of Commands.

Pilot	Basic	Pascal
R: THIS IS A REMARK	REM THIS IS A REMARK	(*THIS IS A REMARK*)
T: GOOD, N , YOU SCORED #T	PRINT "GOOD, ";N$;" , YOU SCORED ";T	WRITELN ('GOOD, ',NAME,' , YOU SCORED ',T)
A: B$	INPUT B$	READLN (B)
M: RED!BLUE&GREEN	CA$="RED!BLUE&GREEN": GOSUB 10	MATCH ('RED!BLUE&GREEN')
J: LABEL	GOTO 500	GOTO LABEL
JY: LABEL	IF Y THEN 500	IF Y THEN ---
TN: SORRY, THE ANSWER IS A	IF N THEN PRINT "SORRY, THE ANSWER IS ";A$	IF N THEN WRITELN ('SORRY, THE ANSWER IS ',A)
U(T>13): SUBLABEL	IF T>13 THEN GOSUB 800	IF T>13 THEN PROCEDURENAME
E:	RETURN	END
C: X=4*B+3	X = 4*B+3	X:=4*B+3
D: W(20,15)	DIM W(20,15)	TYPE W=ARRAY [1..20,1..15] OF REAL

location in the program. The Use command provides for the execution of subroutines.

When writing a Pilot program the command names described above are abbreviated to one letter (See the first column of Table 1 for examples). These commands may be followed by a character or an expression which serves as a modifier or conditioner of the command. A modifier character changes the nature of the command. For example, an "S" following the Match command allows for one-letter misspelling when comparing the student's answer to the author's answer. A conditioner character or expression causes the command to be skipped unless the specified condition is met. For example, a Type command followed by a "Y" will only be executed if the previous match was successful (the student's answer matched the author's answer).

The command and optional modifier and/or conditioner must be followed by a

colon. The colon may be followed by appropriate parameters such as the author's answers to be matched, the expression to be evaluated, etc. Examples of these features may be found in the first column of Table 1.

A CAI language such as Pilot which tries to simplify the courseware author's task by reducing the number of commands in the language has a significant liability. The restriction in the domain of commands creates a restriction in the range of possible outcomes or applications.

Several versions of Pilot written in other high level languages such as Basic expanded the domain of the language by allowing instructions from the host language to be included in a Pilot program by embedding them as parameters into Pilot Compute commands. The severe liability inherent in the limited Pilot commands became very evident to the author while reviewing the code for a Pilot program where almost one-half of the program statements were Compute commands which used instructions from the host language.

The original version of Pilot developed at the San Francisco Medical Center had such a restriction of domain and range that many institutions began developing extensions to the language. Attempts have been made to standardize these extended features into a version called Common Pilot. However, many of the extended features of Common Pilot are merely adaptations of commands available in other high level languages. The Apple version of Pilot has been further extended to include graphics and sound editors.

The principle reason for selecting Pilot over other, more powerful, general purpose languages such as Basic or Pascal seems to be the ease with which it can be learned. However, this reasoning may be somewhat fallacious. Table 1 lists the principle commands available in Pilot along with corresponding commands in Basic and Pascal which perform similar functions. This comparison reveals that a subset of Basic or Pascal which matches the domain of Pilot commands could be learned just as easily. However, the more powerful languages offer the advantage of additional capabilities when the author is ready to go beyond the minimal subset. If an author begins by learning Pilot and then desires greater power, he must then scrap Pilot and begin learning a new language. Why not begin with a powerful language in the first place?

Although Table 1 shows that a subset of Pascal would be just as easy to learn as Basic or Pilot, a word of caution is in order. Most textbooks and manuals on Pascal currently available do not begin with a simple subset of Pascal that can be easily learned. Rather than beginning by showing how commands can be used in a simple, straightforward fashion, most authors try to present commands in their total complexity. The Pascal language is also embedded in a powerful but complex operating system which includes a text editor and file handler. In order to program in Pascal successfully, an author must also learn how to use the Pascal operating system.

The very nature of the principal Pilot commands strongly encourages novice programmers to use a mediocre strategy.

In addition to simplifying the author's task by reducing the domain of commands, Pilot also includes commands designed specifically for instructional applications. This technique is clearly laudable and is obviously necessary in any effort to tailor a computer language for courseware development. However, when this approach is coupled with a restriction in the domain of commands, additional liabilities are incurred. The majority of the commands may be tailored to specific instructional needs while more general purpose commands are excluded. Often the specific commands selected are chosen based on an implied instructional strategy. The availability of this set of commands and the exclusion of more general commands inadvertently requires authors to use a particular strategy and further limits the range of possible applications.

Several CAI languages, including Pilot, include a set of commands which foster a tutorial or dialogue CAI instructional strategy. A tutorial strategy includes a repetitive sequence of the instructional elements or frames listed in Table 2. This particular strategy is advocated by some because of its similarity to a strategy that might be used by an instructor tutoring a student one-on-one. If the segment to which a program branches is made conditional on the student's response then the instruction can be customized to the needs of each student.

Although such a strategy sounds great, in practice it is generally just plain boring. Often the questions asked merely require the student to copy words or data presented in the previous information frame. In fact, one could argue that the resulting CAI program is little more than a fancy and expensive page turner. The same strategy could be successfully implemented using a branching program text.

Obviously Pilot does not force an author to use a poor tutorial strategy. It is possible to implement other types of strategies using Pilot. One can also develop more creative tutorial programs. However, the very nature of principal Pilot commands strongly encourages novice programmers to use a mediocre strategy.

One of the main advantages of Pilot is the provision of the high level command Match. The Match command allows a Pilot program to perform moderately-sophisticated natural language processing. Students may enter free form answers which can be successfully analyzed by the Match command. Many general purpose languages such as Basic, APL and Pascal do not have a comparable command. The author must write special subroutines or procedures to perform similar functions. (See Table 1.)

All computer languages provide a set of basic or primitive commands which can be used to define and perform a higher order function. A set of computer commands organized to perform a specific function is often referred to as a program. Most languages also allow such a set of commands to be defined as a subroutine which can be called from different places in a main program.

These subroutines can subsequently be used as higher order commands to perform complex functions which cannot be performed by a single primitive command in the language. Such higher order commands can greatly simplify the author's task while simultaneously providing greater power.

Although Pilot and Basic provide for

Table 2.

Frames	Pilot Commands
1. Present information	T: Information
2. Ask questions	T: Question
3. Accept student response	A:
4. Check for correct answer	M: Correct Answers
5. Give appropriate feedback	TY: Very Good TN: Sorry, that's wrong
6. Branch to next segment	JY: Next

the specification and calling of subroutines, this capability is severely limited. Many versions of Basic refer to subroutines by number, which reduces the readability of the program.

Neither Basic nor Pilot provides for the passing of parameters from the main program to the subroutine. This makes it nearly impossible to develop subroutines which are truly modular. They cannot be used as a black box and plugged into any program without revision. Thus they are not very useful as higher order commands to an author who is not familiar with their internal workings. The variables in the subroutines are not local to the subroutines and thus may affect variables elsewhere in the main program. This can create bugs in the program which are difficult to find and correct.

On the other hand languages such as Pascal, APL, Logo and the new Actor languages such as Smalltalk provide for truly modular subroutines. Variables can be made local to a subroutine. Once such subroutines have been developed and verified to perform a function, they can be used as higher order commands without regard to their internal operations.

Pascal even allows for such subroutines to be placed in a system library and subsequently linked into any program with a single command. Such capabilities make it possible to extend a language and tailor it to meet specific needs. As mentioned earlier, defining higher order commands in this way simplifies the author's task while at the same time providing greater capacity.

Authoring Systems

Authoring Systems have been developed in an attempt to overcome the problem of having to learn a computer programming language. This is generally accomplished by separating the logical sequencing and the control of the computer program from the instructional content. The logical sequencing of instructional frames or the instructional strategy is preprogrammed into the authoring system. The author is therefore relieved from worrying about the logic and strategy of the courseware and may concentrate on the content of the instructional frames. The authoring system provides the author with a template in which to place the content to be presented.

For example, in the Bell and Howell's Genis Courseware Development System an author merely enters the text for presentation frames, question frames, correct answers, incorrect answers, feedback messages for each alternate answer, etc. The author is prompted by Genis to enter each item of information. The sequence and instructional logic is automatically built into the system.

Authoring in the Ticcit system is slightly more complicated, but the resulting courseware is more flexible. Ticcit was designed based on the philosophy of learner control. When students interact with a completed Ticcit lesson, they are given control over the content and sequence of the instructional segments they study.

The desired presentation form is selected when the student presses special learner control keys on the keyboard. These keys are labeled: Objective, Rule, Example, Practice, Help, Map, Advice, etc. Thus, if students press the key labeled Practice, they will receive a practice item. If they press Advice, they will receive guidance on what to do next. The map provides a table of contents in diagram form showing the hierarchical relationship between lessons. Students may select a different lesson segment when the map is displayed.

Authoring systems reduce cost and effort by reducing variety in much the same way that cost and effort are reduced in fast food restaurants.

Ticcit provides several packaging routines which allow an author to type in content for the rules, examples, practice items, etc. that will make up a lesson. As with Genis, the Ticcit system automatically takes care of the storage and retrieval of the various presentation form files. Thus the author does not have to worry about the computer logic required to display the appropriate instructional frame or presentation form when students press one of the learner control keys.

Authoring systems such as Genis and Ticcit simplify the author's task by using all three techniques listed earlier: very high level routines are built into the system to control the logical sequencing of the instruction; this logical sequencing is designed according to an instructional strategy which meets the specific needs of certain instructional applications; and the domain of possible strategies is obviously reduced.

Authoring systems reduce cost and effort by reducing variety in much the same way that cost and effort are reduced in fast food restaurants, tract homes and formula television shows.

With Ticcit and Bell and Howell's Courseware Development System the author is given a template to use. Although the template greatly simplifies the task, it forces the author to turn out courseware which conforms to the template. Such templates can have the effect of enhancing the quality of the courseware produced by the novice, while restricting the quality of the courseware produced by a creative author. The general quality of the courseware produced is dependent on the quality of the template.

Conclusions

•Authoring systems or languages allow authors to turn out respectable courseware using a specific template. However, authors must recognize the limits of the template, and not try to force all instruction to fit the template. The use of templates would be more acceptable if a variety of templates were provided for the different types of learning.

•CAI languages should not reduce the domain of commands. Beginning authors should initally be taught a simple subset of a language which will allow them to begin writing simple programs quickly. However, they should then have the option to learn additional commands which will give them additional capabilities and allow them to develop more sophisticated courseware.

•CAI languages should not be restricted to commands developed specifically for certain types of instructional applications.

•Experience in developing CAI courseware and in training students to develop courseware has shown that authors very quickly reach the limitations of whatever language they are using. They then clamor for additional capabilities.

•CAI languages should provide for the straightforward development and use of higher order commands which increase the power of the language but do not exclude elementary operations.

•The best language might be a general purpose language, which provides great flexibility, with the provision of higher order commands for instructional applications.

•When possible, subject matter experts with little computer experience should team up with programmers who have had considerable experience programming in a sophisticated language.

As microcomputers invade the home and classrooms the need for large quantities of quality courseware will become acute. It is imperative that authors select an appropriate tool to maximize their productivity and the quality of their courseware products. Care must be exercised to avoid selecting tools which will sacrifice quality for quantity. □

LOGO Ideas

Robert Lawler

Hooray for Bugs!

Making a square with the turtle is pretty easy. FORWARD 100, RIGHT 90 and do it again and again and again. The simplest procedure does it this way, using "recursion" (the third line, "SQUARE" means perform the entire procedure again):

```
TO SQUARE
FORWARD 100
RIGHT 90
SQUARE
```

A procedure to make a *little* square would start with the turtle going forward some smaller distance, such as ten turtle steps. One little change can make a square maze grow out of the little square. You can figure out just what the turtle will draw with this procedure:

```
TO SQUARE.MAZE :DISTANCE
FORWARD :DISTANCE
RIGHT 90
SQUARE.MAZE  :DISTANCE + 5
```

When the turtle turns RIGHT 90, the maze is square. How much should the turtle turn to make a six-sided maze? ("Sixty degrees," you say? That's right.) How much to make a five-sided maze? Five is halfway between four and six. Because 75 is halfway between 60 and 90, that would be one good guess for how many degrees to turn.

```
TO FIVE.MAZE :DISTANCE
FORWARD :DISTANCE
RIGHT 75
FIVE.MAZE:DISTANCE + 5
```

Would you say that using 75 is a mistake because it does not make exactly what you hoped? If so, you must be willing to see that mistakes can be good things. When the result of a procedure turns out to be different from what was expected, programmers say the procedure has a "bug." But sometimes the surprising result is a better one than what you first intended. That's a "new discovery" bug, one of the best kind.

Any bug, something which makes your procedure do the unexpected—if you bother to figure it out—leads to an increase in your knowledge. Although a bug may hinder your objective, the bugs in your procedures will offer the best guidance on what to learn in order to master the Logo programming environment. If bugs can lead you into new discoveries and give good guidance on what to learn, this suggests a new way a teacher or advisor could be helpful to you. Such an advisor could help in exploring and understanding the difference between what you expected and what the computer did. If you, or anybody else, want to know how you are progressing with the computer, the best indication of progress in understanding is a record of the bugs you have encountered, and understood, and those on which you are still working.

Robert Lawler, Ph.D., Associate Director, Logo, P.O. Box 1551, Ansonia Station, New York, NY 10023.

Thinking About Variables

Variables are names which have values assigned to them. A good first way to think about variables is as little boxes, say the kind that are used to keep wooden matches in. Computer memory is made of these little boxes, each of which may or may not have something in it. Naming the boxes is a good way to keep track of specific boxes into which you put things. When you ask what is in a specific box, for example, :BOX2 (read as "dots Box 2"), you don't change what's in the box. When you use the MAKE command, you always CHANGE the contents of the box. You could think of it as emptying the box before packing a new thing in it.

A second important way to think about variables comes from their use as inputs to procedures. You can imagine a procedure as a list of instructions to be performed by a lazy little man. The little man knows how to do what the steps of his procedure specify. He sleeps whenever he is not doing his procedure. He wakes up when somebody calls his name; then he does what he knows how to do and goes back to sleep. The little man never sees other people, but he can get mail in his mail box. This is necessary because he sometimes needs a message to specify exactly how he should execute a command. The message in his mail box when he wakes up is the value of the input variables he needs to perform the steps of his procedure.

A third important way to think about variables comes from their use in controlling the repetition of procedures (whether by looping or by recursion). Here are two ways to draw a square with iteration:

```
TO SQUARE1
1: MAKE "COUNT 4
2: IF:COUNT = 0 STOP
3: FORWARD 25 RIGHT 90
4: MAKE "COUNT (:COUNT - 1)
5: GO "2
END
SQUARE1

TO SQUARE 2 :SIDES.LEFT
IF :SIDES.LEFT = 0 STOP
FORWARD 25 RIGHT 90
SQUARE2 (:SIDES.LEFT - 1)
END
SQUARE2 4
```

Executing SQUARE1 or SQUARE2 4, the turtle passes over each side one time. If the variable is given some other value, the turtle traces that many sides of a square. In general, such iteration count variables control execution of the steps within the boundaries of a procedure.

Summary

Variables—permit indirect reference to values which may change—as one may refer to the contents of a box by naming the box.

Input variables—permit specification of values for use by operation within procedures referring to variables—one may think of them as messages needed by the little man who executes the procedure steps.

Iteration variables—control the number of times procedure steps are executed within their iteration boundary. □

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CIRCLE 175 ON READER SERVICE CARD

Walter Wright

A Versatile Graphics System

We recently received a group of slides of dramatic computer graphics with outstanding picture detail. We decided to use one on our new advertising rate card and another as the cover of this issue. A third one is with this write-up.

I asked Walter Wright to put together an article about the techniques used to produce these images which he promised to do. However, in the meanwhile he provided details about his system and how these images were produced.

I tentatively called the image on the cover, "The Man Wearing Glasses" and the one with this writeup, "Three People Standing Next to Each Other." Thus the titles on two sections in Walter's description.

Walter notes that the first person plural to which he refers is David Cook and himself, both artists and programmers, and sometimes James Guida and Jay Watterworth who are partners in Digital Image Corp. —*DHA*

Hardware

Digital Image Corp. of Grand Rapids, MI, has a Cromemco Z2 with SDI graphics and two 48KTP image planes, a Mitsubishi color monitor, a Houston Instruments bit pad, a Via Video frame grabber with B&W video camera and a Matrix Instruments camera system. All the equipment is off-the-shelf except the Matrix which is off-the-wall. It has been modified at great personal risk to accept a pin registered Nikon back. Images are created in software, for example, word copy, charts and graphs, geometric patterns, etc.; or by transforming a digitized frame of video.

Software

We have written 90% of our software, in both Fortran and Assembler. Most of Cromemco's SDI utilities have been replaced. We started by programming type faces and graphic symbols, shape tables, word copy and "cut and paste." Typefaces were a big headache, our present digital fonts do not use curves.

Next came the menu system. We use the leftover area of the 48KTP image plane to store user-defined color maps and "boxes." Our picture packing and unpacking routines preserve this information on disk. With the box construct we cut and paste letters, lines of text and symbols. We can shift, move and copy boxes. We can left or right justify any group of boxes on any other box. We can center any or all boxes. We can save, load, add, subtract, and, or, xor any box, group of boxes, camera image or disk file with any or all boxes. The menu allows color for color substitution. Finally, we are developing a macro capacity so that user-defined special effects can be assigned to unused buttons on the menu.

Last and least there is a "shoot" program which handles all image files, takes care of multiple exposures, duplicate slides and prompts the operator while he is actually shooting slides on the Matrix camera.

I've left out several programs—pro-

Walter Wright, William James College, Allendale, MI 49401

grams for touching up images, generating charts and graphs, simulating optical effects, geometric printing generators, paint brushes, camera tuning and so on.

The Man Wearing Glasses is David Rathburn, photography instructor at William James College. This is a video image transformed. The original image was encoded as 13 separate gray levels. Most of these gray levels were dropped and color assigned to those that remained. The original image was square, the square became box 0, the background within this box was set to color 1 while background outside the box, the remainder of the screen, remained color 0. Then David's eye became box 1. Boxes are assigned by indicating the lower left and upper right corners using the bit pad. Box 1 was keyed on the full screen over color 0. The sprocket holes containing the image of the house are box 1 containing David's eye.

Three People Standing Next To Each Other is not! This is pure geometry. The menu software has commercial potential. The software used to generate this image has none—or so I thought. This is my computer art software, similar in concept and design to the software described by Mr. Hockenhull in his recent article (*Creative Computing*, Feb. 1982). It is a collection of program modules that generate points, lines, circles, rectangles, pixel iteration, blocking, etc; that save, load and combine images. I confess I cannot describe the creation of this particular image. But I can describe the process of creating images like it.

I begin with a blank screen and proceed to fill it with various geometric shapes. After crowding the screen with random points, lines and shapes, I clean it up by repeatedly reflecting sections of the image. This organizes the image. Well, sometimes it works, sometimes not, in which case I revert to generating more shapes. When satisfied with an image, I choose appropriate colors and shoot it on 35mm slide film. Voila, *Three People Standing Next To Each Other*! □

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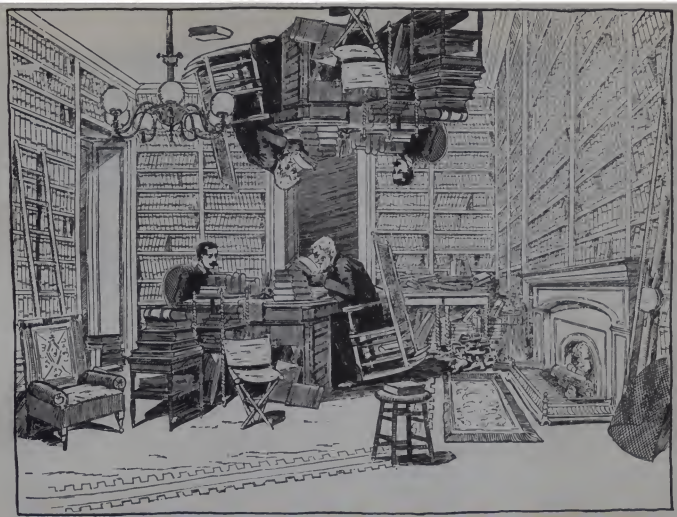

LOOPHOLES

Peter Payack

In a stunning and unparallelled move,
lawyers are beginning to explore an apparent "loophole"
in the long standing and fundamental *Law of Gravity*
in the hope of "overturning" it!

The lawsuit,
    which was filed as a "class action suit,"
contends that the *Law of Gravity*
    by its all-encompassing one-dimensional nature
is essentially limiting in scope
particularly in view of our contemporary
    "anything goes" culture.
Antitrust statutes which severely limit monopolies
will be sighted as precedents.

If by means of the courts
lawyers can successfully overturn
    this centuries old dictum
it may open vast new possibilities for the re-structuring
    of our society, world, and universe.

One practical example
would be to utilize ceilings and walls
    as living spaces
and thus alleviate much of the global housing shortage
by more than doubling the "floor plan" of the average dwelling!
Not only are lawyers cautiously optimistic about this case
but they are already speculating
    about their next action:
to find a loophole in the *second law of thermodynamics*,
    or "entropy."

According to scientific theory,
this classic tenet holds that everything in the material world
    including ball point pens, t.v.'s, comets,
    western civilization, toasters, the eco-system
    of the planet, foreign cars, and the very
    universe itself,
is falling apart in an irreversible and unstoppable fashion.

"It's about time someone takes this sensitive and delicate
matter out of the hands of the bumbling scientists,"
declared one prominent lawyer and consumer advocate.
"Now we'll see," he continued smugly while lifting
    his eyes upward,
"if *we* can turn this whole damn mess around!" □

Peter Payack, 64 Highland Ave., Cambridge, MA 02139.

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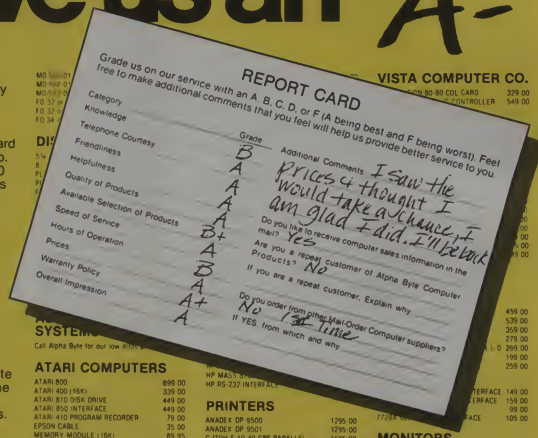

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Computer Graphics: An Art Medium in Lights

Charlotte M. Miller

Many of us who have home computers feel that "Computer graphics are for other people." Many computer owners overlook the graphic capabilities of their computers, relegating computer art to those with advanced programming talents.

Frequently, computer art is treated as "interesting," "colorful," or "nice," but not something a hobbyist would explore.

Because I am an instructor of English in a university, I acquired my system (Apple II Plus, disk drive, and VersaWriter) to write educational software with graphics. But I am also an artist, and have worked with oils, watercolors, and acrylics.

When I started working with VersaWriter, the artist overtook the teacher. I saw the computer as a new medium which paints with lights instead of pigments. As a result, I have not yet learned to program. I have spent all my computer time learning to draw landscapes, portraits, posters, and have even collaborated on some games and programs for profit.

Computer drawing is as absorbing as any other art medium, and one need not be an artist to do it well. The following text and pictures are intended as a kind of mini-cookbook describing what I have learned. Although my drawings are done with the Apple and VersaWriter, similar results can be achieved with different equipment.

First, as with any new medium, experiment and learn about the equipment. VersaWriter uses the Apple keyboard to change color, erase and touch up, save and recall pictures. These commands should be second nature so that drawing is not interrupted to refer to the instruction manual.

The color chart is of special interest because it provides a wide variety of colors that also create texture through patterns. These colors are used to fill in figures and add shading to the picture.

I saw the computer as a new medium which paints with lights instead of pigments.

In short, play with the possibilities for a while. Draw. Change color. Erase. Touch up. Fill in. Use your manual to become comfortable with the VersaWriter (or whatever digitizer you have). One must learn the capabilities of any tool, and this is certainly no exception.

Second, select a subject. Considerations of the medium must be made here. Although pictures can be rendered directly by watching the screen, VersaWriter is also designed to trace an original drawing. There are, however, some size limits.

The scaling function may be used to match the original to the screen (see the VersaWriter manual), but it is best to pick an original that is about 6" by 6". If the original is too small, it will be difficult to shade and render accurately. I chose a picture of the Mona Lisa from a magazine to illustrate the ability of the computer to trace and create pleasing new art.

The accompanying step-by-step illustrations of the process which produced the Mona Lisa show how simple it is to use this new art tool, although it requires some patience and care. The first picture is analogous to a rough sketch for painting. I chose an original that could be traced directly onto the screen without doing a new drawing or adjusting the size.

A white screen is easier to use and more like paper. The outline of the figure is traced and the areas to be shaded are outlined on the first drawing. I saved this basic sketch on disk for future use. That way, no matter what might happen while experimenting with the drawing, I could go back to the original, a flexibility not provided in other media. Watercolors, for example, are not so forgiving.

In Figure 2, the background colors and some shading in the face were added. I chose colors that would approximate and be true to the feel of an old painting because a literal rendering was not possible, or even necessarily desirable. The computer is a different medium with its own special charms.

VersaWriter has a color test function which makes color tests possible during this phase. If there is a mistake, the Paintbrush command can easily erase what you don't like. The dark blues, greens, and yellows of the original are suggested

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in the background color masses. This step went on disk too.

Coloring the face was the next task. In Figure 3, you can see the color test patch in the lower right corner. Use the paintbrush to erase this patch when you are finished.

Although coloring a face usually requires more care and correction than almost anything else, you can always recall the original if you ruin the basic image. This happens sometimes, especially when shading the mouth and eyes. If a few dots are off, the whole facial expression can change.

If this happens and you cannot seem to get it right, do not despair. Recall the previous picture, experiment and recolor until you are satisfied. Paintbrush mode plays a big part in this stage because it erases in tight areas and softens too heavy a pattern (Figures 4 and 5).

Figure 1.

Figure 2.

Figure 3.

Figure 4.

Figure 5.

Art Medium, continued...

In Figure 4, I was dissatisfied with the cheek area, so I erased a small section with the smallest paintbrush and reshaded it. Sometimes you must color one pixel at a time. The Microscope command is sometimes useful here. It blows up a section so you can see it more easily. Be patient. The end result is worth it.

In these figures, the color test square was erased because by then I knew what colors I wanted where, and I knew the VersaWriter color chart by heart.

Photographing the Screen

When your final drawing is complete and saved to disk, what next? The answer, if you do not have a printer, or even if you do but want color reproduction, is photography. It is relatively simple to photograph good color slides from the television screen.

The equipment I used was an ordinary 35mm camera and a tripod. Use a slower film such as Kodachrome 64 instead of the faster ASA400, which seems to produce too much blue. Don't use a flash.

Set up the tripod and get the television screen in focus to eliminate unwanted distortion. Next set the exposure to 1/4 second; this long exposure is necessary to eliminate the TV scanning effects.

Use the screen reverse function of VersaWriter to create a bright white screen. With the room completely dark to eliminate glare, set the F stop to bring the light level to its normal reading for proper exposure.

Recall the picture to be photographed from the disk, and without changing any settings, snap the picture. Take another picture one stop up and another one stop down to be safe.

The white screen is used because the light meter averages light from the total area to arrive at the exposure setting. When the actual picture is placed on the screen, the dots are still as bright, but the average light is usually reduced.

Have the film processed in the normal manner. Slides capture the original best because they produce the image with light rather than pigment. So have color blow ups made or, for as little as forty-five or fifty cents, you can color Xerox your slides until you produce a picture you really like. When a computer picture is enlarged, the effects are quite handsome.

I read a recent article which claimed that home computer art is several years away. I disagree! The existing graphic technology—and a little imagination—are sufficient to produce art as valid and personally satisfying as art produced through traditional media.

In fact, I suspect that if the computer had been invented in the fifteenth century, Leonardo da Vinci would have painted the Mona Lisa in lights instead of oils. □

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The Graph Paper

Part One: Introduction and Explanation

David Lubar

Conspiracy Theory

According to the rumor, there is a big mystery behind Apple graphics, shared by an elite group of programmers who are sworn to secrecy. Such is the myth. And while it is far from true, its origin is understandable.

The instruction manuals have limited room for this sort of information, so the Apple owner who has mastered the information on HPLOT and XDRAW finds, to his dismay, that such techniques are far from adequate to create a fast arcade game. He sees others making the Apple do impossible tricks, and wonders what the secret is.

These "others" have learned through experiment, or through information passed on by friends. Some have taken the time to write a few articles; most are too busy programming.

The purpose of this series is to provide as much information as possible, in an organized fashion, covering every aspect of hi-res graphics. The first few months will cover Applesoft, and amplify areas where the Applesoft manual lacks depth. From there, we'll move into machine language, starting simple but graduating to sophisticated animation. There may be some guest columns or sections from those who are especially strong in a specific area. I'll do what I can.

This month, I just want to cover some of the more common questions and touch on some general concepts.

SHLOAD

There are two or three questions that seem to pop up over and over whenever people discuss graphics. The most frequent question comes from those who started out with tape and then upgraded to disk. They want to know the DOS equivalent of the SHLOAD command (for those of you who have never had to struggle with tape, SHLOAD brings in a shape table, sets up pointers to it, and moves HIMEM below the table). DOS has no such command, but it can load a binary file, which is what a shape table is.

There is a big mystery behind Apple graphics, shared by an elite group of programmers who are sworn to secrecy.

The first step is to put the table on the disk. After booting DOS, use SHLOAD to bring in the table. Next, go into the monitor with CALL -151. Locations E8 and E9 contain the address of the table. To inspect these locations, just type E8.E9 (return).

The two values will be displayed. The address is stored with the lo byte first. So if E8 contains 00 and E9 hold 70, the address of the table will be 7000 (hex). Now you know where the table starts.

The next step is to find where it ends. While still in the monitor, type the address of the table, followed by several returns. A series of numbers will be displayed. The first number tells how many shapes are in the table. Next comes an unused byte, followed by a two-byte offset for each shape. This offset, when added to the original address, will give the address of a shape.

To find the address of the last shape, multiply the number of shapes by two (remember that the value is in hex). Then, add this number to the address at which the table starts, and look at the two bytes at this new address. These contain the offset to the last shape. Add this offset to the starting address of the table and you will finally have the start of the last shape. Type that number and start hitting return. The first 00 you see marks the end of the table (this might seem like a lot to go through, but you'll get used to it).

To put the shape on disk, you need to know the start and length. You already know the start. The length is equal to the end address minus the start, plus one. If you forget to add one, your last byte won't make it to disk. Since this byte marks the end of a shape, its absence would be missed, and might produce some interesting but potentially disastrous results. Anyhow, armed with this knowledge, you save the shape with the command BSAVE filename, A$ start address, L$ length.

Once the table is on disk, you can bring it back with the command BLOAD filename. From inside a program, use 10 PRINT D$; "BLOAD filename" where D$ is control-D. You must also put the address into E8 and E9. Take the lo byte,

David Lubar, 10460 El Mercado Dr., Rancho Cordova, CA 95670.

GraFORTH®

by Paul Lutus

Make Your Graphics Come Alive!

GraFORTH combines sophisticated graphics features with a powerful programming language. Much more than a utility program, GraFORTH's superior graphics make it the ultimate language for entertainment and educational software creation. Included are plotting and line graphics, text display and character image graphics, and high speed 3-D graphics, all with a variety of colors and drawing options. GraFORTH can be used on a 48K Apple][system with DOS 3.3 and one disk drive. A 16K memory card is a useful option.

The Language:

GraFORTH is a graphics language similar in structure to FORTH, but entirely rewritten for ease of use and maximum speed. (Counting to 30,000 in GraFORTH takes less than three seconds!) Immediate commands and programs can be entered and run directly from the keyboard. GraFORTH includes a full set of arithmetic and string handling capabilities. Since standard DOS files are used, communication with other programs and languages is straightforward.

Plotting and Line Graphics:

The first level of graphics consists of plotting points, drawing lines, and filling areas in any of the Apple's high-resolution colors. Lines are drawn much faster than in Basic, and colored lines are never broken. Lines and areas can also be neatly erased from the screen without disturbing other images. Turtle-graphics are included to draw line shapes rapidly at any angle.

Text Display and Character Graphics:

GraFORTH displays both upper and lower case characters. You can use any of the five character sets provided, or create your own with the character editor. Character shapes may be combined to form a single multi-character image, then "block printed" at high speed anywhere on the Apple screen. Characters and character shapes can be drawn in color up to 8 times their normal size.

Three-Dimensional Graphics:

GraFORTH can also draw three-dimensional color images at speeds that make animation possible! Up to sixteen 3-D objects can be manipulated simultaneously. Images can be rotated, scaled, translated, and positioned, with or without perspective. The supplied image editor allows you to create your own 3-D images. Colors may be specified as an image is created, or selected when the image is drawn.

Music:

GraFORTH includes a sophisticated software-based music synthesizer for adding music or sound effects to your programs. Music can be played in any one of several instrument voices.

The System:

Programs written in GraFORTH can be saved to disk as complete stand-alone systems that do not require any additional software to run. This makes GraFORTH the ideal language for developing games and other graphics software.

The Package:

GraFORTH is supplied on a diskette with a special version of DOS 3.3 that loads into a language card (if present), freeing up more memory for your programs. The disk includes many sample image files, utilities, and complete demonstration programs detailing the features of GraFORTH. Included with the disk is a 200-plus page tutorial explaining the ins and outs of GraFORTH. No previous programming experience is necessary to use GraFORTH. See your local Apple dealer for a demonstration today.

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convert it to decimal, and POKE it into 232. POKE the decimal of the hi byte into 233. If you want to protect the table, use a HIMEM statement from Basic. The nice part about having a table on disk is that you can load it anywhere in memory. Just use BLOAD filename, A$ address in hex. And remember to put the new address into E8 and E9.

Multi-Colored Shapes

Another common question also relates to shape tables. People want to know how an arcade game can have multi-colored shapes while a shape from a shape table can only be drawn in a single color.

The answer to this is actually a key to most of this series. Arcade games do not use standard shape tables (though a single shape from a shape table can contain more than one color). While the specifics of advanced shape plotting are too detailed to put in this introduction, I want to cover them briefly now, both to give a taste of what is to come, and to give those of you who are almost there a nudge in the right direction.

Basically, when you put a byte into hi-res memory, it appears as a pattern on the screen. Except for the highest bit, each 1 in the binary value represents an on pixel, each 0 is an off pixel. A dot by itself will have a color; two dots next to each other in a horizontal line will appear white.

Put several bytes across and several down and you have a shape. Erase the bytes and replace them elsewhere and you have animation (actually, there are several ways to animate and they will be covered later).

The problem is getting the bytes in the right places. The hi-res memory is not mapped in a contiguous fashion. And there are certain color restrictions. But it is possible to write a routine that will draw or erase a shape at any location on the screen, and a good portion of future articles will be devoted to such routines.

Many people also wonder whether the shape table routines in the Apple monitor can be used from machine language, and whether they can be used to write arcade games. The good news is that the routines can be used and are fairly easy to implement. The bad news is that, except for certain limited applications, they are still too slow.

There are two problems. First, the routines do a series of calculations to find the correct location for plotting. These calculations take a fair amount of time. Second, the vector method is inherently slow when you are trying to plot full looking shapes. While, for the sake of completeness, this series will cover the ROM routines, you will probably find that you don't want to use them. Once you get a taste of fast animation, nothing else will do.

Details

I realize the above is a bit rambling, but I am 3000 miles from my Apple this month, and didn't want to proceed to the heart of the topic without a chance to verify programs, examples, etc. For now, I just want to cover the scope of the series.

It will start out on a fairly low level, covering graphics from Basic. This part will include information on screen organization, altering images from Basic, and simple animation.

People are sure there is a secret to writing Raster Blaster or Epoch, and they are right.

Next will come a tour of the ROM routines, which will serve as a stepping off point for machine language. The first few machine language programs will be for manipulating the whole screen. From there, we will go into animation, starting with character graphics, then moving into various methods of full animation. Once animation has been covered for single objects, we'll move to multiple objects.

Other advanced topics will include program flow, timing, integration of graphics with sound, and collision detection.

All together, the series should provide enough information to allow anyone to create a complete arcade game.

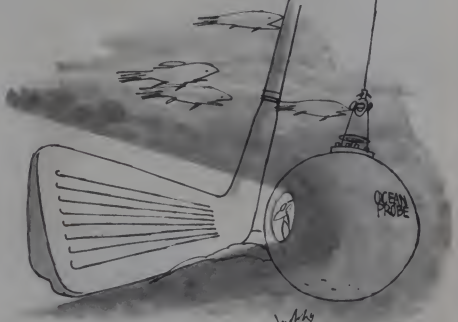
For background, you should understand hex and have some knowledge of machine language. The knowledge of hex is more crucial for the moment. The first few machine code programs will be simple and fully documented, but you will need hex right from the start.

For my part, I will try to cover all the major mysteries of hi-res. For your part, let me know if I miss something. *Creative Computing* will be awarding a copy of *Shape Master* to the person who submits the best question received each month.

As a parting note, I must admit that there is one secret to creating good graphics. People are sure there is a secret to writing *Raster Blaster* or *Epoch*, and they are right. The secret is hard work and practice (I know this sounds preachy, but it's true, and there is no way around it).

Bill Budge wrote many games before *Raster Blaster*, each a bit more sophisticated than the previous one. Take a look at *Penny Arcade*, *Space Album*, and *Trilogy* and you will see what I mean. Larry Miller spent months perfecting his routines for *Epoch*, and the result was worth the time and effort.

You can do it too. I will provide the information, but the rest is up to you. And you might be surprised to find out how much fun this all is. I plan to enjoy myself, and I'm looking forward to this series. See you next month when the fun begins. □



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BACKGROUND

I have been with On-Line Systems for almost two years and have dealt with the entire process of graphics development and animation. I would like to share what I have learned with you.

My experience with programming games has given me insights into how the APPLE works. My animation is smooth, and flicker-free. It's also fast (faster than any graphics package now on the market). I can help you make arcade games and educational products that can truly be called "State of the Art".

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You will find me indispensable in many areas. If you want to create a Hi-Res graphics screen on your Apple - no problem! I have many different ways of doing so and even coloring it in. But have you noticed how boring a screen that stands still is? My true forté shows through when you want your screen to come to life. Even Applesoft programmers will be able to use me to create arcade style animation in minutes, painlessly. I have over six different kinds of animation for you and even save you the bother of creating any shapes or tables I might need. Now that I've created your background, drawn your spaceships and got them moving, how about collisions? How do you know when a missile strikes a spaceship? No problem! I'll let you know. And let's not forget my abilities as an educator. Read my documentation and I'll show you things you never thought you'd see.

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Art And The Computer

A Computer Art Course

Batya Friedman

The computer is emerging as a new medium for art. Over the years technological advances, such as printing, photography, film, and oil painting have served to link the worlds of art and technology. Most of these have had a dramatic effect on our conceptions of art.

It is not surprising, therefore, that people now wonder how the computer will challenge our current concepts of art. What new choices will it offer? How will it change the way people think, solve problems and process visual information? How can these changes be communicated to those who are curious but not well versed in art and computer science?

The computer course described here has been offered by Lawrence Hall of Science for the past two years. It allows people who are inexperienced with computers or art to investigate these questions. Participatory activities help them to explore the use of line, depth, curvature and randomness in art; the integration of sound, movement, color and shape; the expression of emotion or concepts; and the communication of information through visual means.

The course begins with some moments of speculation. Without any previous exposure to computers, the students are asked to identify the nature of art pieces that are created on or by a computer. In the past, students have suggested geometric images, images that move as in film, theater and kinetic sculpture, or drawings made from the repetition or variation of image.

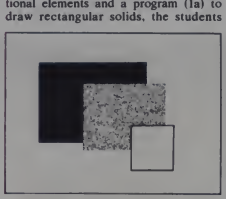
Batya Friedman, Lawrence Hall of Science, University of California, Berkeley, CA 94720.

The students are asked to identify the nature of art pieces that are created on or by a computer.

Then, within the context of these speculations, the class members ease into the creation of their first computer art pieces. The students learn the rudiments of graphics on the Atari microcomputer (GR, COLOR, PLOT, and DRAWTO) as they investigate the colors and drawing area available to them.

The grid format of the graphics screen leads readily to the discovery of straight lines and polygons. With these compositional elements and a program (1a) to draw rectangular solids, the students explore the use of color, shape and the relative placement of shapes to create a sense of depth in their drawings.

The computer drawings they create often contain overlapping shapes, bold rectangles, or elements of perspective, somewhat suggestive of the work of the Dutch artist Piet Mondrian or of the American artist Hans Hoffman. (See Figure 1.)



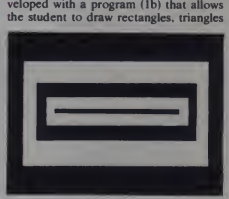


Figure 1. Sample student drawings to create a sense of depth on the computer screen.

Curves

After working with straight lines, the students are challenged to use their graphic tools (GR, COLOR, PLOT, and DRAWTO) to represent a curve. A box of curved objects such as snail shells, features, batteries, tubes and buttons is on hand to reinforce and expand the students' concepts of curvature. The computer drawings in Figure 2 demonstrate the ingenuity used by some students to solve this problem.

The concept of curvature is further developed with a program (1b) that allows the student to draw rectangles, triangles

and arcs of variable dimensions and colors. Using the program, the student artists work to discover as many different ways to describe a curve as possible.

Randomness

Having drawn lines and curves on the computer, the students are ready to explore the ease with which certain aspects of a drawing can be determined randomly by the computer. For example, a computer artist can compose a drawing of dots on a screen, but allow the computer to place the dots or select the color of the dots randomly.

To facilitate exploration of the random component in their art, students learn about line numbers, GOTO, RUN, LIST and the random (RND) function. Using this knowledge, each student writes a program segment that will generate random images on the screen.

For example, one student may write a program using line numbers 100 to 199 to draw random triangles, and a second student may write a program using line numbers 200 to 299 to draw random boxes.

All the completed program segments are then merged into one larger program and a copy of this composite program is given to each student. With this composite program, students can explore several different random effects in an art piece of their own.

The student controls which program segments are executed, the order in which they are executed, and the length of time each segment is allowed to run. For example, a student might choose to mix the random images from program segments 100-199, 800-899 and 300-399. To do this he sets the computer in a graphics mode and runs each program segment successively by typing: GOTO 100, BREAK, GOTO 800, BREAK, GOTO 300, BREAK. The final image on the screen would be a mixture of the random images created by the individual program segments.

To conclude the activity, the students examine the pieces they have created for artistic content and discuss their feelings as artists when they relinquish control over certain aspects of their drawings.

Sound, Movement, Color and Shape

Students next work to integrate sound, movement, color and shape in a single piece of art. To begin, they investigate representations of movement by creating flashing images or by making images appear gradually on the screen.

They can also achieve a simple form of animation by drawing an image, erasing it, and then redrawing it a small distance away.

Next, they are introduced to the sound (SOUND) capability of the Atari, which includes a scale of 31 semi-tones and silence. With these tools, the students can write programs to control sound, color, shape and movement.

The students are given the task of inventing a new planet, then conveying as much information about it as possible, using only the graphics tools available on the computer.

In the past, the students have generated kinetic patterns of sound and color such as syncopated rhythms reinforced by specific patterns of shapes and colors, musical scores that are interpreted visually on the screen, and random noises that are accompanied by random images.

Having struggled to integrate sound, movement, color and shape in a computer art piece of their own, students now view the work of a professional computer artist, John Whitney. In the films "Experiments in Motion Graphics" (2) and "Arabesque" (2), Mr. Whitney works on a similar problem. He uses computer-generated images that exploit color, shape, movement and sound to express musical concepts such as harmony and counterpoint.

To explore further the relationship between sounds and colored images the students use a silent program (1c) that prints sequential bars of different colors and heights on the screen. The students are asked to listen to a piece of music and simultaneously use this program to represent the music on the screen. Here the opportunity to respond immediately and visually to the sounds encourages the students to use their musical and visual intuitions to formulate a response.

Expressing Emotion

Students are next presented with a task that has challenged artists through the millenia. This task is to express an emotion, such as joy or sorrow, or a concept such as creation. The students can select four of 128 available colors with which they would like to draw (SETCOLOR). Their drawings are as varied as the individuals in the class.

Sample student drawings include sequentially larger bursts of color to represent creation, or flashing lines accompanied by harsh sounds and then followed by a quiet, calm screen to describe a thunderstorm.

In the last part of the course the students use the computer to communicate information visually. First, they attempt to identify several three-dimensional objects from their contour drawings. Then, having become somewhat familiar with this type of drawing, they make several different contour drawings of an object that is in their view. They then look at a series of contour drawings of an imaginary object on the computer screen (1d), and work to construct clay models of the object.

After experiencing the subtleties and ambiguities that arise from attempts to transfer three-dimensional information to the computer screen, the students are given the task of inventing a new planet, and then conveying as much information about it as possible, using only the graphics tools available on the computer. To encourage interaction and collaboration, the students work in small groups of three or four.

In the past, the groups have chosen to represent properties such as the shape of the planet (i.e., square, round, triangular),

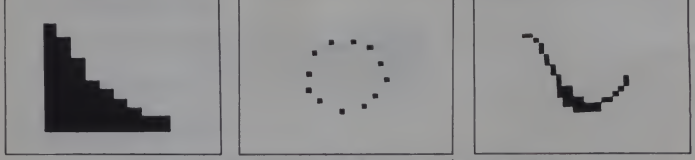


Figure 2. Sample student drawings to represent a curve on the computer screen.

the shape and number of its moons, the temperature gradient on the planet, the distribution of minerals, the atmosphere and the topography.

When the drawings are complete, the students attempt to interpret the physical make-up of each planet from the drawings made by the other groups. The students' drawings can be compared to those created by computers with telemetered signals of Jupiter and Saturn(3). The students can also speculate on the existence and nature of a life form on each of the planets.

Evaluation

In assessing the success of these activities, it is useful to review the goals of the course. These are to have the students identify the challenges that the computer might bring to existing concepts of art; to have them explore the choices that computers can offer to artists; and to have them investigate ways in which the computer might change the way people think, solve problems and process visual information.

There has been no formal evaluation of the course. However, during the course students have raised the following questions: Is a line on a computer screen a piece of art? Of what value is art if you cannot reproduce it? Of what value is art if you cannot control it? Why try to communicate information with a drawing? Why not draw with pencil and paper instead of a computer? How can any image on a television screen express emotion? If we judge that for students to ask and seek answers to these questions reflects at least a partial attainment of the goals, then it seems these activities have been somewhat successful.

Questions or comments about the course are welcome. Please direct them to Batya Friedman, Math and Computer Education Project, Lawrence Hall of Science, University of California, Berkeley, CA 94720. (415)642-3167.

Notes

1. The following programs used in the course are available through the Lawrence Hall of Science:

a. MONDRIAN—Draw rectangular solids of variable dimensions and colors.

b. ARCART—Draw rectangles, triangles, and arcs of variable dimensions and colors.

c. SILENCE—Print sequential bars of different colors and heights.

d. VIEWS—Look at a series of contour drawings of an imaginary object.

2. The films "Experiments in Motion Graphics" and "Arabesque" by John Whitney can be rented from Michigan Media, University of Michigan, A-V Education Center, 416 Fourth St., Ann Arbor, MI 48019.

3. Images of Jupiter and Saturn that have been reconstructed from telemetered signals can be obtained by writing National Aeronautics and Space Administration, Washington, D.C., 20546. Attn: Classroom Education.

Additional Reading

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Halftoning Digital Images

John S. Browning

This tutorial article describes seven halftoning methods for producing digital images. The programming examples are in Fortran. We could easily have translated these to Basic, however, we elected to leave them in Fortran to provide a second level of learning in this tutorial. Fortran has more similarity to Basic than many people have been led to believe.

For example the following Fortran DO loop is easily translated to a Basic FOR loop.

```
    DO 20 J=1021,1024
    G(J)=0
20 CONTINUE

10 FOR J=1021 TO 1024
15 G(J)=0
20 NEXT J
```

Fortran permits DO loop boundaries to be defined by variables or even simple calculations. Basic permits variables, but most do not permit calculations.

```
    DO 20 M=K-1,K+1

10 K1=K-1 : K2=K+1
15 FOR M=K1 TO K2
```

The Fortran logical IF statement is the same as a Basic IF.

```
    IF (G(M,N).LT.T(M,N)) G(M,N)=1
10 IF G(M,N)<T(M,N) THEN G(M,N)=1
```

A Fortran DATA statement can be translated into Basic with either a READ/DATA pair or a series of LET (assign) statements.

```
  INTEGER T(5)
  DATA T/7,9,11,13,15

  10 DIM T(5)
  15 FOR I=1 TO 5
  20 READ T(I)
  25 NEXT I
  30 DATA 7,9,11,13,15
```

or

```
  10 T(1)=7 : T(2)=9 : T(3)=11
  15 T(4)=13 : T(5)=15
```

For two-dimensional variables, an implied FOR loop can be imbedded in a data statement. For example,

```
  INTEGER P(2,5)
  DATA (P(1,I), I=1,5)/4,5,6,7,8
  DATA (P (2,I), I=1,5)/13,14,15,16,17

  10 DIM P(2,5)
  15 FOR I=1 TO 5
  20 READ P(1,I), P(2,I)
  25 NEXT I
  30 DATA 4,13,5,14,6,15,7,16,8,17
```

These hints should permit the subroutines in the article to be converted to Basic. – DHA

Most hobbyist programmers interested in digital image processing are frustrated by the limited range of intensities available on the output devices on which they must display their images. Approaches to solving this problem are called "halftoning methods."

Originally halftoning methods were developed in order to print black and white photographs on paper using one shade of black ink. The objective is to use patterns of black and white to give the impression of intermediate intensities. This is accomplished photographically by using a halftone screen and thresholding. Examples of halftone photographs may be found in most newspapers and magazines.

A similar problem arises when we wish to display a digital image on a bilevel output device. Here something like the analog halftoning is done. A computer is used to generate patterns that can be displayed on the device to give the impression of intermediate intensities.

In this article, I will present seven different halftoning methods, and provide examples of the application of the methods to an image. In the following discussions we will use this notation:

G(X,Y)-gray level of the pixel (picture element) (X,Y)
T - Threshold gray level

John S. Browning, 2071 B. Mercury Dr., Kirtland AFB SE, NM 87118.

Simple Threshold

Using the simple threshold method, if G(X,Y) is less than T, (X,Y) is displayed as black. Otherwise (X,Y) is displayed as white. Figure 1 shows an example of this method.

The simple threshold method fails to show many details present in the image because the decision to display either black or white introduces error.

Figure 1. Simple Threshold Method.

Spiral Threshold

With the spiral threshold method, we define an M,N spiral threshold array as follows

black level less than	T(I,I)
T(I,I) less than	T(I,I+1)
T(I,I+1) less than	T(I-1,I+1)
T(I-1,I+1) less than	T(I-1,I)
T(I-1,I) less than	T(I-1,I-1)
T(I-1,I-1) less than	T(I,I-1)

and so on. T(I,I) is the center of T:M,N.

The image is partitioned into M,N subimage arrays, and each component of the subimage array is compared with the corresponding component of the spiral threshold array. If G(I,J) is less than T(I,J), (I,J) is displayed as black. Otherwise (I,J) is displayed as white (Figure 2). In Fortran we have as an example:

```
      SUBROUTINE SPIRAL
      INTEGER T(5,5),O
      COMMON G(1024,1024)
      DATA (T(1,I),I=1,5)/90,100,110,120,130/
      DATA (T(2,I),I=1,5)/80,210,220,230,140/
      DATA (T(3,I),I=1,5)/70,200,250,240,150/
      DATA (T(4,I),I=1,5)/60,190,180,170,160/
      DATA (T(5,I),I=1,5)/50,40,30,20,10/
      DO 10 J=1,204
      L=J*5-2
      DO 10 I=1,204
      K=I*5-2
      DO 10 M=L-2,L+2
      DO 10 N=K-2,K+2
C     BLACK PIXEL
      IF(G(M,N).LT.T(M-K+3,N-L+3)) O(M,N)=1
C     WHITE PIXEL
      IF(G(M,N).GE.T(M-K+3,N-L+3)) G(M,N)=0
   10 CONTINUE
C     ZERO UNUSED PIXELS
      DO 20 J=1021,1024
      DO 20 I=1,1024
      G(I,J)=0
   20 CONTINUE
      DO 30 J=1,1024
      DO 30 I=1021,1024
      G(I,J)=0
   30 CONTINUE
      RETURN
      END
```

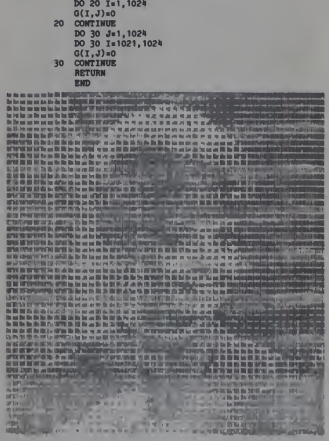


Figure 2. Spiral Threshold Method.

Figure 3. Rectangle Threshold Method.

The spiral threshold method depends on the continuity of the image, i.e., adjacent G(X,Y) are approximately equal. The method produces a "dot" whose size depends on G(X,Y). It is also fairly transparent to abrupt changes in G(X,Y) due to an edge.

Rectangle Threshold

To use the rectangle threshold method, we define a K threshold array where T(K) are fairly randomly distributed and have few factors in common. The image is partitioned into M,N subimage arrays, where MN=K. Each component of the subimage is compared with a selected component of the threshold array. The correspondence between M,N and K is defined to avoid excessive texturing. For example:

```
      SUBROUTINE RECTNGL
      INTEGER T(25),O
      COMMON G(1024,1024)
      DATA T/40,80,140,120,20,60,170,210,190,100,150,
     .  240,250,230,160,
     .90,200,220,180,150,10,110,130,70,30/
      IB=1
      IT=IB
      DO 10 J=1,1024
      DO 10 I=1,1024
C     BLACK PIXEL
      IF(G(I,J).LT.T(IT)) P(I,J)=1
C     WHITE PIXEL
      IF(G(I,J).GE.T(IT)) P(I,J)=0
C     SELECT T
      IB=IB+1
      IF(IB.GT.25) IB=1
      IT=IB
   10 CONTINUE
      RETURN
      END
```

Like the spiral threshold method, the rectangle threshold method is fairly transparent to abrupt changes in G(X,Y) due to an edge. See Figure 3.

Random Modulation

In random modulation, a pseudo random number generator produces a signal which is used to modulate G(X,Y). If G(X,Y) + T*(1 - 2*R) is less than T, (X,Y) is displayed as black. Otherwise (X,Y) is displayed as white. The output of the random number generator is R and is between zero and one with a mean of 0.5. In the example (Figure 4), the random number generator is S = FRAC(S + pi)**5, where the seed is 0.192743568.

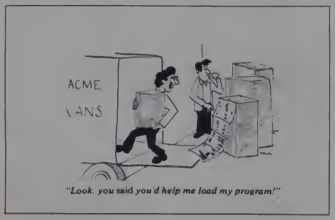
The random modulation method introduces "salt and pepper" noise into the display, which may be unacceptable.

Sinusoidal Modulation

In sinusoidal modulation the function SIN(A*X) * SIN(B*Y) is used to modulate G(X,Y). If G(X,Y) + T*SIN(A*X)*SIN(B*Y) is less than T, (X,Y) is displayed as black. Otherwise (X,Y) is displayed as white.

The sinusoidal modulation method is similar to the spiral threshold technique. The modulation constants, A and B, are chosen to avoid excessive texturing. In the example (Figure 5) the modulation constants are pi/3.

Figure 4. Random Modulation Method.



"Look, you said you'd help me load my program!"

Error Distribution

The error distribution method records the error that will be introduced by simple thresholding and distributes the error to adjacent pixels. Odd structures are introduced into the display as the error is propagated through the image.

In the example (Figure 6), the error is distributed as follows: 3/8 to the right of (X,Y), 3/8 below (X,Y) and 1/4 down the diagonal.

Figure 5. Sinusoidal Modulation Method.

Figure 6. Error Distribution Method.

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```
      SUBROUTINE ERRORD
      INTEGER G,T
      COMMON G(1024,1024),T
      DO 10 I=1,1024
      IP=I+1
C     WRAP-AROUND ERROR
      IF(IP.GT.1024) IP=1
      DO 10 I=1,1024
      J=1024-K+1
      JM=J-1
C     WRAP-AROUND ERROR
      IF(JM.LT.1) JM=1024
C     BLACK=0
      IF(G(I,J).LT.T) ERROR=G(I,J)
C     WHITE=255
      IF(G(I,J).GE.T) ERROR=G(I,J)-255
C     DISTRIBUTE ERROR TO RIGHT
      G(IP,J)=G(IP,J)+3.*ERROR/8.
C     DISTRIBUTE ERROR BELOW
      G(I,JM)=G(I,JM)+3.*ERROR/8.
C     DISTRIBUTE ERROR DOWN DIAGONAL
      G(IP,JM)=G(IP,JM)+ERROR/4.
   10 CONTINUE
      RETURN
      END
```

The above is followed by a simple threshold code module.

Pattern

The pattern technique uses K+1 arrays of K x K dots to display K+1 levels of gray. For I between zero and K, K-I of the KK dots are black and I are white. Patterns are chosen to avoid excessive texturing when they are placed next to each other. K+1 is most often 10, as ten levels of gray are needed to display most natural images (Figure 7).

```
      SUBROUTINE PATTERN
      INTEGER P(10,9),G,T
      COMMON G(1024,1024)
      DATA (P(1,I),I=1,9)/9*0/
      DATA (P(2,I),I=1,9)/8*0,1,8*0/
      DATA (P(3,I),I=1,9)/8*0,2*1,3*0/
      DATA (P(4,I),I=1,9)/0,1,2*0,2*1,3*0/
      DATA (P(5,I),I=1,9)/0,1,0,3*1,3*0/
      DATA (P(6,I),I=1,9)/0,1,0,3*1,0,1,0/
      DATA (P(7,I),I=1,9)/0,1,0,5*1,0/
      DATA (P(8,I),I=1,9)/0,7*1,0/
      DATA (P(9,I),I=1,9)/8*1,0/
      DATA (P(10,I),I=1,9)/9*1/
      DO 10 I=1,3*1
      K=I*3-1
      DO 10 J=1,3*1
      L=J*3-1
      T=G(K,L)/26
      DO 10 M=K-1,K+1
      DO 10 N=L-1,L+1
   10 G(M,N)=P(10-T,M-K+2+3*(N-L+1))
C     ZERO UNUSED PIXELS
      J=1024
      DO 20 I=1,1024
      P(I,J)=0
   20 CONTINUE
      I=1024
      DO 30 J=1,1024
      P(I,J)=0
   30 CONTINUE
      RETURN
      END
```

Conclusion

Figures 1 through 7 are examples of applications of the halftoning methods discussed above. The resolution of the images is low to better illustrate the differences in the methods. Many other halftoning methods have been developed to cope with special situations; consult the references for additional information.

Figure 7. Pattern Method.

Acknowledgement

Some classroom materials from the digital image processing course taught by the Department of Electrical and Computer Engineering of the University of New Mexico were used in the preparation of this article. □

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GO TIME (Available for all computers) Price: $14.00 Cassette/$16.00 Diskette
GO TIME is a chemo children's card game. The opponent is a friendly computer with easy inputs that any simple enough for small children to play easily. The Apple and Atari versions employ high resolution graphics for the display of cards. A must for children!

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FLIGHT SIMULATOR (Available for all computers) Price: $14.95 Cassette/$16.95 Diskette
A realistic flight simulation which includes "real-time" take-off, flight and landing. The program utilizes aerodynamic equations and the characteristics of a real turbofan. You are presented with instruments using which you must control the flight. Simulated landings: The same advanced flyer can also perform loops, half-rolls and similar aerobatic maneuvers. Although this program does not employ graphics, it 5 exciting and very addictive! The software version is COMPUTRONICS' first in a series.

VALDEZ (Available for all computers) Price: $8.95 Cassette/$10.95 Diskette
VALDEZ is a computer simulation of supertanker navigation in the Prince William Sound. Valdez Narrows' report' chart. As loaded in that simulations at a realistic and crossover 256 × 256 element map, portions of which may be viewed using the ship's dphotomatic radar display. The location of the ship and surrounds modified continuously. The simulating ship assumes a model for the tidal patterns in the region, as well as other traffic (ongoing tankers and drifting icebergs). Chart courtesy of the Marine Board of Alaska for a Valdez Narrows' Unique and Natural Formal Code.

BACKGAMMON 2.0 (Atari, North Star, OSBORNE and CP/M only) Price: $24.95 Cassette/$29.95 Diskette
This program uses your backgammon skills and will also improve your game. A human and computer against a computer as opponent. Features include: a choice of playing boards, the option of playing with the doubling cube, and a complete dice roll. Board positions can be created or saved for replay. BACKGAMMON 2.0 plays at approximately the beginner to official rules of backgammon and is easy to provide many fascinating sessions of backgammon play.

CHESS MASTER (North Star and TRS-80 only) Price: $19.95 Cassette/$23.95 Diskette
This complete and very powerful program provides five levels of play. 5 includes castling, en passant captures and the promotion of pawns. Additionally, the board may be printed at the conclusion of play, permitting the resumption of play at a later time. To maximum maximum speed, the program is written in assembly language (by SOFTWARE SPECIALISTS of Cobleskill). Full graphics are employed in the TRS-80 version, and two widths of alphanumeric displays are provided in accommodate both the users' low screen or cat computing.

FOREST FIRE (Atari only) Price: $8.95 Cassette/$10.95 Diskette
Using excellent graphics and sound effects, this simulation puts you in the middle of a forest fire. Your job is to direct operations to put out the fire while extinguishing as little as possible. Water and terrain are important factors in determining which areas to fight first. Can you contain the fire before it burns out of control?

BLACK HOLE (Apple only) Price: $14.95 Cassette/$16.95 Diskette
This is a real-time graphical simulation of the problems involved in silently observing a black hole. Your spaceship is in orbit around the black hole. The object is to avoid destruction, for a prescribed time, one-by-since in a small black hole. Your spaceship is equipped with a variable thrust engine and a gravity meter. Using these instruments, you must maneuver your spaceship in such a way that the tidal stress destroys the probe. Control of the craft is continuously monitored using safe per for minimum and near-maximum fuel consumption. This program must run 16 fine graphics and is educational to well as challenging.

SPACE EVACUATION! (Apple, Atari and TRS-80 only) Price: $14.95 Cassette/$16.95 Diskette
Can you rescue the galaxy and evacuate the Earth before the sun explodes? Your computer becomes the ship's computer as you explore the universe to rescue millions of people. This simulation is particularly interesting as it combines many of the exciting elements of classic space games with the memory challenge of ADVENTURE

MONARCH (Atari only) Price: $11.95 Cassette/$13.95 Diskette
MONARCH is a fascinating economic simulation requiring you to survive an 5-year term as your nation's leader. You determine the amount of acreage devoted to industrial and agricultural use, how much food to distribute to the populace and how much should be spent on military protection. You will find the all decisions involve a compromise and that it is not easy to make everyone happy. Easy to use Atari

CHOMPER (Atari only) Price: $11.95 Cassette/$13.95 Diskette
CHOMPER is really two challenging games in one. One is similar to WUMP, you must face off part of a center, but crowd eating the personal purchase. The other game is an expert-level game! RETIRED. It fully uses the Atari's graphics capability, and is hard to lose. This package will run on a 16K system

AVAILABILITY

DYNACOMP software is supplied with complete documentation containing clear explanations and examples. Unless otherwise specified, all programs will run within 16K program memory space (ATARI requires 24K). Except where noted, programs are available on ATARI, PET, TRS-80 (Level II) and Apple (Applesoft) cassette and diskette as well as North Star single density (diskette density compatible) diskette. Additionally, most programs are for ofcassed on standard (IBM 3740 single density--double density compatible format) 8" CP/M floppy disks for systems running under MBASIC or CBASIC (for example, Altos, Xerox 820 and many others). 5 ¼" CP/M diskettes are available for the North Star and Osborne computer systems

**ATARI, PET/CBM, NORTH STAR, CP/M, MM, OSBORNE, SUPERBRAIN and XEROX are registered trademarks and is trade marks.*

***Except where noted, all TRS-80 Model I software is available on cassette ready for the TRS-80 Model III. Exceptions: VALDEZ, CARDAGE, GRAFIX, CHESSMASTER TRS-80 diskettes are not supplied with either DOS or BASIC*

****For users North Star disk-based systems: DYNACOMP presently does not support the new North Star Advantage*

*****For Altair systems having MONARCH 2.0*

******For SUPERBRAIN systems running under MBASIC or CBASIC (static wheels)*

AND MORE...

NEW

STARTREK 2.1 (Available for all computers) Price: $11.95 Cassette/$14.95 Diskette
STARTREK is the classic Star-trek simulation, but with several new features. For example, the Klingons now shoot at the Enterprise without warning while also starting starbase in either quadrant. The Klingons also attack with both light and heavy cruisers whose heavy cruisers shields. The simulation is basic when the Enterprise is damaged by these heavy cruisers and a starbase 5 0.5 is available! The Klingons get even! See the software reviews in A.N.A.L.O.G. 80 Software Review Merchandising

NEW

LIL' MEN FROM MARS (Atari only) Price: $10.95 Cassette/$12.95 Diskette
Defend yourself! The little men from Mars are out to get you if you don't get them first. This is a delicious high resolution animated graphics (arcade) game which monitors much of the Atari's power. Requires one joystick

NEW

SPACE TILT (Apple and Atari only) Price: $10.95 Cassette/$14.95 Diskette
Use the game paddles to tilt the plane of the TV screen so "roll" a ball into a hole in the screen. Sound simple? Just when the hole gets smaller and smaller? A built in sense allows you to measure your skill against others in this habit forming screen game.

NEW

ESCAPE FROM VOLANTIUM (Atari only) Price: $10.95 Cassette/$19.95 Diskette
Bring the action and excitement of an arcade into your home with ESCAPE FROM VOLANTIUM! To escape you must maneuver your ship through seven deep-space obstacles and then dock with the mother ship. If by a fluke you land a direct shot, then just a big bagged off), a door opens to the outside. However, the door door can not stay indefinitely. If you fail to escape in time, the door closes and a new degree opponent. To maneuver you can escape through the use of thrusters and gravity. 8 Unlike some it is impressive. At the higher levels of play more obstacles and dragons appear (always in the same sequence). Uses high resolution graphics and sound. Runs in 16K.

NEW

ALPHA FIGHTER (Atari only) Price: $10.95 Cassette/$14.95 Diskette
Here's another great graphics and sound programs as ace! ALPHA FIGHTER requires you to destroy the alien starbase passing through your sector of the galaxy. ALPHA BASE is in the path of an alien UFO armada. So free UFO's get by and the game ends. Such game requires the joystick and get progressively more difficult the higher you score! ALPHA FIGHTER will run on 16K systems.

NEW

THE RINGS OF THE EMPIRE (Atari only) Price: $14.95 Cassette/$18.95 Diskette
The empire has developed a new hand weapon powered by weaving rings of energy. Each area you blast through the rings and destroy the menace, the empire develops a new station with more protective rings. This exciting game runs on 16K systems, employs extensive graphics and sound and can be played by one or two players.

NEW

INTRUDER ALERT (Atari only) Price: $14.95 Cassette/$18.95 Diskette
This is a fast paced graphics arcade game which places you in the middle of the "Dreadnaut" having just taken a plate. The dreads have taken over the ship and it's your job to destroy one at all once. You must find and enter your ship to escape with the plane. Five levels of difficulty are provided. INTRUDER ALERT requires a joystick and 16K or more of RAM.

NEW

MIDWAY (Atari only) Price: $14.95 Cassette/$18.95 Diskette
MIDWAY is an exciting extension of the game of Battleship. It seizes the challenges of strategy and chance. Your opponent can be another human or the computer. Color graphics and sound are both included. Runs in 16K.

NEW

TRIPLE BLOCKADE (Atari only) Price: $14.95 Cassette/$18.95 Diskette
TRIPLE BLOCKADE is a two-to-four player graphics and sound action game. It is based on the Atari game BLOCKADE in which millions have enjoyed. Using the Atari joysticks, the object is to direct your blockading box around the screen without touching your opponents' blockades. All the standard graphics and sound effects of the Atari game are included, plus "high resolution".

NEW

GAMES PACK I (Available for all computers) Price: $10.50 Cassette/$14.00 Diskette
GAMES PACK I contained the classic computer games of BLACKJACK, LUNAR LANDER, TARGET, ROULETTE, DWITCH and more! These games have been combined into one large program for ease in loading. They are individually accessed by a convenient menu. This collection 5 worth over $20 if purchased individually. Requires 16K of MEMORY.

NEW

GAMES PACK II (Available for all computers) Price: $10.50 Cassette/$14.00 Diskette
GAMES PACK II includes the games BLAST SHOTS, FOTTO, ACEY DUCEY, TIC TAC TOE and more! As with GAMES PACK I, all the games are loaded at one program and are called from a menu. You will particularly enjoy DYNACOMP's versions of CRAZY EIGHTS

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

NEW

MOON PHOOEY (Atari and North Star only) Price: $14.95 Cassette/$18.95 Diskette
This is a fast paced graphics "shoot 'em up" program. The user must drop from orbit to land at a predetermined target on the moon's surface. You control the thrust and attenuation of your craft plus direct the rate of descent. Requires 24K

NEW

SPACE TRAP (Atari only, 16K) Price: $14.95 Cassette/$18.95 Diskette
This galactic "shoot 'em up" arcade game places you into a black hole. You control your spacecraft using the joystick and in target to blast as many of the alien ships as possible before you are destroyed yourself.

NEW

CHIP INVADERS (PET/CBM only) Price: $9.95 Cassette/$19.95 Diskette
CHIP INVADERS is an addictive game using arrow graphics. A Pedestrian arrow crosses must be rounded before the Chevy Chevrolet arrow. Avoid the business's obstacles, moving arrows, and the smashing Chevys and you have a successful journey! Good luck.

NEW

BUFFER CRASH (Atari only) Price: $9.95 Cassette/$12.95 Diskette
BUFFER CRASH challenges your reflexes and shows off your Atari's sound capabilities. Use your joystick to move the paddle to intercept the falling balls before they hit the bottom of the screen. As the game progresses the balls fall faster and faster. Can you keep up? Requires 16K.

ADVENTURE

CRANSTON MANOR ADVENTURE (North Star and CP/M only) Price: $29.95 Diskette
At last! A comprehensive Adventure game for North Star and CP/M systems. CRANSTON MANOR ADVENTURE what you into mysterious CRANSTON MANOR where you attempt or gather fabulous treasures. Lurking in the manor are wild animals, strange characters and magical objects. CRANSTON MANOR is a full-length game with detailed and entertaining descriptions are much more elaborate than the current popular series of Adventure games, and the game the way as an elite. They can be stopped at any time and the status saved on diskette. Not available in 5¼" CP/M format.

GUMBALL RALLY ADVENTURE (North Star only - 48K) Price: $14.95 Diskette
You are in the GUMBALL RALLY and you're driving a Ferrari Testa Rossa. The goal 0 to find your way to the finish line while maintaining the highest possible speed. You must choose one of five routes available at the garage. The choice will affect your speed and range. Remember to take spare parts and don't get caught speeding!

UNCLE HARRY'S WILL (North Star only - 48K) Price: $14.95 Diskette
Uncle Harry has died and left you everything. However, he has neglected to mention where everything is! Instead he will leave you a series of clues which someone must find. You will have to travel all over the United States both to see and so find to solve the puzzle, and there are over 300 museums to probe! Be careful and watch out for red herrings!

SPEECH SYNTHESIS

DYNACOMP is now distributing the new and most revolutionary TYPE-'N-TALK™ (TNT) speech synthesizer from Votrax. Simply connect TNT to your computer's serial interface, input text from the keyboard and have the words spoken. TNT is the closest to human speech synthesizer on the market. It uses the least amount of memory and provides the most flexible vocabulary available

TYPE-'N'-TALK List price $375 DYNACOMP's price $269.95 plus $3 for shipping and handling.

TALK TO ME (TNT Atari only, 16K) Price: $34.95 Cassette/$39.95 Diskette
This program presents a superb natural on speech synthesis using the Atari 850 and TYPE 'N TALK.™ TALK TO ME will read any text you type in and has a number of special features for controlling the pronunciation. The documentation includes many helpful programming tips. TALK TO ME has been demonstrated at several ACORN TY

MISCELLANEOUS

CRYSTALS (Atari only) Price: $ 9.95 Cassette/$12.95 Diskette
A unique algorithm randomly produces harmonizing graphics patterns accompanied with tones which vary as the patterns are built. The two patterns are the same, and the combined effect of the sound and graphics are mesmerizing CRYSTALS has been used in local stores to demonstrate the sound and color features of the Atari. Uses 16K Atari

NORTH STAR SOFTWARE EXCHANGE (NSSE) LIBRARY
DYNACOMP now distributes the 23 volume NSSE library. These diskettes each contain many programs and offer an outstanding value for the purchase price. They should be part of every North Star user's collection. Call or write DYNACOMP for details regarding the contents of the NSSE collection.
Price: $9 ea.ch/$7 ea.ch ea or more)
The complete collection may be purchased for $149.95

5¼" DISKETTES (well tortured- but survived) Price: $20.95/ 10 Diskettes
As you might imagine, DYNACOMP purchases diskettes in large quantities and at wholesale prices. We want to pass the savings along to you!

BUSINESS and UTILITIES

NEW

MAILMASTER (Atari diskette only) — Price: $39.95 Diskette

MAILMASTER is a very versatile software package for managing and manipulating mail lists and mini data bases. Each disk can hold over 600 customer entries containing name, address, 16 letter key words and a phone number. The display is marked so that entries may be made and edited with ease. The status (e.g., disk space left, options, etc.) is shown at all times. Labels may be printed 1,2 or 3 up, and all sorting (zip code and alphabetic) is performed by a fast machine language program.

PERSONAL FINANCE SYSTEM (Atari and North Star only) — Price: $39.95 Diskette

PFS is a single diskette, menu-oriented system composed of six different programs. Besides recording your expenses and tax deductible items, PFS will sort and summarize expenses by payee, and display information on expenditures by any of 16 user defined codes by month or by payee. PFS will even produce monthly bar graphs of your expenses by category! This powerful package requires only one disk drive, minimal memory (24K Atari, 32K North Star) and will store up to 600 records per disk (and over 1000 records per disk by making a few simple changes to the programs). You can record checks plus cash expenses so that you can finally see where your money goes and eliminate guesswork and tedious hand calculations. Contains high speed machine language sort. PFS has been demonstrated on network (CBS) TV!

FAMILY BUDGET (Apple and Atari only) — Price: $34.95 Diskette

FAMILY BUDGET is a very convenient financial record-keeping program. You will be able to keep track of cash and credit expenditures as well as income on a daily basis. You can record tax deductible items and charitable donations. FAMILY BUDGET also provides a continuous record of all credit transactions. You can make daily cash and charge entries to any of 21 different expense accounts as well as to 3 payroll and tax accounts. Data are easily retrieved giving the user complete control over an otherwise complicated (and unorganized!) subject.

INTELINK (Atari only) — Price: $49.95 Diskette

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

NEW

PAYFIVE (Apple II plus diskette, two drives required) — Price: $149.95

This is an enormously flexible employee payroll system with extraordinarily good human engineering features. PAYFIVE prints checks and compiles the required federal, state and local forms for up to 140 employees. The pay methods may be hourly, salary, commission or any combination. There are multiple options for pay periods, and they also can be used in any combination. PAYFIVE includes many other features and comes extremely well documented with a 200 page manual. The manual may be purchased separately for $30, and that payment later applied to the software purchase.

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

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

TAX OPTIMIZER (North Star only) — Price: $89.95 Diskette

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

NEW

UTIL (Apple only, 48K) — Price: $19.95 Diskette

UTIL is a disk-oriented utility system which permits examining and changing of the contents of DOS 3.2 and 3.3 diskettes to the bit (nibble to byte) level. With UTIL you can easily examine the contents of a diskette sector by sector, restructure the sector pointers, reallocate sectors (e.g. bad sectors may be "hidden"), and perform many other sophisticated operations. For the experienced programmer.

NEW

TURNKEY AND MENU (Atari only) — Price: $17.95 Diskette

TURNKEY is a utility program which allows you to create autoboot/autorun diskettes easily. Simply load and run TURNKEY, load the program diskette to be modified, and answer the questions! The TURNKEY diskette also comes with DOS 2.0 and includes another program, MENU. MENU lists the contents of your diskette alphabetically, and permits the running of any BASIC program on the diskette by typing a single key. TURNKEY and MENU provide you with the ability to run any program on your diskette by simply turning on the computer and pressing a single key.

NEW

STOCKAID (Atari only) — Price: $29.95 Diskette

STOCKAID provides a powerful set of tools for stock market analysis. With STOCKAID you can display point and figure charts, as well as bar charts with oscillators. You can also generate long term moving averages and on-balance volume features. STOCKAID allows you to input daily data with a single diskette storage capability of 239 days = 16 stocks. Included are stock dividend and split adjustment capabilities. A very professional package!

NEW

SHAPE MAGICIAN (Apple II, 48K, diskette only) — Price: $29.95

At last! An utility for painlessly creating graphics shapes for the Apple. Create, edit and save up to 95 shapes which can then be used to develop arcade games or to simply enhance your programs. Add that professional touch!

EDUCATION

HODGE PODGE (Apple only, 48K Applesoft or Integer BASIC) — Price: $14.95 Cassette/$18.95 Diskette

Let HODGE PODGE be your child's teacher. Pressing any key on your Apple will result in a different and intriguing "happening" related to the letter or number of the chosen key. The program's graphics, color and sound are a delight for children from ages 1½ to 7. HODGE PODGE is a most outstanding teaching device which brings a new dimension to the use of computers in education. See the excellent reviews of this very popular program in INFOWORLD and SOFTALK.

NEW

TEACHERS' AIDE (Atari only) — Price: $13.95 Cassette/$17.95 Diskette

TEACHERS' AIDE consists of three basic modules contained in one program. The first module provides addition and subtraction exercises of varying levels of difficulty. The second module consists of multiplication problems in which the student may be tested both on the final answer and/or on the subtotal answers in the long hand procedure. Several levels of complexity are provided here as well. The third module consists of division problems. One particularly nice feature of the division module is that the long hand division steps can be displayed along with the remainder in order to clearly demonstrate the procedure by which the remainder is derived. Using TEACHER'S AIDE is not merely a drill, but rather a learning experience.

NEW

PHARMACOLOGY UPDATE (PET only) — Price: $149.95 Cassette/$149.95 Diskette

This is DYNACOMP's first educational software entry for the medical profession (more are coming!). PHARMACOLOGY UPDATE was written by a R.N. in a masters program, with the aid of a practicing pharmacologist and an electronics instructor. This package comes in two parts. The first part is a 200 page manual which is divided into 11 sections. Each of these sections provides both concise information and probing questions. The second part consists of 11 programs that are keyed to the text and which test the degree of understanding of the text material. This package has great educational value for the beginning student as well as the professional interested in an efficient way to review and update his or her knowledge. Available on cassettes (11) or diskette.

NEW

TEACHER'S GRADEBOOK (Apple 48K dual/single drive) — Price: $39.95 Diskette

TEACHER'S GRADEBOOK is a complete password protected record-keeping system for the classroom. It supports up to nine users, and each user may have data for up to nine classes on one disk (with up to 49 students per class). Typical information which can be entered, edited and processed includes names, absences and grades. Summary reports may be displayed (on the screen) or printed in various ways, with automatic weighted averaging and conversion to letter grades. This system has been tested ("goof-proofed") in the class environment and is both well written and well-documented.

ORDERING INFORMATION

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

Shipping and Handling Charges
Within North America: Add $2.00
Outside North America: Add 15% (Air Mail)

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

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

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

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

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

DYNACOMP, Inc. (Dept. C)
1427 Monroe Avenue
Rochester, New York 14618
24 hour message and order phone: (716)442-8731
Toll free order phones: (800)828-6772
(800)828-6773
Office phone (9AM-5PM EST): (716)442-8960

VISA — MasterCard

New York State residents please add 7% NYS sales tax.

STATISTICS and ENGINEERING

DIGITAL FILTER (Available for all computers) — Price: $39.95 Cassette/$43.95 Diskette

DIGITAL FILTER is a comprehensive data processing program which permits the user to design his own filter function or choose from a menu of filter forms. In the explicit design mode the shape of the frequency transfer function is specified by directly entering points along the desired filter curve. In the menu mode, ideal low pass, high pass and bandpass filters may be approximated to varying degrees according to the number of points used in the calculation. These filters may optionally also be smoothed with a Hanning function. In addition, multi-stage Butterworth filters may be selected. Features of DIGITAL FILTER include plotting of the data before and after filtering, as well as display of the chosen filter functions. Also included are convenient data storage, retrieval and editing procedures.

DATA SMOOTHER (Not available for Atari) — Price: $19.95 Cassette/$20.95 Diskette

This special data smoothing program may be used to rapidly derive useful information from noisy business and engineering data which are equally spaced. The software features choice in degree and range of fit, as well as smoothed first and second derivative calculation. Also included is automatic plotting of the input data and smoothed results.

FOURIER ANALYZER (Available for all computers) — Price: $19.95 Cassette/$23.95 Diskette

Use this program to examine the frequency spectra of limited duration signals. The program features automatic scaling and plotting of the input data and results. Practical applications include the analysis of complicated patterns in such fields as electronics, communications and business.

TFA (Transfer Function Analyzer) — Price: $19.95 Cassette/$23.95 Diskette

This is a special software package which may be used to evaluate the transfer functions of systems such as hi-fi amplifiers and filters by examining their response to pulsed inputs. TFA is a major modification of FOURIER ANALYZER and provides an engineering-oriented decibel versus log frequency plot as well as data editing features. Whereas FOURIER ANALYZER is designed for educational and scientific use, TFA is an engineering tool. Available for all computers.

HARMONIC ANALYZER (Available for all computers) — Price: $24.95 Cassette/$28.95 Diskette

HARMONIC ANALYZER was designed for the spectrum analysis of repetitive waveforms. Features include data file generation, editing and storage/retrieval as well as data and spectrum plotting. One particularly unique facility is that the input data need not be equally spaced or in order. The original data is sorted and a cubic spline interpolation is used to create the data file required by the FFT algorithm.

FOURIER ANALYZER, TFA and HARMONIC ANALYZER may be purchased together for a combined price of $51.95 (three cassettes) and $63.95 (three diskettes).

REGRESSION I (Available for all computers) — Price: $19.95 Cassette/$23.95 Diskette

REGRESSION I is a unique and exceptionally versatile one-dimensional least squares "polynomial" curve fitting program. Features include very high accuracy, an automatic degree determination option, an extensive internal library of fitting functions, data editing, automatic data, curve and residual plotting, a statistical analysis (e.g. standard deviation, correlation coefficient, etc.) and much more. In addition, new fits may be tried without reentering the data. REGRESSION I is certainly the cornerstone program in any data analysis software library.

REGRESSION II (PARAFIT) (Available for all computers) — Price: $19.95 Cassette/$23.95 Diskette

PARAFIT is designed to handle those cases in which the parameters are imbedded (possibly nonlinearly) in the fitting function. The user simply inserts the functional form, including the parameters (A(1), A(2), etc.) as one or more BASIC statement lines. Data, results and residuals may be manipulated and plotted as with REGRESSION I. Use REGRESSION I for polynomial fitting, and PARAFIT for those complicated functions.

MULTILINEAR REGRESSION (MLR) (Available for all computers) — Price: $24.95 Cassette/$28.95 Diskette

MLR is a professional software package for analyzing data sets containing two or more linearly independent variables. Besides performing the basic regression calculation, this program also provides easy to use data entry, storage, retrieval and editing functions. In addition, the user may interrogate the solution by supplying values for the independent variables. The number of variables and data size is limited only by the available memory.

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

ANOVA (Not available on Atari cassette or for PET/CBM) — Price: $39.95 Cassette/$43.95 Diskette

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

BASIC SCIENTIFIC SUBROUTINES, Volumes 1 and 2 (Not available for Atari)

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

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

Price per collection: $14.95 Cassette/$18.95 Diskette

All three collections are available for $39.95 (three cassettes) and $49.95 (three diskettes).

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

Price per collection: $16.95 Cassette/$18.95 Diskette

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

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

BASIC SCIENTIFIC SUBROUTINES, Vol 1 (319 pages): $19.95 + 75¢ postage
BASIC SCIENTIFIC SUBROUTINES, Vol 2 (790 pages): $23.95 + $1.50 postage

See reviews in KILOBAUD and Dr. Dobbs.

NEW

SOFTNET (Apple II, 48K, diskette only) — Price: $129.95

SOFTNET may be used to create models of liquid pipeline systems to evaluate their flow performance. Up to 198 nodes with up to 198 connecting elements may be simulated, and models may be combined to form yet bigger models. If you are involved in water distribution systems, chemical fluid flow problems, building plumbing, or similar situations, this is an ideal analysis tool.

NEW

MATCHNET (TRS-80 only) — Price: $19.95 Cassette/$23.95 Diskette

It often takes days to iteratively optimize an L, Pi or T matching network for a particular application. Take a few minutes with MATCHNET and you will have the Q, frequency response and reflection coefficients for any of twelve matching networks. You input the source and load impedance and MATCHNET calculates the R, C, (and L) values and plots (and/or prints) the frequency response and reflection coefficients for each configuration. The reviewer of this program remembers when he had to do this by hand and loves MATCHNET!

ACTIVE CIRCUIT ANALYSIS (ACAP) (48K Apple only) — Price: $39.95 Cassette/$39.95 Diskette

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a graphics package for the apple II

Christopher Hansen

The Apple II computer is a very powerful graphics instrument, but many of its graphics capabilities are difficult to use because of the software that comes with the Apple. For example, I find it very inconvenient to draw pictures with the HPLOT statement. I dislike the origin (point 0,0) being placed at the top left-hand corner of the TV screen. I also do not like to use shape tables to draw complex pictures involving transformations. I like a Cartesian coordinate system (X-Y axis) and simple concepts such as moving and drawing with an imaginary pen. That is why I wrote the Apple Graphics Package (AGP).

I find it very inconvenient to draw pictures with the HPLOT statement.

Christopher Hansen, Rd #4 Box 163, Troy, NY 12180.

AGP is a set of subroutines, written in Applesoft Basic, that, when combined with a "main" or "caller" program, allows the programmer to draw complex pictures with simple GOSUB statements. I will explain all of this later and provide several demonstration programs. AGP is easy to use, but some care is necessary when programming with it. And, last, but probably most important, AGP is fun to use.

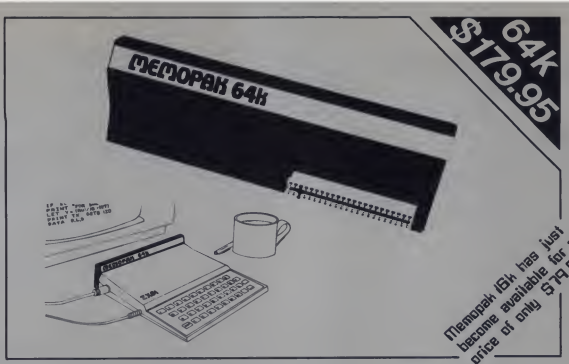
Loading the Package

In order to use AGP the first thing to do is type it in to your Apple (see Listing 1) and save it on disk or tape. This is your permanent copy of AGP, so be sure to correct any typing errors in this copy.

To use the package with your programs first load AGP into memory from disk or tape. After AGP has been loaded, type in your program. Be sure, however, that you do not type NEW before entering your program or AGP will be cleared from memory. Also be sure that your programs do not use line numbers from 10000 to 10980 because AGP uses these.

Listing 1.

```
10000  REM  APPLE GRAPHICS PACKAGE
10010  REM  REVISION 2.8 -- 05/01/81
10020  REM
10025  REM  CHRISTOPHER HANSEN
10027  REM  AVERILL PARK HIGH SCHOOL
10028  REM  AVERILL PARK, NEW YORK.
10029  REM
10030  REM  RESET SUBROUTINE
10040  X=FRE(0)
10045  XT=0 : YT=0
10050  X=0 : Y=0 : X1=0 : X2=0 : X3=0 : Y1=0 : Y2=0
10060  Y3=0 : XB=0 : XC=0 : YB=0 : YC=0 : XS=1 : YS=1
10070  XO=0 : YO=0 : DG=0 : RD=0 : SN=0 : CS=0
10080  XE=0 : XF=0 : WT=7.95 : WB=-WT: WR=10
10090  WL=-WR : VT=WT : VB=WB : VR=WR : VL=WL
10100  UA=1 : UB=0 : UC=1 : UD=0
10110  C$="" : C1$="" : C2$= "" : UT$="" : RETURN
10120  REM
10130  REM  MOVE SUBROUTINE
10140  X1=X : Y1=Y : RETURN
10150  REM
10160  REM  DRAW SUBROUTINE
10170  X2=X : Y2=Y : XH=X : X1=Y
10175  X1=X1+XT : Y1=Y1+YT : X2=X2+XT : Y2=Y2+YT
10180  IF XS<>1  OR  YS<>1  THEN GOSUB 10290
10190  IF DG<>0 THEN GOSUB 10320
```



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Graphics Package, continued...

```
10200  GOSUB 10420
10210  GOSUB 10630
10220  IF CN THEN 10260
10230  XB=(X1+10)*13.95 : XC=(X2+10)*13.95
10240  YB=191-((Y1+7.95)*12) : YC=191-((Y2+7.95)*12)
10250  HPLOT XB,YB TO XC,YC
10260  X1=XH : Y1=X1 : RETURN
10270  REM
10280  REM SCALING
10290  X1=X1*XS : X2=X2*XS : Y1=Y1*YS : Y2=Y2*YS
10300  RETURN
10310  REM
10320  REM ROTATE
10330  X1=X1-XO : X2=X2-XO : Y1=Y1-YO : Y2=Y2-YO
10340  RD=(DG*3.1415926)/180 : SN=SIN(RD) : CS=COS(RD)
10350  XE=(X1*CS)+(Y1*SN) : XF=(-X1*SN)+(Y1*CS)
10360  X1=XE+XO : Y1=XF+YO
10370  XE=(X2*CS)+(Y2*SN) : XF=(-X2*SN)+(Y2*CS)
10380  X2=XE+XO : Y2=XF+YO : RETURN
10390  REM
10400  REM
10410  REM WINDOW
10420  X1=UA*X1+UB : Y1=UC*Y1+UD
10430  X2=UA*X2+UB : Y2=UC*Y2+UD
10440  RETURN
10450  REM
10500  REM CODE SUBROUTINE
10510  C1$=""
10520  IF X1<VL THEN C1$="L" : GOTO 10530
10525  C1$="X"
10530  IF X1>VR THEN C1$=C1$+"R" : GOTO 10540
10535  C1$=C1$+"X"
10540  IF Y1<VB THEN C1$=C1$+"B" : GOTO 10550
10545  C1$=C1$+"X"
10550  IF Y1>VT THEN C1$=C1$+"T" : RETURN
10560  C1$=C1$+"X" : RETURN
10565  C2$=""
10570  IF X2<VL THEN C2$="L" : GOTO 10580
10575  C2$="X"
10580  IF X2>VR THEN C2$=C2$+"R" : GOTO 10590
10585  C2$=C2$+"X"
10590  IF Y2<VB THEN C2$=C2$+"B" : GOTO 10600
10595  C2$=C2$+"X"
10600  IF Y2>VT THEN C2$=C2$+"T" : RETURN
10610  C2$=C2$+"X" : RETURN
10620  REM CLIP SUBROUTINE
10630  GOSUB 10510 : GOSUB 10565
10640  IF C1$="XXXX" THEN IF C2$="XXXX" THEN CN=0 : RETURN
10650  UT$=LEFT$(C1$,1) : IF UT$=LEFT$(C2$,1) AND UT$<>"X"
       THEN CN=1 : RETURN
10652  UT$=MID$(C1$,2,1) : IF UT$=MID$(C2$,2,1) AND UT$<>"X"
       THEN CN=1 : RETURN
10654  UT$=MID$(C1$,3,1) : IF UT$=MID$(C2$,3,1) AND UT$<>"X"
       THEN CN=1 : RETURN
10656  UT$=RIGHT$(C1$,1) : IF UT$=RIGHT$(C2$,1) AND UT$<>"X"
       THEN CN=1 : RETURN
10660  C$=C1$ : IF C$="XXXX" THEN C$=C2$
10670  IF LEFT$(C,1)="X" THEN 10700
10680  Y3=Y1+(Y2-Y1)*(VL-X1)/(X2-X1) : X3=VL
10690  GOTO 10780
10700  IF MID$(C$,2,1)="X" THEN 10730
10710  Y3=Y1+(Y2-Y1)*(VR-X1)/(X2-X1) : X3=VR
10720  GOTO 10780
10730  IF MID$(C$,3,1)="X" THEN 10760
10740  X3=X1+(X2-X1)*(VB-Y1)/(Y2-Y1) : Y3=VB
10750  GOTO 10780
10760  IF RIGHT$(C$,1)="X" THEN 10780
10770  X3=X1+(X2-X1)*(VT-Y1)/(Y2-Y1) : Y3=VT
10780  IF C$=C1$ THEN 10810
10790  X2=X3 : Y2=Y3 : GOSUB 10565
10800  GOTO 10640
10810  X1=X3 : Y1=Y3 : GOSUB 10510
10820  GOTO 10640
10830  REM
10840  REM
10850  REM SET WINDOWING/CLIPPING
10860  UA=(VR-VL)/(WR-WL) : UB=VL-WL*UA
10870  UC=(VT-VB)/(WT-WB) : UD=VB-WB*UC
10880  RETURN
10890  REM
10900  REM RELATIVE MOVE
10910  X1=X1+X : Y1=Y1+X : RETURN
10920  REM
10930  REM RELATIVE DRAW
10940  X=X+X1 : Y=Y+Y1
10950  GOSUB 10170
10960  RETURN
10970  REM ######################################
10980  REM END OF AGP
```

Programming With the Package

The first statement in a program using AGP must be: GOSUB 10040. This subroutine call resets and initializes AGP; it is called the RESET subroutine. If you forget to place this statement in your program, AGP will not work properly.

The next statement should usually be HGR2. This statement tells the Apple to enter page two of hi-res graphics, which, in turn, means that the entire screen will be used for graphics and that the Apple will use high-resolution or fine line graphics. HGR2 is the only "enter-graphics" statement that should be used with AGP. The others will work either incorrectly or not at all.

After the HGR2 statement I would recommend an HCOLOR statement to set the color of the lines to be drawn. My favorite color to use is white (number 3) because white gives you the highest resolution possible (finest lines). But any other color will work well, too. (Be sure not to pick black, however, unless you are drawing over another color.)

Basic Drawing Subroutines

The Basic Drawing Subroutines are the routines used to draw lines in AGP. Each one is invoked by the main program assigning a value to the variables X and Y and then calling the specific subroutine with a GOSUB statement. X and Y correspond to the ordered pair (x,y) where x is the position on the horizontal or x-axis and y is the position on the vertical or y-axis. The center of the screen (the origin) is the ordered pair (0,0). The left side of the screen has an x value of -10, while the right side has an x value of 10. Likewise, the bottom of the screen has a y value of -7.95, while the top has a y value of 7.95.

Drawing is done with an imaginary pen which can be moved to the desired position by a Move subroutine and can draw lines from its current position with a Draw subroutine. Connecting lines can be drawn by a series of calls to the Draw subroutine.

Here are the first two line drawing subroutine calls:

MOVE: 30 X=a : Y=b : GOSUB 10140

where a and b are the x and y coordinates, respectively, of the point to which the pen is to be moved. Line number 30 is a dummy line number, of course, but the GOSUB number for Move must always be 10140.

DRAW: 30 X=a : Y=b : GOSUB 10170

where a and b are the x and y coordinates, respectively, of the point to which you wish to draw and 30 is a dummy line number as before.

With both of these subroutine calls, as with all AGP calls, the format can be changed (i.e., the X and Y specification

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Creature Venture
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Napoleon's Campaigns
Oldorf's Revenge
Oo Topos
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Race for Midnight
Southern Command
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statements put on separate lines), but this is the format I like to use.

It is necessary at this point to explain exactly what the variables X and Y are and why they are used in AGP calls. X and Y are "system variables." They are to be used in AGP calls and should not be used anywhere else in a program loaded with AGP. At the end of this article there is a list of all the system variables used by AGP. Some of them are used in AGP calls, but most are used internally (i.e., to do calculations). Altering these values in a program will cause AGP to work improperly.

Getting back to the drawing subroutines: there are two more subroutines that are used to draw lines. They are Relative Move and Relative Draw. These routines work the same way as Move and Draw, except that instead of moving or drawing to an absolute point, they move or draw a relative distance from the current imaginary pen position. This distance is specified by a displacement in the x and y directions. Here they are:

RELATIVE MOVE: 30 X=a : Y=b : GOSUB 10910

RELATIVE DRAW: 30 X=a : Y=b : GOSUB 10940

where a and b are the amount of displacement in the x and y directions, respectively, to move or draw.

Listing 2 is a demonstration program using the Basic Drawing Subroutines. Test this program on your Apple. You will see that it draws the x-y axis on the TV screen.

You may now be thinking to yourself, "What happens if I try to draw a line off the side of the screen?" No, you won't get the message ILLEGAL QUANTITY ERROR. Instead, the line will be chopped off where it intersects the side of the screen. This is one of the most powerful features of AGP, so don't be afraid to use it.

Table 1.

AGP System Variables

C$	C1$	C2$	CN	CS	DG	RD	SN	UA
UB	UC	UD	UT$	VB	VL	VR	VT	WB
WL	WR	WT	X	X1	X2	X3	XB	XC
XE	XF	XH	XI	XO	XS	XT	Y1	Y2
Y3	YB	YC	YE	YF	YO	YS	YT	

Listing 2.

```
10  REM  DEMO
20  GOSUB 10040 : REM RESET
30  HGR2 : HCOLOR=3 : REM ENTER GRAPHICS AND SET COLOR
40  X=-10 : Y=0 : GOSUB 10140 : REM  MOVE
50  X=10 : Y=0 : GOSUB 10170 : REM  DRAW
60  X=-10 : Y=-10 : GOSUB 10910 : REM  RELATIVE MOVE
70  X=0 :Y=20 : GOSUB 10940 : REM  RELATIVE DRAW
80  END
```

Listing 3.

```
1   REM DEMO ROTATE AND SCALE SQUARES
5   HCOLOR=3
10   GOSUB 10040
20   HGR2
30   FOR Z=0 TO 200 STEP 5
40   DG=Z
45   XS=Z/70+.05 : YS=XS
50   X=4 : Y=4 : GOSUB 10140
51   X=4 : Y=-4 : GOSUB 10170
52   X=-4 : Y=-4 : GOSUB 10170
53   X=-4 : Y=4 : GOSUB 10170
54   X=4 : Y=4 : GOSUB 10170
70   NEXT Z
80   END
```

Advanced Graphics With AGP

AGP not only allows you to draw lines, it also allows you to transform them. This is done with built-in advanced graphics features. Advanced graphics includes translating, scaling, rotation, windowing, and clipping lines drawn with the Basic Drawing Subroutines.

Translating

Translating causes the origin (0,0) to be placed on any point specified. Therefore, if you decided to place the origin on the point (0,2), all lines drawn would be shifted to the right two units. Lines will still be clipped on the edges of the screen when the origin is moved. The origin can even be moved off screen. The syntax of the translating statement is:

30 XT=a : YT=b

where a is the x coordinate and b is the y coordinate of the origin and 30 is a dummy line number.

After setting the translation point, as with all other AGP transformations, all lines drawn will be transformed.

Scaling

Scaling causes the lines that are drawn to be scaled in both the x and y directions and specified. For example, if you set the x scaling to 2 and the y scaling to 0.5, the lines drawn would be twice as long as normal in the x direction and half as long as normal in the y direction. The syntax of the scaling statement is:

30 XS=x : YS=y

where x is the scaling in the x direction and y is the scaling in the y direction and 30 is a dummy line number.

Rotation

Rotation is performed in AGP by specifying the amount of rotation in degrees. The syntax of the rotate statement is:

30 DG=theta

where theta is the amount of rotation in degrees and 30 is a dummy line number. Rotation is around the origin, and positive degrees rotate clockwise and negative degrees rotate counter-clockwise.

In order to rotate around a point other than the origin, the point must be specified. This is done with this command:

30 XO=a : YO=b

where (a,b) is the point around which lines are to be rotated.

Windowing and Clipping

Windowing and clipping transformations are the two most complex parts of AGP. Together they allow you to set up a "world coordinate system." The world coordinate system can be thought of as the x-y axis coordinate system of an infinite plane or two-dimensional world.

When the RESET subroutine is called from a program it automatically sets the TV screen to show from -10 to 10 on the x-axis and -7.95 to 7.95 on the y-axis. This is only a default, however. AGP allows you to show any part of the world that you want. In this way the TV screen is analogous to a window. This is why it is called the window transformation. The syntax of the AGP window subroutine call is:

```
30 WL=a : WR=b : WB=c : WT=d
40 GOSUB 10860
```

where a is the x value of the left side of the screen, b is the x value of the right side of the screen, and c and d are the y values of the bottom and top of the screen, respectively.

All lines drawn with the Basic Drawing Subroutines are in the world coordinates, so this transformation affects all moves, draws, relative moves, and relative draws. And, as before, all lines drawn outside the window are clipped.

Adjusting the Viewport

The viewport is the part of the screen that displays what the window contains. When RESET is called, the viewport is set to be the entire screen. But, as with other AGP defaults, this may be modified.

When defining the viewport, Screen Coordinates are used. On the TV screen, the screen coordinates range from -10 to 10 on the x axis and from -7.95 to 7.95 on the y-axis (the same as the default world coordinates). Unlike world coordinates, whose positions may be changed (by adjusting the window), screen coordinates always have the same positions on the TV screen. To specify the viewport use the command:

```
30 VL=a : VR=b : VB=c : VT=d
40 GOSUB 10860
```

where a, b, c, d, are the left, right, top and bottom, respectively, of the viewport in screen coordinates.

Here are a few hints for the Window and Viewport settings:

Remember that the window is specified using world coordinates and that the viewport is specified using screen coordinates.

Do not set the viewport so that it extends over the sides of the TV screen (i.e., VL must be greater than or equal to -10; VR must be less than or equal to 10; VB must be greater than or equal to -7.95 and VT must be less than or equal to 7.95). If you don't follow this rule, AGP will become confused and cause an error if you try to draw a line off screen.

Keep the window rectangle and the viewport rectangle in geometric proportion or the lines drawn by AGP will be distorted.

Listing 4.

```
5  REM DEMO PROGRAM #2
10  TEXT : HOME : GOSUB 10140
20  PRINT "ENTER COLOR (WHITE,RED,GREEN,BLUE)"
30  INPUT A$
40  IF A$="WHITE" THEN H=3
50  IF A$="RED" THEN H=5
60  IF A$="GREEN" THEN H=1
70  IF A$="BLUE" THEN H=2
80  HCOLOR=H
90  PRINT : PRINT
95  PRINT "ENTER D FOR DEFAULTS" : GET D$
96  IF D$="D" THEN 250
97  PRINT : PRINT
100  PRINT "ENTER WINDOW DIMENSIONS (WORLD COORDINATES)"
110  INPUT WL,WR,WB,WT
120  PRINT : PRINT
130  PRINT "ENTER VIEWPORT DIMENSIONS (SCREEN COORDINATES)"
140  INPUT VL,VR,VB,VT
150  GOSUB 10860
160  PRINT : PRINT
170  PRINT "ENTER AMOUNT OF SCALING (X,Y)"
180  INPUT XS,YS
190  PRINT : PRINT
200  PRINT "ENTER DEGREES OF ROTATION"
210  INPUT DG
220  PRINT : PRINT
230  PRINT "ENTER POINT OF ROTATION"
240  INPUT XO,YO
250  HOME : SPEED=20
260  PRINT "----- DRAWING BEGINS"
270  SPEED=255
280  HGR2 : X=O : Y=O : GOSUB 10140
290  FOR Z=.5 TO 3 STEP .3
300  AX=Z
310  AY=SQR((AX*AX*AX)+2)
320  X=AX : Y=AY : GOSUB 10170
330  X=-AX : Y=AY : GOSUB 10170
340  X=AX : Y=-AY : GOSUB 10170
350  X=-AX : Y=-AY : GOSUB 10170
360  NEXT
370  X=O : Y=O : GOSUB 10170
380  FOR J=1 TO 2500 : NEXT J
390  HGR2 : TEXT : HOME
400  END
```

Figure 1. This photograph shows what AGP will draw with the program Listing 3. Notice the clipping at the screen edges.

Demo Programs

To give an idea of the power and ease of use of AGP, I have written two demo programs. The first one (see Figure 1 and Listing 3) demonstrates rotation, scaling, and clipping. The program itself, however, is very simple.

First the program resets AGP and then enters hi-res graphics and sets the color to white. Then the FOR/NEXT loop sets a different amount of rotation and scaling and draws a square for each repetition.

Try this program on your Apple. It is fascinating to watch each line being drawn and to see the vertices of the squares connect to form curved lines. Also you will notice that the connecting vertices are clipped where they move off the screen but then come around and appear in a different position.

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creative computing

Figure 2. This photograph shows one of the many combinations of rotation, scaling and windowing possible with the program in Listing 4.

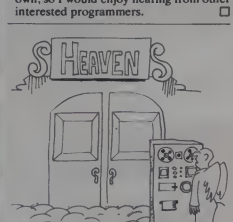
The second program (Figure 2, Listing 4) is interactive (the computer asks for input). It lets you enter the color you want, and then asks whether you want default values for the different transformations. If a D is input the program draws the picture normally. If any other key is pressed the program asks you to input the world and screen coordinates and other goodies. The photo shows one of the many pictures possible with this program.

AGP has many applications, including pictures, maps and games.

Conclusion

AGP has many applications, including: pictures, maps and games. It also is a great tool for demonstrating the Apple and for learning about computer graphics.

If you have an interesting program using AGP, please send it to me. The only programs I have seen using AGP are my own, so I would enjoy hearing from other interested programmers. □



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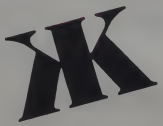

Most Apples speak English, which is fine for most applications. But what if you or your prospective user speaks and reads Russian, Chinese, Hebrew, Greek or Japanese?

Character Editor is a program, written in Pascal, to change the character set displayed by the Apple, thereby enabling it to communicate in any language you choose—even mathematics.

Every APPLE1: disk comes with a file called SYSTEM.CHARSET. This file contains a printable character for every character on the keyboard including control and lower case letters. You may wonder why lower case letters cannot be displayed on the screen if they are actually present in the character set. The reason is that the Apple does not use the character set file when printing to a text screen. It has a built-in ROM-like character generator from which it prints characters. The character set on your APPLE1: disk can only be displayed on a hi-res screen.

Now the problem arises: How can hi-res screens be used to display text? There are two ways in which this can be done. The first is to modify the BIOS (the Pascal Basic Input Subsystem which resides in the file SYSTEM.APPLE) so that it directs text to a hi-res page. This is complex and requires a knowledge of machine language. It has been done by Charlie Kellner, who developed the public-domain hi-res1 disk which displays both upper and lower case.

Jeffrey T. Mangasarian, 6021 Old Middleton Rd., Madison, WI 53705.

The second way to use a hi-res screen to display text is to use the Turtlegraphics unit found in the SYSTEM.LIBRARY. It is this simpler method which I will use with the character editor (CHARED).

CHARED can edit up to 128 characters (0-127) at a time. Each character, an 8 x 8 matrix of Boolean, is really 8 bits tall and 7 bits wide. The last column is not printed in order to allow 40 characters to fit on a line. (There are 280 dots across the screen.

How can hi-res screens be used to display text?

Hence, 7 dots per character times 40 letters equals 280 dots. In short, 8 x 7 fits, and 8 x 8 doesn't.)

It is a good idea to experiment with the editor before sitting down to create a complete character set. Two difficulties which you may encounter are: characters placed in a location inaccessible from the Apple keyboard, and printing the new character set.

There are 128 ASCII characters. These characters are numbered sequentially from 0 to 127. So there are 128 locations in memory that can be edited. Some of these locations, however, are inaccessible from the keyboard and therefore can be used only with difficulty. The Apple-accessible ASCII characters are as follows: 0-91, 93, 94, and 96-122.

In fact, all these "inaccessible" characters can be used in a Pascal program using the Pascal CHR(X) function. Control characters (ASCII 0-31) are rather awkward to use and can't be typed into the text while using the SYSTEM.EDITOR. So there are some limitations, but both upper and lower case can be used.

The second difficulty is that characters must be displayed on a hi-res page by using the unit Turtlegraphics. There are two main methods for displaying text on the hi-res screen: WCHAR and WSTRING. Both are used in the programs below. There is also a command, CHARTYPE (MODE), for determining how the characters are to be drawn on the screen. For example, one could have all the characters drawn in inverse by using CHARTYPE (11).

CHARTYPE(6) allows one to write text over a graphics image; then later when you write the same text over the same

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location, the text will be erased, leaving the picture intact. This method is used in the programs below for moving the cursor around on the screen without changing the hi-res screen.

The CHARED program does not actually modify the SYSTEM.CHARSET, but creates a different file called CHARS.DATA. Once this new file is saved on disk, you can replace your SYSTEM.CHARSET with it. The following steps are recommended when first using this program to install a new character set:

- Enter the filer by typing "F."
- Change the SYSTEM.CHARSET to OLD.CHARSET by using the C)hange option.
- Change the name of CHARS.DATA to SYSTEM.CHARSET, again using the C)hange option.

Once the program has copied SYSTEM.CHARSET to CHARS.DATA, or has reset an already existing CHARS.DATA, the following commands are possible:

Pen Status Commands

F: This command fills the pen with "ink" so that a mark of this color ink is plotted wherever you move the Apple cursor on the grid.

E: This option empties your pen so that you can move the cursor around without leaving a mark. It is like lifting the pen from the paper.

B: This command sets the "ink" color to black.

W: This command sets the "ink" to white.

Cursor Pen Movement Commands

U: This moves the cursor up one space.

D: This moves the cursor down one space.

L: This moves the cursor to the left one space.

R: This moves the cursor to the right one space.

Character Utilities Commands

G: This command loads in a character from the ASCII table of characters found on page 283 of the Operating System Reference manual. When you type "G," you will be prompted by a message that says "TYPE IN CHAR NUMBER." At this point type the ASCII number of the character that you wish to edit (e.g. to edit the character "*" type 42, or to edit the digit "7" type the number 55).

C: This command copies one character in the ASCII list to another location in the ASCII list. When you type "C," you are prompted by "FROM TO." To transfer the data you must type the source ASCII number, followed by a space, not a comma, then type the destination ASCII number (e.g., to move the contents in letter "A" TO "O," you type "65 48").

Q: This exits the CHARED program and writes the newly-edited character set to the file CHARS.DATA.

Graphics Editor

The graphics editor (GEDIT) was created to demonstrate the display of made-up character sets on a hi-res page using Turtlegraphics. It is intended that this program be modified to suit your needs. GEDIT will function just as the Pascal editor does, except that only the exchange command and cursor movements are possible. Table I lists the commands. □

H	Exchanges text horizontally until a control c is typed*
V	Exchanges text vertically until a control c is typed*
•	Moves cursor right*
←	Moves cursor left*
ctrl 0	Moves cursor up*
ctrl L	Moves cursor down*
ctrl I	Tabs over five spaces*
esc	Exits the program*
space bar	Spaces over one space
return	Go to next line

*Does not work while in the exchange mode.

Table I. Graphics Editor Commands.

Keyboard Positions.

```
'1234567890-~      "!"£$%&/()=_`
±ςερτυθιοπ¦´      §`ΕΡΤΥΘΙΟΠ¦¨
ασδφγηξκλ'+@      ΑΣΔΦΓΗΞΚΛ'*¢
~ζχψωβνμ,.'       ~ΖΧΨΩΒΝΜ;:?

ö1234567890-ü     Ö!"§%&/()=_Ü
qwertyuiopäµ      QWERTYUIOPÄ¯
asdfghjkl~+²      ASDFGHJKL`*³
#zxcvbnm,.ß       'ZXCVBNM;:?

¨1234567890-=     °!@#$%¢&*()_+
qwertyuiop`^      QWERTYUIOP~¯
asdfghjkl;´³      ASDFGHJKL:¯³
«zxcvbnm,.é       »ZXCVBNM'/?

ñ1234567890-º     Ñ!"£$%&/()=_ª
qwertyuiopß¢      QWERTYUIOP¿¦
asdfghjkl~+|      ASDFGHJKL"*ï
~zxcvbnm,.'       ^ZXCVBNM;:?

±1234567890-=     °!@#$%¢&*()_+
qwertyuiopЬ]      QWERTYUIOPЬ[
asdfghjkl;'²      ASDFGHJKL:"³
$zxcvbnm,./       ¶ZXCVBNM,.?

1234567890-=      !?×$%½/*()_+
פסן וטארקי'ף      ÷פסן וטארק"£
הרלחיעכגדש,      הרלחיעכגדש,
עתצמנהבסז.       עתצמנהבסז.
```

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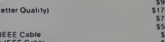

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Cyrillic, continued...

```
(*$S+*)
{**************************************}
{*                                    *}
{*      CHARACTER EDITOR              *}
{*                                    *}
{*            BY                      *}
{*                                    *}
{*     JEFFREY MANGASARIAN            *}
{*                                    *}
{*                                    *}
{**************************************}
PROGRAM CHARACTER_EDITOR;
USES TURTLEGRAPHICS;

{**************************************}
{*                                    *}
{*   VAR TABLE                        *}
{*                                    *}
{*                                    *}
{*   SOURCE    : BEGINNING BIT OF A   *}
{*               CHARACTER IN THE     *}
{*               ARRAY BUFFER         *}
{*                                    *}
{*   ABS       : POINTER TO A BIT IN  *}
{*               THE BUFFER WHERE THE *}
{*               CURSOR IS LOCATED    *}
{*                                    *}
{*   X1        : CURRENT X LOCATION   *}
{*               IN THE GRID          *}
{*                                    *}
{*   Y1        : CURRENT Y LOCATION   *}
{*               IN THE GRID          *}
{*                                    *}
{*   NOX       : USED IN TESTING FOR  *}
{*               CURSOR MOVEMENT      *}
{*                                    *}
{*   NOY       : USED IN TESTING FOR  *}
{*               CURSOR MOVEMENT      *}
{*                                    *}
{*   PEN_FULL  : TRUE FOR A FULL PEN  *}
{*               FALSE MEANS EMPTY    *}
{*                                    *}
{*   COLOR     : TRUE IF INK IS WHITE *}
{*               FALSE IF INK BLACK   *}
{*                                    *}
{*   LEGALSET  : SET OF COMMAND       *}
{*               CHARACTERS           *}
{*                                    *}
{*   BUFFER    : ARRAY OF 8192        *}
{*               BOOLEAN I.E. 128     *}
{*               CHARACTERS OF AN     *}
{*               8 BY 8 MATRIX        *}
{*                                    *}
{*   CURSOR    : ARRAY OF BOOLEAN     *}
{*               FOR APPLE CURSOR     *}
{*               ON THE EDIT GRID     *}
{*                                    *}
{**************************************}
```

"Look at this, Peckham—now that's what I call a microcomputer!"

```
VAR  COLOR : BOOLEAN;
     CHARMODE,NOX,NOY,SOURCE,OLOX,OLOY,BLOCK,ABS,X1,Y1 : INTEGER;
     OISK,OISKDATA : FILE;
     BUFFER : PACKED ARRAY[1..8192] OF BOOLEAN;
     CURSOR : PACKED ARRAY[1..8,1..8] OF BOOLEAN;
     PEN_FULL,SUCCESSFUL :BOOLEAN;
     CH : CHAR;
     LEGALSET : SET OF  CHAR;


{**************************************}
{*                                    *}
{* THIS PROCEDURE CREATES A           *}
{* CURSOR FOR THE EDITING GRID        *}
{*                                    *}
{**************************************}

     PROCEDURE MAKE_CURSOR;

        PROCEDURE MAKE(J : INTEGER; LINE : STRING);

          VAR I : INTEGER;

          BEGIN
          FOR I := 1 TO 8 DO
              CURSOR[I,J] := (LINE[I]='*');
          END;

        BEGIN
        MAKE(1,'   ***   ');
        MAKE(2,' ****** ');
        MAKE(3,' ****** ');
        MAKE(4,'  **** * ');
        MAKE(5,' ****** *');
        MAKE(6,' ****** ');
        MAKE(7,'   ***   ');
        MAKE(8,'         ');
        END;


{**************************************}
{*                                    *}
{* ORAWGRID SETS UP THE EDITING GRID  *}
{*                                    *}
{**************************************}

     PROCEDURE ORAWGRID;

         VAR I,VERT,HOZ : INTEGER.
         BEGIN
         INITTURTLE;
         GRAFMODE;
         PENCOLOR (NONE);
         TURNTO(270);
         FOR I := 0 TO 7 DO
              BEGIN
              VERT := 40+I*12;
              MOVETO (VERT,162);
              PENCOLOR(WHITE),
              MOVE (112);
              PENCOLOR(NONE);
              END;
         TURNTO(0);
         FOR I := 0 TO 8 DO
              BEGIN
              HOZ :=  50+I*14;
              MOVETO (40,HOZ);
              PENCOLOR (WHITE);
              MOVE (83);
              PENCOLOR (NONE);
              END;
         END;

{**************************************}
{*                                    *}
{*  ORAWOPTIONS WRITES ALL THE        *}
{*  COMMANDS ON THE HI-RES SCREEN     *}
{*  NEXT TO THE EDITING GRID          *}
{*                                    *}
{**************************************}

     PROCEDURE ORAWOPTIONS;

        BEGIN
        MOVETO (159,135);
        WSTRING ('E=PEN EMPTY');
        MOVETO (159,125);
        WSTRING ('F=PEN FULL');
        MOVETO (159,115);
```

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```
      WSTRING ('U=UP'),
      MOVETO (159,105),
      WSTRING ('D=DOWN'),
      MOVETO (159,95),
      WSTRING ('R=RIGHT'),
      MOVETO (159,85),
      WSTRING ('L='LEFT'),
      MOVETO (159,75),
      WSTRING ('Q=QUIT'),
      MOVETO (159,65),
      WSTRING ('B=BLACK'),
      MOVETO (159,55),
      WSTRING ('W=WHITE'),
      MOVETO (159,45),
      WSTRING ('G=GETCHAR (X)'),
      MOVETO (159,35);
      WSTRING ('C=COPY (FROM TO)'),
      END;

{************************************}
{*                                  *}
{* COPY MOVES WHOLE CHARACTERS FROM  *}
{* ONE ASCII LOCATION TO ANOTHER     *}
{* IN THE BOOLEAN ARRAY BUFFER       *}
{*                                  *}
{************************************}

 PROCEDURE COPY;

   VAR S,D,I : INTEGER;

   BEGIN
   MOVETO(50,10);
   WSTRING('FROM, TO');
   (*$I-*)
   READLN (KEYBOARD,S,D);
   (*$I+*)
   S := S*64;
   D := D*64;
   FOR I := 1 TO 64 DO
      BUFFER[D+I] := BUFFER[S+I];
   MOVETO (50,10),
   WSTRING('           ');
   END;

{************************************}
{*                                  *}
{* DRAWSQUARE DRAWS A BLOCK IN THE   *}
{* GRID WHERE THE CURSOR IS          *}
{* THIS BLOCK MAY BE BLACK OR WHITE  *}
{* DEPENDING ON THE PENCOLOR         *}
{*                                  *}
{************************************}

 PROCEDURE DRAWSQUARE (X,Y,YSKIP : INTEGER);

          VAR MODE,X2,Y2 : INTEGER;
              OKSET : SET OF CHAR;

        BEGIN
        OKSET := ['U','u','D','d','L','l','R','r','B','b','W','w'],
        X2 := X+1;
        Y2 := Y+1;
        X:=4I+X*12;
        Y:=SI+Y*14,
        IF CH IN OKSET THEN
           BEGIN
           BUFFER[SOURCE-72+Y2*8+X2] := COLOR,
           IF ((X2<8) AND (X2>0)) AND ((Y2<9) AND (Y2>0)) THEN
              BEGIN
              CASE COLOR OF
                 TRUE : MODE := 15,
                 FALSE: MODE := 0,
                 END;
              DRAWBLOCK (BUFFER,7,0,YSKIP,10,12,X,Y,MODE);
              DRAWBLOCK (BUFFER,7,0,YSKIP,1,1,X2+17,Y2+40,MODE),
              DRAWBLOCK (BUFFER,7,0,YSKIP,1,1,X2+10,Y2+40,MODE),
              DRAWBLOCK (BUFFER,7,0,YSKIP,1,1,X2+10,Y2+48,MODE),
              END;
           END;
        END;

{************************************}
{*                                  *}
{* THIS PROCEDURE MOVES THE CURSOR   *}
{* FROM WHERE IT WAS (OLDX,OLDY) TO  *}
{* A NEW POSITION (X,Y)              *}
{*                                  *}
{************************************}
PROCEDURE MOVE_CURSOR(X,Y :INTEGER);

   BEGIN
   IF (OLDX<>X) AND (OLDY<>Y) THEN
        BEGIN
        DRAWBLOCK (CURSOR,2,0,0,8,8,OLDX,OLDY,6),
        X := 41+X*12,
        Y := SI+Y*14;
        OLDX :=X;
        OLDY :=Y;
        DRAWBLOCK(CURSOR,2,0,0,8,8,X,Y,6);
        END;
   END,

{************************************}
{*                                  *}
{* FILLARRAY IS THE CORE OF THE PROG *}
{* IT IS WHERE ALL THE COMMANDS ARE  *}
{* INPUT                            *}
{*                                  *}
{************************************}
PROCEDURE FILLARRAY;
          {************************************}
          {*                                  *}
          {*      MOVES CURSOR UP             *}
          {*                                  *}
          {************************************}
          PROCEDURE UP;

              BEGIN
              IF Y1<7 THEN
                 BEGIN
                 Y1:=Y1+1;
                 ABS := ABS+1,
                 END;
              END;
          {************************************}
          {*                                  *}
          {*      MOVES CURSOR DOWN           *}
          {*                                  *}
          {************************************}
          PROCEDURE DOWN;
              BEGIN
              IF Y1>0 THEN
                 BEGIN
                 ABS :=ABS-1;
                 Y1:=Y1-1,
                 END;
              END;
          {************************************}
          {*                                  *}
          {*      MOVES CURSOR RIGHT          *}
          {*                                  *}
          {************************************}
          PROCEDURE RIGHT;
              BEGIN
              IF X1<6 THEN
                 BEGIN
                 X1:=X1+1;
                 ABS := ABS+8;
                 END,
              END;
          {************************************}
          {*                                  *}
          {*      MOVES CURSOR LEFT           *}
          {*                                  *}
          {************************************}
          PROCEDURE LEFT;
              BEGIN
              IF X1>0 THEN
                 BEGIN
                 X1:=X1-1;
                 ABS := ABS-8,
                 END,
          END,
{************************************}
{*                                  *}
{* GETCHAR PULLS IN A NEW CHARACTER  *}
{* TO EDIT FROM THE BUFFER ARRAY     *}
{* IT ALSO WRITES THE NEW CHAR ON    *}
{* THE GRID                         *}
{*                                  *}
{************************************}
PROCEDURE GETCHAR (VAR CNUMBER : INTEGER);

   VAR MODE,I1,J1,I,J : INTEGER;

   BEGIN
   (*$I-*)
```

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CIRCLE 218 ON READER SERVICE CARD

Cyrillic, continued...

```
    REPEAT
      MOVETO (50,10);
      WSTRING('TYPE IN CHAR NUMBER');
      READLN (KEYBOARD,CNUMBER);
      SOURCE := (CNUMBER+1)*64;
      IF (CNUMBER<0) OR (CNUMBER>127) THEN
          WRITE (CHR(7));
      MOVETO (50,10);
      WSTRING('                    ');
    UNTIL (CNUMBER>-1) AND (CNUMBER<128);
    (*$I+*)
    CNUMBER := (CNUMBER+1)*64;
    FOR J := 8 DOWNTO 1 DO
       FOR I := 8 DOWNTO 1 DO
          BEGIN
          J1:=51+(J-1)*14;
          I1:=41+(I-1)*12;
          CASE BUFFER[CNUMBER] OF
              TRUE : MODE := 15;
              FALSE: MODE := 0;
            END;
          DRAWBLOCK (BUFFER,7,0,CNUMBER,10,12,11,J1,MODE);
          DRAWBLOCK (BUFFER,7,0,CNUMBER,1,1,I+17,J+40,MODE);
          DRAWBLOCK (BUFFER,7,0,CNUMBER,1,1,I+10,J+40,MODE);
          DRAWBLOCK (BUFFER,7,0,CNUMBER,1,1,I+10,J+48,MODE);
          CNUMBER := CNUMBER-1;
          END;
    CNUMBER := 1;
    END;

{************************************}
{*                                  *}
{* THIS INITS DATA FOR GETTING A    *}
{* NEW CHAR                         *}
{*                                  *}
{************************************}
    PROCEDURE GET(VAR ABS:INTEGER);

        BEGIN
        OLDX := 41;
        OLDY := 51;
        ABS :=1;
        GETCHAR(ABS);
        X1 :=0;
        Y1 :=0;
        PEN_FULL := FALSE;
        DRAWBLOCK(CURSOR,2,0,0,8,8,OLDX,OLDY,6);
        END;

BEGIN (* FILLARRAY *)
COLOR := FALSE;
MOVETO(3,175);
WSTRING('CHARACTER EDITOR BY JEFFREY MANGASARIAN');
MOVETO(90,165);
WSTRING('     19B0     ');
LEGALSET :=['e','E','f','F','w','W','b','B','u','U',
            'd','D','l','L','r','R','g','G'];
OLDX := 41;  (*SETUP STARTING X,Y FOR APPLE CURSOR*)
OLDY := 51;
DRAWBLOCK(CURSOR,2,0,0,8,8,OLDX,OLDY,6);
ABS :=1;
GET(ABS);
X1 :=0;
Y1 :=0;
REPEAT
  GRAFMODE;
  READ (CH);
  NOX := X1;
  NOY := Y1;
  CASE CH OF
     'e','E' : PEN_FULL := FALSE;
     'f','F' : PEN_FULL := TRUE;
     'w','W' : COLOR:=TRUE;
     'b','B' : COLOR:=FALSE;
     'u','U' : UP;
     'd','D' : DOWN;
     'l','L' : LEFT;
     'r','R' : RIGHT;
     'g','G' : GET(ABS);
     'c','C' : COPY;
    END;
  IF (CH IN LEGALSET) AND ((X1<>NOX) OR (Y1<>NOY)) THEN
    BEGIN
    IF (CH<>'Q') OR (CH<>'q') THEN
       IF PEN_FULL THEN
          DRAWSQUARE (X1,Y1,ABS);
    MOVE_CURSOR(X1,Y1).
    END.
  IF (CH='b') OR (CH='B') OR (CH ='W') OR (CH ='w') THEN
       BEGIN
       IF PEN_FULL THEN
          BEGIN
          IF (CH='B') OR (CH='b') THEN
             BEGIN
             COLOR := FALSE;
             CHARMODE := 0;
             END
          ELSE
             BEGIN
             COLOR := TRUE;
             CHARMODE := 15;
             END;
          ABS := SOURCE-72*(Y1+1)*8+X1+1;
          BUFFER[ABS] := COLOR;
          DRAWBLOCK(BUFFER,7,0,0,10,12,41+X1*12,51+Y1*14,CHARMODE);
          DRAWBLOCK(CURSOR,2,0,0,8,8,41+X1*12,51+Y1*14,6);
          DRAWBLOCK (BUFFER,7,0,ABS,1,1,X1+18,Y1+41,CHARMODE);
          DRAWBLOCK (BUFFER,7,0,ABS,1,1,X1+11,Y1+41,CHARMODE);
          DRAWBLOCK (BUFFER,7,0,ABS,1,1,X1+11,Y1+49,CHARMODE);
          END;
       END;
  UNTIL (CH = 'q') OR (CH='Q');
  END;

{************************************}
{*                                  *}
{* DISKIO DOES ALL THE DISK CHECKING *}
{* TO SET UP THE BUFFER ARRAY WITH  *}
{* THE CHARACTER DATA.  IT FIRST    *}
{* LOOKS TO SEE IF THERE IS A FILE  *}
{* CALLED 'CHARS.DATA'. IF THERE IS, *}
{* IT WILL LOAD THAT CHARACTER SET.  *}
{* OTHERWISE, IT WILL LOAD THE SET  *}
{* FROM THE FILE SYSTEM.CHARSET.    *}
{*                                  *}
{************************************}

PROCEDURE DISKIO;

        BEGIN
        (*$I-*)
        RESET (DISKDATA,'CHARS.DATA');
        SUCCESSFUL :=(IORESULT=0);
        IF NOT SUCCESSFUL THEN
           BEGIN
           RESET (DISK,'SYSTEM.CHARSET');
           BLOCK := BLOCKREAD(DISK,BUFFER,2,0);
           CLOSE (DISK,LOCK);
           REWRITE (DISKDATA,'CHARS.DATA');
           BLOCK := BLOCKWRITE(DISKDATA,BUFFER,2,0);
           SUCCESSFUL :=(IORESULT=0);
           IF NOT SUCCESSFUL THEN
              BEGIN
                 PAGE(OUTPUT);
                 WRITELN ('<ERROR> POSSIBLY NO MORE ROOM ON DISK');
                 HALT;
                 END;
           END
        (*$I+*)
        ELSE
              BLOCK := BLOCKREAD(DISKDATA,BUFFER,2,0);
        END;


BEGIN (* MAIN PROGRAM *)
DISKIO;
DRAWGRID;
DRAWOPTIONS;
MAKE_CURSOR;
FILLARRAY;
BLOCK := BLOCKWRITE(DISKDATA,BUFFER,2,0);
CLOSE (DISKDATA,LOCK);
PAGE(OUTPUT);
TEXTMODE;
END.

{******************************}
{*                            *}
{*     GRAPHICS EDITOR        *}
{*                            *}
{*           BY               *}
{*                            *}
{*   JEFFREY MANGASARIAN      *}
{*                            *}
{******************************}
PROGRAM GEDIT;
USES TURTLEGRAPHICS;
```

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CIRCLE 191 ON READER SERVICE CARD

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VISA

AARDVARK - 80
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TRS 80 COLOR (313) 669-3110 OSI

CIRCLE 101 ON READER SERVICE CARD

Cyrillic, continued...

```
{*****************************}
{*                           *}
{*  VAR TABLE                *}
{*                           *}
{*  XVECTOR : DISTANCE FOR   *}
{*            HORZ. COMPONENT*}
{*                           *}
{*  YVECTOR : DISTANCE FOR   *}
{*            VERT. COMPONENT*}
{*                           *}
{*  X,Y     : CURSOR POSITION*}
{*                           *}
{*  XO,YO   : PREVIOUS CURSOR*}
{*            POSITON        *}
{*                           *}
{*****************************}
VAR XVECTOR,YVECTOR,I,X,Y,XO,YO : INTEGER;
    CURSOR,CTRLC,CTRLI,ESCAPE,UP,DOWN,LEFT,RIGHT,CH : CHAR;

{*****************************}
{*                           *}
{*  MAXMIN : TEST TO SEE IF  *}
{*  THE LOCATION TO BE DRAWN *}
{*  IS ON THE HIRES SCREEN   *}
{*                           *}
{*****************************}
PROCEOURE MAXMIN;
   BEGIN
   IF X>39 THEN
      X := 39;
   IF X<0 THEN
      X := 0;
   IF Y>23 THEN
      Y := 23;
   IF Y<1 THEN
      Y :=1;
   END;

{*****************************}
{*                           *}
{* DRAWXY  DRAWS A  CHARACTER *}
{* ON THE HI-RES SCREEN      *}
{*                           *}
{*****************************}
PROCEOURE DRAW(X1,Y1,GMODE : INTEGER; LETTER:CHAR);

    BEGIN
    MOVETO(X1*7,191-Y1*8);
    CHARTYPE(GMODE);
    WCHAR(LETTER);
    END;

{*****************************}
{*                           *}
{* EXCHANGES CHARACTERS EITHER*}
{* VERT. OR HORZ. DEPENDING  *}
{* ON WHICH COMMAND WAS      *}
{* SELECTED                  *}
{*                           *}
{*****************************}
PROCEDURE EXCHANGE;
   VAR BYTE : CHAR;

   BEGIN
   READ(KEYBOARD,BYTE);
   WHILE BYTE <> CTRLC DO
      BEGIN
      IF EOLN(KEYBOARD) THEN
         BEGIN
         MAXMIN;
         DRAW(X,Y,6,CURSOR);
         X := 0;
         Y := Y+1;
         MAXMIN;
         DRAW(X,Y,6,CURSOR);
         END
      ELSE
         BEGIN
         MAXMIN;
         DRAW(X,Y,10,BYTE);
         X := X+XVECTOR;
         Y := Y+YVECTOR;
         MAXMIN;
         DRAW(X,Y,6,CURSOR);
         END;
      READ(KEYBOARD,BYTE);
      END;
   MAXMIN;
   DRAW(X,Y,6,CURSOR);
   END;
```

```
{*****************************}
{*                           *}
{* EDITSCREEN ALLOWS THE     *}
{* MOVEMENT OF THE CURSOR    *}
{* AND CALLS THE EXCHANGE    *}
{* ROUTINE                   *}
{*                           *}
{*****************************}
PROCEOURE EDITSCREEN;

      BEGIN
      MAXMIN;
      DRAW(X,Y,6,CURSOR);
      READ(KEYBOARD,CH);
      WHILE CH<>ESCAPE DO
         BEGIN
         XO :=X;
         YO := Y;
         IF EOLN(KEYBOARD) THEN
            BEGIN
            X :=-1;
            Y := Y+1;
            END;
         IF CH=LEFT THEN
            X := X-1;
         IF CH=CTRLI THEN
            X := X+5;
         IF (CH=RIGHT) OR (CH=' ') THEN
            X := X+1;
         IF CH=DOWN THEN
            Y :=Y-1;
         IF CH=UP THEN
            Y := Y+1;
         IF (CH='H') OR (CH='H') THEN
            BEGIN
            XVECTOR :=1;
            YVECTOR :=0;
            EXCHANGE
            END
         ELSE
            IF (CH='V') OR (CH='V') THEN
               BEGIN
               XVECTOR :=0;
               YVECTOR :=1;
               EXCHANGE
               END
            ELSE
               DRAW(XO,YO,6,CURSOR);
         MAXMIN;
         DRAW(X,Y,6,CURSOR);
         READ(KEYBOARD,CH);
         END;
      END;

{*****************************}
{*                           *}
{* STARTUP INITS THE         *}
{* PARAMETERS FOR THE PROGRAM *}
{*                           *}
{*****************************}
PROCEDURE STARTUP;

      BEGIN
      X :=0;
      Y :=1;
      XVECTOR := 1;
      YVECTOR := 0;
      UP := CHR(12);
      DOWN := CHR(15);
      LEFT := CHR(8);
      RIGHT:= CHR(21);
      ESCAPE := CHR(27);
      CTRLC  := CHR(3);
      CTRLI  := CHR(9);
      CURSOR := CHR(127);
      PAGE(OUTPUT);
      GOTOXY(5,5);
      WRITE ('1) GRAPHMODE  2) INITTURTLE :');
      READLN(I);
       IF I=2 THEN
          INITTURTLE;
      GRAFMODE;
      END;

   BEGIN    (* MAIN PROGRAM *)
   STARTUP;
   EDITSCREEN;
   PAGE(OUTPUT);
   TEXTMODE;
   END.
```

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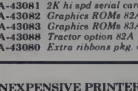

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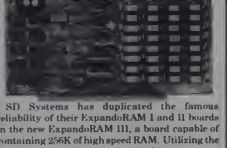

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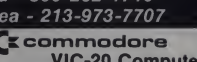

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Printing Apple Low-Resolution Graphics

Joseph J. Navarro

If you possess a printer with "dot-image" graphics capabilities, such as the Epson MX-80 with Graftrax-80, there are several programs on the market which you can use to print Apple high-resolution graphics screens. There does not, however, seem to be any such software available for printing the low-resolution graphics screen.

The program in Listing 1 contains two subroutines, spanning lines 14000 through 15340, which perform this task. The main routine of the program in lines 10 through 170 is simply an example of the way in which the subroutines are used. They are designed to be easily merged into any Applesoft program.

The first subroutine should be executed with a GOSUB 14000 instruction during initialization processing in your program. The second subroutine contains the actual print logic, and can be invoked at any point in your program with a GOSUB 15000 instruction. Whatever is present on the low-resolution graphics screen at the time that this second subroutine is invoked will then be printed.

How The Subroutines Work

The Epson MX-80 is a dot matrix printer; that is, each character it prints is actually composed of dots arranged within a matrix of nine rows and five columns. Thus the letter "E" is formed as follows:

```
. . . . .
.
.
. . .
.
.
. . . . .
```

Note that only seven of the possible nine rows are used for this upper-case letter. The other two rows are used for lower-case letters with "descenders," such as "g" and "p," and for underlining.

When operating in "dot-image" graphics mode, the printer interprets each character sent to it not as a printable character but rather as a byte containing a binary number composed of eight bits. Each such number represents one column of dots, and each column is printed immediately adjacent to the prior column, with no intervening space.

A dot will be printed within the column if its corresponding bit is on in the binary number. The top dot in the column maps to the high-order bit in the binary number, the bottom dot to the low-order bit.

The subroutine beginning at line 15000 sends to the printer six consecutive columns for each of the 1600 plotting positions on the low-resolution graphics screen. Incidentally, these plotting positions are described as "squares" in the Applesoft reference manual, but are actually rectangular on most monitor screens. All dot columns sent by the Apple are seven dots high, because the Apple is a seven-bit machine — it cannot send an eight-bit character over the Epson parallel interface. The printed block resulting from the six seven-dot columns sent to the printer is roughly proportional to the dimensions of the plotted screen rectangle.

The number of bits which are on — and therefore the number of dots which print in each of the columns — depends on the color of the corresponding plotted screen

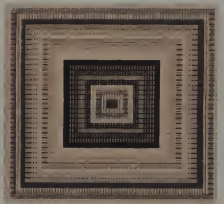

Figure 1. Horizontal Scale 1, Vertical Scale 1.

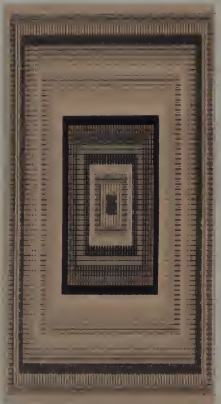

Figure 2. Horizontal Scale 1, Vertical Scale 2.

Joseph J. Navarro, 117 Chelsea Way, Bridgewater, NJ 08807

Figure	Horizontal Scale	Vertical Scale
1	1	1
2	1	2
3	2	1
4	2	2

Table 1.

Figure 3. Horizontal Scale 2, Vertical Scale 1.

Figure 4. Horizontal Scale 2, Vertical Scale 2.

rectangle. Darker colors generate columns with more dots printed than do lighter colors. This varying density of dots results in correspondingly different shades of grey in each printed block of columns. In this way, an attempt is made to compensate for the lack of color capability in the printer.

Sample Program Results

Sample output from the program is shown in Figures 1 through 4, which resulted from the following combinations of print scale factors in Table 1.

In these Figures, the outermost box was plotted in color #5, which is a medium grey in the Apple spectrum.

The Initialization Subroutine

Line 14010 defines the control characters needed by the printer, DOS, and the parallel interface.

Lines 14020 through 14190 load the binary values for the 15 sets (one for each possible color) of six bytes per printed block. Line 14040 defines the most dense pattern, which is used for color #0 (black). Line 14190 defines the least dense pattern, which is used for color #15 (white).

Lines 14200 through 14250 define the horizontal and vertical print scale factors to be used when printing. A scale of 2 will double the size of the printed image in the dimension to which the scale is assigned. Using scale 2 increases printing time significantly.

The Printing Subroutine

Lines 15010 through 15020 send the DOS and parallel interface commands which change the output device (referenced in PRINT instructions) from the screen to the printer, and set the line width to 80 characters.

Line 15030 advances the printer to the top of the next page, in preparation for beginning the graphics print.

Line 15040 sends the printer command which sets the height of a line feed to 7/72" of paper. Since the Apple sends columns which are seven dots (bits) in height, and since a dot is 1/72" in diameter, this command insures that each row of printed graphics will immediately abut the row above it, with no intervening space.

Lines 15050 through 15290 are the heart of the print subroutine. A group of six nested FOR/NEXT loops actually generates the printed representation of the plotted low-resolution graphics screen. The loops, identified by the variable which controls each, are:

- The "Y" Loop — lines 15050 through 15290. This loop executes once for each of the 40 plotted rows on the screen.
- The "Z" Loop — lines 15055 through 15280. This loop executes either once or twice, depending on the chosen vertical print scale factor.
- The "S" Loop — lines 15056 through 15260. Each printed line is transmitted to

the printer in four separate patterns. This loop is executed once for each of those patterns, which are cleared in line 15057, filled by the loops described below, and then sent to the printer in line 15250. Line 15240, executed immediately before the pattern is sent, signals the printer that the forthcoming stream of data is a bit-image graphics string of either 60 or 120 bytes in length, depending on the chosen horizontal print scale factor.

- The "X" Loop — lines 15060 through 15230. Each pattern printed by the "S" loop described above maps to ¼ of a plotted row from the low-resolution graphics screen. This ("X") loop is executed once for each of the 10 plotted spots in each of those ¼ rows. Line 15070 checks the color of the spot and stores it for later use by the "U" loop described below.
- The "V" Loop — lines 15080 through 15220. This loop executes either once or twice, depending on the chosen horizontal print scale factor.
- The "U" Loop — lines 15090 through 15210. This loop executes six times. Its purpose is to add to the developing print pattern the six sets of binary values which will generate the shade of grey matching the color which was saved during execution of the "X" loop.

Line 15300 advances the paper to the top of the next page after the entire low-resolution graphics screen has been processed.

Line 15310 reinitializes the printer to its default values.

Lines 15320 through 15330 re-direct output generated by the PRINT instruction back to the screen.

The Main Routine

Line 10 invokes the initialization subroutine.

Line 15 sets the normal Apple low-resolution graphics mode (see **Using Full-Screen Graphics** below).

Lines 20 through 110 generate a graphics pattern of nested boxes on the low-resolution graphics screen. Line 20 chooses the color for the outermost box at random.

Line 120 invokes the printing subroutine.

Lines 130 through 170 determine if another print is desired. If not, the program terminates. If another print is desired, then the portion of the initialization subroutine which sets the print scale factors is invoked and then the program branches to line 120 for printing.

Using Full-Screen Graphics

These low-resolution graphics print subroutines are written for use with an Applesoft program that uses the "mixed-graphics-plus-text" mode which is invoked by the GR instruction. This mode provides graphics plotting on a 40 by 40 plot matrix at the top of the screen, together with four text lines at the bottom of the screen.

The Apple also provides a "full-screen" low-resolution graphics capability. In this mode, which is invoked by POKEing 0 to address -16302 after the GR instruction has been issued, graphics plotting is done on a full-screen matrix of 48 lines, each containing 40 plotting positions, with no text print facility on the screen.

Listing 1.

```
10  GOSUB 14000
15  GR
20 T =  INT ( RND (1) * 16)
30  FOR R = 0 TO 19
40 T = T + 1
50  IF T > 15 THEN T = 0
60  COLOR= T
70  HLIN R,39 - R AT R
80  VLIN R,39 - R AT 39 - R
90  HLIN 39 - R,R AT 39 - R
100  VLIN 39 - R,R AT R
110  NEXT R
120  GOSUB 15000
130  PRINT "PRINT AGAIN? ";: GET RESPNSE$
140  IF RESPNSE$ <  > "Y" THEN  END
150  PRINT
160  GOSUB 14200
170  GOTO 120
14000  REM  ### INITIALIZATION SUBROUTINE ###
14010 E$ =  CHR$ (27):D$ =  CHR$ (4):I$ =  CHR$ (9)
14020  DIM BYTE%(15,6)
14030  FOR X = 0 TO 15: FOR Y = 1 TO 6: READ BYTE%(X,Y): NEXT : NEXT
14040  DATA  127,127,127,127,127,127
14050  DATA  127,73,85,127,73,85
14060  DATA  127,85,85,127,85,85
14070  DATA   85,85,73, 85,85,73
14080  DATA  127,73,127,127,73,127
14090  DATA   85,0,0,85,0,0
14100  DATA  85,85,85,85,85,85
14110  DATA  127,0,0,127,0,0
14120  DATA  127,85,127,85,127,85
14130  DATA  85,73,85,73,85,73
14140  DATA  85,0,73,85,0,73
14150  DATA  73,0,0,73,0,0
14160  DATA  73,73,73,73,73,73
14170  DATA  85,0,85,0,85,0
14180  DATA  73,0,73,0,73,0
14190  DATA  0,0,0,0,0,0
14200  HOME : PRINT "HORIZONTAL SCALE 1 OR 2? ";: GET RESPNSE$
14210  IF RESPNSE$ = "2" THEN HSCALE% = 2: GOTO 14230
14220 HSCALE% = 1
14230  PRINT : PRINT : PRINT "VERTICAL SCALE 1 OR 2? ";: GET RESPNSE$
14240  IF RESPNSE$ = "2" THEN VSCALE% = 2: GOTO 14260
14250 VSCALE% = 1
14260  HOME
14270  RETURN
15000  REM   ### PRINT SUBROUTINE ###
15005  PRINT
15010  PRINT D$;"PR#1";: REM     PRINTER ON
15020  PRINT I$;"80N";: REM      SCREEN OFF
15030  PRINT  CHR$ (12);: REM  TOP OF FORM
15040  PRINT E$;"A";  CHR$ (7);: REM SET LF TO 7/72 OF AN INCH & LF ONE LINE
15050  FOR Y = 0 TO 39
15055  FOR Z = 1 TO VSCALE%
15056  FOR S = 0 TO 3
15057 PTRN$ = ""
15060  FOR X = 0 TO 9
15070 W =  SCRN( ((S * 10) + X),Y)
15080  FOR V = 1 TO HSCALE%
15090  FOR U = 1 TO 6
15200 PTRN$ = PTRN$ +  CHR$ (BYTE%(W,U))
15210  NEXT U
15220  NEXT V
15230  NEXT X
15240  PRINT E$;"K";  CHR$ (60 * HSCALE%);: CHR$ (0);: REM    SIGNAL PRINTER
           THAT A GRAPHICS STRING IS COMING
15250  PRINT PTRN$;
15260  NEXT S
15270  PRINT ""
15280  NEXT Z
15290  NEXT Y
15300  PRINT  CHR$ (12);: REM     TOP OF FORM
15310  PRINT E$;"2": REM          RESET PRINTER
15320  PRINT I$;"1": REM          SCREEN ON
15330  PRINT D$;"PR#0": REM       PRINTER OFF
15340  RETURN
```

In order to use these subroutines with an Applesoft program using full-screen low-resolution graphics plotting, simply change the 39 in line 15050 to 47 so that it reads:

```
15050 FOR Y = 0 TO 47
```

This will extend the scan/print iteration to the eight additional graphic lines. □

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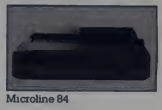

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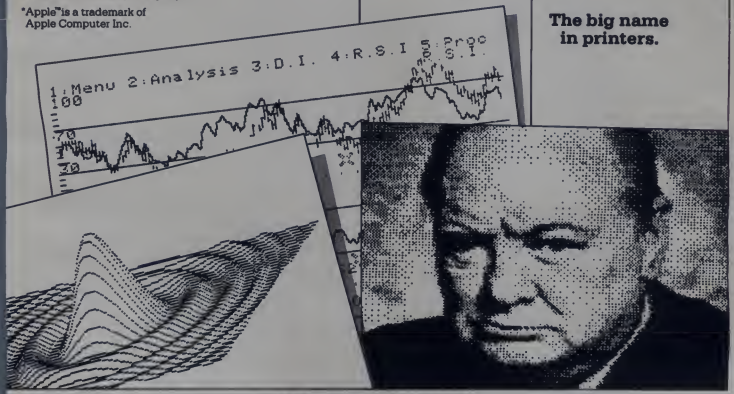

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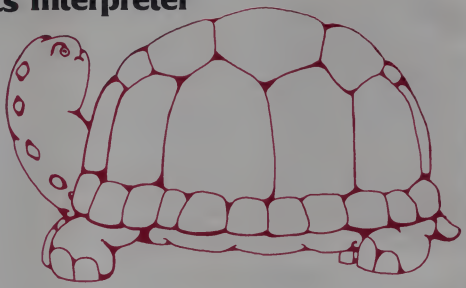
Al Evans



"Quick — give me a Basic routine to draw a polygon with any number of sides anywhere on the screen," challenged my "famous artist" friend Jim Gabour.

Shades of high school trigonometry. I thought fast — well, medium fast.

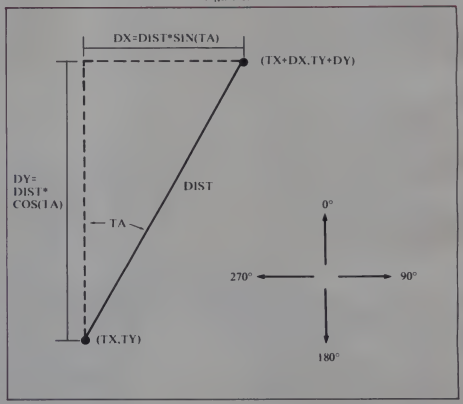
The Apple II has marvelous graphics capabilities. The problem is that to plot a point, you must know its X and Y coordinates. To draw a hexagon, for example, you must know which six points to draw lines between. And unless you are more intimate with simple geometric figures than I am, finding the coordinates of those six points can be occasion for a great deal of head scratching.

Enter the ideas of Dr. Seymour Papert of MIT the "inventor" of the computer language Logo and, specifically, of Turtlegraphics. "Why not," says Dr. Papert, "have a small beastie somewhere on the screen — call it a turtle — which knows where it is and what direction it's facing, and is capable of moving, turning, and drawing lines with its tail?"

Hmmm . . . in that case, if N were the number of polygon sides to be drawn and DIST were the length of each side, we could simply tell the turtle TURN(360/N): MOVE(DIST) N times, and there's our polygon.

But how do we get that turtle into the Apple without springing for Pascal and a language card?

Figure 1.



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13	CHECKBK1	Checkbook maintenance program
14	MORTGAGE/A	Mortgage amortization table
15	MULTMORT	Computes time needed for money to double, triple, etc.
16	SALVAGE	Determines salvage value of an investment
17	RRVARIN	Rate of return on investment with variable inflows
18	RRCONST	Rate of return on investment with constant inflows
19	EFFECT	Effective interest rate of a loan
20	FVAL	Future value of an investment (compound interest)
21	PVAL	Present value of a future amount
22	LOANPAY	Amount of payment on a loan
23	REGWITH	Equal withdrawals from investment to leave 0 over
24	SIMPDISK	Simple discount analysis
25	DATEVAL	Equivalent & nonequivalent dated values for oblig.
26	ANNUDEF	Present value of deferred annuities
27	MARKUP	% Markup analysis for items
28	SINKFUND	Sinking fund amortization program
29	BONDVAL	Value of a bond
30	DEPLETE	Depletion analysis
31	BLACKSH	Black Scholes options analysis
32	STOCVAL1	Expected return on stock via discounts dividends
33	WARVAL	Value of warrant
34	BONDVAL2	Value of a bond
35	EPSEST	Estimate of future earnings per share for company
36	BETAALPH	Computes alpha and beta variables for stock
37	SHARPE1	Portfolio selection model-i.e. what stocks to hold
38	OPTWRITE	Option writing computations
39	RTVAL	Value of a right
40	EXPVAL	Expected value analysis
41	BAYES	Bayesian decisions
42	VALPRINF	Value of perfect information
43	VALADINF	Value of additional information
44	UTILITY	Derives utility function
45	SIMPLEX	Linear programming solution by simplex method
46	TRANS	Transportation method for linear programming
47	EOQ	Economic order quantity inventory model
48	QUEUE1	Single server queueing (waiting line) model
49	CVP	Cost-volume-profit analysis
50	CONDPROF	Conditional profit tables
51	OPTLOSS	Opportunity loss tables
52	FQUOQ	Fixed quantity economic order quantity model

NAME	DESCRIPTION
53 FQEOWSH	As above but with shortages permitted
54 FQEOQPB	As above but with quantity price breaks
55 QUEUECB	Cost-benefit waiting line analysis
56 NCFANAL	Net cash-flow analysis for simple investment
57 PROFIND	Profitability Index of a project
58 CAPI	Cap. Asset Pr. Model analysis of project
59 WACC	Weighted average cost of capital
60 COMPBAL	True rate on loan with compensating bal. required
61 DISCBAL	True rate on discounted loan
62 MERGANAL	Merger analysis computations
63 FINRAT	Financial ratios for a firm
64 NPV	Net present value of project
65 PRINDLAS	Laspeyres price index
66 PRINDPA	Paasche price index
67 SEASIND	Constructs seasonal quantity indices for company
68 TIMETR	Time series analysis linear trend
69 TIMEMOV	Time series analysis moving average trend
70 FUPRINF	Future price estimation with inflation
71 MAILPAC	Mailing list system
72 LETWRT	Letter writing system-links with MAILPAC
73 SORT3	Sorts list of names
74 LABEL1	Shipping label maker
75 LABEL2	Name label maker
76 BUSBUD	DOME business bookkeeping system
77 TIMECLCK	Computes weeks total hours from timeclock info.
78 ACCTPAY	In memory accounts payable system-storage permitted
79 INVOICE	Generate invoice on screen and print on printer
80 INVENT2	In memory inventory control system
81 TELDIR	Computerized telephone directory
82 TIMUSAN	Time use analysis
83 ASSIGN	Use of assignment algorithm for optimal job assign.
84 ACCTREC	In memory accounts receivable system-storage ok
85 TERMSPAY	Compares 3 methods of repayment of loans
86 PAYNET	Computes gross pay required for given net
87 SELLPR	Computes selling price for given after tax amount
88 ARBCOMP	Arbitrage computations
89 DEPRSF	Sinking fund depreciation
90 UPSZONE	Finds UPS zones from zip code
91 ENVELOPE	Types envelope including return address
92 AUTOEXP	Automobile expense analysis
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CIRCLE 136 ON READER SERVICE CARD

Hazy memories of twelfth grade math and a frantic search of available references led to Figure 1.

In this figure, TX and TY are the turtle's present X and Y coordinates. TA is the turtle's present angle with respect to the vertical, and DIST is the distance we want it to move. If DX is the distance the turtle will move on the X axis and DY the distance on the Y axis, the other end of the line it will draw is (TX+DX,TY+DY). So we need to compute DX and DY.

Straight from the moldy old trig text comes the answer: DX = DIST * SIN(TA) and DY = DIST * COS(TA). Pretty simple, huh?

Pop quiz: what happens to the formulas if we turn the picture 90° so that 0° faces due east, as is the case in Apple Pascal Turtlegraphics?

If you answered "Why, the X and Y axes are interchanged, so that now DX = COS(TA) and DY = SIN(TA)" without actually turning the picture sideways, you're a lot better at visualization than I am. Go to the head of the class.

How do we get that turtle into the Apple without springing for Pascal and a language card?

Let's play with the turtle a bit, then come back to the question of polygons.

Listing 1 is HTURTLE, an interactive Turtlegraphics emulator written in Applesoft Basic. It works like the Turtlegraphics unit used in Apple Pascal, except that 0° is due north and angles increase in a clockwise direction (points of personal preference). In addition, the maximum Y value is 159 (to leave room for text at the bottom).

The turtle understands the following commands:

INITTURTLE: Clears the screen to black and places the turtle in the center, heading north (0°).

PENCOLOR(COLOR): Tells the turtle what color of electrons to fill its tail with. The possible values are NONE, BLACK, GREEN, BLUE, WHITE, ORANGE, and VIOLET.

TURN(ANGLE): Tells the turtle to turn ANGLE degrees. Positive values are clockwise, negative values counterclockwise.

TURNTO(ANGLE): The turtle turns to face in the direction ANGLE.

Listing 1:

```
10  REM  "HTURTLE"
11  REM  TURTLEGRAPHICS
12  REM  APPLESOFT INTERPRETER
13  REM  COPYRIGHT 1981 BY
14  REM  AL EVANS
49 :
50  LOMEM: 16384
55  GOSUB 10000: REM   INITIALIZE
56 :
100  REM  MAIN LOOP AND
101  REM  COMMAND PARSER
110 IN$ = "":CMD$ = "":PAR$ = "": PRINT ">";
115  GET CH$: IF CH$ =  CHR$ (13) THEN 145
120  IF CH$ < > CHR$ (8) THEN 140
125  IF  LEN (IN$) = 0 THEN 115
130  IF  LEN (IN$) = 1 THEN IN$ = "": POKE 36, PEEK (36) - 1: GOTO 115
135 IN$ =  LEFT$ (IN$, LEN (IN$) - 1): POKE 36, PEEK (36) - 1: GOTO 115
140  PRINT CH$;:IN$ = IN$ + CH$: GOTO 115
141 :
145  PRINT : FOR I = 1 TO  LEN (IN$)
150  IF  MID$ (IN$,I,1) = "(" THEN CMD$ =  MID$ (IN$,1,I - 1):PAR$ =  MID$
     (IN$,I + 1):I = 0: GOTO 200
155  NEXT I
160 CMD$ = IN$
198 :
199  REM  COMPARE TO CMD$ LIST
200  FOR I = 1 TO NC
205  IF CMD$ = CMD$(I) THEN CASE = I:I = 0: GOTO 300
210  NEXT I
220  INVERSE : PRINT "DO NOT UNDERSTAND": NORMAL : GOTO 110
299 :
300  REM  SELECT SUBROUTINE
301  REM  THEN LOOP BACK
305  ON CASE GOSUB 1000,1500,2000,2500,3000,3500,4000,4500,5000,5500: REM
     "CASE SELECTOR"
310  GOTO 110
311 :
1000  REM  INITTURTLE
1005 TX = 140:TY = 80:TA = 0:DF = 0
1010  POKE 34,20: HOME : HGR
1015  RETURN
1499 :
1500  REM  PENCOLOR
1505  FOR I = 1 TO  LEN (PAR$)
1510  IF  MID$ (PAR$,I,1) = ")" THEN PAR$ =  MID$ (PAR$,1,I - 1):I = 0:
      GOTO 1520
1515  NEXT I
1520  IF PAR$ = "NONE" THEN DF = 0: RETURN
1525  FOR I = 1 TO 6
1530  IF PAR$ = CLR$(I,1) THEN CLR =  VAL (CLR$(I,2)):I = 0: GOTO 1545
1535  NEXT
1540  INVERSE : PRINT "NO SUCH COLOR": NORMAL : RETURN
1545  HCOLOR= CLR:DF = 1
1550  RETURN
1999 :
2000  REM  TURN
2005 TA = TA + CF *  VAL  (PAR$)
2010  IF TA < 0 THEN TA = TA + TWOPI: GOTO 2010
2015  IF TA  > TWOPI THEN TA = TA - TWOPI: GOTO 2015
2025  RETURN
2499 :
2500  REM  TURNTO
2505 TA = CF *  VAL  (PAR$)
2510  IF TA < 0 THEN TA = TA + TWOPI: GOTO 2510
2515  IF TA  > TWOPI THEN TA = TA - TWOPI: GOTO 2515
2525  RETURN
2999 :
3000  REM  MOVE
3005 DIST =  VAL  (PAR$):DX = TX:DY = TY
3010 DX = DIST *  SIN  (TA):DY = DIST *  COS  (TA)
3015 TX = DX + DX:TY = DY + DY
3020  IF TX > 279 OR TX < 0 OR TY > 159 OR TY < 0 THEN TX = DX:TY = DY:
      INVERSE : PRINT "OFF SCREEN": NORMAL : RETURN
3025  REM  FLIP Y COORDINATE
3030  REM  AND DRAW LINE
3035  IF DF THEN  HPLOT DX,159 - DY TO TX,159 - TY
3040  RETURN
3499 :
3500  REM  MOVETO
3502 DX = TX:DY = TY
```

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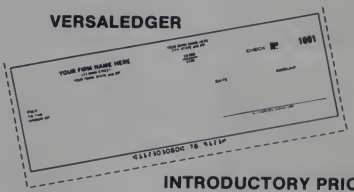

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CIRCLE 137 ON READER SERVICE CARD

HTURTLE, continued...

MOVE(DISTANCE): The turtle moves DISTANCE units in the direction it is presently facing. If PENCOLOR is anything other than NONE, it draws a line in PENCOLOR.

MOVETO(X,Y): The turtle moves to screen coordinates X,Y. If PENCOLOR is anything other than NONE, it draws a line in PENCOLOR.

TURTLEX: Reports the turtle's present X position.

TURTLEY: Reports the turtle's present Y position.

TURTLEANG: Reports the turtle's present direction.

QUIT: Switches the computer back to text, resets the normal text window, homes the cursor, and ENDs the program.

Order the turtle about by typing in commands and parameters in the format shown above. The closing parenthesis may be omitted. The turtle's "box" is 280 x 160 screen units, with point 0,0 in the lower left-hand corner.

Now back to the original problem: to draw an N-sided polygon anywhere on the screen. The aforementioned trig text only had the one illustration (I went to a cheap high school), so I played with it a bit and came up with Figure 2.

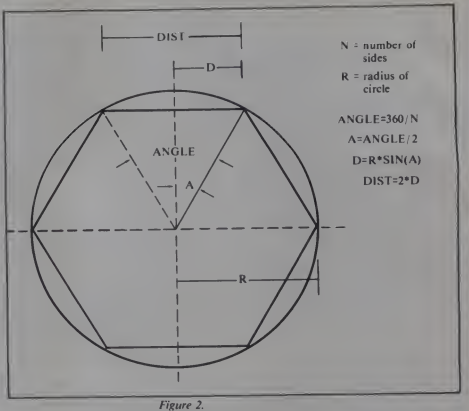

Figure 2.

Listing 1, continued...

```
3505  FOR I = I TO  LEN (PAR$)
3510  IF  MID$ (PAR$,I,1) = "," THEN TX =  VAL ( MID$ (PAR$,I,I - I))
      :TY = VAL ( MID$ (PAR$,I + 1)):I = 0: GOTO 3530
3515  NEXT I
3520  INVERSE : PRINT "NEED TWO NUMBERS": NORMAL : RETURN
3530  IF TX > 279 OR TX < 0 OR TY > 159 OR TY < 0 THEN TX = OX:TY = OY:
      INVERSE : PRINT "OFF SCREEN": NORMAL : RETURN
3531  REM  FLIP Y COORDINATE
3532  REM  AND DRAW LINE
3535  IF DF THEN  HPLOT OX,159 - OY TO TX,159 - TY
3540  RETURN
3999 :
4000  REM  TURTLEX
4002 TX =  INT (TX + .5)
4005  INVERSE : PRINT "TURTLEX = ";TX: NORMAL
4010  RETURN
4499 :
4500  REM  TURTLEY
4502 TY =  INT (TY + .5)
4505  INVERSE : PRINT "TURTLEY = ";TY: NORMAL
4510  RETURN
4999 :
5000  REM  TURTLEANG
5005  INVERSE : PRINT "TURTLEANG = "; INT (TA / CF + .5): NORMAL
5010  RETURN
5499 :
5500  REM  QUIT
5510  POKE 34,0: TEXT : HOME : END
5999 :
10000  REM  INITIALIZATION
10005  DIM CMD$(20):CF = .0174533:TWOPI = 6.2831853
10010  READ NC: FOR I = 1 TO NC: READ CMD$(I): NEXT
10020  FOR I = 1 TO 6: READ CLR$(1,1): READ CLR$(1,2): NEXT
10030  GOSUB 1000: REM  INITTURTLE
10040  FLASH : PRINT "YOUR TURTLE IS READY": NORMAL
10100  RETURN
10999 :
11000  REM  COMMANDS PRESENTLY
11001  REM  IMPLEMENTED
11100  DATA  10: REM  NC - NUMBER  OF COMMANDS
11105  DATA  INITTURTLE,PENCOLOR
11110  DATA  TURN,TURNTO,MOVE,MOVETO
11115  DATA  TURTLEX,TURTLEY,TURTLEANG
11120  DATA  QUIT
11200  REM  COLORS
11300  DATA  BLACK,0,GREEN,1,BLUE,2,WHITE,3,ORANGE,5,VIOLET,6
```

Obviously, if we inscribe the N-sided polygon inside a circle, the circle will be divided into N equal "pie slices," and the included angle for each slide (ANGLE) will be 360 / N. In addition, the turtle will have to turn N times, so the angle of each turn will also be 360 / N.

If we divide one of the slices in half vertically, we have the triangle shown in Figure 1 once again. The included angle is now A = ANGLE / 2. Using the same formula as in Figure 1, we have D = R * SIN(A). And 2 * D is the distance the turtle should move after each turn.

So now we can draw a polygon with any number of sides anywhere on the screen, given the number of sides N and the radius R. Listing 2 is POLYGON, a short program which demonstrates this fact.

Lines 60000-60020 and 61000-61020 in POLYGON are "extracts" of the MOVE and TURN subroutines in HTURTLE, and are obviously intended to be "detached" for use in your own programs.

How the Programs Work

HTURTLE has three main parts: the initialization section, the command parser, and the working subroutines.

The initialization routine (lines 10000-11300) first makes room for a list of commands (CMDS(1 to 20)) and sets values for CF, a degree-to-radian conversion factor, and TWOPI, the number of radians in a circle. The next two lines read the number of commands available, the name of each command, the names of the colors available, and the "HCOLOR"


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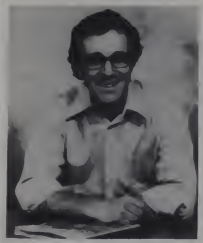

David Ahl, Founder and Publisher of Creative Computing

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CIRCLE 261 ON READER SERVICE CARD

HTURTLE, continued...

Listing 2.

```
10  REM  "POLYGON"
11  REM  MOVE & TURN SUBROUTINES,
12  REM  POLYGON ROUTINE
13  REM  BY AL EVANS, 1980
14 :
15 CF = .0174533:TWOPI = 6.2831853: REM  CONSTANTS
20 TX = 0:TY = 0:TA = 0:DX = 0:DY = 0:OX = 0:OY = 0: REM TURTLE'S VARIABLE
     S
25 DIST = 0:ANGLE = 0: REM  PARAMETERS
26 :
100  REM  CONTROL LOOP
105  HGR : HCOLOR= 3: POKE 34,20: HOME
110  INPUT "CENTER OF POLYGON (X,Y): ";CX,CY
115  INPUT "RADIUS OF POLYGON: "1R
120  IF CX + R > 279 OR CX - R < 0 OR CY + R > 159 OR CY - R < 0 THEN
     INVERSE : PRINT "TOO BIG": NORMAL : GOTO 115
125  INPUT "NUMBER OF SIDES: "1N
130  GOSUB 1000
135  GOTO 110
136 :
1000  REM  POLYGON
1005  HPLOT CX,CY: REM  MARK CENTER
1010 ANGLE = 360 / N: A = ANGLE / 2
1015 DIST = 2 * (R * SIN (A * CF))
1020 TX = CX + R * SIN (A * CF):TY = 159 - CY + R * COS (A * CF):TA = 90
     * CF: REM  START AT TOP RIGHT, FACING EAST
1025  FOR I = 1 TO N
1030  GOSUB 61000: GOSUB 60000
1035  NEXT I
1040  RETURN
1041 :
60000  REM  MOVE
60005 DX = DIST * SIN (TA):DY = DIST * COS (TA):OX = TX:OY = TY
60010 TX = OX + DX:TY = OY + DY
60015  HPLOT OX,159 - OY TO TX,159 - TY
60020  RETURN
61000  REM  TURN
61005 TA = TA + CF * ANGLE
61010  IF TA < 0 THEN TA = TA + TWOPI: GOTO 61010
61015  IF TA > = TWOPI THEN TA = TA - TWOPI: GOTO 61015
61020  RETURN
```

number for each color from the data list in lines 11000-11300. The routine then initializes the turtle, prints a "hello" message, and RETURNs. Control passes to the command parser, the "main loop" of this program.

The command parser (lines 100-310) has the job of getting a command from the keyboard character-by-character, separating it into its command (CMD$) and parameter (PAR$) parts, and comparing the command to the list of defined actions. If the command entered is not on the list, an error message is displayed and the program loops back to get another command. If the command is valid, the appropriate subroutine is selected in line 305.

Note that this command parser simply passes all input following the command to the working subroutine as a string of characters. Each subroutine is smart enough to figure out whether it has the information it needs.

The design of the initialization routine and command parser make it easy to add new commands. Simply change NC in line 11100, add the new commands at the end of the data list (line 11020), and add the line numbers on which the new subroutines begin to the list of "cases" in line 305.

The working subroutines begin at line 1000.

INITTURTLE (lines 1000-1015) places the turtle in the middle of the screen heading north, clears the screen to HI-RES page 1, and homes the cursor to the top of the text window. DF (draw flag) is a logical variable which controls whether any plotting actually takes place. It is set to 0 by INITTURTLE so that nothing will be drawn on the screen (PENCOLOR will be NONE).

The last time I saw him he was negotiating with a room full of turtles and an ink manufacturer for "exclusive representation rights."

PENCOLOR (lines 1500-1550) removes the final parenthesis (if any) from the parameter it receives and sets DF to 0 if the parameter is NONE. Otherwise, it checks PAR$ against the list of colors. If a match is not found, it issues an error message and RETURNs. If the parameter is a defined color, it sets HCOLOR to the appropriate value and sets DF to 1 so that plotting can take place.

TURN (lines 2000-2025) adds VAL(PAR$) * CF radians to the turtle angle (TA), then adds or subtracts as many complete circles (TWOPI) as necessary to keep the final angle between 0 and 360 degrees. Note that no parsing is necessary in this subroutine if PAR$ cannot be interpreted as a number, its VALue is 0, and the subroutine will do nothing.

TURNTO (lines 2500-2525) works identically, except that the old value of TA is simply replaced with the new one.

MOVE (lines 3000-3040) uses the formulas given above to calculate the X and Y components (DX and DY) of the vector DIST. These components are added to TX and TY to determine the new screen position of the turtle. If the new position is not within the graphics window, an error message is displayed and the old position is restored. If the new position is on the screen and the draw flag is set, the line is drawn.

MOVETO (lines 3500-3535) looks through the PAR$ passed to it for a comma. If it doesn't find one, it issues an error message and RETURNs to the main loop. If PAR$ contains a comma, everything numeric before the comma is used as a new TX value and everything of VALue after it as a new TY value. If the new coordinates are off the screen, an error message is displayed and the old position is restored. If the new position is on the screen and DF is set, the line is drawn.

TURTLEX, TURTLEY, and TURTLEANG (lines 4000-5010) display the turtle's present X position, Y position, and angle. The X and Y coordinates are rounded to integers; the angle is converted back from radians to degrees and rounded to the nearest degree.

The POLYGON program is very simple. The constants, variables, and parameters used by the turtle are initialized in lines 15-25. Lines 100-135 control the program.

The POLYGON routine in lines 1000-1040 uses the techniques developed earlier to draw an N-sided polygon with a radius of R centered at CX,CY. ANGLE and DIST are calculated in lines 1015-1020 using the formulas of Figure 2. The starting position is calculated in line 1025. Then lines 1030-1040 draw the polygon using the MOVE and DRAW subroutines.

These subroutines can be extracted (by DELeting lines 10 to 1046) and used in any program. Note that DRAW does no error-checking; make sure your program doesn't call on it to draw a line off the screen. The value 159 in line 60015 can be changed to 191 for full-screen plotting. Or the line can be changed to HPLOT OX,OY TO TX,TY to use the normal Apple coordinate system with 0,0 at the upper left.

"Eureka!" cried Jim, "it actually works!" He ran off muttering something about squaring the circle, and the last time I saw him he was negotiating with a room full of turtles and an ink manufacturer for "exclusive representation rights." □

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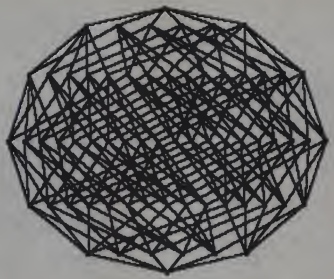

Plotting N-Space Cubes

Dennis Clark

Every school child knows how to draw a square or a cube on a piece of paper. It is something we all learn at an early age. We can do it almost without thinking. But very few people can draw a picture of a tesseract (four-space cube) on a piece of paper.

For those people who know what a tesseract is, many would consider drawing one a rather pointless job. But there are a few strange individuals who are possibly science fiction buffs, or mathematicians or puzzle solvers who enjoy thinking about, and devising methods for drawing things like N-space cubes.

I do not claim to be a mathematician (I have trouble integrating e^x) but I do read a great deal of science fiction and I like to fiddle with puzzles.

Now it happens that N-space cubes are full of puzzling riddles, one of which is: How do you draw them on paper? Not many people could draw a four-space cube, but even fewer are able to draw a five- or six-space cube.

This article then, is dedicated to those puzzle solvers who wish to explore the mysteries of plotting N-space cubes on their home computers.

Although some of the characteristics of N-space cubes are perhaps hard to envision, many of their properties can be reduced to simple ideas that anyone can understand, and if I can understand how to draw them, you can too.

If you try to think of the fourth dimension as being time, and that dimension as being somehow tied together with a three-space cube you have already gone beyond my understanding of what a cube is, and have left me in the dust.

Dennis Clark, Route 2 Box 264, Paint Rock Ferry Road, Kingston, TN 37763

What I have to say about cubes has nothing to do with time travel or exiting from one side of a tesseract only to end up back inside of the thing. I won't discuss walking through a tesseract house watching yourself watch yourself walking through a tesseract house. What I am going to show you is how to draw a picture of an N-space cube on a two-dimensional surface.

Everything is aimed at magically obtaining order from the chaos of points which will appear as you create larger and larger N-space cubes.

Let's start out with an easy one. We'll start with a square. A square is really nothing more than a two-space cube. It is a two-dimensional cube. If we view a cube from one side, all we see is a square. This is easy to understand because we "took away" the third dimension of the cube, and are left with the square.

To draw a cube, all we need is two squares and four extra lines which conneet each corner of one square to the same corner of the other square. Stated another way: a three-space cube can be made from two two-space cubes by drawing a line from each corner of one square to the same corner on the other square.

This can be generalized into the following rule: An (N+1)-space cube can be made from two N-space cubes by drawing a line from each corner of one N-space cube to the same corner on the other N-space cube.

Once you understand this rule, you can create any N-cube. For instance, to make a four-space cube just place two three-space cubes close together on a piece of paper, and draw a line between identical corners on each cube. Give it a try.

Drawing a Cube

Take a piece of paper right now, and draw two cubes, and then connect the top corners of each cube with a line segment, and the two bottom corners with a line segment, and the other six corners of each cube to their corresponding corners on the other cube. You will have created a four-space cube from two three-space cubes.

This method can be used to create any N-space cube from two (N-1)-space cubes. So if you wish, you could create a five-space cube by first drawing two four-space cubes close to each other, and then connecting each corner of one of the four-space cubes to its corresponding corner on the other four-space cube. Try it onee you have drawn a four-space cube.

Of course, you may notice that the drawings you produce become a bit messy after a while. This comes from not knowing where to put the corners of the cubes so that they don't interfere with each other. We'll clean that up in a minute.

The important thing to understand is the very simple concept that any N-space cube is just made up of two (N-1)-space cubes, which are each made up of two (N-2)-space

cubes, etc. You can even extend the method on down to one-space and zero-space cubes.

A two-space cube (square) is made up of two one-space cubes (line segments) with two lines connecting the beginning point of the first line segment to the beginning point of the second line segment. And of course, the end point of the first line segment is connected to the end point of the second line segment.

A one-space cube is made from two zero-space cubes (points) with a single line drawn between those points. I thought I would include those last two examples for the mathematicians who feel insecure if the method doesn't work for all cases, but I personally refuse to consider anything less than a zero-space case.

For convenience, I would like to define a "point" as being any corner of a cube. A picture of a cube is really made up of nothing but line segments. The places where the line segments come together to form corners are really points, and it will be easier to refer to them as such from here on.

If you have followed these ideas up to this point, you are now capable of drawing any N-space cube on a piece of paper. If you wish to clean up the mess you would create by drawing them, read on. From here on, everything is aimed at magically obtaining order from the chaos of points which will appear as you create larger and larger N-space cubes.

For instance, each N-cube has $N*2^{(N-1)}$ line segments and 2^N points. If you draw an 11-space cube, your cube will have over 11,000 line segments, and over 2000 points, which gets very messy if you don't have logical places to put all of those points and lines. So, even though you can now make N-space cubes out of two (N-1)-space cubes, you need a better method which will tell you where to put all of the points of the cube.

Naming the Points

If you tried to create a four- or five-space cube by the methods outlined above, you are aware by now that it is sort of like trying to keep 16 or 32 children in line without knowing what their names are. So to keep order we have to name each of the points in any N-space cube.

Rather than call the points Johnny, Bruce, Dick, or Sally, it might be better if we use a mathematical model to name them. Let's really be original and name them 0, 1, 2, 3 . . . (2^N -1) where N is the dimension of the cube you are going to draw. Let's further say that the points will be labeled using binary numbers, not decimal numbers.

Why use binary numbers instead of decimal? Because they have the wonderful property of telling us which points should be close to each other. They solve the problem of keeping track of which point should be tied to which other points by line segments.

They tell us which points are "adjacent" to each other. They do this because in a three-space cube each point is adjacent to exactly three other points. A three-digit binary number can tell us which three points are adjacent to itself.

In a four-space cube, each point is adjacent to exactly four other points. A four-digit binary number can tell us which four points are adjacent to it.

In an N-space cube, each point is adjacent to exactly N other points. Another way of putting it is to say that three lines emanate from each corner in a three-space cube. Four lines radiate from each point in a four-space cube. These facts eventually lead us to a definition for points which are adjacent to each other.

Two points are said to be adjacent if the binary number "names" of those points differ by one and only one binary digit. "Adjacents" are those points which are adjacent to any given point.

This is the most important rule you must understand in order to create neatly structured N-space cubes. In fact, it is the only rule you need to understand how to create them. It is easy to think of an N-space cube being created out of two (N-1)-space cubes, but since the method creates messy cubes, it is only of value in understanding the structure of N-space cubes.

When you can determine which points are adjacent to each other, you will be able to make several different styles of any N-space cube which will (probably) look neat and orderly when you draw them. The rule will become clear when we try an example.

Connecting the Dots

Let's build a three-space cube by labeling its corners with binary numbers. Remember that two points which are adjacent are connected by a single line segment. Since we are working with a three-space cube, it will have 2^3 points.

It can be represented by the eight three-digit binary numbers 000 through 111. If we start by placing the point 000 on a piece of paper, we can readily see that its three adjacent points are those that differ from 000 by one digit only; namely, 001, 010, and 100.

Place the three adjacent points on an imaginary horizontal line below the point 000. Since 000 is adjacent to all three of the points, draw a line from 000 to each of the three adjacents. Now move down to the point 001 and find the three numbers which differ from it by one binary digit. They are the numbers 000 which we already have on the paper, 011, and 101. Computer programmers will recognize the process of finding numbers which differ by one digit as an exclusive "or" binary operation.

Place these two points on an imaginary horizontal line below the points, 001, 010,

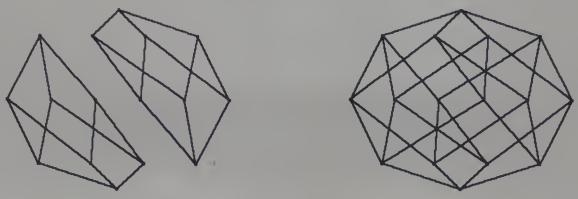

Figure 1. An N-space cube can be made by placing two (N-1)-space cubes next to each other and then connecting each corner of one cube to the same corner of the other cube. In the picture above, two three-space cubes have been slightly distorted into a shape which is good for displaying a four-space cube. When identical corners of each three-space cube are connected with line segments, a four-space cube is created.

and 100. Draw a line from 001 to these new adjacents. Move from the point 001 to the point 010 and figure out what its adjacents are. They are 011 which is already on the line below 010, and 000 which is on the line above and 110 which is a new point which should be placed on the same line with 011 and 101. Draw lines from 010 to all of its adjacents.

Next find the adjacents for 100. You will notice that they are all on the paper. They are 101, 110 and 000. Draw lines to these adjacents from 100. There is only one more adjacent to create. It is found by moving down to the next line of adjacents and finding the number which differs from 011 by one binary digit only, and which is not already on the paper.

It is the point 111. Place it on a line below 110, 101 and 011. If you connect line segments between 111 and its adjacents you will have created a rather lop-sided two-dimensional representation of a three-space cube.

You must remember that even though the angles of the cube are not those that you traditionally think of as belonging to a picture of a cube, it is still a cube. All of the angles in a "cube" are 90 degrees. But when we try to draw those angles in two dimensions they become distorted.

You must remember this when you plot five and six-space cubes, because you may see four connected lines which are of unequal lengths and which do not look anything like squares. Nonetheless, any four lines which link together to form a closed figure represent a square with 90 degree angles. It is just that when we display them in two-space, they look very squashed. Almost all of the angles in an N-space cube will be distorted when viewed in less than N dimensions.

Almost all of the angles in an N-space cube will be distorted when viewed in less than N dimensions.

But I have strayed from the main point. You have just created an N-space cube by starting at an arbitrary point and creating a map of all of the points which were adjacent to the first and subsequent points.

This method can be applied to any N-space cube. I have used it to draw seven-space cubes by hand. By the way, it isn't very fun drawing seven-space cubes by hand. It turns out I am no better at figuring out adjacents than I am at integrating. Just when I am about finished drawing a cube, I draw a line to the wrong point . . . in ink.

Pascal's Triangle

If you decide to create larger cubes by hand, here is an oddity to help you. The Nth level of Pascal's triangle describes the number of points on each horizontal level of the cube you are creating. It also shows you how many levels there should be in the cube. There are always N+1 levels in an N-cube. Pascal's triangle looks like this:

```
1
1  1
1  2  1
1  3  3  1
1  4  6  4  1
1  5 10 10  5  1
1  6 15 20 15  6  1
1  7 21 35 35 21  7  1
```

The top line of Pascal's triangle would correspond to a zero-space cube. That is, a zero-space cube has only one level. It couldn't have any more, since it only has one point. The fifth line of Pascal's triangle would correspond to a four-space cube, which has five levels.

There would be one point on the first level, four points on the second horizontal level, six points on the third level, four on the fourth, and one last point on the fifth level.

A seven-space cube (represented by the eighth line) would have one point on one line, seven on the next line or level, 21 points on the third line, and so on. Knowing how many points should be on each line gives you a convenient method of checking to see if you missed one of the adjacents which should be on that level.

Because of this feature, I call this type of cube a "Pascal's triangle cube." Still, it isn't easy to draw them by hand. It is too easy to make mistakes.

So the computer enters the picture to save the day. Once the computer is programmed properly, it makes fewer

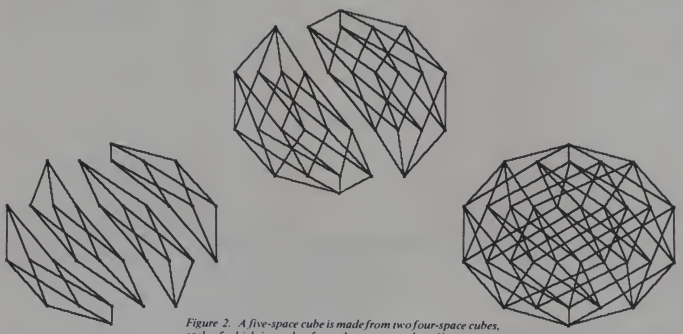

Figure 2. A five-space cube is made from two four-space cubes, each of which is made of two three-space cubes. Here you see the four three-space cubes which can be made into two four-space cubes, which combine to make a five-space cube.

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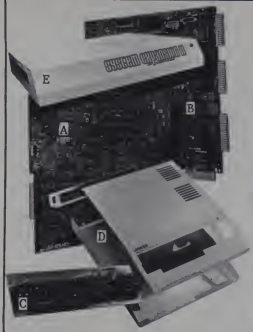

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mistakes than its human counterpart. The computer code which is included in this article was written for an Apple II plus with 48K of memory using the Applesoft floating point Basic.

No attempt was made to use the space available efficiently because the code was originally developed on a DECsystem-10 computer, and I was not anxious to rewrite the code completely.

Much to my surprise, I was able to plot colored graphs of a seven-space cube, as well as all of the smaller cubes. I also have a Silentype thermal printer which I used to create hard-copies of the cubes. Here then is a discussion of what the code does.

The Program

The first section of code creates a list of all of the adjacent points for each and every point from 0 to 127. This list of adjacents uses an array which is 7 x 128. I could have created an adjacent each time I needed one, thereby saving most of the space that I used, but was too lazy to code the program that way.

The program tells you that it has created the lists of adjacents and then asks you whether you would like the cube drawn for you, or whether you would like to create it from the sets of lines which are made by connecting adjacents which differ in a particular digit.

The program then asks you what size cube you would like to plot. You can draw all of the N-cubes up to and including a seven-space cube.

Then the code asks you which type of cube you would like to plot. It draws three

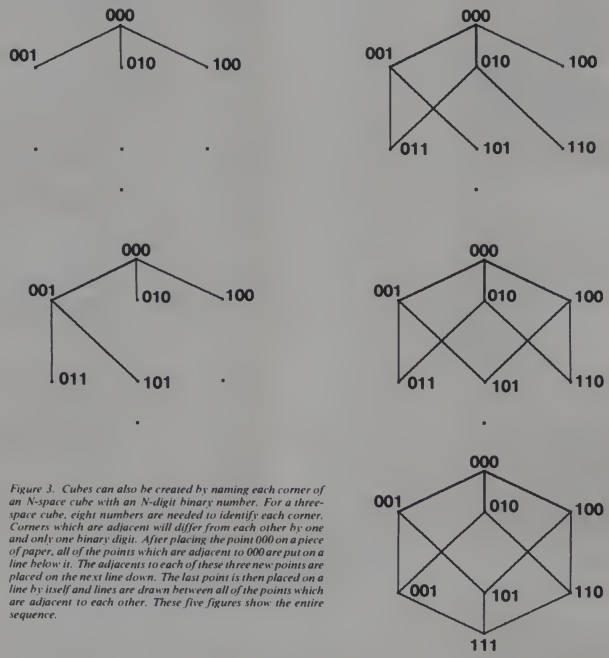

Figure 3. Cubes can also be created by naming each corner of an N-space cube with an N-digit binary number. For a three-space cube, eight numbers are needed to identify each corner. Corners which are adjacent will differ from each other by one and only one binary digit. After placing the point 000 on a piece of paper, all of the points which are adjacent to 000 are put on a line below it. The adjacents to each of these three new points are placed on the next line down. The last point is then placed on a line by itself and lines are drawn between all of the points which are adjacent to each other. These five figures show the entire sequence.

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types of cubes. For two of the types, it places all of the corners of any N-space cube in a circle. It really doesn't matter where the "corners" of the cube are placed, as long as each point remains connected to all of its adjacents by single line segments.

A mathematician would tell you that as long as the connectivity of all of the points remains the same, then no matter where you put the corners, the cube remains topologically equivalent.

One of the "circle cubes" comes out looking twisted. So I call it a twisted circle cube. The twisted circle cube looks as if it could be untwisted if the correct portions of the cube were moved, and, in fact, it can.

The result is the second type of cube which the program draws. I call it an "untwisted circle cube." The reason becomes obvious the first time you view the two types of cubes.

The third type of cube is the type which we have discussed already, where the points of the cube are placed on multiple horizontal levels.

But no matter which type of cube you wish to display, two things must be determined before the cubes can be plotted. The order in which the points will be used must be determined, and the X-Y co-ordinates for each point must be calculated.

For instance, in the twisted circle cube, the X-Y co-ordinates are calculated in sequence, one right after the other as we progress around the circle. The points are used sequentially, starting with point number 1.

When all of the corners are connected to their adjacent corners, a twisted cube results. It looks as if you could untwist certain portions of the cube, and many of the line segments would not cross each other. Indeed that is the case.

By changing the order in which the points are used, the cube can be untwisted. So when you have decided which type of cube to plot, and you have decided what size N-cube you want to plot, the order in which the points will be used is calculated, and then the X-Y co-ordinates of those points are calculated.

Next, the program plots tiny figures which mark the position of each of the corners. It does this to show you where the corners of the cube are located. If your monitor is a color TV, the points will be plotted in different colors depending on where they are plotted. This is due to the funny ways TVs create their color.

When the program finishes plotting the corners, it will wait for you to enter sets of two numbers. The first number will indicate the color of the line to be drawn, and the second number will indicate which set of lines is to be drawn.

If the set of adjacents which differ in the first digit is to be plotted, the second of those two numbers will be a 1. If the set of lines for adjacents which differ in the seventh binary digit is to be drawn, the second number will be a 7.

Two of the colors are black, which means that you can erase lines as well as draw them. That is, you can draw with black, which is the color of the background. There are eight colors which are numbered from 0 to 7. The colors may differ on different televisions.

Also, if a –1 is entered for either a color, or a set of lines, the user is returned to the point in the program where he can plot another N-space cube. If the second number is –1, the user will be asked whether he wants the picture to be printed on a Silentype printer. The printer should either be installed in slot #1 or the program should be changed.

If the user then types anything but YES, he is returned to plot another N-space cube. Unfortunately, since the program is usually displaying what is being drawn, you can't see the program prompts most of the time. So you must remember what to type. Because of this, I have included an actual run of the program so you have a working example.

The lines which are completely capitalized are part of the computer run, while the lines in regular type are comments which I have added to tell you what is going on.

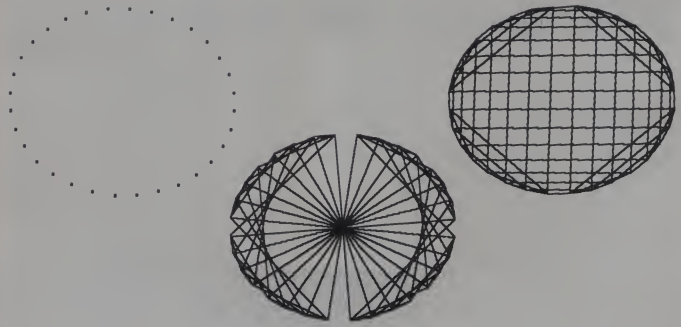

Figure 4. It isn't necessary to place the corners for a cube in any particular position. As long as each corner is connected to its adjacent corners with single line segments, the end result can still be called a cube. In this figure the 32 corners of a five-space cube have been placed in a circle. If the corners are labeled consecutively from the bottom and progressing counter-clockwise, a "twisted circle cube" results when all of the points are connected to their adjacent points. It appears as if the cube could be untwisted by changing the position of some of the corners. When this is done, an "untwisted circle cube" appears.

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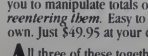

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CIRCLE 198 ON READER SERVICE CARD

N-Space Cubes, continued...

Sample Run

```
RUN CUBES

THIS SECTION OF CODE CREATES THE

ADJACENTS FOR ALL OF THE 'CORNERS'

OF UP TO 7-SPACE CUBES.
```

The program sits there and churns for about 30 seconds.

```
THE ADJACENTS HAVE NOW BEEN CREATED.

DO YOU WANT ME TO DRAW THE

ENTIRE CUBE FOR YOU? (Y OR RETURN) N
```

Anything except Y means that you want to draw the cube yourself.

```
WHAT SIZE N-CUBE DO YOU

WANT TO PLOT? (1-7) 5
```

I wanted to draw a five-space cube, so I entered 5.

```
(1) TWISTED CIRCLE CUBE

(2) UNTWISTED CIRCLE CUBE

(3) PASCAL'S TRIANGLE CUBE

WHICH CUBE DO YOU WISH TO PLOT? 3
```

I wanted to plot the Pascal's Triangle five-space cube.

```
THE PROGRAM IS NOW CALCULATING

THE ORDER IN WHICH THE 32

POINTS OF THE CUBE WILL BE PLOTTED.
```

It sits there and thinks for a while . . .

```
THE PROGRAM IS CREATING THE X-Y

CO-ORDINATES FOR EACH CORNER

OF A PASCAL'S TRIANGLE TYPE OF CUBE
```

It sits there and thinks some more . . .

```
READY TO PLOT. (PRESS 'RETURN')
```

If you don't press the carriage return key, it will sit there forever. When you do press return, the screen will be blanked, and the points of the cube will be plotted. Then, although you won't see the prompt, the program will ask you for a color and line set. Each point of a five-space cube will have five adjacents so you will be able to specify five sets of lines. The five sets are: the set of adjacents which differ in only the first digit, the set of adjacents which differ in only the second digit, and the three sets of adjacents which differ in the third, fourth and fifth binary digits respectively.

```
WHAT COLOR AND LINE SET? 7,1

WHAT COLOR AND LINE SET? 7,2

WHAT COLOR AND LINE SET? 7,3

WHAT COLOR AND LINE SET? 7,4

WHAT COLOR AND LINE SET? 7,5
```

At this point, the cube is entirely plotted, although you never saw the "what color & line set" messages. 7 is white on my television, while 4 is black, so now I'll erase sets of lines.

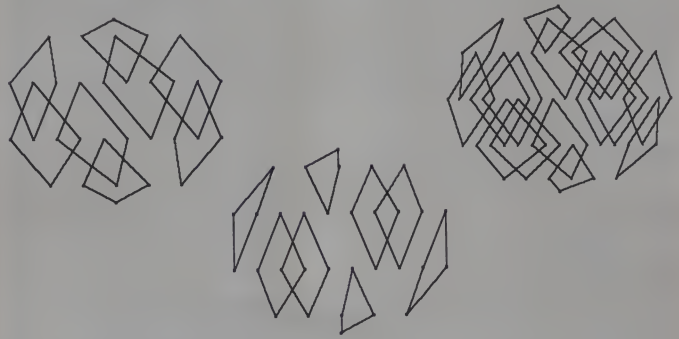
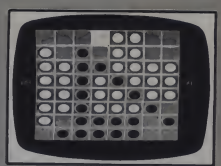


Figure 5. Many different designs can be produced by plotting only portions of the cubes. These figures illustrate some of those designs. Each angle actually represents a 90 degree angle, but since it is being displayed on a two-dimensional surface, it can only be shown distorted out of shape. In all of the pictures where the figures are composed of four lines, the figures are squares created by two sets of lines. For instance, the first figure is composed of the set of adjacents which differ in the second digit, and the set of adjacents which differ in the fourth digit. The second figure is created by drawing lines between points which differ in the second digit, and the points which differ in the third digit. The first two figures are portions of a five-space cube. The third figure is a six-space cube with only the 2 and 4 line sets drawn.

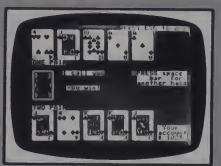
1. APPLE "21"

5. BAKER'S TRILOGY



9. REVERSI

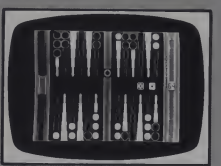
2. CROSSWORDS



6. DRAW POKER

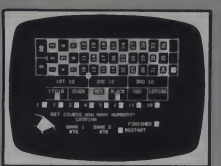
10. CRAPS

3. PHOTAR



7. MICROGAMMON II

11. GOMOKU



4. ROULETTE

8. BEST OF BISHOP

12. STARMINES

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CIRCLE 239 ON READER SERVICE CARD

```
WHAT COLOR & LINE SET? 4,1

WHAT COLOR & LINE SET? 4,2

WHAT COLOR & LINE SET? 4,3

WHAT COLOR & LINE SET? 4,4

WHAT COLOR & LINE SET? 4,5
```

Now, nothing is left but the "corners" which we originally plotted. If you now input 1,0 the plot will disappear and you will be able to choose another type and size of N-cube.

```
WHAT COLOR & LINE SET? -1,0

DO YOU WANT ME TO DRAW THE

ENTIRE CUBE FOR YOU? (Y OR RETURN) ^C
```

A control-C will get you out of the program at any time. That may be an inelegant way to exit from the program, but it works.

One of the nice features about plotting individual sets of lines, instead of plotting the entire cube all at once, is that you can see how N-space cubes are made from two (N-1)-space cubes. Cubes of lesser degree can also be seen by choosing particular sets of lines. You can discover many interesting designs and patterns by playing with the sets of lines in any of the N-cubes. Different combinations of those sets of lines will give you a better idea of how N-cubes are made.

Now that you know the structure of an N-cube and know several ways to draw them, perhaps you can think of other ways to display them. The symmetries involved are fascinating. Cubes are good for stretching your imagination and can lead you to many interesting discoveries. □

Program Listing

```
10  REM  THIS PROGRAM CREATES N-DIMENSIONAL CUBES
20  REM  WHERE N VARIES FROM 1 TO 7
30  REM  WRITTEN SEPT 1981 BY
40  REM  DENNIS CLARK
50  REM  R2 BOX 264
60  REM  PAINT ROCK FERRY ROAD
70  REM  KINGSTON, TENN. 37763
80  REM
90  HOME
100  PRINT "THIS SECTION OF CODE CREATES THE"
110  PRINT
120  PRINT "ADJACENTS FOR ALL OF THE 'CORNERS'"
130  PRINT
140  PRINT "OF UP TO 7-SPACE CUBES."
150  PRINT
160  DIM ADJ(7,128)
170 N = 7
180 ITMP = 2 ^ N
190 NN = N - 1
200  FOR J = 0 TO NN
210 JJ = J + 1
220 LL = 2 ^ J
230 KK = LL
240 JK = 1
250 L2 = 2 * LL
260  FOR K = 1 TO LL
270 ADJ(JJ,JK) = KK
280 JK = JK + 1
290 KK = KK + 1
300  NEXT K
310 KK = KK - L2
320  FOR K = 1 TO LL
330 ADJ(JJ,JK) = KK
340 JK = JK + 1
350 KK = KK + 1
360  NEXT K
370 KK = KK + L2
380  IF (JK <  = ITMP) GOTO 260
390  NEXT J
400  PRINT "THE ADJACENTS HAVE NOW BEEN CREATED"
410  DIM XY(128),X(128),Y(128),P(9),IP(9)
```

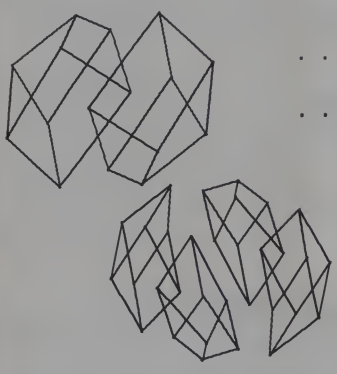

Figure 6. All figures which are composed of eight lines are actually three-space cubes residing in a higher-space cube. The first figure shows two three-space cubes created with the 1, 2, and 3 line sets in a four-space cube. The next figure shows three-space cubes inside a five-space cube.

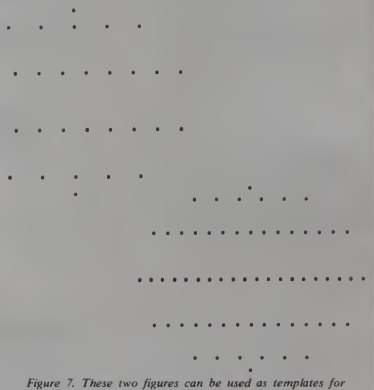

Figure 7. These two figures can be used as templates for creating five- and six- space cubes. The first figure contains the points for a five-space Pascal's triangle cube. The second figure is a six-space cube without the lines between adjacents drawn. Although it is possible to create the cubes by hand, it is easier to let a computer do the work.

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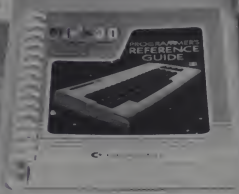

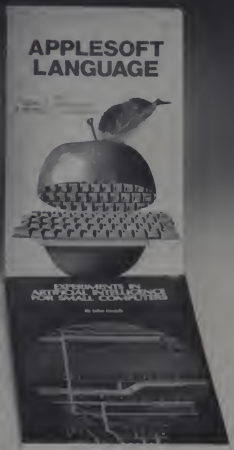

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CIRCLE 148 ON READER SERVICE CARD

N-Space Cubes, continued...

```
420 Q$ = "": REM  CONTROL-Q
430 D$ = "": REM  CONTROL-D
440  TEXT
450 PRINT
460 PRINT "DO YOU WANT ME TO DRAW THE ENTIRE"
470 PRINT
480 INPUT "CUBE FOR YOU? (Y OR RETURN) ";ZG$
490 PRINT
500 PRINT
510 PRINT "WHAT SIZE N-CUBE DO YOU"
520 PRINT
530 INPUT "WANT TO PLOT? (1-7) ";N
540 PRINT
550 PRINT
560 IF N > 7 OR N < 1 THEN  GOTO 440
570 PRINT "(1) TWISTED CIRCLE CUBE"
580 PRINT
590 PRINT "(2) UNTWISTED CIRCLE CUBE"
600 PRINT
610 PRINT "(3) PASCAL'S TRIANGLE CUBE"
620 PRINT
630 PRINT
640  INPUT "WHICH CUBE DO YOU WISH TO PLOT? ";PL
650 IF PL > 3 OR PL < 1 THEN  GOTO 570
660 NN = 2 ^ N
670  PRINT
680 PRINT
690 PRINT "THE PROGRAM IS NOW CALCULATING"
700  PRINT
710 PRINT "THE ORDER IN WHICH THE ";NN
720 PRINT
730 PRINT "POINTS OF THE CUBE WILL BE PLOTTED"
740  PRINT
750  ON PL GOTO 1000,2000,3000
1000  REM  THIS SECTION OF CODE IS FOR THE
1010  REM  TWISTED CIRCLE TYPE OF CUBE
1020  FOR J = 1 TO NN
1030 XY(J) = J
1040  NEXT J
1050  PRINT
1060  PRINT
1070  PRINT "THE PROGRAM IS CREATING THE X-Y"
1080  PRINT
1090  PRINT "CO-ORDINATES FOR EACH CORNER"
1100  PRINT
1110  PRINT "OF A TWISTED CIRCLE CUBE."
1120  PRINT
1130  GOTO 2260
2000  REM  THIS SECTION OF CODE IS FOR
2010  REM  THE UNTWISTED CIRCLE CUBES
2020  FOR J = 1 TO NN
2030 XY(J) = J
2040  NEXT J
2050  FOR J = 1 TO N - 1
2060 J2 = 2 ^ J
2070 JL = 2 ^ (J - 1)
2080  FOR I = 1 TO NN
2090 IN =  INT (( I - 1) / J2)
2100  IF (( INT (IN / 2) * 2) = IN) THEN  GOTO 2170
2110 ID = I - IN * J2
2120  IF (ID > JL) THEN  GOTO 2170
2130 IP = J2 * IN + J2 - ID + 1
2140 TMP = XY(I)
2150 XY(I) = XY(IP)
2160 XY(IP) = TMP
2170  NEXT I
2180  NEXT J
2190  PRINT
2200  PRINT "THE PROGRAM IS CREATING THE X-Y
2210  PRINT
2220  PRINT "CO-ORDINATES FOR EACH CORNER"
2230  PRINT
2240  PRINT "OF AN UNTWISTED CIRCLE CUBE."
2250  PRINT
2260 WDTH = 278
2270 HGT = 189
2280 XX = 0
2290 XC = WDTH / 2
2300 YC = HGT / 2
2310 SN = 6.28 / 2 ^ N
2320  FOR J = 1 TO 2 ^ N
2330 X(XY(J)) =  SIN (XX) * XC + XC + 1
2340 Y(XY(J)) =  COS (XX) * YC + YC + 1
2350 XX = XX + SN
2360  NEXT J
2370  GOTO 10000
3000  REM  THIS SECTION OF CODE IS FOR THE
3010  REM  PASCAL'S TRIANGLE TYPE OF CUBE
3020 XY(1) = 0
3030 XY(NN) = NN - 1
3040 NE = 2
3050 N2 = NN / 2
3060  FOR J = 1 TO N2
3070  FOR K = 1 TO N
3080  IF XY(J) >  = 2 ^ (K - 1) THEN  GOTO 3120
3090 XY(NE) = ADJ(K,XY(J) + 1)
3100 XY(NN - NE + 1) = NN - XY(NE) + 1
3110 NE = NE + 1
3120  NEXT K
3130  NEXT J
3140  PRINT
3150  PRINT "THE PROGRAM IS CREATING THE X-Y"
3160  PRINT
3170  PRINT "CO-ORDINATES FOR EACH CORNER"
3180  PRINT
3190  PRINT "OF A PASCAL'S TRIANGLE TYPE OF CUBE"
3200  PRINT
3210 PI = 3.14159265
3220 NP1 = N + 1
3230  FOR J = 1 TO NP1
3240 IP(J) = 1
3250 P(J) = 1
3260  NEXT J
3270  FOR L = 2 TO N
3280  FOR J = 2 TO L
3290 P(J) = IP(J - 1) + IP(J)
3300  NEXT J
3310  FOR K = 2 TO L
3320 IP(K) = P(K)
3330  NEXT K
3340  NEXT L
3350 WDTH = 137
3360 HGT = 93
3370 I = 1
3380 ANG =  - PI * .5
3390 AI = PI / N
3400  FOR J = 1 TO NP1
3410 XWDTH =  COS (ANG) * WDTH
3420 XP = WDTH - XWDTH + 1.
3430 YY =  SIN (ANG) * HGT + HGT + 1.
3440  FOR K = 1 TO P(J)
3450  IF (P(J) - 1 = 0) THEN  GOTO 3470
3460 XINC = (XWDTH * 2.) / (P(J) - 1.)
3470 II = XY(I) + 1
3480 X(II) = XP
3490 XP = XP + XINC
3500 Y(II) = YY
3510 I = I + 1
3520  NEXT K
3530 ANG = ANG + AI
3540  NEXT J
3550  FOR J = 1 TO NN
3560 XY(J) = XY(J) + 1
3570  NEXT J
10000  PRINT
10010  INPUT "READY TO PLOT. (PRESS 'RETURN') ";DUMY$
10020  HGR2
10030  HCOLOR= 7
10040  FOR J = 1 TO NN
10050  HPLOT X(J) - 1,Y(J) - 1 TO X(J) + 1,Y(J) - 1
10051  HPLOT X(J) + 1,Y(J) - 1 TO X(J) + 1,Y(J) + 1
10052  HPLOT X(J) + 1,Y(J) + 1 TO X(J) - 1,Y(J) + 1
10053  HPLOT X(J) - 1,Y(J) + 1 TO X(J) - 1,Y(J) - 1
10060  NEXT J
10070  IF (ZG$ = "Y") THEN  GOTO 20000
10080  PRINT
10090  INPUT "WHAT COLOR  & LINE SET ? ";H,K
10100  IF H < 0 THEN  GOTO 440
10110  IF H > 7 THEN  GOTO 10080
10120  HCOLOR= H
10130  IF K < 0 THEN  GOTO 30000
10140  IF K < N + 1 THEN  GOTO 10170
10150  PRINT "BAD NUMBER TRY AGAIN";G$,G$,G$
10160  GOTO 10080
10170  FOR JJ = 1 TO NN
10180 J = XY(JJ)
10190  IF (ADJ(K,J) < J) THEN  GOTO 10220
10200 MJ = ADJ(K,J) + 1
10210  HPLOT X(J),Y(J) TO X(MJ),Y(MJ)
10220  NEXT JJ
10230  GOTO 10080
20000  FOR J = 1 TO N * 500
20010  NEXT J
20020  FOR KK = 1 TO NN
20030 K = XY(KK)
20040  FOR J = 1 TO N
```

```
20050  IF (ADJ(J,K) < K) THEN  GOTO 20080
20060 MJ = ADJ(J,K) + 1
20070  HPLOT X(K),Y(K) TO X(MJ),Y(MJ)
20080  NEXT J
20090  FOR L = 1 TO 4096 / NN
20100  NEXT L
20110  NEXT KK
30000  PRINT
30010  INPUT "END THE PLOT BY PRESSING 'RETURN' ";DUMY$
30020  PRINT
30030  INPUT "PRINT PICTURE? (YES OR RETURN) ";DUMY$
30040  IF DUMY$ >  < "YES" THEN  GOTO 440
30050  TEXT
30060  POKE  - 12529,255
30070  POKE  - 12525,64
30080  POKE  - 12524,0
30090  PRINT D$;"PR#1"
30100  PRINT
30110  PRINT Q$
30120  PRINT
30130  PRINT D$;"PR#0"
30140  POKE  - 12525,32
30150  POKE  - 12529,0
30160  POKE  - 12524,255
30170  GOTO 10000
30180  END
```

Screensaver

Andy Gamble

Screensaver grew from the need to draw on the screen quickly and to save the entire screen in some permanent form within a program. Take, for instance, the logo in Figure 1. How could I design that on the screen and save it to be used in other programs?

Previously I had been typing in "direct mode," fiddling about with a recalcitrant cursor and trying very, very hard to refrain from pressing Return at the edge of the screen.

Even using that method, the screen still needed to be saved in some way; the easiest was to leave a margin down the left side in which to place a series of statements like 10 PRINT"... Did I say easy?

A different technique is used here, one that I hope will give you ideas for other uses. The program splits rather neatly into three parts.

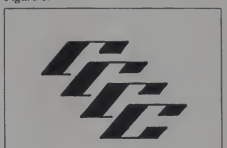
The first is a simplified method for drawing or printing on the screen. Insert/delete and return are inoperable, which prevents much gnashing of the teeth. All other keys repeat.

In the second part, the entire screen is saved in the form of DATA statements, which can be read by the third part, which is a small program to return the original screen.

The first part is quite straightforward. The program checks to see which key is pressed, and POKEs that character to the appropriate place on the screen, marked by a dummy cursor. The program further checks to see if the key is being held down, and if so the procedure is repeated.

When the screen design has been completed, shift-return starts the second part of the program. Each screen position is scanned (you can see the dummy cursor flying around here) and the PEEK values

Figure 1.



stored in a temporary array. The values in this array are in turn POKEd into the DATA statements at the beginning of the program. The zeros in lines 100 to 760 are thus replaced by the PEEK/POKE values of the screen characters.

Now here is where a bit of ingenuity creeps in. Since most screen designs contain a great deal of blank space, and even quite small designs will necessarily fill all the 1000 places in the DATA statements, a technique was chosen to compact the information.

Briefly, the largest value stored in a DATA line would be 255, since that is the largest PEEK/POKE value possible. This means that all values from 256 to 999 would not normally be used.

In this program, the spaces in a design are not stored in their normal form (which would be a value of 32), but instead are merely counted. For instance, if while scanning the screen the program came across 80 successive spaces (two blank lines), this information would be stored in the DATA statement as 380. All non-space characters are, thus, stored normally, but all spaces are counted and the count plus 300 stored.

There is a small advantage here in that the largest number of contiguous spaces which can be stored is 699 (999-300), but this is more than offset by the great saving of program space.

Lastly, an end-of-file marker of -99 is written in the last available DATA position. Once the screen is saved into the DATA lines, the rest of the program (lines 770 on), can be deleted. A Toolkit helps a great deal here.

In order to make use of the screen, a short program (Listing 2) should be appended to the DATA statements. Again, the Toolkit is useful. The program runs on Basic 3 CBM machines and requires 12K of memory.

Andy Gamble, Columbia College, 1619 West 10th Ave., Vancouver, B.C., Canada V6J 2A2.

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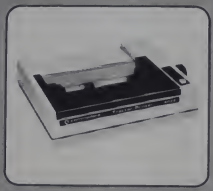

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The Program

The following is a line-by-line description of the program:

Lines 100 to 760: These DATA statements will store the numerical values of all the characters on the screen. One thousand sets are needed in all, for the extreme case of each position being filled by a non-space character. Yes, I know there is 1001; the 1001st set stores the 99 end-of-file marker.

Lines 770 to 860: A few initializing statements.

Lines 870 to 1050: Move dummy cursor. Screen will not scroll, and cursor will not move off the screen.

Lines 1060 to 1080: Check RVS on or off.

Lines 1090 to 1200: Convert ASCII value to PEEK/POKE value and POKE to screen.

Lines 1210 to 1220: Fill the array.

Lines 1230 to 1400: POKE values into DATA statements.

Lines 1410 to 1490: Title page.

Lines 1500 to 1620: Instructions.

Lines 1630 to 1650: "Continue" subroutine.

The tremendous number of DATA lines are best entered into the program using the screen-editing facilities; that is, type line 100 as given, return, alter the line number to 110, return, and so on. The task is not as arduous as it may seem.

It is however, very important that these DATA lines be typed exactly as given. In particular, don't be tempted to put anything before them. The statement MS=1030 in line 1240 marks the position in memory of the first zero in line 100. In other words, it is where the program starts looking for zeros.

If you are typing this program for a machine other than a PET, this number will have to be changed. In this case, use your machine language monitor to find the location of the first zero. Other changes would include:

The POKE instruction in line 810 which sets the graphic mode.

Variable HM in line 880: The start of screen memory.

Variable KD in line 870: The location to show which key is pressed.

Variable SD in line 870: The location to show if the shift key is down.

Variable CC in line 890: Cursor character.

Variable CR in lines 930 to 1000: Cursor control characters.

Variable C2 in line 1020: End of screen memory.

Armed with that information, it should be possible to convert to any Microsoft or similar Basic.

Listing 1.

```
100 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
110 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
120 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
130 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
140 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
150 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
160 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
170 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
180 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
190 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
200 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
210 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
```

Lines 220 to 620 are similar.

```
630 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
640 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
650 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
660 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
670 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
680 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
690 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
700 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
710 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
720 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
730 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
740 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
750 DATA000,000,000,000,000,000,000,000,000,000,000,000,000,000
760 DATA000,000,000,000,000,000,000,000,000,000,000
770 REM SCREENSAVER ANDY GAHALE OCT 81
780 REM COLUMBIA COLLEGE 1619 W10 AVE
790 REM VANCOUVER BC V6J 2A2
800 REM NEW ROMS (BASIC 3) ONLY
810 DIMS#(300):FOKE59468,12
820 GOTO1410
830 INPUT"□DO YOU NEED INSTRUCTIONS (Y/N) ";Z#
840 IFZ#="Y"THENPRINT"□":GOTO830
850 Z#=LEFT#(Z#,1):IFZ#="Y"THEN1500
860 IFZ#<>"N"THEN830
870 PRINT"□";:KD=151:SD=152
880 HM=32768+CL+HM+CZ=C1
890 CC=102:CB=PEEK(C1)
900 RV=0
910 GETCR#:IFCR#□""THENCR=ASC(CR#)
920 IFPEEK(KD)=255THEN1040
930 IFCR=19ORCR=17ORCR=29ORCR=147ORCR=145ORCR=157THEN950
940 GOTO1060
950 IFCR=19THENC2=32768
960 IFCR=17THENC2=C1+40
970 IFCR=29THENC2=C1+1
980 IFCR=147THENC2=32768:PRINT"□";
990 IFCR=145THENC2=C1-40
1000 IFCR=157THENC2=C1-1
1010 IFC2>32768THENC2=C1
1020 IFC2<32767THENC2=C1
1030 CB=PEEK(C2):C1=C2
1040 POKEC1,CC:FORZZ=1TO30:NEXT
1050 POKEC1,CB:FORZZ=1TO30:NEXT:GOTO910
1060 IFCR=18THENRV=1:GOTO910
1070 IFCR=146THENRV=0:GOTO910
1080 IFCR=141THEN1210
1090 CP=CR
1100 IFCR<32THEN910
1110 IFCR>63ANDCR<128THENCP=CR-64
1120 IFCR>128ANDCR<160THEN910
1130 IFCR>159ANDCR<192THENCP=CR-64
1140 IFCR>191THENCP=CR-128
1150 POKEC1,CP+RV+128:C2=C1+1
1160 IFC2>32767THENC2=C1
1170 CB=PEEK(C2):C1=C2
1180 POKEC1,CC:FORZZ=1TO30:NEXT
1190 POKEC1,CB:FORZZ=1TO30:NEXT
1200 GOTO910
1210 FORI=1TO1000:C1=32767+I:SP$(I)=PEEK(C1)
1220 POKEC1,CC:POKEC1,SP$(I):NEXT
1230 PRINT"□□□□FORING VALUES INTO DATA STATEMENTS"
1240 PRINT"PLEASE WAIT...":C=0:MS=1030
1250 FORI=1TO1000
1260 IFI=1000ANDSP$(I)=32THENC=C+1:GOTO1290
```

```
1270 IFSP(1)=32THENC=C+1:NEXT
1280 IFSP(1-1)<>32THEN1330
1290 X$=STR$(C+100300):PRINT"■";1
1300 FORZZ=0TO2:POKEMS+ZZ,ASC(MID$(X$,5+ZZ,1)):NEXT:C=0
1310 MS=MS+1:IFPEEK(MS)=48ANDPEEK(MS+1)=48ANDPEEK(MS+2)=48THEN1330
1320 GOTO1310
1330 X$=STR$(SP(1)+100000)
1340 FORZZ=0TO2:POKEMS+ZZ,ASC(MID$(X$,5+ZZ,1)):NEXT
1350 IF1<>1000THEN1370
1360 MS=MS+4:FORZZ=0TO2:POKEMS+ZZ,ASC(MID$("-99",1+ZZ,1)):NEXT:GOTO1390
1370 MS=MS+1:IFPEEK(MS)=48ANDPEEK(MS+1)=48ANDPEEK(MS+2)=48THEN1390
1380 GOTO1370
1390 NEXT
1400 END
1410 PRINT"■";FOR1=32768TO32807:POKE1,224:POKE1+960,224:NEXT
1420 FOR1=32808TO33688STEP40:POKE1,224:POKE1+39,224:NEXT
1430 PRINT"■■■■■"
1440 PRINTTAB(9)"  ▛ ▗▘  ▙"
1450 PRINTTAB(9)"  ▙▗▗▗▗▗▗▗▟"
1460 PRINT"■■■■■■■■■■■■■■■■"TAB(13)"■SCREENSAVER"
1470 PRINT"■■■■■■■■■■■■■■■■"TAB(25)"ANDY GAMBLE"
1480 GOSUB1630
1490 GOTO830
1500 PRINT"■■■THIS PROGRAM ENABLES YOU TO DRAW"
1510 PRINT"DIAGRAMS ON THE SCREEN AND SAVE THEM IN"
1520 PRINT"DATA STATEMENTS."
1530 PRINT"■■HEN DRAWING ON THE SCREEN, THE CURSOR"
1540 PRINT"IS A FLASHING ■, AND ALL THE CURSOR"
1550 PRINT"CONTROLS WORK EXCEPT INSERT AND DELETE."
1560 PRINT"ALL KEYS ALSO REPEAT."
1570 PRINT"■■HEN YOUR SCREEN IS FINISHED, PRESS"
1580 PRINT"SHIFT-RETURN TO SAVE IT."
1590 PRINT"■DELETE ALL THE PROGRAM FROM LINE 770."
1600 PRINT"AND READ BACK THE VALUES FROM THE DATA"
1610 PRINT"STATEMENTS IN A NEW PROGRAM.■■■"
1620 GOSUB1630:GOTO870
1630 PRINT"■■■■■■■"TAB(8)"■PRESS ANY KEY TO CONTINUE"
1640 GETZZ$:IFZZ$=""THEN1640
1650 RETURN
```

Listing 2.

```
1000 REM BACK-TO-SCREEN
1010 MM=32768
1020 READZA:IFZA=-99THEN9999
1030 IFZA>300THENFORZ1=MMTOMM+ZA-300:POKEZ1,32:NEXT:MM=Z1-1:GOTO1020
1040 POKEMM,ZA:MM=MM+1:GOTO1020
9999 REM PROG CONTINUES
```

Listing 3.

```
100 DATA475,100,100,100,100,100,100,333,233,160,105,301,233,160,105
110 DATA332,233,160,105,301,100,100,100,100,100,100,329,233,160,105
120 DATA301,233,160,105,301,233,160,105,329,099,099,099,233,160,105
130 DATA301,100,100,100,100,100,100,329,233,160,105,301,233,160,105
140 DATA301,233,160,105,329,099,099,099,233,160,105,301,100,100,100
150 DATA100,100,100,329,233,160,105,301,233,160,105,301,233,160,105
160 DATA329,099,099,099,233,160,105,336,233,160,105,301,233,160,105
170 DATA333,099,099,099,099,099,099,716,-99
1000 MM=32768
1010 READZA:IFZA=-99THEN9999
1020 IFZA>300THENFORZ1=MMTOMM+ZA-300:POKEZ1,32:NEXT:MM=Z1-1:GOTO1010
1030 POKEMM,ZA:MM=MM+1:GOTO1010
9999 REM PROG CONTINUES
```

Listing 3 shows the result of running Screensaver and appending the program in Listing 2. It will draw the logo in Figure 1. Notice that the 475 in line 100 and the 716 in line 170 successfully compress large amounts of blank space. □

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Renewal

warm earth and fields
no time to turn
'I know it's over'

'I suppose,' he said
'if the water's dark'
the sky's violent blue
too long
too late

'softly'
'it won't be easy'

and later her dry palms
no time to turn
like a new green leaf
without breath or fear or love

Transition: 3

Renewal

with the graceful line of flight
'please, now!'
the words were brittle
time, time to start again

as the fields rolled in the sunlight
to feel again
under velvet skies
... still it's early
just alloy and circuitry
it's so simple...
'it won't be easy'
while air shifted, sullen, heavy
as the fields rolled in the sunlight

Transition: 4

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CIRCLE 126 ON READER SERVICE CARD

Verse Weaving, continued...

Here's a game for the Atari that everyone can play. All you need is a little imagination and the time to retype some data statements. The program itself is so simple that I hesitated for some time to pass it on. But the technical simplicity of the code doesn't necessarily mean that the program lacks challenge.

The idea is a straightforward one and not particularly new. Randomly selecting lines of verse from a set of data statements, the program displays a poem on the screen. It generates ten variations in 17-line units. You can begin your experimentation with the lines already in the program and then go on to alter words and phrases until you are ready to replace all of the data with your own lines of verse, dialog, or story material.

Initially the screen displays will seem to be ten separate poems, good or bad. After you run the program a time or two, you'll find out that, in fact, what is generated is not ten poems but one much longer poem, expressed in terms of ten variations on the dominant situation or theme. This means that the program does not simply randomly produce verses that result accidentally in one or two tolerable poems out of the total ten.

The verse generated is actually dynamic and changing, and the real product is a theoretically endless statement of repeated variation and mutation. The theme is constant, but the interpretation or emphasis fluctuates, shifts and cycles, but always with slight variations of nuance and implication.

The greater the number of lines in the data set, the greater the variety of each version and the more unlikely it is that two displays will be identical. Increasing the set, however, makes the coherence of theme much more difficult to control.

This variety and impermanence offer a new kind of verse, fiction, or dialog that is constantly changing and elusive.

My own experiments with this almost embarrassingly simple drive program (it could easily be made much more varied and complex with added branching) has led me to realize that as one reads the consecutive units as they are displayed on the screen there comes about a kind of immersion in the lines themselves. Their repetition and repatterning, cycling on and on, tends to create the illusion of the evolution of a work much more expansive in scope than the finite data set would ever suggest by itself.

I arbitrarily generate ten displays before the program terminates. You can extend the number of versions easily so that the series will not be broken by having to re-run the program to continue. Until fatigue sets in, immersion is intensified significantly by longer unbroken sequences. Just increase the FOR loop in line 9, from 10 to whatever number you wish.

Ned Davison, 1373 Butler Ave., Salt Lake City, UT 84102.

Suggestions for Use

You might begin by changing a few words or lines in the data set listed here, and from what you discover, then write your own set of lines. When you do this, it might be easier to begin with only a few, say 20 to 30, and add others as the theme begins to define itself and require new tones and nuances.

You will quickly discover that the "poem" will grow as you experiment, and you may well end up with something very different from what you originally had in mind. This doesn't mean that the result is merely an accident. What happens is that you gradually uncover your own feelings about the subject or theme.

When you make up your lines you can't just rely on chance. There are certain principles that you should probably follow. First, you have to have some basic emotion or theme in mind—for example, "young love," a "lost love," "loneliness, the "joy of living," and so on.

A celebrative theme might be especially fun for the kids—the sights and sounds of Christmas, a birthday or anniversary, "school's out," the fourth of July, etc. As a guide to the kinds of moods that are easiest to work with, listen to popular songs and note the sorts of feelings about which they sing.

The verse generated is dynamic and changing.

Next, you probably should include lines that cover at least the following types of things:

- A place. Some sense of location or setting is needed.
- People or animals. There must be "characters" that do things. To begin, it is usually best to use only a few.
- Actions. Happenings, small precise things—the turn of a head, a gesture, along with an event or episode of some kind, an encounter, a farewell, etc.
- A time. Time is very flexible and expansive and may present problems at first. It helps to think of time as a "time of day," a "time of life," or "moments." Time is best handled initially with open lines that begin or end with words like "before," "after," "later," and other adverbs. The time of day is important and can be suggested with the movement of the sun, light and dark.

In developing lines to cover these things it is very important to *focus on details*. For example, when expressing "place," you might try things like "blades of grass," "grains of sand," "a golden leaf," (to express both time of year and place), or "window pane." With regard to people, things like "fingers," "eyelids," and "lips." In the case of "actions" it is usually effective to include precise gestures that suggest attitudes or moods, a "sudden glance," "her hand fell slowly," and so on.

```
                Renewal

while air shifted, sullen, heavy
     it's over
no time to turn
          time, time to start again
  they know
too far
and later her dry palms
  'if the water's dark'
    shallow trails, shadows
 and she turned away


   shallow trails, shadows
      softly, softly
          time, time to start again
  ... still it's early
                'please, now!'

              Transition: 5
```

```
                Renewal

                'softly'
      forever dusk, always
   they know
as if gliding down
        it's so simple...
    like a new green leaf
    to feel again
                'please, now!'
   they know
just alloy and circuitry
as if gliding down


    'if the water's dark'
as if gliding down

always the clock and pen
    shallow trails, shadows

              Transition: 6
```

```
                Renewal

as if gliding down
   grasses  glistening
and later her dry palms
     with the graceful line of flight
     to feel again
              'it won't be easy'
  when we're there
under velvet skies

                forever dusk, always
    too long
  when we're there


                ...and it was
as if gliding down

              Transition: 7
```

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CIRCLE 160 ON READER SERVICE CARD

Verse Weaving, continued...

Spoken words, fragments of speech and dialog are also very important, adding dramatic intensity and defining emotions.

Finally, there is the question of the number of lines desirable in a data set. This program has 48, of which 17 are selected for each screen display. You will notice that eight of those 48 are simply print statements that produce a blank line.

A celebrative theme might be especially fun for the kids.

Remember that space itself communicates meaning, sometimes in a very powerful way. It regulates pace and modulates the rhythm and flow of the images; so empty lines and indentation are important to your texts.

You will want to experiment with spacing since it can be one of your most powerful tools.

Punctuation is also very significant. Avoid commas, periods, and such, at the end of your lines so they can blend into those that surround them, giving the emotion or mood clearer definition, direction, and intensity.

```
            Renewal

     with the graceful line of flight
    like a new green leaf
      softly, softly

          the words were brittle
          time, time to start again
  'I know it's over'
    ... still it's early
  'I know it's over'

and later her dry palms
without breath or fear or love

        too late
          it's so simple...
            'softly'

                    Transition: 8
```

```
            Renewal

  when we're there
        'but there's always spring'
 and she turned away
   warm earth and fields
  they know
 the sky's violent blue
   grasses  glistening
  when we're there

always the clock and pen
      it's over
   shallow trails, shadows
just alloy and circuitry
     softly, softly
    'I suppose,' he said
...with little care or gesture
     softly, softly

                    Transition: 10
```

The Drive Program

Lines 1-6 generate a colorful graphics title. These may be omitted. The string "XC$" dimensioned in 6 is for the screen-printer routine, as is all of line 7.

The print routine itself is contained in lines 500-570 and is for my serial Diablo printer. You can make the appropriate changes for your printer or omit the routine, string "XC$," and line 7. One virtue of this simple program is that, with the print routine removed, it can still be run with only a cassette drive.

Since the program is very short, it can be loaded and saved quickly. If you delete these elements you can revise line 63 to read: IF PEEK(53279)=6 THEN GOTO 65. This will then enable you to use the Start bar to cycle to the next screen display, if you wish, before the timing cycle terminates automatically.

The instructions in line 7 should then be changed to read: "TO GO DIRECTLY TO NEXT VERSION, PRESS". Statements 208 and 220 which show "PRINT" contain escape/control down-arrows to enhance formatting of the closing screen display. These can be set to your own liking. The symbol " " in 65, 205, and 215 indicates the "clear screen" command (escape/control and Clear). The title words "VERSE" in 5, and "WEAVING" in 6 are in inverse characters which produce dark blue letters.

Happy weaving! □

Verse Weaving: Program Listing

```
1 GRAPHICS 2:REM POETIC VARIATIONS. 9/17/81
2 ? :? "            'Renewal'"
3 ? "                        by N.J.Davison"
4 X=7:Y=3:POSITION X,Y
5 ? #6;"VERSE":POSITION X-2,Y+2
6 ? #6;" WEAVING":FOR I=0 TO 3000:NEXT I:GRAPHICS 0:DIM XC$(39)
7 OPEN #3,4,0,"S:":? " TO PRINT CONTENTS OF SCREEN, PRESS"
8 ? "          THE 'START' BAR":? :FOR H=0 TO 900:NEXT H
9 FOR H=1 TO 10:? :? "                Renewal":? :H=0:L=0
10 REM SET "RND" TO ONE MORE THAN NUMBER OF VERSES
12 L=INT(49*RND(1)+100)
14 IF L=L2 THEN GOTO 10
20 L2=L
45 A=A+1
47 IF A>17 THEN 60
50 GOTO L
60 PRINT :T=T+1
61 PRINT "                    Transition: ";T
62 FOR I=0 TO 7500
63 IF PEEK(53279)=6 THEN GOSUB 500:GOTO 65
64 NEXT I
65 ? ")"
67 NEXT H:GOTO 210
100 PRINT "          ...and it was":GOTO 10
101 PRINT "without breath or fear or love":GOTO 10
102 PRINT "  they know ":GOTO 10
103 PRINT "    'I suppose,' he said":GOTO 10
104 PRINT "as if gliding down":GOTO 10
105 PRINT "while air shifted, sullen, heavy":GOTO 10
106 PRINT "under velvet skies":GOTO 10
107 PRINT :GOTO 10
108 PRINT :GOTO 10
109 PRINT "too far":GOTO 10
110 PRINT "    too long":GOTO 10
111 PRINT "      too late":GOTO 10
112 PRINT "    ... still it's early":GOTO 10
113 PRINT "    grasses  glistening":GOTO 10
114 PRINT "    warm earth and fields":GOTO 10
115 PRINT "    shallow trails, shadows":GOTO 10
116 PRINT "always the clock and pen":GOTO 10
117 PRINT "just alloy and circuitry":GOTO 10
118 PRINT "no time to turn":GOTO 10
119 PRINT "          time, time to start again":GOTO 10
120 PRINT "    to feel again":GOTO 10
121 PRINT "  (the air, moist--skin, cool)":GOTO 10
122 PRINT "and later her dry palms":GOTO 10
123 PRINT "          forever dusk, always ":GOTO 10
124 PRINT :GOTO 10
125 PRINT "      'but there's always spring'":GOTO 10
126 PRINT "  'if the water's dark'":GOTO 10
127 PRINT "          'it won't be easy'":GOTO 10
128 PRINT " and she turned away":GOTO 10
129 PRINT "as the fields rolled in the sunlight":GOTO 10
```

continued overleaf

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By Fred Huntington

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Melody doesn't hover around the Apple at home now, just the Atari, because she wants to play Hodge Podge. Whenever she presses a letter, something happens. For example, if she presses 'B' a banjo appears and plays music. There is some action for every key on the keyboard.

The graphics are tremendous and the music is great. There is one major flaw, however. Everytime I get near the Atari, I can't play my games. Melody wants to play Hodge Podge.

So, if you have a child between two and six, get them Hodge Podge and be a hero. And, to help celebrate Melody's third birthday, if you say 'Happy Birthday, Melody,' you can have it for **$13.94** instead of the $19.95 list price. Even at full list price, I believe Hodge Podge to be one of the best bargains available today. (We'll even give you the Apple version for $15.99.)

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Verse Weaving, continued...

```
130 PRINT :GOTO 10
131 PRINT "                    'please, now!'":GOTO 10
132 PRINT "        softly, softly":GOTO 10
133 PRINT "...with little care or gesture":GOTO 10
134 PRINT :GOTO 10
135 PRINT "    like a new green leaf":GOTO 10
136 PRINT :GOTO 10
137 PRINT " the sky's violent blue":GOTO 10
138 PRINT :GOTO 10
139 PRINT "     with the graceful line of flight":GOTO 10
140 PRINT :GOTO 10
141 PRINT "        it's so simple...":GOTO 10
142 PRINT "            'softly'":GOTO 10
143 PRINT "  when we're there":GOTO 10
144 PRINT "              smooth, like sand":GOTO 10
145 PRINT "       it's over":GOTO 10
146 PRINT " 'I know it's over'":GOTO 10
147 PRINT "     'I suppose,' she said":GOTO 10
148 PRINT "          the words were brittle":GOTO 10
150 READ Q$:PRINT Q$
200 REM REMEMBER TO ADD "GOTO 10" TO EACH NEW PRINT LINE
203 REM AND TO INCREASE "RND" IN STATEMENT 10.
205 PRINT "}"
208 PRINT ""
210 PRINT "                END OF SERIES"
213 FOR I=0 TO 300:NEXT I
215 PRINT "}":PRINT "":PRINT "        TO REPEAT, TYPE RUN"
220 PRINT "":END
500 REM TO PRINT CONTENTS OF SCREEN
502 REM (COURTESY OF LEN LINDSAY)
505 XC$="                                        "
510 FOR YL=0 TO 22
515 POSITION 1,YL
517 FOR XL=1 TO 39
520 GET #3,XC
530 XC$(XL,XL)=CHR$(XC)
540 NEXT XL
550 OPEN #2,8,0,"R2:"
552 XIO 36,#2,192,0,"R2:"
554 XIO 36,#2,0,4,"R2:"
556 ? #2;XC$
558 CLOSE #2
560 NEXT YL
570 RETURN
```

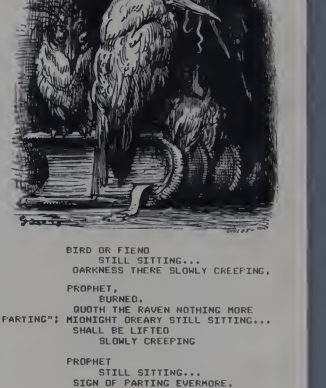
Computer Poetry: Not So New

David Ahl

Every once in a while I feel compelled to get up on my soap box and wave my hand around a bit and speak out to the legions of programmers and would-be programmers entering the computer field. And what I try to say is "Look back, learn from your predecessors, learn from the pioneers."

Although personal computers have only been with us a few years, minicomputers and mainframes have been around for much longer.

continued overleaf



Poet: Program Listing and Sample Run

```
90 RANDOM
100 IF I<>1 THEN 101 ELSE PRINT "MIDNIGHT DREARY";
101 IF I<>2 THEN 102 ELSE PRINT "FIREY EYES";
102 IF I<>3 THEN 103 ELSE PRINT "BIRD OR FIEND";
103 IF I<>4 THEN 104 ELSE PRINT "THING OF EVIL";
104 IF I<>5 THEN 210 ELSE PRINT "PROPHET";
105 GOTO 210
110 IF I<>1 THEN 111 ELSE PRINT "BEGUILING ME";
111 IF I<>2 THEN 112 ELSE PRINT "THRILLED ME";
112 IF I<>3 THEN 113 ELSE PRINT "STILL SITTING...";:GOTO 212
113 IF I<>4 THEN 114 ELSE PRINT "BURNED.   ";:GOTO 212
114 IF I<>5 THEN 210 ELSE PRINT "NEVER FLITTING";
115 GOTO 210
120 IF I<>1 THEN 121 ELSE IF U=0 THEN 210 ELSE PRINT "SIGN OF PARTING";
121 IF I<>2 THEN 122 ELSE PRINT "AND MY SOUL";
122 IF I<>3 THEN 123 ELSE PRINT "DARKNESS THERE";
123 IF I<>4 THEN 124 ELSE PRINT "SHALL BE LIFTED";
124 IF I<>5 THEN 210 ELSE PRINT "QUOTH THE RAVEN";
125 GOTO 210
130 IF I<>1 THEN 131 ELSE PRINT "NOTHING MORE";
131 IF I<>2 THEN 132 ELSE PRINT "YET AGAIN";
132 IF I<>3 THEN 133 ELSE PRINT "SLOWLY CREEPING";
133 IF I<>4 THEN 134 ELSE PRINT "...NEVERMORE";
134 IF I<>5 THEN 210 ELSE PRINT "EVERMORE,";
210 IF U=0 THEN 212 ELSE IF RND(0)>.19 THEN 212 ELSE PRINT ",";:U=2
212 IF RND(0)>.65 THEN 214 ELSE PRINT " ";:U=U+1:GOTO 215
214 PRINT:U=0
215 I=INT(5*RND(0)+1)
220 J=J+1:K=K+1
230 IF U>0 THEN 240 ELSE IF INT(J/2)<>J/2 THEN 240 ELSE PRINT "     ";
240 ON J GOTO 100,110,120,130,250
250 J=0:PRINT:IF K>20 THEN 270 ELSE GOTO 215
270 PRINT:U=0:K=0:GOTO 110
999 END
```

```
BIRD OR FIEND
    STILL SITTING...
 DARKNESS THERE SLOWLY CREEPING,

PROPHET,
    BURNED.
 QUOTH THE RAVEN NOTHING MORE
MIDNIGHT DREARY STILL SITTING...
 SHALL BE LIFTED
    SLOWLY CREEPING

PROPHET
    STILL SITTING...
 SIGN OF PARTING EVERMORE.

MIDNIGHT DREARY BEGUILING ME
AND MY SOUL EVERMORE.

NEVER FLITTING
THING OF EVIL
    STILL SITTING...
 DARKNESS THERE SLOWLY CREEPING
THING OF EVIL BEGUILING ME
    AND MY SOUL ...NEVERMORE

FIREY EYES, NEVER FLITTING
SHALL BE LIFTED
    EVERMORE.
```

While you probably don't want to look over every program ever written in CAL, GATE, or Auto coder, it is probably worthwhile to look over previous efforts in Basic, Fortran and Algol.

Let's take this program, Verse Weaving. Fourteen years ago, a similar program was written at Digital Equipment Corporation. I believe by Jim Bailey, called Poet. The output of the program from Poet is similar to that from Verse Weaving by Ned Davison except that Poet is a considerably simpler program. Poet puts spaces in the printed lines randomly whereas Verse Weaving requires that spaces be inserted when the phrases are entered.

Two years after Poet was written, I took the general frame and modified it to accept user input of the poetic phrases and to print out to either the screen or a line printer. This resulted in the program called "Bard" published in several DEC publications as well as in *Creative Computing* in 1976. For comparison, we have included listings of both Poet and Bard along with Davison's Verse Weaving. Needless to say Poet and Bard cannot be run directly on your Atari, Apple or TRS-80 or whatever. They were written for the RSTS-11 time-sharing using Basic Plus and, thus require some conversion to run in MicroSoft Basic or the Basic available on a personal computer. Nevertheless, the basic concepts are there and may be incorporated into your poetry programs and probably improved upon. *Creative Computing*, Vol. 2, No. 5 had four lists of phrases that made reasonable sounding poetry in the Bard framework. One such list is below.

Davison has some nice ideas and states the case for computer poetry rather well. However, I believe that if you look over the books and periodicals of the sixties and seventies you may be startled by the original material and novel ideas found therein.

3-YEAR-OLD PHRASES

Romper stompers
"Look at me!"
Dancing and singing
Sparkling eyes
Bouncing curls
"Tie my shoes"
"I can do it myself"
Skipping and jumping
Radiating joy
Devilishly spirited
Oh, so lively!
Unbounded energy
Supremely happy
Inquiring, curious
Looking, discovering
Always active
And gumballs
. . . . Delightful
. . . . So lovable
Adventure!

Bard: Program Listing and Sample Run

```
10 REMARKS OF ANOTHER PROGRAM, POET, APPEAR IN THIS
20 REMARKABLE PROGRAM, BARD, WRITTEN BY DAVID AHL
30 PRINT "BARD WRITES RANDOM POETRY WITH YOUR WORDS OR PHRASES."
40 PRINT "YOU SUPPLY 20 WORDS OR PHRASES UP TO 16 LETTERS LONG."
50 RANDOM: DIM A$(20): FOR I=1 TO 4
60 PRINT: PRINT "FIVE PHRASES FOR LINE"I"PLEASE"
70 FOR J=1 TO 5: S=(I-1)*5+J: INPUT A$(S)
80 IF LEN(A$(S)) 16 THEN INPUT "TOO LONG. AGAIN...";A$(S):GOTO 80
90 NEXT J: NEXT I
200 PRINT A$(1);:GOTO 300
210 PRINT A$(I*5);:GOTO 300
220 PRINT A$(I+10);:GOTO 300
230 PRINT A$(I+15);:GOTO 300
300 IF U=0 THEN 310 ELSE IF RND(0) .19 THEN 310 ELSE PRINT ",";:U=2
310 IF RND(0)>.65 THEN 320 ELSE PRINT " ";:U=U+1:GOTO 330
320 PRINT: U=0
330 I=INT(5*RND(0)+1): J=J+1: K=K+1: L=L+1
340 IF U>0 THEN 350 ELSE IF INT(J/2)<J/2 THEN 350 ELSE PRINT "      ";
350 ON J GOTO 200,210,220,230,360
360 J=0: PRINT: IF K>20 THEN 370 ELSE GOTO 330
370 PRINT: U=0: K=0: IF L<200 THEN 200
999 END
```

```
-RUN
BARD WRITES RANDOM POETRY WITH YOUR WORDS OR PHRASES.
YOU SUPPLY 20 WORDS OR PHRASES UP TO 16 LETTERS LONG.

FIVE PHRASES FOR LINE 1 PLEASE
? CARPET OF FERNS
? MORNING DEW
? TANG OF DAWN
? SWAYING PINES
? THE SONG OF NATURE
TOO LONG. AGAIN...? SONG OF NATURE

FIVE PHRASES FOR LINE 2 PLEASE
? ENTRANCES ME
? SOOTHING ME
? RUSTLING LEAVES
? GENTLY CARESSES
? RADIATES CALM

FIVE PHRASES FOR LINE 3 PLEASE
? MIGHTY OAKS
? GRACE AND BEAUTY
? SILENTLY SINGING
? NATURE SPEAKING
? CAPTURES MY SENSES
TOO LONG. AGAIN...? SENSUAL

FIVE PHRASES FOR LINE 4 PLEASE
? UNTOUCHED, UNSPOILED
?Extra ignored
? SHADES OF GREEN
? TRANQUILITY
? ...EVERMORE
? SO PEACEFUL...

SONG OF NATURE
     GENTLY CARESSES
NATURE SPEAKING ...EVERMORE

MORNING DEW
     RADIATES CALM
SILENTLY SINGING
     ...EVERMORE
TANG OF DAWN, RUSTLING LEAVES GRACE AND BEAUTY, TRANQUILITY


SONG OF NATURE
TANG OF DAWN RADIATES CALM SENSUAL SHADES OF GREEN

SWAYING PINES
SWAYING PINES SOOTHING ME
MIGHTY OAKS
     TRANQUILITY

MORNING DEW RUSTLING LEAVES SILENTLY SINGING
     SO PEACEFUL...

SWAYING PINES SONG OF NATURE SOOTHING ME,
MIGHTY OAKS
     ...EVERMORE
```

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SOFTWARE

TORAX

Apple II

Defend your home planet against the invading Torids! Try to protect your nuclear fuel tanks, which the aliens are intent on stealing. The Torids drop down, steal a fuel tank, and rise up to escape. They are also armed, and will not hesitate to shoot at you. While you whiz by the surface of your planet at incredible speed, you must avoid enemy fire, maneuver your ship, and try to shoot down the Torids without hitting the fuel tanks! (Requires paddles.)

#4520 **Torax Apple II 32K DOS 3.3 Diskette** $24.95

STAR CLONES

Apple II

There is unrest in the galaxy. The evil master clone has disrupted life for everybody except for members of the Clone Conspiracy and their evil clone agents. But there is hope. By mastering the four simulations on this disk you can save the galaxy from certain doom. Three skill levels allow you challenging practice for the ten missions that must be accomplished in order to defeat the Master Clone. (Requires Apple II or Apple II Plus, DOS 3.3, and game paddles.)

#4527 **Star Clones Apple II 48K DOS 3.3 Diskette** $29.95

SUPER INVASION

Apple Apple II TRS-80 Sorcerer

This is the original arcade game, with superb high resolution graphics, high speed action, nail-biting tension, and hilarious antics by the moon creatures. Fifty-five aliens whiz across the screen, quickening their descent, challenging you to come out from behind your blockades and pick them off with your lasers before they bomb you, destroy your shields, or drop down right on top of you. (TRS-80 version uses low resolution graphics. Apple II version requires paddles and is licensed from Astar International.)

#4006	**Super Invasion Apple 32K Cassette**	$19.95
#4505	**Super Invasion Apple II 48K DOS 3.3 Diskette**	$19.95
#3020	**Super Invasion TRS-80 32K Cassette**	$19.95
#3520	**Super Invasion TRS-80 Model 1 32K Diskette**	$19.95
#5011	**Super Invasion Sorcerer 8K Cassette**	$19.95

BLISTERBALL and MAD BOMBER

Apple II

A frantic, fast-paced romp that can be played for hours, *Blisterball* is the first truly original arcade-type game for a home computer. As the bouncing balls drop from above, you move your laser base and try to shoot them. It's easy at first—with just one ball. Then come two... then three. It gets harder. Four balls come, and finally five. If you survive them, you get to shoot at inelastic bonus balls. If you make it this far, the second round starts. The balls bounce lower, the walls close in! Making superb use of Apple graphics and sound, *Blisterball* can be played by one or two people.

Mad Bomber, included on the same disk, is another fast-paced arcade game. Racks of bombs fill up above you. Whenever four bombs are in any rack, they start to fall. You can shoot them either in the rack or while they're falling, but with racks all across the top of the screen, you need to stay ahead of them to survive! (Requires paddles.)

#4511 **Blisterball/Mad Bomber Apple II 48K DOS 3.3 Diskette** $24.95

SOFTWARE

POOL, SNOOKER and BILLIARDS

Atari

POOL

Old pros and beginners alike will enjoy the challenge and realism of *Pool*. From the satisfying click of a tough combination shot to the accuracy required for a three-cushion bank shot, *Pool* has it all. You control the angle and force of your stroke, then watch the object ball speed toward the pocket. It's so real you can almost feel the felt! *Pool* has a practice mode for one player, 8-Ball and Tournament Pool for two.

SNOOKER

A tough British game using 26 balls requiring the eye of a sharpshooter and the strategy of a chess master. (Not available on cassette.)

BILLIARDS

This captivating British game is played with three balls on a standard pool table. Each player attempts to score by sinking a shot or hitting two balls with his cueball.

#7010.	**Pool Atari 16K Cassette**	$14.95
#7012.	**Billiards Atari 16K Cassette**	$14.95
#7509.	**Pool, Snooker & Billiards Atari 16K Disk**	$24.95

Available only in North America

DARTS and TILT

Atari

DARTS

Walk into the pub, grab a pint of lager and a handful of darts, and try for a bull's eye in this amazing graphic game. One or two players can play, testing their aim at ten skill levels. Whether you want to throw a few, or just show your friends what the Atari computer can do, *Darts* is an ideal addition to your software library. This is Britain's most popular Atari game.

TILT

Remember playing with the wood labyrinth game that tilts in all directions? Now it's on computer! One or two players attempt to navigate balls through a maze and into scoring holes. Nine skill levels and nine speeds.

#7011.	**Darts Atari 16K Cassette**	$14.95
#7013.	**Tilt Atari 16K Cassette**	$11.95
#7506.	**Darts and Tilt Atari 16K Disk**	$24.95

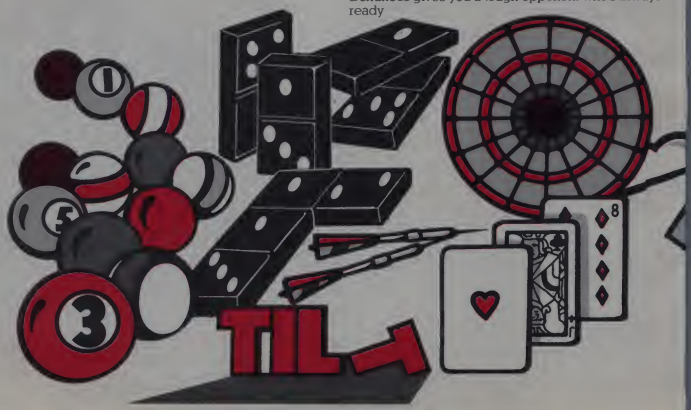
Available in North America only

DOMINOES and CRIBBAGE

Atari

DOMINOES

Take on your computer at a game of draw dominoes. With options for repeating or alternating draw, *Dominoes* gives you a tough opponent who's always ready



CRIBBAGE

Can you be the first to peg twice around the board? Your computer will put up a tough fight in this head-to-head game of cribbage. A graphic display of board and cards highlights this game of skill.

#7007 . . . **Dominoes Atari 16K Cassette** $11.95
#7008 . . . **Cribbage Atari 16K Cassette** $11.95
#7507 . . . **Dominoes and Cribbage Atari 24K Diskette** $24.95

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MICRO GOLF

Apple II

Your whole family will enjoy playing *Micro Golf*, the new miniature golf simulation. The game includes high-resolution graphics and uses a machine language subroutine to move the ball in a realistic manner. Three different courses are provided, as well as a course editor that allows you to create your own miniature golf courses. One to four players can play, using either the Apple II keyboard or paddles. Requires 48K Apple II with one disk drive, DOS 3.3, and Applesoft in ROM.

#4518 . . . **Micro Golf Apple II 48K Diskette** $19.95

ACTION and BUMPING GAMES

Apple II

Six games for action fans. Cross a deadly field in your *Mine Rover*. Hit the ramps and try to make it over the trucks in *Moto Jump*. Race against the clock with the *Road Machine*. Get in shape with *Obstacle Course*. Test your reflexes at *Bumper Blocks* and *Hustle Junior*. Requires Applesoft in ROM or Apple II Plus and game paddles.

#4516 . . . **Action and Bumping Games Apple II 32K DOS 3.3 Disk** $24.95

ICBM

TRS-80

TRS-80 version of the popular arcade game where you must destroy incoming missiles with your own anti-ballistic missiles before they destroy your cities with nuclear warheads.

#3521 . . . **ICBM TRS-80 Model I Diskette** $19.95
#3021 . . . **ICBM TRS-80 16K Cassette** $19.95

SOFTWARE

AIR TRAFFIC CONTROLLER

Atari Sorcerer Apple TRS-80

This fast-moving, real-time game places you in the role of an air traffic controller. You control 26 prop planes and jets as they land, take off, and fly through your airspace. You have a radar map, and give orders to change altitude, maintain a holding pattern, turn, approach, and land at one of two airports.

Written by an air traffic controller, this is a realistic machine language simulation. There are 84 different skill levels, so you won't easily tire of this absorbing simulation.

#5008	**Air Traffic Controller Sorcerer 8K Cassette**	$11.95
#4008	**Air Traffic Controller Apple Cassette**	$14.95
#3006	**Air Traffic Controller TRS-80 16K Cassette**	$14.95

ADVANCED AIR TRAFFIC CONTROLLER

Same as Original Air Traffic Controller, except you have five different airport configurations and radar maps to choose from and added responsibilities such as watching the fuel supply of the planes.

#7004	**Advanced ATC Atari 16K Cassette**	$14.95
#7503	**Advanced ATC Atari 16K Disk**	$19.95
#3519	**Advanced ATC TRS-80 16K Disk**	$19.95
#4517	**Advanced ATC Apple 32K DOS 3.3 Diskette**	$19.95

MILESTONES

Apple II

Take a colorful, challenging 700-mile journey in this computer version of the French card game loved by millions around the world. Overcome accidents, flat tires, gas shortages, speed limits, and traffic lights to arrive before your opponent. Spectacular high resolution color graphics make this the program to use to demonstrate the abilities of your Apple II. (Requires Applesoft Basic and 48K Apple II.)

#4515	**Milestones Apple II 48K DOS 3.3 Diskette**	$19.95

TSUNAMI

Apple II

With *Tsunami* you get dozens of superior arcade games rolled into one program. To begin with, wave after wave of alien attackers attempt to overwhelm your defenses. Each wave comes in a different formation and uses different attack and defense strategies. In the first set of games, the attackers are without shields. Next, with shields sheltering them, the attackers can drop bombs right through their shields . . . but you cannot shoot through them. Successive waves use different strategies. Some move from shield to shield, allowing you to shoot while they are in between. Others just come out briefly to attack and you need fast reflexes to get them. Bonus points are awarded for beating the clock, with a countdown timer displayed on the screen. This may be our finest arcade game ever! (Requires paddles.)

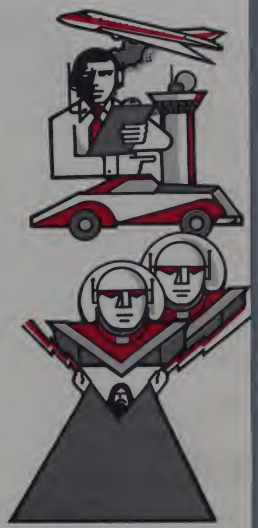
#4526	**Tsunami Apple II 48K DOS 3.3 Diskette**	$29.95

ORIGINAL ADVENTURE

Atari TRS-80

Somewhere nearby you is a colossal cave where others have found fortunes in treasures and gold, but some who have entered have not been seen again. You start your adventure at a small brick building—the wellhouse for a large spring. You must try to find your way into the underground caverns . . . where you'll meet a giant clam, nasty little dwarves, and much more!

#7504	**Original Adventure Atari 40K Disk**	$24.95
#7009	**Original Adventure Atari 32K Cassette**	$19.95
#3518	**Original Adventure TRS-80 48K Disk**	$19.95



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PERIPHERALS

SUPER JOYSTICK

SUPER JOYSTICK

Star Wars. Played with paddles, it's difficult at best and frustrating at worst. But with a joystick, it becomes an entirely new experience.

Drawing with one paddle for horizontal movement and the other for vertical is slow and tedious. But with a joystick, drawing is an absolute joy.

EXCEPTIONAL PRECISION

The Apple high-resolution screen is divided into a matrix of 160 by 280 pixels. To do precise work on this screen, you need a precise device. Most potentiometers used in paddle controls are not quite linear. If you rotate a paddle control at a constant speed, you'll notice that the cursor speeds up slightly at the beginning and end of the paddle rotation.

The Super Joystick has a pure resistive circuit which is absolutely linear within one tenth of one percent. In other words, it would give you precise control over an image of 1000 by 1000 pixels, were such resolution available. Thus it is suitable for high precision professional applications as well as educational and hobbyist ones.

MATCHED TO YOUR APPLICATION

The Super Joystick also has two external trim adjustments, one for each direction. This allows you to perfectly match the unit to your application and computer. If you want to work in a square area instead of the rectangular screen, just reduce the horizontal size with the trim control.

How many times have you played Space Invasion and had your thumb ache for hours from the repeated button pressing? This won't happen with the Super Joystick. Its two pushbuttons are big. Moreover, they use massive contact surfaces with a life of well over 1,000,000 contacts. A few games of Super Invasion using these big buttons will justify the purchase of the Super Joystick.

The Super Joystick is self-centering in both directions. That means when you take your hand off it, the control will return to the center. However, if you want it to stay where you leave it, self-centering may be easily disabled by removing two springs.

The Super Joystick plugs right into the paddle control socket and doesn't require an I/O slot.

HIGH-QUALITY CONSTRUCTION

The sturdy case of the Super Joystick matches that of the Apple computer. Every component used is the very highest quality available. The Super Joystick even uses a full 16-conductor ribbon cable and you can add a second joystick (using our Select-A-Port extension unit for example) if you wish. The first Super Joystick replaces Paddles 0 and 1. You may not realize it, but the Apple has the capacity to support four paddle controls. A second Super Joystick would replace Paddles 2 and 3.

We invite your comparison of the Super Joystick with any other unit available. Order it and use it for 30 days. If you're not completely satisfied, return it for a prompt and courteous refund plus your return postage. You can't lose.

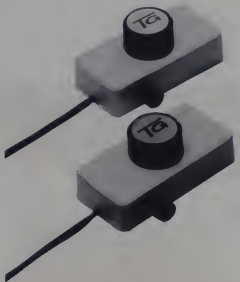
The Super Joystick consists of a self-centering linear joystick, two trim controls, and two pushbuttons mounted in an attractive case. It comes complete with schematics and a 90-day limited warranty.

#0013 **Super Joystick** $59.95 (P&H $3)

SUPER PADDLES

Are the paddle controllers on your Apple wearing out? Or did you get a new Apple without paddles?

We've got good news for you! Super Paddles. Each paddle control consists of a high-precision linear potentiometer and a big (1/2" D) industrial-quality pushbutton mounted in a sturdy high-impact molded plastic case which matches the Apple. Each of the two paddles is connected with a long 5-foot cable to the Apple paddle socket. Every component in a set of Super Paddles is the very finest quality available. The set is backed by a 90-day limited warranty from the manufacturer as well as our money-back guarantee of satisfaction.



#0012 **Super Paddles** $39.95 (P&H $2)

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The Most Versatile and Creative Music Peripheral or Instrument You Can Own

SOUNDCHASER™
COMPUTER MUSIC SYSTEMS

The Soundchaser Gives Apple Owners A Chance To Become Musicians —And Musicians A Reason To Buy Apples

Your Apple Can Be the Heart of a Sophisticated Sound Studio

Would you like real music and total control? The Soundchaser Computer Music System plus an Apple computer produces dazzling results While a studio synthesizer can cost as much as a small house, Soundchaser gives you a polyphonic synthesizer and multibank sequencer, with features found on most professional systems, for about the same cost as twenty hours of studio time The system represents a new generation in music, combining computer and synthesizer hardware under the control of sophisticated software Add a human at the keyboard and you've got a dynamite package

The keyboard is exceptional It is a professional, four-octave, 49-note unit housed in a handsome wood cabinet It looks as good as it sounds Just as important, it feels right Installation is simple the keyboard interface plugs into peripheral slot seven in the Apple No special wiring or chip changes are required As soon as you insert the card the keyboard is ready to talk to the Apple Add a synthesizer, and you can play live, lay down a sequence, or play over a recorded sequence

Outstanding Synthesizer Hardware

The Soundchaser Voice Card is a computer controlled, full feature dynamic synthesizer Each card provides three voices A two card system with a total of six voices is recommended, but we don't lock you into one product line Soundchaser can sing just as well with other synthesizers, most notably the Mountain Music System. This board is highly regarded by Passport Designs and by pairing the sixteen channels, they allow the Soundchaser system to produce eight full-bodied voices

The Software Side of the Story

A system that's hard to use is less than worthless You want to concentrate on music, not programming Soundchaser helps you out with intelligent and flexible menu-driven software A highlight of the software is the Editor With the aid of graphically displayed envelopes, slides, and switches, you can create a wide range of instrument sounds Envelopes and oscillator waveforms are drawn right on the screen There is no better aid for experimentation

Once you create an instrument sound, it's onto the Sequencer Here, you can record a sequence of notes, storing them in memory Later, the sequence can be played back, using a new instrument sound if desired You can sit back and listen, or play live over the sequence Instruments and sequences can easily be saved to disk and retrieved all under program control

Added Support

Passport Designs has already produced a full series of support software to augment Soundchaser The Notewriter displays your music in standard notation on the hi-res screen, right as you play It lets you easily write your own lead sheets and fake books There is no simpler way to produce sheet music and you can obtain hard copy using virtually any graphics printer With the Notewriter, you can compose arrange, and transcribe without having the drudge work get in the way of your creativity

The Musictutor transforms Soundchaser into a challenging educational tool. The software includes programmed courses in ear training, music theory, and harmony It can be used both by teachers and by individuals who want to sharpen their musical skills (curriculum outline is available upon request)

The software will continue to grow, so Soundchaser will never grow obsolete For those with the interest and desire, the manual includes instructions for accessing the keyboard from user programs

System Requirements

Apple II or Apple II Plus, 48K, Disk Drive, Paddles, Monitor or Television with RF Modulator (black and white or color), and printer (only required for making hard copy from Notewriter)

Write for free brochure Dealer inquiries invited

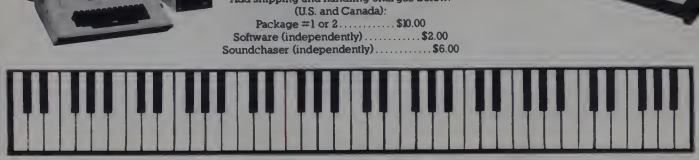
Your system is fully backed by a 90 day manufacturer warranty and a complete money back guarantee of satisfaction (trial period is 30 days)

Soundchaser Packages

Soundchaser with Mountain Music System Boards (Eight Voices-Digital) =	$1045 00
Soundchaser with Dual 3-Voice Synthesizer Boards (Six Voices-Analog) =	$1350 00
Notewriter (1 Disk) =	$99 00
Musictutor (3 Disks) =	$150.00
Soundchaser Keyboard and Interface without Synthesizers =	$650 00

Add shipping and handling charges below: (U.S. and Canada):

Package = 1 or 2 ..... $10.00
Software (independently) $2.00
Soundchaser (independently) $6.00



TWO EXTENSION UNITS TO IMPROVE YOUR APPLE II

EZ PORT

EZ Port extends the game I/O port to the outside of your Apple II so you don't have to open the computer to switch from paddles to joystick or other peripherals.

EZ Port is designed to outlast other I/O extenders—and extend the life of your peripherals, too! The secret is in the sockets. Ordinary DIP sockets are not designed to be used over and over—eventually they won't make contact or the pins will snap off. EZ Port uses Zero Insertion Pressure (ZIP) sockets. You plug in the 16-pin connector and throw a small switch which engages the connections within the socket. The only time there is any stress on the 16-pin connector is when the switch is thrown.

Installation is easy. Just plug EZ Port's cable into the game I/O, run the 24" cable to the outside of the computer and stick EZ Port to the side of your computer with its adhesive strip. Now making I/O changes is quick, easy and safe!

#0022 **EZ Port** $24.95 (P&H $2)

SELECT A PORT

Select A Port not only extends the game I/O port to the outside of your Apple II, it lets you conveniently plug in up to four peripherals simultaneously!

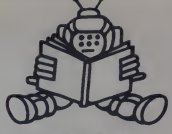
Select A Port consists of five switchable I/O ports. One socket directly parallels the game socket in the Apple: can be used for sensitive devices for which diode isolation would interfere, and has a switch for future expansion where this socket overrides the other four.

With Select A Port you can use two joysticks simultaneously. Because the Apple II can read more than two game controllers (paddles) simultaneously, we cross wired the second I/O port on Select A Port. This port can be reversed to read Paddles 2 and 3. Just plug another joystick into any of the remaining three ports and enjoy dual joystick operation.

The Select A Port is mounted in a 6" x 2¾" x ½" high-impact plastic case. You simply switch on the peripheral to be used and you're ready—without plugging and unplugging delicate 16-pin connectors.

#0023 **Select A Port** $59.95 (P&H $2)

BOOKS



CHILDREN'S BOOKS

Computers for Kids

by Sally Greenwood Larsen

This book has 12 chapters with instructions for operating and programming the TRS-80, the Atari, the Apple, or the Sinclair ZX-81. The book is easy to understand and large type makes it easy to read. Children can find out how to put together a flowchart, and how to get a computer to do what they want to do. They learn how to write their own games and draw pictures that move. There's also a section of helpful hints for parents and teachers. The books include detailed lesson ideas and advice on how to fix small problems that might pop up.

#12G **Computers for Kids/Apple** $3.95 (P&H $)

#12H **Computers for Kids/TRS-80** $3.95 (P&H $)

#12I **Computers for Kids/Atari** $3.95 (P&H $)

#12 **Computers for Kids/Sinclair** $3.95 (P&H $)

Katie and the Computer

Fred D'Ignazio and Stan Gilliam have created a delightful picture book adventure that explains how a computer works to a child. Katie "falls" into the imaginary land of Cybernia inside her Daddy's home computer. Her journey parallels the path of a simple command through the stages of processing in a computer, thus explaining the fundamentals of computer operation to 4 to 10 year olds. Supplemental explanatory information on computers, bytes, hardware and software is contained in the front and back end papers.

Thrill with your children as they join the Flower Bytes on a bobsled race to the CPU. Share Katie's excitement as she encounters the multi-legged and mean Bug who lassoes her plane and spins her into a terrifying loop. Laugh at the madcap race she takes with the Flower Painters by bus to the CRT.

"Towards a higher goal, the book teaches the rewards of absorbing the carefully-written word and anticipating the next page with enthusiasm."

The Leader

"Children might not suspect at first there's a method to all this madness—a lesson about how computers work. It does its job well."

The Charlotte Observer

"... the book is both entertaining and educational."

Infosystems

Katie and the Computer is hardbound, and illustrated in full color.

#12A **Katie and the Computer** $6.95 (P&H $1.50)

Be a Computer Literate

Marion Ball and Sylvia Charp wrote this introduction to the world of computers for children aged 10-16. Excellent for use as a supplemental textbook in school, it discusses large and small computers, how they are used and their impact on our lives. Simple programming concepts are also introduced. Illustrated in full color, with diagrams and photos on every page. Large format, paperbound, 66 pages with glossary.

#6H **Be a Computer Literate** $3.95 (P&H $)

GAME BOOKS

Basic Computer Games

A complete anthology of 101 favorite games and simulations, each complete with sample runs, program listings, and description. All games run in standard Microsoft Basic and are easy to use with any computer. There are games just for fun, to develop logic strategies, to teach environmental solutions, to simulate athletic competition, to play alone or with a group. The 101 games offer the kind of challenge, excitement, and delight you want from your computer. Edited by David Ahl and illustrated by George Beker. Large format paperbound, 200 pages.

#6C **Basic Computer Games** $7.95 (P&H $)

More Basic Computer Games

In this sequel to *Basic Computer Games* there are 84 new games to challenge you. All games are complete with program listings, sample runs, and description. All run in Microsoft Basic and are easy to use with any computer. A Basic conversion table is included.

Talk to Eliza, visit the psychologist, evade a man-eating rabbit, crack a safe, tame a wild horse, become a millionaire, race your Ferrari, joust with a Knight, trek across the desert on your camel, navigate in deep space, hunt a wumpus and much more.

Edited by David Ahl and Steve North, with a preface by Christopher Cerf, illustrated by George Beker. Large format paperbound, 200 pages.

#6C2 **More Basic Computer Games** $7.95 (P&H $1.50)

#6C4 **More Basic Computer Games/TRS-80** $7.95 (P&H $1.50)

BOOKS

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All the articles, stories, learning activities, games, and puzzles that appeared in *Creative Computing* Volume 1. The contents cover computer applications in education and recreation. Over 200 contributors are represented from college professor to high school student, from U.S. Senator to underground cartoonist, and from corporation president to science fiction author. A must for anyone concerned with the role of and potential for the computer in society. Edited by David Ahl. Large format paperbound, 328 pages.

#6A. **Best of Creative Computing Vol. 1** ..... $8.95 (P&H $2)

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336 pages of the best articles, fiction, foolishness, puzzles, programs, games and reviews from *Creative Computing* Volume 2. It contains a potpourri of information on languages and programming theory, on artificial intelligence, on computers in education and in the arts. 67 pages are devoted to puzzles, programs, and things to do. Edited by David Ahl. Large format paperbound.

#6B. **Best of Creative Computing Vol. 2** ..... $8.95 (P&H $2)

Best of Creative Computing Volume 3

336 pages of articles, activities, fiction, games, programs, reviews, cartoons, and other information from Volume 3 of *Creative Computing*. It includes features on technology, public access, educational use, medical applications, and computers in music. It contains great resource listings and reviews of calculators, games, equipment, software, and books. There are 96 pages of things to do—puzzles, programs, problems, and games. Edited by David Ahl and Burchenal Green. Large format paperbound, 336 pages.

#12C. **Best of Creative Computing Vol. 3** ..... $8.95 (P&H $2)

The Colossal Computer Cartoon Book

The best collection of computer cartoons ever is now in its second printing. The fifteen chapters contain hundreds of cartoons about robots, computer dating, computers in the office, home, and lab, and much more. Large format paperbound, 120 pages.

#6G. **The Colossal Computer Cartoon Book** ..... $4.95 (P&H $1)

How to use computers to help teach math!

COMPUTERS IN MATHEMATICS:

A SOURCEBOOK OF IDEAS

The National Council of Teachers of Mathematics has strongly endorsed the use of computers in the classroom. Yet most textbooks don't include programs or computer teaching techniques. And you probably don't have the time to develop programs on your own.

Computers in Mathematics can solve your problem. It contains pragmatic, ready-to-use, classroom-tested ideas on everything from simple binary counting to multiple regression analysis and differential equations. Whether you teach first grade or twelfth, you'll find plenty of ways to use computers to help you teach mathematical concepts.

Computers In Mathematics includes 134 articles and applications written for *Creative Computing* by math teachers. Flowcharts, programs and sample runs that make it easy to use. Over 250 problems, puzzles and programming ideas. And even many activities that don't require a computer.

#12D. **224 pages, large format. Softbound** ..... $15.95 (P&H $2)

The most complex computer circuit can be explained with just nine pennies!

COMPUTER COIN GAMES

Now there's an easy (and fun) way to learn about the inner workings of computers! *Computer Coin Games*, by Joe Weisbecker (the designer of the RCA 1802 microcomputer), simplifies the concepts of computer circuitry through games played with your pennies and the playing boards supplied. Even the most complex circuitry is made understandable!

Games Magazine said, "Whether or not you have any experience with computer technology, you'll be both amazed and delighted with the simplicity of the format and the complexity of the play. All you need are some common cents."

#10R. **Computer Coin Games** ..... $3.95 (P&H $1)

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Send payment (NJ residents add 5% sales tax) plus postage and handling charges (appears in parentheses ( )) following the price of each book) to Creative Computing, Dept. C7I20, 39 E. Hanover Avenue, Morris Plains, NJ 07950. Orders may also be charged to your Visa, Mastercard or American Express account—by mail include credit card name, number and expiration date, or, use our toll free number 800 631-8112. In NJ only 201-540-0445.

side...the other side...the

Guy Kewney

It just isn't possible to explain to anybody in America, quite what a fuss is being raised about the British Broadcasting Corporation's new microcomputer in Europe.

The machine itself is about half the price of a naked Apple II, and offers about as much as an Apple, an Atari, a VIC and a Nestar network all put together — so it's an impressive machine. But that doesn't explain, on its own, suspicions of dirty dealing, allegations of black markets, and all-round jealousy on an incredible scale.

The machine and its fuss have almost totally overshadowed several significant events, including the release of a French look-alike for the Osborne 1, a big boom in "software publishing" and Clive Sinclair's plans for a new machine.

The BBC computer, then, is late. Quite why this should be surprising isn't clear to me, given the troubled history of the beast, which a year ago was still a design under alteration by committee — but people are very indignant about the fact that a series has started on television, featuring a beautiful machine which nobody can get his hands on.

I suppose the explanation is that winning the contract to design and supply the BBC micro was a prestige contract as well as a lucrative one. It spelled recognition in letters so big that the BBC's book on computers, published to back up the program, didn't mention the firm that builds the machine — not even once.

The contract went to a company called Acorn. Acorn became famous when it was one of two companies selected by the British Department of Education to supply micros to schools. The deal was that each high school got one micro, and the Government stumped up half the price. And since the other "approved" micro cost around £2000 sterling, and the Acorn Atom cost around £150 sterling, you can place your own bets on which machine sold most under this scheme.

The BBC had plans for a broadcast program on "encouraging computer literacy" as long ago as November 1980, when it awarded the contract for building its approved micro to a firm called Newbury.

Newbury is the Lear Siegler of Britain, and it had inherited a computer which it called the Newbrain, from the wreckage of Clive Sinclair's first company. The government had rescued Sinclair, and had grabbed two of his microcomputer designs in exchange, kicking him out with an obvious loser (a design called the ZX80) to manage as best he could.

Newbury packaged Sinclair's idea into a series of powerful hand-held machines, capable of sitting on an office desk and driving a video display, but also of working on your lap in the train, off batteries.

It seems that it hadn't really occurred to either Newbury or the BBC that running a program on television, featuring a brand new micro of revolutionary design, might attract the attention of more than a couple of thousand customers.

And just about the time that this message was getting through inside the BBC, Newbury decided (for reasons they have tried to explain to me, but failed) that the business it understood was the computer terminal market, and it was not going to get into the dangerous-looking micro business on a large scale.

Newbury cancelled the project and killed the Newbrain, having first dismissed the managing director who had thought of the project. He eventually bought the project from Newbury, and the Newbrain is available at last — but as late as the Apple III, and in similar quantities.

This cunning marketing ploy left the BBC with a "pilot" program featuring a non-existent machine, and a sense of urgency amounting almost to panic. "Who," it said, "will help us?"

"I will," said almost every little red hen in the book. Sinclair said he would let them use his ZX81, newly launched at the time. Transam offered a machine like the Apple but using the S-100 bus and CP/M — called the Tuscan. Tangerine offered a choice of any of its popular hobbyist-experimenter micros.

And Acorn revealed, diffidently, that it had a rather ambitious design to follow up its popular Atom — a design called the Proton.

At this point, the accusations of double-dealing started to be heard.

A very respected micro pioneer called John Coll was at that time a teacher, an adviser to the BBC on its micro project, and a man looking for a job in the micro business.

First, Coll accepted a job with Apple UK as head of education sales. Then, before he could take this job up, he accepted a similar job with Acorn — who subsequently announced that they would build the official BBC micro.

My own suspicions are easily aroused by this sort of thing, but in this case I don't think there is any double-dealing to find. Apart from the fact that Coll is an old friend of mine, and honest (as are all my friends, of course) as the day is long, I think the computer which Acorn designed answers any doubts on its own merit.

The Machine

So, a bit about the machine.

It uses the 6502 chip, like its predecessor. And it has one or two of the features which distinguished the Atom from the rest of the pack — primarily a very friendly machine code running system. This lets you type lines of assembler mnemonic into the Basic listing as if they were lines of Basic, and runs them under Basic — not as fast as a fully machine-code routine, but much faster than Basic.

But it goes much further: the machine display facilities equal anything in the new Commodore Ultimax family for color and sound and games. The Basic is very powerful and "structured" in a way that rivals the latest educational cult language Comal, and the main circuit board includes, as standard, a local area network

which misses only the £50 worth of chips needed to upgrade the basic machine. And it has all the usual games paddle inputs, printer circuits, and so on, included.

Best of all is the "Tube" — which is 4K of machine code in ROM, which allow the BBC micro to act as a "slave" to a more powerful processor.

Possible "master" processor designs already in prototype at Acorn include a Z80 based CP/M master, a 6502 master running at 3 MHz, a Motorola 68000 based master running Unix, and even a 32-bit National Semiconductor 16032 chip, which I have actually seen running.

All of these masters retain the marvellous display of the BBC CPU — color, sound, and interfaces.

As an example of how the Tube works, Acorn quotes the CP/M master. Instead of the normal BIOS, the master has the Tube software in its top 4K of memory. All calls made by standard CP/M software are trapped by the Tube, and passed to the BBC micro. Here the CP/M procedures (excluding known bugs) are emulated by the 6502, running quite a bit faster on input and output than the Z80 can, and the necessary data are then passed back through the tube to the Z80 processor, which carries on proudly processing, in the belief that it has done all the hard work.

Cost of BBC micro and Z80 master together should be very similar to the cost of an Osborne 1.

A very tasty machine. Since it was just a prototype this time twelve months ago, with the Basic and machine code ROM barely started and not finalized, I'm not astonished that the machine is only available in tens, rather than the thousands or tens of thousands which people would like to buy.

Commodore UK isn't surprised either, and is cashing in enormously with its VIC — selling 10,000 machines a month through normal electrical and electronic consumer shop chains. Even Texas Instruments is (apparently) managing to sell some of its 99/4s in the vacuum.

But other people are surprised, and accusations of black marketeering, profiteering and muddleering are plentiful. That doesn't surprise me either, because the BBC project is more than success (which none of us begrudges a rival) but recognition. And recognition is unforgiveable.

Here We Go Again

All this hassle will start to repeat itself over the next month or so, as the UK Department of Industry selects the "approved" micros for supply to Government installations.

Last year, the department advertised for people to be approved without telling anybody that that was what was happening.

In a masterly piece of non-publicity, the civil servants arranged to run two small advertisements inviting tenders for "a project" using micros. Not everybody saw the advertisement, and those who did, didn't read into its moderate offering the notion that if they didn't get this one, nobody in Government would be *allowed* to buy their micros. But that turned out to be the case.

Pressed, the official concerned informed me afterwards that the ploy had been deliberate. "If it had been known that we were selecting an 'approved' list," he said, "then every paper tiger in town would have been offered. The way we did it, if somebody had design problems or production teething troubles, they held back, and we did without their problems."

Nice logic, but it only works once. Enraged, those excluded from the glory list are now lobbying furiously to get their newest paper tigers on the new list, being drawn up now. It includes some American manufacturers, which is apparently unforgiveable.

Guy Kewney

Across The Channel

They do these things with even more enthusiasm in France, however.

In that country, the micro industry is severely handicapped by two aspects of French chauvinism: first, a determination to do everything through local manufacturers; and second, a commitment to companies that do defense contracts.

Defense contracts, in France as elsewhere, mean rich pickings — but in France, the control of the market is very jealous because of the country's enthusiastic rejection of American and British suppliers. The result is that anybody who can get a defense contract sets up an operation designed not for the economics of market pressure, but for the economics of Government contracting. And thus are they rendered unable to compete in open markets, and their products rendered overpriced to the consumer.

Whatever, the country doesn't have a strong micro manufacturing sector. So it was astonishing to see an Osborne lookalike emerge from France before the UK or Germany could try it.

The imitation isn't available on the open market yet, but it weighs a little more, costs a little more, and offers a little less in the way of software.

One thing it does have, however, is a pair of smaller diskettes (the BASF two-third size drive) which allows a slightly bigger screen. And another thing is an acoustic coupler built in.

Another Sinclair?

By the time you read this, Clive Sinclair will probably have astonished Europe with his next micro.

All I know about it is guesswork confused by gleefully misleading hints and quips from Clive himself, but here are some pointers.

First, Clive Sinclair is incensed and enraged about the awarding of the BBC contract to Acorn, beyond the rage of anybody else. Apart from the fact that one of the partners of Acorn used to work for him before splitting off, he felt rejected by the established authorities, who still regard him with suspicion. And he felt that his best-selling ZX81 design, now into its second half-million production, stood a better chance of being ready by the launch of the TV series.

So I expect Clive to produce a "BBC killer" with a proper keyboard, color, game paddles, and more standard peripherals than his ultra-cheap printer.

He will stick to his own Basic, though he may enhance it, because he's proud of that. It is, after all, a nice Basic, in that it won't let you enter a faulty line (the way Hewlett-Packard's HP85 Basic won't) and runs pretty quickly too.

Clive has said, very definitely, that the new machine won't be a rival to his ZX81, which is taking off all by itself. I believe him, though he has little to lose by producing a rival. With 500,000 machines installed, the Sinclair has become an industry of its own.

As an illustration of the popularity of the micro: at a recent London computer show, dedicated to the ZX range, there were no fewer than 60 different companies selling add-ons, plug-ins, modifications, programs, things to go underneath, things to be controlled by, and things to replace, the ZX81.

Some of them were very sophisticated laboratory controllers, some were very cheap diskette interfaces and drives, some were proper keyboards, and some were just games.

I gather that there are twice that number of firms in the business already. □

ARTWORX. IT'S A WHOLE NEW WORLD OF SOFTWARE.

Scene from BETA FIGHTER during creation using the DRAWPIC graphics editor.

HODGE PODGE: by Marsha Meredith (Atari and Apple)

NOW AVAILABLE FOR ATARI!!! This captivating program is a marvelous learning device for children from 18 months to 6 years. HODGE PODGE consists of many cartoons, animation and songs which appear when any key on the computer is depressed. A must for any family containing young children

PRICE $19.95 diskette

☐ **PM EDITOR**: by Dennis Zander (Atari, 16K)

Create your own fast action graphics game for the Atari 400 or 800 using its player missile graphics features. By using player data stored as strings, players can be moved or changed (for animation) at machine language speed. All this is done with string variables (POKE)=SHIFT4). This program is designed to permit creation of up to 4 players on the screen, store them as string data and then immediately try them out in the demo game included in the program. Instructions for use in your own game are included. PM EDITOR was used to create the animated characters in **ARTWORX** RINGS OF THE EMPIRE and ENCOUNTER AT QUESTAR IV.

PRICE $29.95 cassette **$33.95** diskette

☐ **ROCKET RAIDERS** by Richard Petersen (Atari 24K)

Defend your asteroid base against pulsar bombs, rockets, lasers, and the dreaded "black hole". An alien's attempt to penetrate your protective force field. Precise target sighting allows you to fire at the enemy using magnetic impulse missiles to help protect your colony and its vital structures

PRICE $19.95 cassette **$23.95** diskette

☐ **FOREST FIRE**: by Richard Petersen (Atari,24K)

Using excellent color graphics, your Atari is turned in to a fire scanner to help you direct operations to contain a forest fire. You must compensate for changes in wind, weather and terrain. Not protecting valuable property can result in startling penalties. Life-like variables make FOREST FIRE a very suspenseful and challenging simulation **PRICE** $16.95 cassette **$20.95** diskette

☐ **GIANT SLALOM**: by Dennis Zander (Atari, 16K)

Bring the Winter Olympics to your computer anytime of the year! Use the joystick to guide your skier's path down a giant slalom course consisting of open and closed gates. Choose from three levels of difficulty. Take practice runs or compete against from two to eight additional skiers

PRICE $15.95 cassette **$19.95** diskette

☐ **THE PREDICTOR** by Thomas Barker

(Apple, Atari, TRS 80, North Star and CP/M (M BASIC)

This is a complete package that covers least squares fitting of parameters for two or more variables. THE PREDICTOR can be used for predicting sales and process behavior, trend analysis, model building and many other uses calling for multilinear regression techniques. Each option in the program is prompted with simple YES/NO commands making it very easy to use

PRICE $29.95 diskette

☐ **PILOT**: by Michael Piro (Atari, 16K)

Pilot your small airplane to a successful landing using both joysticks (for elevator and attack angle). PILOT produces a true perspective rendition of the runway, which is constantly changing. Select from two levels of pilot proficiency

PRICE $16.95 cassette **$20.95** diskette

☐ **TEACHER'S PET**: by Arthur Walsh (Atari, Apple TRS 80, PET, North Star and CP/M (MBASIC) systems)

This is an introduction to computers as well as a learning tool for the young computerist (ages 3-7). The program provides counting practice, letter word recognition and three levels of math skills

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☐ **MAIL LIST 3.0**: (Atari, Apple and North Star)

The very popular MAIL LIST 2.2 has now been upgraded. Version 3.0 offers enhanced editing capabilities to complement the many other features which have made this program so popular. MAIL LIST is unique in its ability to store a maximum number of addresses on one diskette (typically between 1200 and 2500 names!) Entries can be retrieved by name, keyword(s) or by zip code (5 or 9 digits) or alphabetically (by last name). Files are easily merged and MAIL LIST will even find and delete duplicate entries! The address files created with MAIL LIST are completely compatible with **ARTWORX** FORM LETTER SYSTEM

PRICE $49.95 diskette

☐ **THE VAULTS OF ZURICH**: by Felix and Greg Herlihy (Atari, 24K, PET)

Zurich is the banking capital of the world. The rich and powerful deposit their wealth in its armed impregnable vaults. But you, as a master thief, have dared to under take the boldest heist of the century. You will journey down a maze of corridors and vaults, eluding the most sophisticated security system in the world. Your goal is to reach the Chairman's Chamber to steal the most treasured possession of all: THE EPIC OIL DEED!

PRICE $21.95 cassette **$25.95** diskette

☐ **BRIDGE 2.0** by Arthur Walsh (Atari (24K), Apple TRS 80, PET, North Star and CP/M (MBASIC) systems).

Rated #1 by Creative Computing, BRIDGE 2.0 is the only program that allows you to both bid for the contract and play out the hand (on defense or offense!). Interesting hands may be replayed using the "duplicate" bridge feature. This is certainly an ideal way to finally learn to play bridge or to get into a game when no other (human) players are available

PRICE $17.95 cassette **$21.95** diskette

☐ **ENCOUNTER AT QUESTAR IV**: by Douglas McFarland (Atari, 24K)

As helmsman of Rkar starship, you must defend Questar Sector IV from the dreaded Zentarians. Using your plasma beam, hyperspace engines and wits to avoid Zentarian mines and death phasers, you struggle to stay alive. This BASIC/Assembly level program has super sound, full player missile graphics and real time action

PRICE $21.95 cassette **$25.95** diskette

NEW PROGRAMS!

HAZARD RUN: by Dennis Zander (Atari 16K)

The sheriff has spotted you and you must make the treacherous run through Smoked Canyon past Bryan's Pond to the jump at Hazard Creek and safety. You can even put the joystick in controlled CELLEE car up on two wheels to make it through some tight spots. A lead foot is not always the answer as you dodge trees, rocks and the lens in this new racing game. HAZARD RUN employs full use of player missile graphics, re-defined characters and fine scrolling techniques to provide loads of fast action and visual excitement.

PRICE $27.95 cassette $31.95 diskette

BETA FIGHTER: by Douglas McFarland (Atari, 16K)

See who will be the ace gunner in this action game set on a spectacular Martian landscape. BETA FIGHTER can be played with one or two players and uses player/missile graphics and delightful sound effects

PRICE $16.95 cassette **$20.95** diskette

DRAWPIC: by Dennis Zander (Atari 16K)

DRAWPIC provides the user with an unbelievably easy way to create screens in graphics mode 3 7. Just sit back with your joystick and use POINT PLOT DRAW LINE, RUBBER BAND, fill and COLOR SET to create beautiful images on your Atari. Full or partial screen images are saved as string data in the program and can be instantly recalled and combined into new images using machine language subroutines. These graphic images can be easily incorporated into your own programs. The example BRIDGE POOL and the landscape of BETA FIGHTER were made using DRAWPIC.

PRICE $29.95 cassette **$33.95** diskette

T: A TEXT DISPLAY DEVICE: by Joseph Wobel (Atari 16K)

T is an auto-loading, no-resident assembly language routine which greatly expands the display capabilities of the Atari. It allows you to freely intermix both text and graphics without the use of modified display lists, PEEKS or POKES. This is done by defining a new device (T:), printing to that device puts text onto the screen. The size of the text is determined by the graphics mode used.

PRICE $17.95 cassette **$17.95** diskette

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David and Sandy Small

For this month's column, a variety of interesting things, including some coverage of the recent West Coast Computer Faire (edited for Atari-interested readers), program listings, interesting news from the mail box, language reviews, and so Forth.

The 7th West Coast Computer Faire was held March 19-22 at the San Francisco Civic Center (in San Francisco, CA, naturally). It was quite a show. Being as near as it was to the various Atari offices in the southern Bay area, it attracted many Atari employees. A large number of software and hardware houses were also there to show off their Atari products.

There was some exciting new hardware demonstrated, such as the 80-column video output board from Bit-3 and the PROMmer package from MPC, and also some old friends, such as the RAMDisk from Axlon.

Of course, there was a large variety of software also, which ranged from the new *Apple Panic* for the Atari to the nth version of *Protector* from Synapse. We'll be reviewing many of these products in future issues. I am especially interested in the 80-column word processor that LJK is writing specially for Bit-3.

Some of the exhibitors had really classy booths. Scott Adams of Adventure International showed up with a complete castle, and ran business from within. Sirius had what looked like a coin-op arcade game set up with an Apple inside, and On-Line and Creative Computing had a large number of games set up to play. (John Harris was showing off his new "Frogger," for instance).

David & Sandy Small, 11314 Yucca Dr., Austin, TX 78750.

I had a fine time, and talked with lots of people. One thing that consistently came out when talking to software houses (Sirius, Creative Computing, Synapse, Adventure International, Datasoft, Gebelli, etc.—the list gets longer every day) was the great interest in Atari software. If you have written some decent software, particularly a game, be sure to let a software house see it; it may be worth your while.

Our Readers Write

Now, let's turn to our mail box. We have been a bit negligent in answering letters. There is a reason for this: our new son, Eric, was born in January. Those of you who know about newborns know exactly how much spare time we had for a while there. But we are learning to manage, and things are slowly returning to a new kind of normal.

Opening the mailbox has become a bit like Christmas, with users sending in their latest code and accomplishments, plus new product announcements. Here's some of the best we have seen; there will be more next month.

Drew Holcomb sends a very nice graphics demonstration (Listing 1) which is worth the five minutes it takes to type in.

Thomas Marshall (those of you on the CERL PLATO network system know him as marshall/physetmp) sends in the fine program in Listing 2 which uses the DLI routine from the December column. It puts a 128-color menu onscreen, then allows the user to move a cursor around the colors. When the user settles on a color and presses the button, the decimal value of the color (for use in SETCOLOR) appears in players on the top and bottom of the screen. There are some very nice techniques being used here; the program deserves a good look. Thanks Tom.

Dennis Baer (868 Main St., Farmingdale, NY 11735) has Algol for the Atari. Ac-

Listing 1.

```
WHEELS

5 REM WHEELES WITHIN WHEELS BY D. HOLCOMB
10 GRAPHICS 23:Y=INT(RND(0)*16):FOR X=708 TO 711:POKE X,Y*16+12:NEXT X:COLOR 1:D
EG
20 FOR X=1 TO RND(0)*4+2:A=INT(RND(0)*5)*1000+2000:POKE 77,0
30 B=(INT(RND(0)*11)*INT(RND(0)*5)^2-79)*INT((RND(0)*2)-1)/(A/1500)*79
35 C=(INT(RND(0)*4)*INT(RND(0)*5)^2-47)*INT((RND(0)*2)-1)/(A/1500)*47
40 D=01E=INT(RND(0)*3)-1:IF E=0 THEN 40
50 FOR Y=0 TO A STEP 15:F=F+E:IF F<1 THEN F=3
60 IF F>3 THEN F=1
70 COLOR F:D=D+.08:DRAWTO B+D*COS(Y),C+D*SIN(Y)
80 NEXT Y:NEXT X
90 FOR Z=0 TO 9
100 A=RND(0)*16:B=RND(0)*9+4:C=RND(0)*30+10
110 FOR X=0 TO 1500/C
120 FOR Y=0 TO 2:SETCOLOR Y,A,B:FOR F=0 TO C:NEXT F
130 SETCOLOR Y,0,0:NEXT Y:NEXT X:NEXT Z:GOTO 10
```

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cording to his letter, it supports all I/O and graphics also. He also has a word processor for the Atari written in Algol. Since there are quite a few folks familiar with Algol, you might want to get in touch. He mentioned he is interested in beta-testing his product.

The Young People's LOGO Association wants to hear from people interested in Atari Pilot. Contact them at 1208 Hillsdale Dr., Richardson, TX 75081. They have a very good newsletter and a great deal of interest in the Logo language.

Atari in Europe

Finally, Nigel Haslock in Switzerland wrote to give me details of the European Ataris. Software houses may be quite interested in this information. He writes:

•European Ataris run 12% slower if tied to VBLANK.

•Atari has kept the one CPU clock/color clock; hence, the 6502 is a 3 MHz model (not 2 MHZ as in the United States), and is clocked at 2.217 MHz or about 25% faster.

•All European models have GTIA chips—hence the GTIA shortage here.

•The E000 and F000 ROMS are different (hence many software problems).

•Cassette handling is different and possibly incompatible.

I have also received a great deal of mail concerning piracy and disk copy protection, which Nigel mentions. He tells of not being able to fix US-version Atari programs to work on the European Ataris because of the copy-locks placed on them. He has a good point.

There is a European market looking for software. Besides the obvious language problems, software houses have another worry—will their software work as it is with a PAL TV?

Atari has provided a hardware location to determine if a given machine is PAL (European) or NTSC (North American); it looks as if it's time to start writing software to check it.

Atari Basic

For those of you with new Ataris, here is a short and highly opinionated discussion of the various languages available for your use. It may serve to clear up some of the confusion you may have over which language is best for you to buy and use. Doubtless, there will be those who will disagree with me; feel free to write and let me know if you do.

Atari Basic, in the 8K cartridge is the original language for this system, developed in a great hurry for the unveiling of the new Atari machines back in 1978. Like

Listing 2.

```
COLOR128

19000 REM The following subroutine can
19001 REM be added to program 5 of
19002 REM ATARI OUTPOST in the December
19003 REM issue of Creative Computing.
19004 REM It adds utility to displaying
19005 REM the 128 colors available to
19006 REM the Atari.  By plugging a
19007 REM joystick in port 1, the sub-
19008 REM routine will give you the
19009 REM specific number one needs to
19010 REM poke in the color registers.
19011 REM
19020 REM POKE 708,XXX   COLOR 0
19021 REM POKE 709,XXX   COLOR 1
19022 REM POKE 710,XXX   COLOR 2
19023 REM POKE 711,XXX   COLOR 3
19024 REM POKE 712,XXX   COLOR 4
19025 REM
19030 REM In program 5, besure to add
19031 REM 410 GOTO 20000
19032 REM
20000 X=105:Y=8
20010 A=PEEK(106)-24:POKE 54279,A:PMBASE=256*A
20020 POKE 559,46:REM DOUBLE LINE RES.
20021 POKE 623,4:REM PLAYFIELD OVER PLAYER PRIORITY
20022 POKE 53277,3:REM TURN ON PM GR.
20030 FOR III=PMBASE+384 TO PMBASE+1024:POKE III,0:NEXT III:REM CLEAR P-M GR....
20040 POKE 5324B,X:REM PL 0 POSITION
20041 POKE 53249,X+16:REM PL 1 POSITION
20042 POKE 53250,X+32:REM PL 2 POSITION
20043 POKE 53251,X-32:REM PL 3 POSITION
20044 POKE 53252,X+48:REM M1 0 POSITION
20045 POKE 53253,X+56:REM M1 1 POSITION
20046 POKE 53254,X+64:REM M1 2 POSITION
20047 POKE 53255,X+72:REM M1 3 POSITION
20050 POKE 704,53:REM PL 0 COLOR ORANGE
20051 POKE 705,65:REM PL 1 COLOR RED
20052 POKE 706,145:REM PL 2 COLOR BLUE
20053 POKE 707,27:REM PL 3 COLOR YELLOW
20069 REM PLAYER SIZE:  0=NORMAL,1=DOUBLE,3,QQUAORUPLE
20070 POKE 53256,1:POKE 53257,1:POKE 53258,1:POKE 53259,2
20071 POKE 53260,255:REM SAME CONVENTION BUT 2 BITS FOR EACH MISSILE SIZE
20080 REM *** PRINTS MISSILE NOS. *****
20090 CHR=17:III=0:FOR III=PMBASE+512+Y TO PMBASE+519+Y:POKE III,PEEK(57344+CHR*8
+II):II=II+1:NEXT III
20091 CHR=18:III=0:FOR III=PMBASE+640+Y TO PMBASE+647+Y:POKE III,PEEK(57344+CHR*8
+II):II=II+1:NEXT III
20092 CHR=241:III=0:FOR III=PMBASE+768+Y TO PMBASE+775+Y:POKE III,PEEK(57344+CHR*8
+II):II=II+1:NEXT III
20093 FOR N=PMBASE+512 TO PMBASE+1024 STEP 128
20094 FOR M=16 TO 0 STEP -1
20095 POKE N-M,255:NEXT M:NEXT N
20096 XO=125:XN=125:YO=93:YN=93:COLR=255:Y=8:GOTO 20170
20099 REM ***** JOYSTICK ROUTINE ******
20100 MOVE=STICK(0):IF STRIG(0)=0 THEN 20230
20105 IF MOVE>7 AND MOVE<11 AND MOVE>13 AND MOVE<>14 THEN 20108
20110 IF MOVE=7 THEN XN=XO+3:COLR=COLR-2:IF YN<0 THEN YN=93:COLR=COLR+64
20120 IF MOVE=13 THEN YN=YO+3:COLR=COLR+2:IF YN>94 THEN YN=0:COLR=COLR-64
20140 IF MOVE=11 THEN XN=XO-4:COLR=COLR-64:IF XN<0 THEN XN=125:COLR=COLR+256
20150 IF MOVE=7 THEN XN=XO+4:COLR=COLR+64:IF XN>141 THEN XN=51:COLR=COLR-256
20170 LOCATE XO+10,YO,CO:CN=CO-2:IF CN<0 THEN CN=CO+2
20180 COLOR CO:PLOT XO,YO:DRAWTO XO+5,YO:PLOT XO,YO+1:DRAWTO XO+5,YO+1
20190 COLOR CN:PLOT XN,YN:DRAWTO XN+5,YN:PLOT XN,YN+1:DRAWTO XN+5,YN+1
20200 XO=XN:YO=YN
20220 GOTO 20100
20230 FOR M=8 TO 3:POKE 704+N,COLR:NEXT N
20235 REM DISASEMBLE COLR FOR PM PRINT
20240 IF COLR<99 THEN CHR0=16+INT(COLR/100):CHR1=16+INT((COLR-(CHR0-16)*100)/10)
20241 IF COLR>99 THEN CHR2=16+COLR-((CHR0-16)*100-(CHR1-16)*10):GOTO 20300
20250 IF COLR<9 THEN CHR0=16:CHR1=16+INT(COLR/10):CHR2=16+COLR-(CHR1-16)*10:GOTO
 20300
20260 CHR0=16:CHR1=16:CHR2=16+COLR
20300 II=0:FOR III=PMBASE+512+Y TO PMBASE+519+Y:POKE III,PEEK(57344+CHR0*8+II):II
I=II+1:NEXT III
20310 II=0:FOR III=PMBASE+640+Y TO PMBASE+647+Y:POKE III,PEEK(57344+CHR1*8+II):II
I=II+1:NEXT III
20320 II=0:FOR III=PMBASE+768+Y TO PMBASE+775+Y:POKE III,PEEK(57344+CHR2*8+II):II
I=II+1:NEXT III
20500 GOTO 20100
20090 REM
20900 REM If you change graphics modes
20905 REM from here, suggest you
20910 REM FOR N=0 TO 7
20920 REM POKE 5324B+N,0
20930 REM NEXT N
20940 REM to remove the player-missile
20950 REM graphics from the screen.
```

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most things done in haste, it lacks something. In this case, speed and the fixing of obvious bugs were neglected to the point where the whole product was compromised.

All arithmetic done in this Basic is done in 6-byte BCD. While this gives great accuracy, it also slows execution to a crawl. Atari 8K Basic is the slowest Basic I have ever used. To be sure, all computers have a tradeoff between memory use and speed, but this is a little ridiculous.

Add to this the many known bugs that will crash the machine, the slowness and occasional inaccuracy of the floating point operations, and numerous other flaws, and it just isn't much of a language. It could have been done better.

Unfortunately, so much of the available software uses the Basic, and even the bugs (remember the old saw about "documented bugs" becoming features in the next version), that Atari can't fix it. We're stuck with it. Too bad.

For speed reasons, it is just about impossible to write professional software in Atari Basic; any assembly program runs so much faster than the Basic that there is no comparison. Games written in Basic are easily identifiable by their slow speed.

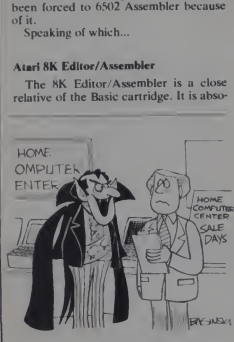
In all fairness, the Atari Basic cartridge was meant for small Basic programs, not the huge amounts of code it is sometimes asked to execute, so it must be forgiven. The overall design structure is just wrong for fast program execution.

In conclusion, I wish it were better, but we are stuck with it. Great things have been done with the computer in spite of the Basic, and many Atari users have been forced to 6502 Assembler because of it.

Speaking of which...

Atari 8K Editor/Assembler

The 8K Editor/Assembler is a close relative of the Basic cartridge. It is absolutely unacceptable for major software development. I can remember delays of up to an hour assembling large programs, and I have heard many other horror stories. This cartridge is also 8K and has bugs.



"Tell me more about 'bytes?"

For instance, any CPY instruction hangs the TRACE function. This cartridge has inspired many software houses to come out with their own assemblers, some of which are very good. The Atari cartridge has a handy debugger, but as an assembler, (how do I put this tactfully?) it is useful only for assembling small subroutines for Basic.

One good thing about the Basic and Assembler/Editor cartridges is that there are now books designed to help the beginner get going with both of them. This is a good way to learn about the Atari and to get started but don't limit yourself to these products once you are past the beginning stage. Another advantage is that they are cartridges, so you don't have to buy a disk drive or more memory in order to run them, as is the case with most other languages.

The above products are supported by a company called Optimized Systems Software, located in Cupertino, CA. OSS also markets a 16K disk-based Basic known as Basic A+ and an assembler in their operating system called EASMD. Lo and behold, Basic A+ and EASMD are so close to the original cartridge code that they even have the same bugs.

The Basic is just as slow, but it does have new commands for handling players and missiles and disk I/O. It is a big step up from the original Basic, but still needs work. I would like to see integer variables and something to speed up the execution?

Microsoft Basic

Atari Microsoft Basic is the Basic that Atari should have released initially. It is a 19K disk-based Basic. Add to that about 8K of DOS which must also be booted with it, and the result is 21K of user memory available for the programmer on a 48K system or only 13K on a 40K system.

That could be hard to live with. For instance, if you go into graphics 8, you have only 13K left on the 48K system, and only 5K on the 40K system. Still, Microsoft Basic is a very powerful and convenient language to use, and I have found few bugs in it. But don't get it unless you have 40 or 48K.

Microsoft Basic has integer variables which are very fast, PRINT USING for business applications, and 4- or 8-byte accuracy (whichever you select), which speeds everything up. It is very much like TRS-80 Basic or Applesoft. Best of all, it has several nice features for player-missile graphics, character set redefinition, and other Atari-specific capabilities.

I like it, and try to use it whenever I have to do anything serious in Basic. While the bootup process takes a while, the time saved in program development is worth it. Any professional developer should seriously consider Microsoft Basic.

A 16K single cartridge (yes, you can put 16K on a single cartridge, check the hardware manual for details) version of Microsoft Basic is planned, but some features, such as renumber or PRINT USING, may still have to boot in from disk. More on this later; things haven't settled down yet.

Microsoft has extremely good documentation which looks even better when compared to the original Basic document. It was this documentation that was responsible for the delay in delivering the product; the disks have been ready to ship for some time but the manuals weren't. Considerable time and effort have gone into them, and it shows. Good job.

Atari Macro Assembler/Editor

The Atari Macro Assembler/Editor is a very, very powerful disk-based assembler, which is a joy to work with. Light years beyond the original cartridge, it is extremely fast; it will completely assemble 100 pages of code in six minutes. It features support for independent files with Include, macros, systext files, and raw speed. I have discovered a few trivial bugs in it, but this is one product I can rave about without reservation. I have worked with it for more than four months and like it better each time I use it.

If you have any serious assembly language programming to do, get the Macro Assembler/Editor.

The Editor is also quite nice, and is being sold through APEX. It is a powerful and reasonably fast editor for developing text with no line numbers. This allows easy input of data, since you need not bother to strip off extraneous line numbers. Pascal, the assembler, and future goodies rely on the editor to generate source text.

Atari Pascal

Atari Pascal is brand new, and not reviewed yet. It is not a UCSD Pascal, but those of you who like Pascal might want to look it over and send me comments.

Atari Pilot

The Atari version of Pilot is a pretty clean implementation of the famous educational language. I have not done much with it but the feedback I have gotten is all good. The documentation in particular is extremely well done.

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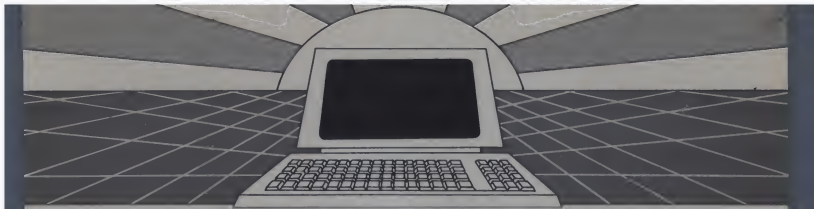

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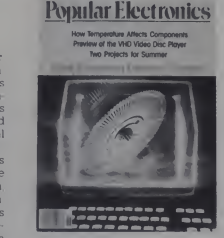

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Outpost: Atari, continued...

Forth

To understand "Why Forth?" you must look at some basic programming philosophy. Many languages are unsuitable for serious software development work. For most high speed games, for example, even Microsoft Basic isn't fast enough. For business applications Pilot is out, and so on.

Well, Forth is difficult to describe, but let me try: it is a stack-oriented language which you define yourself. You start with a basic set of commands (input, output, arithmetic), and define your own commands (called words) from there. The language executes extremely quickly, compared to everything except assembler, and once you get into it, is much easier to write and debug, which drastically cuts development time.

Assembly language provides the ultimate in speed and machine control, but is not much fun to work with. Even with the very good macro assembler, debugging assembly code (especially without very good debug tools) is a frustrating, time consuming process. Forth helps the user get away from that.

The Atari is a very good machine for Forth. There are so many unique hardware features that a generic language such as Basic isn't good at handling them all, but Forth is.

You can define language commands to deal with players and missiles, character sets, vertical blank interrupts, and whatnot. Each user's Forth thus ends up growing along with him.

Sandy and I had been thinking of going to Forth, but it seemed like too much effort to get started. There were even two Atari Forths on the market: QS Forth and Pink Noise Forth. Yet I had a difficult time following QS Forth, even with its reasonably good instructions, and it seemed more a generic Forth implementation than an Atari-specific Forth. So we waited.

Two things changed our minds: 1) The book *Starting Forth* by Leo Brodie, from Prentice-Hall, which is simply superb and easy to read (complete with really, really good illustrations), and 2) VALForth, a new Forth based on figForth, which is currently being sold by APEX.

VALForth has commands designed especially to take advantage of the features of the Atari. It also includes a character set editor, easy player graphics, a very nice screen editor, and several other useful features. We were shown a preliminary version, and after reading the *Starting Forth* book, could dive in immediately and do things.

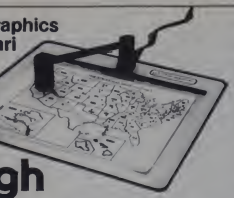
The transition is reasonably painless, and the power of the language unfolds around the user; I'm very happy to be working in it and we plan to write our next game in VALForth. The stack orientation is easy to get used to, especially if you just consider the stack data as part of the instruction set format.

The development speed of Forth has not been overlooked by Atari. Atari's Coin-Op group has a semi-legendary "Coin-Op Forth" which is supposed to be quite something to use. The Atari demo disk with the "Disco Dirge" background music is all "coin-op Forth." Rumor also has it that many of the new Coin-Op games are written in Forth (Battlezone, for one). This wouldn't surprise me; it's a powerful language.

As a point of philosophy, we feel that as Atari programmers we began in Basic, moved to 6502 Assembly for speed, and now, after experiencing assembly debugging, are moving to Forth to reduce the amount of time we must spend on programming. We have great hopes for VALForth and what we have seen already is very worthwhile.

This brings us to the end of the July column. I hope you have enjoyed the sample programs and information. See you next month. □

High-Resolution Color Graphics for the Apple and Atari



Graphics Breakthrough

How many programs have you written that would benefit from animated high-resolution graphics? Probably several. It is this kind of dramatic graphics that distinguish outstanding programs from ordinary ones. But if you've ever agonized for hours or days just to get one image perfected, you're probably not anxious to do it again. Now there's a better way.

New Graphics Entry System

Today there is a new graphics system available that is not only amazingly user-oriented but surprisingly economical. Called VersaWriter, it starts with an ingeniously simple entry board consisting of a 14"X12" high impact plastic bed with a tough clear plastic overlay sheet. The original drawing or diagram is fastened with masking tape to the plastic bed and then covered with the clear sheet. Instead of using a light pen or complicated electronic X-Y head, the VersaWriter uses a double jointed arm attached to the top of the entry board at one end and a magnifying lens with crosshairs at the other end. The VersaWriter resembles a draftsman's pantograph on a smaller scale.

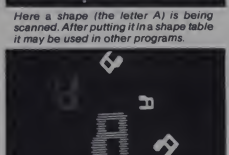
At each joint in the arm of the VersaWriter is a potentiometer. A cable from these pontentiometers connects to the paddle input of the computer. No special interface electronics or board is needed. Since the arm of the VersaWriter bends only in one direction, each point on the plotting head corresponds to a unique set of resistances on the potentiometers. All that's needed now is software to translate these resistances into usable screen coordinates.

Exceptionally powerful software

It is in the software where VersaWriter really stands out. VersaWriter comes with two full disks of user-oriented software. First it has sets of "low level" commands for entering, creating and copying drawings and diagrams. Secondly, it has extensive sets of application routines for moving, enlarging, rotating, coloring or animating drawings that the user has created.

Of course the basic commands let you enter a drawing freehand or by tracing it. Want a wider brush stroke? Six widths are available. Drawings can be independently scaled in both the vertical and horizontal directions. An enclosed shape may be filled in with any of 106 colors. No, that is not a misprint—By the same technique that a printing press can create hundreds of colors from the three primary ones, so can VersaWriter.

Here a shape (the letter A) is being scanned. After putting it in a shape table it may be used in other programs.



From the shape table, a shape (the letter A) may be enlarged, rotated, colored or moved about the screen.

Create Animation for Other Programs

The shapes you create with VersaWriter can be used and manipulated with ease in other programs. Up to 255 shapes can be entered into a shape table. These shapes may then be placed on the screen in any position or may be overlaid on a full or partial screen image. Animation is produced easily by moving about a portion of the image created by VersaWriter. For example, by alternating between two images of an airplane propeller it will appear to be spinning.

Other VersaWriter software includes text-writer with which text can be added to graphics. Upper and lower case, choice of color, text size, direction and starting point all may be specified.

The Area/Distance program lets you calculate distances (or perimeters) by entering a scale and tracing a shape or map route with the drawing arm. Areas of figures, open and irregular, can be similarly calculated.

The software also includes sets of electronic and computer logic shapes. In addition, an entire disk of dramatic demonstration graphics is included. These twelve full-screen graphics run the gamut from a fully labeled cross section of a human skull to colored maps to animated cartoons to an electronics schematic.

Software Updates

You may have read a review of VersaWriter that indicated that the color fill routine was slow. It was. But not any more. Several routines and improvements were added to the VersaWriter software since its introduction. An added feature, the Expansion Pac, is also now available. This third disk of software contains an area distance program, a microscope feature, and will save your graphics in the exact colors you prefer. It also includes shape tables for architecture, plumbing, electrical, circuit boards, landscape, chemistry, games, and more; 350 predefined shapes in all.

At Peripherals Plus, we evaluated every graphics device. We wanted to handle the best one regardless of price. VersaWriter has the best performance bar none. Surprisingly, it also has the lowest price, just $299.00 for the Apple version. It requires an Apple II Applesoft in Rom (or an Apple II Plus), disk, and 48K memory. VersaWriter comes complete with two disks of software, a comprehensive instruction manual, and a 90-day limited warranty. The additional Expansion Pac is available for $39.95.

The Atari version, which varies slightly from the Apple version in number and types of functions performed, is available for $299.00. As new updates are developed for the Atari, Peripherals Plus will furnish them free to all customers—just send us the disk and we'll supply the updated material. We make this unique offer because it is in our best interest to have you make the best use of your computer. We're also convinced that if other people see your VersaWriter in use they'll want one too.

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Will Fastie

Things are starting to warm up.

I now have a stack of programs (with their manuals, of course) that's about a foot tall. My press release file (pile?) is growing, and I'm getting more unsolicited information, which simply means my visibility is increasing. These are all encouraging signs for you because my information flow becomes your information flow. These are depressing signs for me because it raises my workload without a corresponding increase in my compensation. Maybe I should take in laundry on the side.

In the April issue of *Creative*, Stephen Gray recommended that the readers of his TRS-80 Strings column also read the other columns. He pointed to the similarity of the Basic for each machine, plus the benefit of knowing something about the other computers. He makes a very sensible point with which I agree. I did get a chuckle as I read "Keep your eyes on the IBM column, which may just have some programs you can pick up..." because I knew what I was putting together for this column. You'll see what I mean later on.

This will be another month of free form. I've decided not to embarrass myself by showing you my graphics screen dump program until I can test it. My problem is a lack of printer graphics, which I hope to resolve soon. I hope the programs I have included, though simple, will be interesting to you.

W. H. Fastie, 7110 Sheffield Road, Baltimore, MD 21212. Correspondence can only be acknowledged when a stamped, self-addressed envelope has been provided.

Photo 1. "Leggs" for Epson printers, from Argus, Inc.

New Hardware Products

I really have a great deal of respect and admiration for inventors who come up with simple, elegant, and powerful ideas. A firm in Baltimore named Argus, Inc., has come up with the simplest stand for the Epson printer yet: a set of long legs. Called Epson 'Leggs,' these legs are inserted in the holes at each corner of the printer base and raise the entire unit about 3" or so, just enough so that a stack of paper can be placed under the unit. That's all the other stands do, but the advantage is price.

A set of these legs costs $9.75 when ordered directly from the manufacturer. The other stands cost about $25 to $30, and the IBM stand is $55 list. The legs are shown in Photo 1. The address of the firm is at the end of the column.

Note: the legs are for the MX-80, but not the MX-70 or MX-100. I've tried them, and they are very clever indeed.

The next significant product is something called SemiDisk, from SemiDisk Systems. I'm a little light on information, but the device is a memory card with 512KB. It is not an expansion board, though. It is a disk emulator.

The manufacturer provides software so that the memory appears to be a floppy disk, but one that runs much, much faster. More than one board can be installed, and a bigger board provides 1 megabyte of storage.

This product should be of interest primarily to those who need very fast access to large amounts of data. SemiDisk costs $1995 for 512KB in the S-100 configuration—a high price for this amount of storage. It was not yet available for the IBM PC at the time of this writing.

IBM has also announced something related to the IBM Personal Computer, although not actually for the system. They have announced the IBM 7535 Manu-

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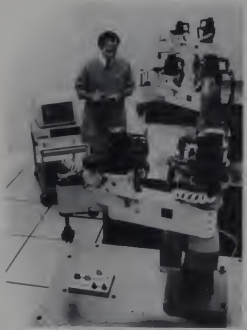

Photo 2. An IBM Personal Computer is used to develop programs for the IBM 7535 Manufacturing System.

Photo 3. Davong Systems' DSI-501 5MB, 5 1/4" Winchester disk. Software for integration with IBM DOS is included.

facturing System, a robot arm. The 7535 can be programmed using a programming language called AML and where do you think this program development is done? The IBM Personal Computer, of course! Once the program has been loaded into the arm the Personal Computer can be detached and used for some other purpose. Photo 2 shows the system.

One hardware announcement has nothing to do with the IBM, but reflects the opinion that the IBM is a signficant market force. It is the MetaCard from Metamorphic Systems, Inc. This is an 8088 processor card with memory for the Apple II computer. It even allows MS-DOS (Microsoft's name for the IBM DOS) to run on the Apple, as well as CP/M-86 and UCSD Pascal version 4. CP/M-86 is supplied with the $980 product, and the other operating systems are optional.

Finally, Davong Systems has shaken things up by announcing their DSI-501 hard disk drive. List price: $1995 for five megabytes of storage, interface, power supply, and software. The drive is shown in Photo 3. Of course, the price of this unit is very interesting, the lowest I know of so far.

What's more interesting to me is that the price includes software support for IBM DOS. Most of the hard disks I know about have been announced with CP/M-86, and some of the disk vendors are even offering that operating system since IBM has yet to announce it.

Davong seems to be unique in this regard—I think to their advantage. They are also supporting an operating system called Qunix from Quantum Software Systems. The Davong press release called Qunix a "multi-user, multi-tasking system at a very low cost." I'll know more about the disk next month.

A comment about hard disks. There are quite a few companies jumping into the IBM market with disk drives, and the lure of 30 times the capacity of diskette drives is very tempting. Unless you have critical need for such capacity now, I advise patience.

The fact is that the market simply cannot sustain 20 or 30 disk subsystem manufacturers. If you can wait for a little while some of these companies will drop out and the leaders will emerge. IBM should also come bounding in soon, and I think it will be important to see what their unit looks like.

The goal is to get the most standard device possible, so there is no danger of software incompatibility. By the way, I haven't said too much about hard disks yet, because I am waiting too. I am in the process of getting some drives to evaluate, so you'll hear more as time goes on.

Cover Competition

Last month I mentioned three companies who manufacture dust covers for the IBM PC. They are TecMar, CompuCover, and Cover Craft. The Cover Craft covers came late this month, so I have tried them but haven't used them for long. They are made of a translucent, anti-static vinyl material and are well-made. All the seams are rolled so there is additional thickness where the material is stitched.

The cover for the IBM display and system unit fits well, although it is a little snug and requires the monitor to be positioned just so. The keyboard cover is nice, but it does not have a slit on the rear for the cable and as a result does not fit perfectly. Cover Craft's printer cover, however, fits like a glove. Considerable attention has been paid to its design.

I used both the TecMar and the CompuCover covers on my system over the last month. The TecMar covers are unacceptable, because they attract dust like a magnet. This news is a blessing in disguise, since these covers are the most expensive. By comparison, not a trace of dust could be found on my CompuCover set.

I have not seen the CompuCover printer cover, but other than that, I call it even between CompuCover and Cover Craft. The products from both companies are well made. Best fit for the system unit goes to Cover Craft. Best fit for the keyboard is CompuCover, hands down. CompuCover will have to work hard to match the Cover Craft printer cover, though.

Now, with all that digested, what is my preference? Well, I really like the

IBM, continued...

CompuCover covers because of the nice color and feel of the cloth-backed vinyl. I am using the Cover Craft printer cover because it is so well made.

IBM Service

I got a letter in the mail this month advising me that my warranty was just about up and that I should consider a maintenance agreement with IBM. I learned a disturbing fact. The letter informed me that if I did not take an agreement with IBM, I could only get IBM service by mailing my unit to Greencastle, IN, because IBM does not offer walk-in service.

I didn't realize that. IBM just lost any chance of getting my service business, since I have a very respectable Computerland store which is only too happy to see me walk in with a broken computer for time and materials repair.

By the way, IBM is charging $179 for a one year, pick-up/delivery service agreement for the Epson Printer. I won't tell you not to buy this contract, but everyone tells me that Epson printers simply do not break. My personal experience bears this out, as none of the people I know with Epsons have ever required repair. It sounds like $179 is a little high.

IBM Program Submission Plan

If you have considered submitting a program to IBM, then you have probably already taken the first step of writing away for their information packet. I got one to see what it was like, and to learn what the "deal" is.

The packet contains two agreements. The first is an agreement for submission of the program. The form is used to describe your product, establish the relationship between your employer, you, and the software package, and also includes some "specific provisions." Most of these are routines.

Watch out for paragraphs 3, 4, and 6. Paragraph 3 says that you agree to enter into an acceptance agreement if your submission is accepted. In effect, the agreement to submit binds you to accept if IBM does. However, the entire agreement is worded to clearly indicate that IBM can do whatever it pleases with the program. I read it as saying that even if they accept it, they do not necessarily have to market it.

Paragraph 4 says that, except as protected by patent claims and copyright laws, IBM can disclose any material submitted as they choose.

Paragraph 6 says IBM may "make, procure, or market" something that competes with your program. This agreement also calls out that IBM will only be liable to $100,000 in the event a controversy arises over the agreement.

The second agreement is the Acceptance Agreement. If you are in the process of executing one of these, it means IBM has accepted your submission. The agreement is broad. First, you will be paid an advance royalty of $250. You will be paid 15% of IBM's revenue for the product (Watch it: IBM's revenue may be 40% of list price) to a maximum of $100,000, and payments are quarterly. The royalties are terminated after four years. The term of the agreement is at least 75 years. You must provide maintenance for your program for four years, and must send IBM, within one month, any changes you make to the program. Maintenance of the program is at your expense.

This is a tough agreement. My advice is: don't bother. In the first place, if you have a really great program, why settle for $100,000? Do you think VisiCalc has a $100K ceiling? Ha!

In the second place, the agreement is not balanced and favors IBM at every turn. They certainly have a right to protect their interests, but you must protect yours as well. I think you give away too much when you sign this piece of paper.

Here's my best piece of advice: don't listen to me. Have your attorney look it over for you. What do I know about the law, anyway?

Publications

I really like *Creative Computing*, and I'm glad to be writing for it. I have always found it to be my best source of information. However, there are some other publications that will be of particular interest to IBM PC owners.

The first is *PC*, "The Independent Guide to IBM Personal Computers." The charter issue is the February/March 1982 issue, and the magazine will be published bi-monthly. It was 100 pages, including covers, and I thought it was a competent job. It is professionally done with good graphics and lots of color, and the writing is good. I thought the cover was striking.

The second is *Personal Computer Age*, "The Definitive Journal for the IBM Personal Computer User." It will be published monthly. The February issue was 32 pages. I think the journal is a little light. Much of the content of the first two issues was not particularly original, coming from IBM documentation. The writing leaves a little to be desired.

There are two very good features of the publication. The first is a section called "Problem Reporting." Ten dollars is offered if you are the first to report a bona fide bug or problem. It's an excellent way to encourage a flow of this kind of information.

Listing 1. Basic version of the ROMCHAR program.

```
100 ' ROMCHAR   display dot matrix characters from ROM patterns
110 '  Will Fastie -- Revised 24 March 1982
120 DEFINT A-Z
150 DIM COLMASK(8)
140 FOR I = 0 TO 7: COLMASK(I+1)=2^(7-I): NEXT I
150 DOTCHAR=219
160 DOTSIZE=1
170 DOT$=STRING$(DOTSIZE,DOTCHAR)
180 DEFSEG=&HF000
190 DEF SEG=&HF000
200 BASEADR=&HFA6E
210 BYTESPERCHAR=8
220 KEY OFF
230 '  Main loop
240 CLS
250 CHAR$=INKEY$: IF CHAR$="" THEN 250
260 IF CHAR$=" " THEN CLS: END
270 CODE=ASC(CHAR$)
280 IF CODE < 128 THEN BEEP: GOTO 230
290 ADR = BASEADR+ (CODE*BYTESPERCHAR)
300 CLS
310 X=8
320 Y=SCREENWIDTH -(8*DOTSIZE)
330 GOSUB 350
340 GOTO 250
350 '  Subroutine to display character
360 FOR ROW=1 TO 8
370   ROWVAL=PEEK(ADR+(ROW-1))
380   FOR COL=1 TO 8
390     COLMASK=COLMASK(COL)
400     IF (ROWVAL AND COLMASK)    0 THEN GOSUB 450
410   NEXT COL
420 NEXT ROW
430 LOCATE 1,1
440 RETURN
450 '  locate to bit position and display giant pixel
460 LOCATE X+(ROW-1),Y+(COL-1)*DOTSIZE
470 PRINT DOT$;
480 RETURN
490 '  Initialize display
500 SCREENWIDTH=80
510 RETURN
```

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Unicorn

Mince	$149
Scribble	$149
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Data Base

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CIRCLE 144 ON READER SERVICE CARD

IBM, continued...

The second is the directory at the end of the magazine. This lists software and hardware vendors, services, publications (except they did not mention my column), and clubs and users groups. This list has already helped me and can be very valuable if you are looking for something in particular. I encourage *Personal Computer Age* to continue this section, no matter how big it gets.

There is a new book out from Que Corporation called *IBM's Personal Computer.* It has 303 pages and costs $14.95. I think it's very good, especially for someone considering the purchase of a personal computer of any kind, but who is not sure how the IBM machine fits in the scheme of things. I'm pretty well-informed, but the book had some surprises for me, too. I recommend it.

Software

I had a lot of fun with my system over the last month, which is unusual. For the most part, I haven't done too much playing with my machine. When I have the time to fool with it, it's a word processor and these columns are in progress. What got me fired up was the arrival of *PC/Forth* from Laboratory Microsystems.

Forth is, well, uh... umm... well, interesting. At the risk of inflaming Forth devotees, I'll say that Forth is a programmer's programming language. Its power lies in the fact that it gives the programmer total control, and that's also the danger. As you can see from my listings, Forth is not for the faint of heart.

I found *PC/Forth* to be complete and pretty well thought out for the IBM PC. There were a few bugs, but Ray Duncan, who *is* Laboratory Microsystems, promptly repaired the system and sent me an update. The documentation that comes with the system is meant for someone who understands Forth. You must supplement it with other materials if you are a neophyte.

Ray sent me a copy of Leo Brodie's "Starting Forth," which is a very good tutorial. It has the small problem of speaking in one variant of Forth, while *PC/Forth* is the other variant. *PC/Forth* is derived from Release 1.0 of fig-Forth's 8086 version.

Although *PC/Forth* is the first language other than Basic that I have been able to test, I am anxious to review whatever tools are available for the IBM PC. I put together three rather simple programs which I intend to implement with each language system that I get. Let me describe the three programs. Listings 1 thru 6 are these programs written in Basic and Forth.

The first program is ROMCHAR. This is the program that was used in the March column to demonstrate memory access. The program also shows output to the display with cursor control.

Listing 2. PC/Forth version of the ROMCHAR program.

```
Screen # 30
  0 ( FORTH version of ROMCHAR
  1 FORTH DEFINITIONS DECIMAL
  2 : TAG# ;
  3 : STACK.BITS 7 0 DO 2 /MOD LOOP ;
  4 : GET.CHAR ( KEY DUP BL = CLEARSCREEN IF QUIT ENDIF ;
  5 : GET.VAL  1+ 2DUP CAL ;
  6 HEX
  7 : CONVERT F000 SWAP 8 * FACE + I- ;
  8 DECIMAL
  9 : DISPLAY 7 + 36 SWAP GOTOXY
 10            8 0 DO IF 219 EMIT ELSE BL EMIT ENDIF LOOP ;
 11 : ROM.CHAR 0 0 GOTOXY GET.CHAR CONVERT
 12              8 0 DO GET.VAL STACK.BITS 1 DISPLAY LOOP
 13  ;
 14 : ROMCHAR CLEARSCREEN BEGIN ROM.CHAR AGAIN ;
 15
```

Listing 3. HILO game in Basic.

```
100 ' HILO - Guessing game.  Object is NOT to guess the number.
110 ' Will Fastie -- 22 Feb 82
120 PROG$="HILO v1.00 22-Feb-82"
130 KEY OFF
140 RANDOMIZE VAL(RIGHT$(TIME$,2))
150 ' Main program
160 CLS: PRINT PROG$: PRINT
170 GOSUB 220
180 PRINT
190 INPUT "Another game? (Y) or N)  ";ANSWER$
200 IF LEN(ANSWER$) = 0 THEN ANSWER$ = "Y"
210 IF ANSWER$ = "Y" OR ANSWER$ = "y" THEN GOTO 160 ELSE CLS: END
220 ' Game playing routine
230 HIGH = 100: LOW = 0
240 NUMBER = INT(99*RND)+1
250 ' Guessing loop
260 ROW = CSRLIN: INPUT "Your guess:  ",GUESS
270 LOCATE ROW,20
280 IF GUESS  = LOW OR HIGH  = GUESS
        THEN PRINT "is out of range!  You LOSE!": GOTO 330
290 IF GUESS = NUMBER THEN PRINT "is the number!  You LOSE!": GOTO 330
300 IF GUESS > NUMBER THEN HIGH = GUESS: PRINT "is high.": GOTO 320
310 IF GUESS < NUMBER THEN LOW  = GUESS: PRINT "is low."
320 GOTO 250
330 RETURN
```

Listing 4. HILO game in PC/Forth.

```
Screen # 36
  0 ( HILO, by Will Fastie
  1 FORTH DEFINITIONS DECIMAL : GAME.HILO ;
  2 0 CONSTANT CONTINUE   1 CONSTANT GAME.OVER
  3 0 VARIABLE SELECTION
  4 0 VARIABLE HIGH  0 VARIABLE LOW
  5 HERE VARIABLE RND.X @DATE + @TIME + + RND.X @ + RND.X !
  6
  7 : RND RND.X @ 31421 * 6927 + DUP RND.X ! 99 U* SWAP DROP 1+ ;
  8 : GET.GUESS ( --- ) ." Your guess:  " #IN ;
  9 : OUTOF.RANGE ( guess --- guess f )
 10       DUP DUP HIGH @ > SWAP LOW @ < OR ;
 11
 12 : .ILLEGAL ." is out of range!  You LOSE!" ;
 13 : .CORRECT ." is the number!  You LOSE!" ;
 14 :    .LOW ." is low." ;  : .HIGH ." is high." ;
 15
```

```
Screen # 37
  0 ( HILO continues )
  1 : CHECK.LIMITS ( guess --- f )
  2     OUTOF.RANGE
  3     IF .ILLEGAL DROP GAME.OVER ELSE DUP SELECTION @ =
  4     IF .CORRECT DROP GAME.OVER ELSE DUP SELECTION @ <
  5     IF LOW ! .LOW ELSE HIGH ! .HIGH ENDIF CONTINUE
  6       ENDIF ENDIF CR ;
  7
  8 : PLAY.HILO 100 HIGH ! 0 LOW ! RND SELECTION !
  9       BEGIN GET.GUESS CHECK.LIMITS UNTIL ;
 10
 11 : HILO  BEGIN
 12       CLEARSCREEN ." HILO  v1.00  25-Mar-82" CR CR
 13       PLAY.HILO
 14       CR ." Another game?  (Y or N)  " KEY 78 =
 15    UNTIL ;
```

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CIRCLE 102 ON READER SERVICE CARD

IBM, continued...

The second program is a simple game I call HILO. Besides being simple, it has sentimental value because it is the first program I ever wrote, and in machine code on an NCR 500 (what?) to boot. It demonstrates control structures and interactivity.

The third program is a benchmark designed to provide a rough, unscientific measure of relative language performance. To be quite frank, it will really only give an idea how fast other languages are compared to Basic, although my forthcoming assembly language version of this program should represent something close to absolute best performance.

The results of the benchmark for Basic and *PC/Forth* are shown in Figures 1 and 2. Note that the Forth version ran with 30,000 iterations while Basic ran with 10,000. I don't have the floating point routines for Forth yet, so only the integer results are helpful. They indicate a performance ratio of 18 to 1 in favor of Forth.

I'm looking for other languages. In particular, I'm looking for the more esoteric ones, since we know the usual ones will be available. For example, let me know if you know of a Lisp, Snobol, APL, Pilot, or Sail for the PC. Other versions of C, Pascal, or Ada will be of interest also. Lest I give the wrong impression, I am interested to learn of the standard languages but I don't intend to review them unless they have some outstanding characteristic.

Figure 1. Benchmark results for IBM Basic.

```
    10000  iterations in loop.

 Integer test
 ------- ----
 Time started:  03:44:15
 Time stopped:  03:44:45
 Elapsed time:  00:00:30

 Single Precision Floating Point Test
 ------ --------- -------- ----- ----
 Time started:  03:44:46
 Time stopped:  03:45:23
 Elapsed time:  00:00:37

 Double Precision Floating Point Test
 ------ --------- -------- ----- ----
 Time started:  03:45:24
 Time stopped:  03:46:10
 Elapsed time:  00:00:46
```

Figure 2. Benchmark results for PC/Forth. Note 30,000 iterations as opposed to 10,000 for Basic.

```
    30000 iterations in loop.

 16-bit Integer test
 ------- ------- ----
 Time started:  03:29:18
 Time stopped:  03:29:23
 Elapsed time:  00:00:05

 32-bit Integer test
 ------- ------- ----
 Time started:  03:29:23
 Time stopped:  03:29:31
 Elapsed time:  00:00:08
```

Listing 5. Basic benchmark.

```
100 ' BENCH - BASIC "number crunching" performance test
110 ' Will Fastie     24 March 1982
120 PROG$ = "BENCH v1.00 24-Mar-82"
130 NRITERATIONS = 10000
140 DEF FNSECS(T$) = VAL(LEFT$(T$,2))*3600 + VAL(MID$(T$,4,2))*60
                   + VAL(RIGHT$(T$,2))
150 DEFINT I
160 KEY OFF: CLS: PRINT PROG$: PRINT
170 PRINT NRITERATIONS;" iterations in loop.": PRINT
180 TEST$ = "Integer test"
190 START$ = TIME$
200 FOR I = 1 TO NRITERATIONS
210   B% = B%+1
220 NEXT I
230 STOP$ = TIME$
240 GOSUB 400
250 TEST$ = "Single Precision Floating Point Test"
260 START$ = TIME$
270 FOR I = 1 TO NRITERATIONS
280   B! = B! + 1
290 NEXT I
300 STOP$ = TIME$
310 GOSUB 400
320 TEST$ = "Double Precision Floating Point Test"
330 START$ = TIME$
340 FOR I = 1 TO NRITERATIONS
350   B# = B#+1#
360 NEXT I
370 STOP$ = TIME$
380 GOSUB 400
390 END
400 ' Subroutine to calculate and display results of test
410 PRINT TEST$
420 PRINT STRING$(LEN(TEST$),"-")
430 PRINT "Time started:  ";START$
440 PRINT "Time stopped:  ";STOP$
450 ELAPSED = FNSECS(STOP$) - FNSECS(START$)
460 HOURS   = ELAPSED\3600
470 MINUTES = (ELAPSED-HOURS*3600)\60
480 SECONDS = ELAPSED MOD 60
490 PRINT "Elapsed time:  ";
500 FORMAT$ = "##:##:##"
510 IF HOURS   < 10 THEN MID$(FORMAT$,1,1) = " "
520 IF MINUTES < 10 THEN MID$(FORMAT$,4,1) = "0"
530 IF SECONDS < 10 THEN MID$(FORMAT$,7,1) = "0"
540 PRINT USING FORMAT$;HOURS,MINUTES,SECONDS
550 PRINT
560 RETURN
```

Listing 6. PC/Forth benchmark. Program tests both single and double precision integers.

```
Screen # 40
  0 ( BENCH by Will Fastie
  1 FORTH DEFINITIONS DECIMAL
  2 : BENCH ;
  3 ( Definitions of time routines )
  4 : SEXTAL 6 BASE ! ;
  5 : :00 # SEXTAL # DECIMAL 58 HOLD ;
  6 : HH:MM:SS ( dsecs --- )
  7     # :00 :00 # # #  TYPE SPACE ;
  8 : TIME  SECS ( forth-time --- dsecs )
  9     R> 256 /MOD 60 # * 60 U# R> 256 /MOD SWAP DROP S->D D+ ;
 10 : .SHOWTIME ( dsecs --- dsecs )
 11     2DUP HH:MM:SS ;
 12 : .ELAPSED  ( dsecs1 dsecs2 --- )
 13     D- HH:MM:SS ;
 14
 15

Screen # 41
  0 ( BENCH, continues )
  1 : DASHES ( n --- ) 0 DO ." -" LOOP ;
  2 10000 VARIABLE NRITERATIONS  0 VARIABLE B 2 ALLOT
  3 : INTEGERS-16 0 B ! NRITERATIONS @ 0 DO B @ 1 + B ! LOOP ;
  4 : INTEGERS-32 0 0 B 2!
  5     NRITERATIONS @ 0 DO B 2@ 1. D+ B 2! LOOP ;
  6 : .REPORT ( time1 time2 --- )
  7     TIME  SECS 2SWAP TIME  SECS CR 19 DASHES CR
  8     ." Time started:  "  .SHOWTIME CR
  9     ." Time stopped:  " 2SWAP .SHOWTIME CR
 10     ." Elapsed time:  " 2SWAP .ELAPSED  CR CR ;
 11 : BENCHMARK CLEARSCREEN ." BENCH v1.00 24-Mar-82" CR CR
 12     NRITERATIONS @ . ." iterations in loop." CR CR
 13     ." 16-bit Integer test" @TIME INTEGERS-16 @TIME .REPORT
 14     ." 32-bit Integer test" @TIME INTEGERS-32 @TIME .REPORT
 15     ;
```

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IBM, continued...

I was looking for my IBM macro-assembler, but it's finally here. I got the call from the IBM product center at 5:30 on a Friday afternoon, so I couldn't rush down to get it and I didn't get to try it out in time for this column. You'll hear more.

For now, I'll quietly complain that the product was announced in December for February delivery, and that mine got into town on March 26. I had it on order for about 60 days. There is a problem lurking here somewhere. I found out that some of IBM's direct customers, that is, Data Processing Division customers, had their macro-assemblers in February.

Software Mini-Reviews

Systemics offers *EZLabel*, a $39.95 mailing label and phone list program. Bill Clements of Systemics writes that the program is not intended to be the most powerful or the fastest. Instead, it is supposed to be easy to use. I fooled around with it for a little while and I think it is pretty easy to use. I didn't read the directions (on purpose), but I had no difficulty. I don't know how well the program runs with a larger file, or if that even makes any difference for things other than searches and sorts.

The program allows up to 1000 name and address records per diskette. The only bad thing I noticed is that there seems to be quite a bit of disk activity while the program is running, more than I would have thought necessary. I think the package is reasonable, and priced well.

The biggest package I received this month, measured by weight, came from The Basic Business Software Company, Inc. I have six offerings from them, but I have only been able to try four. The *Statistics* package, which I was anxious to try, came with an unreadable diskette. I'm sure Basic Business will replace it; I just haven't been able to get it off to them.

Plot, their general purpose plotting package, requires a fair amount of data entry and setup before anything can be done, and I didn't have the time.

There are two financial packages, both of which sell for $30. The first is called *Financial Calculator* and performs a variety of calculations on present and future values. The document says the program closely matches the features of some of the popular hand-held financial calculators.

The second program is *Amortization and Depreciation*, which should be self-explanatory. Both these programs run smoothly and seem useful to me. In particular, I thought the *Financial Calculator* worked very well and was easy to use and understand.

I see little practical use for Basic Business's *Some Common Basic Programs*. This is a two-disk set for $35 which contains 76 Basic programs as published in the Osborne/McGraw-Hill book of the same name. The programs are very simple and all work according to the specifications from the book. However, most of these programs are small and should be easy to program.

I think you have to be able to use five or more of the programs, before the price of the package is worth the time you will save in program entry. Documentation for this package consists of brief instructions from Basic Business plus the Osborne/McGraw-Hill book.

I mentioned last month that I was anxious to try the Basic cross reference program from Basic Business's *IBM Basic Utilities* package. A cross reference program reads a Basic program and prints a listing of each name, identifying the line in which each "reference" occurs.

This particular program works well and produces a nicely formatted listing. It cross references variables, constants, line

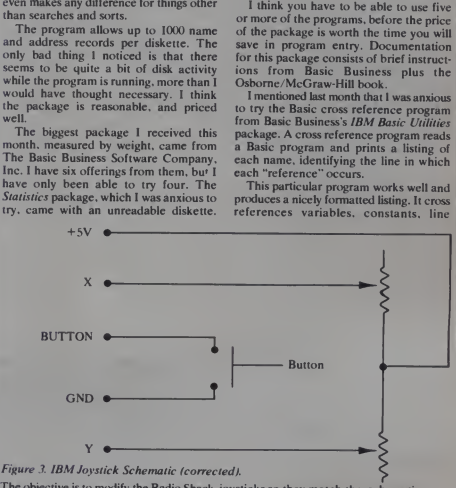


Figure 3. IBM Joystick Schematic (corrected).
The objective is to modify the Radio Shack joysticks so they match the schematic.

numbers, and (optionally) the Basic reserved words, that is, words like PRINT, FOR, etc. The listing is printed alphabetically.

The main problem with this program is that it is written in Basic, and is very slow. A nice touch, designed to let you know that the program is running, is the way the program constantly updates the display.

The Utilities package also includes a number of other useful programs and subroutines. There is a program to print paginated listings of text files. There are some subroutines for taking input and for dealing with the display, some matrix routines, a file search routine, and even a tiny screen editor (which edits a single screenful only).

My favorite, however, is the line drawing routine. This program, like the other subroutines, is designed to be integrated into your program. It is used to draw boxes or lines, and can be used to construct rather nice looking screen layouts for forms or other displays.

I think $75 is not unreasonable for the utilities, but I wish the cross reference program ran a little faster for that price, since it is the most useful program in the package.

All the Basic Business packages have one thing in common: they are very well documented. In the *Financial Calculator*, for example, all the formulas used in the program are explained in detail. Many examples are given, along with pictures depicting the way the display will look at various stages of program operation. The programs were not originally written for the IBM, so they have some maturity and can be expected to be free of bugs.

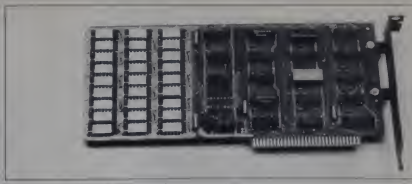


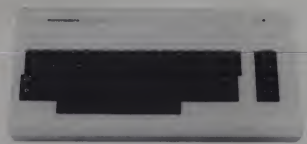
Photo 4. Davong Systems' 192Kb memory expansion board.

My Face is Red Department

The schematic for the Radio Shack joystick from my April column is incorrect. The correct drawing is shown in Figure 3. I apologize for this trivial mistake. Thanks to Frank Buswell of Essex Junction, VT, for calling this to my attention.

This one was not my fault, but my face is red anyway. Last month I reported on add-in memory boards for the IBM PC. When I got to Davong Systems I mentioned prices and had photographs. All were wrong. While most of the manufacturers are building a 256K board that can be populated in multiples of 64K, Davong is building boards with exact capacities. Assuming they can get the necessary volume, this helps keep the price down, and Davong has some low (they say the lowest) prices. The DSI-64K is $299, the DSI-192K is $599, and the DSI-256K is $799. For you Apple owners, Davong has the DSI-A16K expansion board for $99. The 192K board is shown in Photo 4. □

Personal Electronic Transactions



I am happy to hear from you, and encourage your correspondence. I will try to acknowledge all correspondence, and a SASE makes things easier for both of us. Please send your letters to "Personal Electronic Transactions" c/o PO Box 354, Palo Alto, CA 94301.

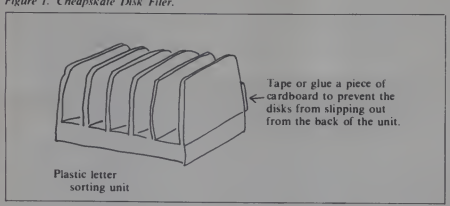
Greg Yob

When I first got my PET, I thought that a few dozen cassettes would be sufficient for my computing needs. Then it was 50 cassettes, then about 100 cassettes. When I got my disk drives, I knew better, and started with 50 diskettes. At this time, my collection is about 100 diskettes.

Naturally, I had a problem storing all these things. Fortunately, several manufacturers now provide binders for cassettes, plastic pouches and binder inserts for diskettes and so on. If you visit any major stationery store and look in the "word processing" department you can usually find a variety of holders for diskettes (and sometimes tapes). A not very representative sampling of these have crossed my desk recently, and several are described below.

First, if your funds are limited, go to Woolworth's or Radio Shack and buy their cassette holding boxes for about $2.75. These will hold 12 or 15 tape cassettes. For diskettes, purchase a letter-filer (This widget looks like a base with several vanes about 5" square projecting upward) for about $6 and tape a piece of cardboard to the back as shown in Figure 1. This is a handy way of holding your often-used diskettes. One disadvantage is that your diskettes are not protected from dust and grime.

Figure 1. Cheapskate Disk Filer.



For cassette storage, plastic binders with pop-in slots for the tapes are available from: Ettessac, Inc., 23704 West Sards Road, Valencia, CA 91355 and Reliance Plastics, 225 Belleville Ave., Bloomfield, New Jersey 07003. Write a letter requesting their catalogs and the name of a local dealer. Both companies prefer to work with dealers and do custom packaging if you need it.

Reliance also offers a wide variety of binders and pocketed plastic binder pages for holding diskettes. I am personally a bit concerned about the tendency of plastic to gather dust, but many of my friends use these without any problems. For more rapid access to diskettes, Skyles Electric Works, 231 E. South Whisman Road, Mountain View, CA 94041, offers Flip Sort, a plastic flip-top box which holds 60 diskettes for about $30. (Skyles has several other neat things for the PET, so ask for their catalog. They also offer Floppy-Armour, which is my personal choice for mailing diskettes.)

If you have a business or an office, and can afford more costly things, Postal Equipment Corp., 752 Military Rd., Buffalo, NY 14216 offers the MM-1 which is a steel diskette tray about 8" deep with steel and cardboard dividers and a vinyl

Smith-Corona introduces the only daisy wheel printer for under $900.*

You're putting together a desktop computer system for your office or home. And you want to add a letter quality printer so you can do word processing, too. But you don't want to spend a fortune.

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The basic TP-I will handle letter or legal sized paper. An option that will be available soon will enable it to handle either fanfold or single sheet paper.

The TP-I is easy-to-use—just turn the power on, load the paper, and away it goes. There are drop-in ribbon cassettes and a choice of easy-to-change, snap-on daisy print wheels for a variety of fonts.

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dust cover. This unit is well-built; I could drop it down a flight of stairs with no worries. This company only sells through dealers, so ask them for a local distributor's name. The MM-1 is about $75.

At the top of the heap is the Disk Bank by Amary, 2251 Grant Rd., Suite H, Los Altos, CA 94022. This is a plastic, box-like unit which has a sliding drawer which pulls out and turns to the side for each access to the diskettes. Each box holds 10 or 12 diskettes. The boxes lock together to make a filing unit of any size you want. The sliding part can be positioned to make the slide come out upwards instead of to the side for tub files. Though this unit is excellent, the price is a bit high — about $11 per unit. Amary will be offering this unit through diskette suppliers and the additional cost should be less (that is, you buy 10 diskettes and one Amary unit for $5 to $8 over the diskette price).

"Uncopyable" Tapes

The PET is a very difficult machine for which to provide software protection, and the only effective methods I know involve some hardware, usually a ROM whose firmware is used by programs on tape or disk. Some software suppliers protect their programs by placing machine language in the cassette buffer. When you SAVE such a program, the SAVEd copy will not work when reloaded, because the cassette buffer portion is not on the SAVEd copy. The cure is to use the Machine Language Monitor to help out a bit. Reset the PET and LOAD (but don't RUN) the program. Then SYS 1024 to get into the Monitor. You will now see something like this:

```
SYS 1024
B*
    PC  IRQ  SR  AC  XR  YR  SP
.; 0401 E62E  32  04  5E  00  F8
```

Now enter the following line starting with the S (the Monitor prints the period):

```
.S "0:FILENAME",08,0200,8000
(RETURN)
```

This will save the program to your disk, drive number 0. If you know the size of the program, the 8000 may be replaced by a smaller value. For example, 16K programs would use 4000 and 8K programs use 2000. If you have problems with this, note that the Monitor does not like spaces after the filename and the commas must be present. Also note that the first letter in your line is the period printed by the Monitor.

If you want to save to tape, use:

```
.S "FILENAME",01,0200,8000
```

By the way, don't use this method to make copies for your friends. The current copyright law lets you make a copy for archival and backup uses only. (Note to Educators: Many schools with several PETs buy one copy of a software package and then make copies for the other machines. This is unfair (and illegal) to the software vendors. I know of several *excellent* programs that were never marketed due to this problem.)

A Reasonable GET Routine

If you have used your PET for very long you have noticed that the Basic INPUT statement is not without flaws. If you press the Return key without anything else, the Basic program simply quits. (Use CONT to resume your program.) Also, quotation marks, commas, colons and semicolons do strange and non-beneficial things when entered in response to INPUT. If you want your program to be crash proof, you must

Listing 1. Utility Get Routines.

```
10000  REM GENERAL GET ROUTINE WITH
10005  REM FALSE CURSOR
10010  REM RECOGNIZES ONLY THE DEL KEY
10015  REM WHEN GETTING A STRING
10020  REM
10025  REM CURSOR DEFINITIONS
10030  REM C1$,C2$ = BLINKING CURSOR
10035  REM C1,C2 = TIMING OF BLINK
10040  REM CW = FIELD WIDTH
10045  C1$="{RVS}{V}{F4}{CL}"+C2$+"{D}{CL}"+C3$+" {CL}"
10050  C4$=CHR$(1)
10055  C1=75:C2=50:CW=72
10060  REM FOR NUMBERS
10065  DIM N(20)
10070  RETURN
10100  REM ACTUAL CODE
10105  REM MAIN GET LOOP
10110  PRINT C1$;
10115  GET A$:IFA$<>""THENRETURN
10120  FORJ=1TOC1:NEXT
10125  PRINT C2$;
10130  GET A$:IFA$ =""THENRETURN
10135  FORJ=1TOC2:NEXT
10140  GOTO 10110
10200  REM SELECTION & ECHOING
10205  A=ASC(A$):AF=0
10210  IF A$=CHR$(13) THEN 10255
10215  IF A<20 THEN 10265
10220  IF A<32 THEN PRINTC3$;:RETURN
10225  IF A=34 THEN PRINTCHR$(34)CHR$(20);
10230  IF A<95 THEN PRINTC2$;:RETURN
10235  IF LEN(B$)<CW THENPRINTC3$;:RETURN
10240  B$=B$+A$
10245  A=FRE(A):PRINTA$;:RETURN
10250  REM CARRIAGE-RETURN
10255  PRINTC3$:AF=1:RETURN
10260  REM DELETE
10265  IFB$=""THENRETURN
10270  IF LEN(B$)=1 THEN 10280
10275  B$="":GOTO10245
10280  B$=LEFT$(B$,LEN(B$)-1)
10285  GOTO 10245
10300  REM INPUT A STRING B$
10305  B$=""
10310  GOSUB10100:GOSUB10200
10315  IF AF THEN RETURN
10320  GOTO 10310
10400  REM GET A NUMBER OR SERIES THEROF
10405  REM N(0) HOLDS NUMBER OF #S FOUND
10410  REM SCIENTIFIC FORM IGNORED
10415  N(0)=0:J=1:B$=""
10420  REM GET B$ ONLY NUMERICS OR
10425  GOSUB10100
10430  IF A$ ="9"THENA$=C4$
10435  IF A$ ="0"THEN 10455
10440  GOSUB10200
10445  IF AF THEN 10490
10450  GOTO 10425
10455  IF A$="."THEN10440
10460  IF A$="-"THEN10440
10465  IF A$="."THEN10440
10470  IF A$="+"THEN10440
10475  IF A$ ="E"THEN10440
10480  GOTO10425
10485  REM NOW PARSE B$
10490  N$="":IFB$=""THEN RETURN
10495  FORJ=1TOLEN(B$)
10500  IF MID$(B$,J,1)="","THEN 10510
10505  NEXT
10510  N$=LEFT$(B$,J)
10515  B$=MID$(B$,J+1)
10520  N(0)=VAL(N$):N(0)=J:J=J+1
10525  IF J > 20 THEN RETURN
10530  GOTO 10490
```

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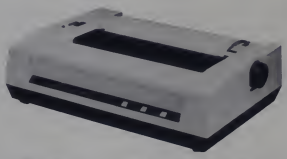

Pro/Writer and Pro/Writer II Low Profile Printers

These low profile printers provide professional, quality printing through a combination of high-speed matrix printing, logic seeking uni- and bidirectional printing, and quick return head motion. The Pro/Writer II accommodates paper widths up to 15½", with up to 231 columns. The precision 9 x N matrix produces consistent, letter-quality printing. Five alphabets, in eight character sizes, provide added versatility. What's more, Pro/Writer and Pro/Writer II feature proportional spacing combined with excellent character resolution. Built-in graphics capability includes character generated and high resolution features.

Specifications	Pro/Writer 8510ADC	Pro/Writer 8510AP	Pro/Writer II
Number of columns	80 column max.	80 column max.	136 std., 231 compressed
Print speed	120 cps	120 cps	120 cps
Print width	8" max.	8" max.	13.6" max.
Standard interfaces			
Serial	EIA RS-232-C with 3K buffer & 20 mA current loop	—	EIA RS-232-C with 3K buffer & 20 mA current loop
Parallel	TTL compatible, 7-bit	TTL compatible, 7-bit	TTL compatible, 7-bit
High resolution graphics 144 x 160 positions per inch	Standard	Standard	Standard

F-10 Printmaster Daisy Wheel Printer

This high quality printer features a choice of 40 and 55 cps. Extensive word-processing functions have been built in to allow easy adaptability and reduced software complexity. Choice of friction feed or bidirectional tractor feed enables precise print positioning of tabular and graphics data.

Specifications:

Number of printable columns: 136, 163 variable
Return time: 900 mSec @ 40 cps; 500 mSec @ 55 cps
Line feed time: 40 mSec
Interface: 8-bit parallel, RS-232-C compatible, X-ON, X-OFF, 12-bit Qume and Diablo compatible
Model #: F10-40PU (Parallel interface)
Model #: F10-40RU (Serial interface)

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disable the STOP key and use GET for all inputs.

Listing 1 shows a GET routine which I have found quite useful for most of my general programming in Basic. Several subroutines are provided:

- 10000 initializes variables for the other routines.
- 10100 displays a false cursor until a key is pressed.
- 10200 handles quotes, delete key, carriage-return and echoing.
- 10300 returns BS as a line of input.
- 10400 returns numbers in array N().

A closer look at these routines may be of interest. Subroutine 10000 defines the strings C1$ and C2$ which hold the characters used as a false cursor. C1$ is set to Reverse Shift-V Off Cursor-Left. C2$ is set to Shift-Q Cursor-Left. C3$ is a space and cursor left and is used to erase any false cursor on the screen when a keypress is detected.

The numbers C1 and C2 are used to determine the blinking rate of the cursor. CW is used as the maximum number of characters that can be entered. If the user enters more than CW characters, subroutine 10300 will return automatically.

Subroutine 10100 is used to print a false cursor, check for a keypress, wait for a while and then repeat using the other false cursor characters. Lines 10100 through 10120 do this for the first cursor, C1$, and lines 10125 through 10135 do this for the second cursor, C2$.

Note that you can change the values of C1$, C1, C2$, C2 to suit yourself as to the cursor and how rapidly it blinks. Remember to include a Cursor-Left in the false cursor string to leave the cursor on top of the character you select for the cursor. Also, set C2 to less than C1 as it takes some time for Basic to execute the GOTO 10110 after the second cursor.

Subroutine 10200 is more complex. The string A$ holds the keypress from subroutine 10100 and we must now decide what to do about it. Line 10205 converts A$ to its ASCII value as A and the flag AF is set to false. AF is used in subroutines 10300 and 10400 to detect if the Return key was pressed.

Line 10210 checks for Return, and if found we go to 10255 which prints C3$. This erases the last false cursor which is still on the screen. AF is set to True and we are done.

Line 10215 checks for the DEL key which puts us into lines 10260 through 10285. BS is used to store the characters already entered, and the code here is used to correct BS for the deletion and prevent a crash due to an empty BS string. When we are done with BS, line 10245 is used to print the deletion on the screen as DEL is still in A$.

Lines 10220 and 10230 check for other special characters like the cursor movements. In all such cases, we erase the false cursor and otherwise ignore special characters. The only way to correct an entry is via the DEL key. Line 10225 handles quotes, since to get into Quotes Mode would be a disaster. (Try moving this line and enter a quote, and you'll see what I mean.) The trick used here is to print a Quote, then a DEL and when we get to line 10245, the Quote again. Only *one* Quote is on the screen and we are *not* in Quotes Mode.

Line 10235 checks for the limiting line length CW. If too many keypresses have been made, the false cursor is "stuck" at the end of a line until you press Return.

Line 10240 adds the keypress to BS, and in line 10245 we echo the keypress to the screen. The call to FRE forces garbage collection. If you ignore this the PET will occasionally stop cold for up to a minute as garbage collection takes time, especially in Basic 3.0 machines.

With subroutine 10200 doing most of the work, subroutine 10300 clears BS and repeatedly calls subroutines 10100 and 10200 until the flag AF notes that the Return key was pressed. For most purposes, when you want to replace an INPUT, use GOSUB 10300 and then look at the contents of BS. If BS is empty, only Return was entered.

If you need some numbers, subroutine 10400 will permit entry of floating point numbers but not scientific numbers (scientific numbers have the E in them like 1.23 E22). If you need scientific numbers, add this line:

```
10472 IF AS="E" THEN 10440
```

Subroutine 10400 clears the array N() by setting N(0) to zero. N(0) is used to count the number of entries made in BS. It then calls subroutine 10100 to get the keystrokes and checks them for the characters which are legal in numbers (that is, 0-9, +, - and .).

Legal number characters then go into BS. When we see the Return key (line 10445) the code in lines 10490 to 10530 looks through BS for commas. Each chunk of BS between commas is moved to NS and converted into the array N() in lines 10510 through 10520. Since we use the VAL function, this code will not see entries like ++25; you will get a zero back instead.

Listing 2 is a brief example of how the GET routines might be used.

Line 50 checks for a non-entered name and line 90 checks for the wrong number of numbers. Note that the array N() uses N(0) for the number of entries which are then stored in N(1), N(2) . . . and so on.

```
10 REM GET ROUTINES EXAMPLE
20 GOSUB 1000 :REM INITIALIZE
30 PRINT "YOUR NAME: ";
40 GOSUB 10300:NM$=BS: REM GET NAME
50 IF BS="" THEN 30 :REM TRY AGAIN
60 PRINT
70 PRINT "ENTER THREE NUMBERS: ";
80 GOSUB 10400 :REM GET NUMBERS
90 IF N(0)=3 THEN 110 :REM CHECK FOR THREE
100 PRINT "I NEED THREE NUMBERS!":GOTO60
110 S=N(1)+N(2)+N(3)
120 PRINT
130 PRINT NM$","
140 PRINT "THE AVERAGE IS: ";S/3
150 END
```

Listing 2.

Line 50 checks for a non-entered name and line 90 checks for the wrong number of numbers. Note that the array N() uses N(0) for the number of entries which are then stored in N(1), N(2) . . . and so on.

The Pedisk II

CGRS Microtech, P.O. Box 102, Langhorne, PA 19047, offers an alternative to the Commodore disks called the Pedisk II. The Pedisk offers more storage per diskette and much faster disk I/O since it does not use the IEEE-488 bus. Both 5¼" and 8" disk drives are available, with the 8" drive having the IBM standard format. (When CP/M arrives for the PET, I expect the Pedisk will be much simpler to interface than the Commodore drives.) Basic, Forth, MAE (Editor/Assembler) and several other utility programs are now available.

The Pedisk DOS offers several interesting options not found in Basic 4.0 or the Commodore disks. Many of the DOS commands look simpler to use than Commodore's. If you are looking for an alternative to the CBM Disks, take a look at CGRS Pedisk II. When you do so, note that I haven't personally tested their system and that you will have to find a friend with the CBM drives to transfer software. Many programs are very dependent on the CBM drives and you may have to spend some time making suitable modifications. I expect CGRS will form a user's group soon.

The User Port Workshop

Back in early 1979 I wrote an article which described how to use the PET User Port. To illustrate the operation of the User Port, I designed and built a small set of switches and LEDs which controlled each User Port line and indicated the level of the lines.

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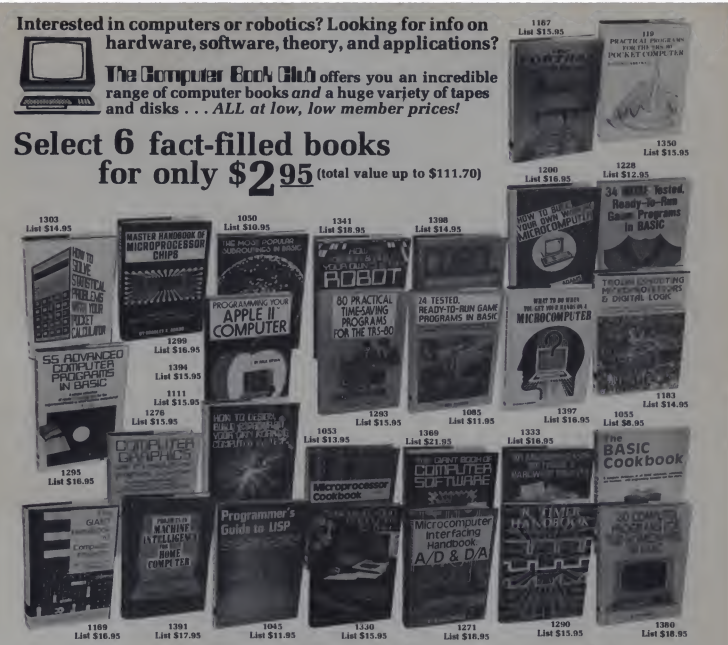

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CIRCLE 124 ON READER SERVICE CARD

Machsize Ltd., York House, Clarendon Ave., Leamington Spa, England, CV32 5PP, offers a User Port Workshop for about $95 (£59.95). The Workshop is a green PC card about 5" by 9" with an 18" connecting cable which attaches to the User Port and the Cassette Port on the rear of the PET. The cable lets you use the Workshop in front of the PET.

On the PC card are ten switches with LEDs in them. Eight of these switches are for the PA0 to PA7 data lines and two switches connect to CA1 and CB2. The data switches are normally open, which lets the data lines float to the high state. Pressing a data switch grounds the line, making a low (0) state. The CA1 and CB2 switches are debounced (very handy!) and the CA1 switch has a jumper which lets you select the low to high or high to low transition when the switch is pressed.

The card has expansion edge pins for the User Port and Tape Port to let you debug any equipment on the User Port.

Twelve buffered screw connectors are also provided, including the +5V line from the Tape Port in case you want to build a kludge or use an oscilloscope.

Although I like the card, I have two small criticisms. First, sometimes I like to set a User Port line while doing something else. Slide or toggle switches would be better than momentary contact switches.

Second, if you set the User Port to output a line and set the line high, when you ground the line, the VIA suffers (and sometimes dies). Limiting resistors on the switches would remove this hazard.

A binder is provided with instructions and a demonstration diskette. The card has two holes so you can store the Workshop in its binder — a neat touch. The instructions are reasonably clear, with summaries of the required PEEKs and POKEs and some interesting exercises to do. The diskette has 11 programs which include four programs which are solutions to the suggested exercises. The demonstrations are nicely done, with Petophone providing a monophonic organ using CB2. (You will have to provide the speaker to hear this one.)

I feel the User Port Workshop is a nicely done product which would make an excellent addition to a high school electronics class. Machsize also offers several other cards including A/D and D/A converters, BCD input card and an optoisolated 8-line I/O card capable of driving relays and small lamps.

An Eclectic ROM — Faster Basic

If you are a hacker who studies how Basic works to make your programs run more rapidly, you know that in a few cases PET Basic isn't all that smart.

For example, a GOTO 1234 stores the number 1234 as the digits and not as a 16-bit binary number. At the same time, the line numbers themselves are in 16-bit form, so when Basic does the GOTO it must first convert 1234 to 16-bit form and then look for the line.

If Basic had stored 1234 in 16-bit form when the line was entered, the conversion time would be saved. The true fanatic can go further and store a direct pointer to line 1234 and also save the searching time.

In long programs, a small jump to a preceding line, say in a subroutine, involves a search through almost all of the program lines, which can slow things down a great deal. Similar arguments apply to simple variables. If we scanned through the program and set up the variables table first, the simple variables could be replaced by pointers and the search time eliminated.

Faster Basic is a 2K ROM which speeds up the jumping and variable search times by methods similar to those suggested above. Developed in England, it is available from Skyles Electric Works whose address was given earlier. In tests of very small programs, the GOTO and THEN and GOSUB statements executed about twice as rapidly, and numeric and string variables gained about 30% in speed. In larger programs the gains will be much greater — perhaps as much as twice as fast overall.

There are two catches to this. First, the FOR-NEXT loops in Basic already use pointers and will not run any faster. Second, arrays are not handled in Faster Basic. (When you think about it, there is really no way to do so — most arrays use variables in their indices like A(K).) If you are doing scientific number-crunching, you will probably use arrays and Faster Basic can't help you.

Hope is in the offing, however. Several compilers for Basic exist, and I will review these as they arrive.

And A Fun ROM — The PIC Chip

Another neat goodie from England is the PIC Chip (available from Skyles Electric Works for $60). The PIC Chip is a 2K ROM which has about 40 commands for control and modification of the PET display. This includes direct positioning of the cursor, screen fill, reverse, flip for normal/reverse field and set or flip case (i.e., upper to lower or vice versa) for the screen. Distinct areas of the screen may also be chosen for these operations.

The entire screen or a selected rectangular area can be shifted in all four directions or rolled (i.e., what goes off one edge returns on the other side). A complete set of plotting commands for 25x40 and 50x80 graphics is included along with the commands for "fine plotting" which lets you do up to 200 positions in Y or 320 in X. As a final touch, you can turn a repeat key option on or off which is helpful in editing. The PIC Chip is available for all addresses from $9000 to $B800 at 2K intervals.

The use of PIC Chip commands involves several reserved variables in Basic, specifically C, X, Y, X1, Y1, X2, Y2, A1, A2 and N. You must first set these variables to the correct values and then execute the PIC Chip command. For example, if you want to plot a character "A" at the co-ordinates 12, 15, you must do:

C=1:X=12:Y=15:!PC

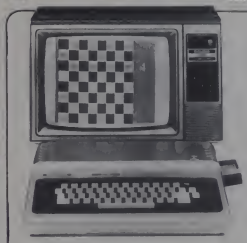
I find this a bit awkward as !PC 1, 12, 15 seems more elegant (and, for an expert hacker, not that hard to do). One other drawback is that you must keep separate copies of these variables if you are doing many different PIC Chip commands. When you roll the screen, for example, the previous values for X1, Y1, X2 and Y2 are wiped out when you set them up for the screen roll.

When you are used to these oddities, the PIC Chip is a lot of fun. The manual gives a series of examples to help you get started. As a mystery I am leaving you with Listing 3, which is a short and mysterious program that requires the PIC Chip to run, and even with the PIC Chip I am sure you won't know what it does until you run the program. By the way, the bracketed parts of line 60 mean Home-Cursor, Cursor-Down and two Cursor-lefts. □

Listing 3. Mystery PIC Chip Program.

```
10  REM PIC CHIP DEMO
20  REM AND MYSTERY PROGRAM
30  REM BY GREGORY YOB
40  SYS 4096:'RE
50  C=32:!SF:N=1
60  PRINT"(Home)";:FORJ=1TO15:PRINT"PUNK(CD)(2 CL)";:NEXT
70  x=79:FORJ=9TO77:Y=J*J/55:'WX:Y=Y+4
80  'EX:NEXT
90  Y=49:FORJ=3TO80:X=J*J/39:'WY:X=X+X
100 'EY:NEXT
110 FORJ=1TO500:STEP5
120 X2=X2+J*1.21:X1=X1+J:Y1=Y1+J*1.12:Y2=Y1+J*1.27:'EX1:'EY
130 IFX1 79THENX1=X1/1.55
140 IFX2>79THENX2=X2/1.77
150 IFY1>39THENY1=Y1/1.33
160 IFY2>39THENY2=Y2/1.23
170 'A1:'EC:'UR:!LR:NEXT
```

Note: Change the SYS address in line 40 to the SYS you use for your PIC Chip.



rings...trs-80 strings...trs-8

Stephen B. Gray

Diving with a roar into the 42-mile tunnel that burrows beneath the glitter and swank of Park Avenue, our TRS-80 train brings you the details of how Radio Shack checks out your disk drives, three programs from Instant Software, a closer look at those ads offering lower-priced TRS-80s, Sharp's pocket-computer manuals, and a short screen-saver program.

Disk-Drive Repair

Late last year, drive 1 on my TRS-80 Model III began to act up, giving GAT, CRC and HIT error messages. Eventually it just wouldn't work at all. I tried to use it now and then, hoping that, like a toothache, the problem would go away.

When the problem persisted, I put the III back into its box and took it to the service department of the Radio Shack Computer Center at Fifth Ave. and 36th St. in New York. With the very kind permission of a Radio Shack vice president and of the center's service manager, Patrick Raeihle, I was allowed to watch computer technician Michael Simmons tackle the drive.

Mike told me that ordinarily he can align a pair of disk drives in about 20 minutes, once a Model III is unbuttoned. However, with all my questions and his very patient answers, it took several times that long.

Mike removed one screw from the back and ten from the bottom of the Model III. A warranty sticker covers one of those ten. Once you remove this sticker to do your own thing inside a Model III, you'll find you can't put it back on, and you've probably voided the remaining warranty.

What happens if you have installed a "foreign" modification in your Model III (or any other Radio Shack) computer? According to Pat, you have to take out the modification before Radio Shack will repair it. If you don't take it out before bringing your machine to be repaired, they'll do it for you, if they find they can't work around the modification, but will charge you for the removal, and won't re-install the modification. This is the official Radio Shack service policy, as stated in the back pages of the Model III manual, among other places.

After lifting off the top of the Model III, Mike tried a backup, "to verify the complaint." Although drive 1 wrote the backup, and a DIR could be read, the drive slowed down during the formatting, so Mike felt it might need alignment. He loaded the alignment program, which has seven parts, displayed on a menu and numbered 0 through 6.

(0) SPEED CAL/DEVIATION

Although there is a strobe disk on the drive (much like the one on some hi-fi turntables), a more accurate reading of the drive speed is obtained from a scale on the screen. The speed of my drive 1 was a little off, so Mike adjusted a potentiometer on the PC board, and brought the speed to 300 rpm.

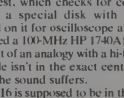
(1) CARRIAGE STEP

This test makes sure the head travels smoothly along its carriage between tracks 0 and 40, without binding.

(2) HEAD RADIAL/AZIMUTH

This test, which checks for centering, requires a special disk with a signal recorded on it for oscilloscope alignment (Mike used a 100-MHz HP 1740A). There's somewhat of an analogy with a hi-fi record: if the hole isn't in the exact center of the record, the sound suffers.

Track 16 is supposed to be in the center of the disk, and the test checks to make sure it is. Instead of using a circular pattern on the disk, alignment is simplified by checking a two-lobe pattern something like this:



Mike looked at the scope while running this test, and made mechnical adjustments on my drive until the amplitudes of the two lobes were equal. Then he stepped the head to track 0 and back, checked to see that the disk was still centered, and stepped the head out to track 39 and back, and did the same check again.

(3) TRACK 00 ALIGNMENT

A mechnical switch makes sure the head starts reading at track 0, which is where the boot track is; if this switch is out of alignment the Model III can't boot up, can't get started.

(4) INDEX/SECTOR TIMING

This test checks the timing of the small

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hole that is an inch from the center of the floppy disk. Sector timing is provided by a signal picked up by a photocell that detects the light from an LED on the other side of this index hole. My drive had to have its light path realigned, to line up the LED, index hole, and photocell.

(5) HEAD AMPLITUDE

This check on the read/write head detects if it's worn or dirty. The scope amplitude of the head on my drive was only about 160 to 170 millivolts, and should have been greater than 200mV. According to the missing index/sector timing being off, and a worn head.

Rather than replace the head, which is a $90 job because of the time required to make many precise adjustments, Mike followed standard Radio Shack procedure and replaced instead the mechanical portion of the drive, after removing the drive electronics, which are mounted on a PC board. "It's cheaper to change the whole drive mechanism," said Mike, "because the exchange price of the mechanism is $74. Head alignment is time-consuming and tricky."

Although the new drive mechanism had been tested when it was built, Mike ran quick checks on it after installing it in the Model III. What causes head wear? "Normal wear, or dirt grinding away, or excessive use of a head cleaner," said Mike.

(6) RAW DATA CHECK

Mike didn't perform this test, which he does only when there is a source-disk read error or destination-disk write error. He ran the first six tests on my other drive, drive 0, found the speed was OK but adjusted it a little anyway. The lobes were off in test 2, so he adjusted the centering, and also aligned the light path for the index hole.

Diagnostic and Memory Tests

As a final test, Mike ran a diagnostic that writes into each sector on each track, and then verifies what is written, and follows with a memory test of ROM, RAM and video (normal, graphics, and alternate characters). The drives passed these tests, so Mike buttoned up the Model III and put a new warranty sticker over that one screw. The Repair Warranty covers 90 days for parts, 30 days for labor.

Labor time is $15 per half hour. A drive alignment is $25 per drive, a straight charge that includes labor time.

Common Disk-Drive Problems

How often do disk drives have to be aligned? That all depends, of course, on how much you use them, said Mike. The three most common disk-drive problems are those involved with tests 0, 2 and 4: mechanical adjustments of speed, centering, and index light path. The next most common problem is detected by test 5: head amplitude.

If, as some TRS-80 users have done after picking up their repaired computers, you take yours home without the protection of the original packing case, and either lay it on the floor of your car, or on the floor of your commuting train, one or more of those mechanical adjustments may go out of kilter. TRS-80 disk drives aren't like $60 cassette recorders, which can take a lot of bouncing around and still work.

Mike, incidentally, prefers the Model III, "because it has two internal drives and 48K of internal RAM without expensive interfaces, and it has room for boards such as the RS-232."

My thanks to Pat and Mike, who answered all my questions with great patience, in a 90-minute session after the 1:00 closing time on a Saturday last winter.

Beginner's Russian

Two $9.95 cassettes for learning to read Russian are available from your local software dealer, or from Instant Software (Peterborough, NH 03458). They require a 16K Level-II machine, and will run on the Model III.

Beginner's Russian teaches the shapes of 33 Cyrillic letters. You start with seven simple consonants, which are displayed 5/8-inch high, along with brief advice on how to pronounce each. Then you get ten vowels, followed by the third item on the menu, twenty "Words to Translate." These are presented in Cyrillic, and if you didn't memorize the letters, you can repeat menu items 1 or 2, or ask for HELP, which will display an abbreviated letter chart. If you don't guess what the Russian word is, you're asked to try again, and again, which is one way of making you learn the letters.

Consonants of "medium difficulty" are displayed later, as are the names (in Cyrillic) of two famous poets along with short biographies. The last part includes "difficult" consonants (but with no pronunciation help for seven of the eight), and the names and short biographies of Lenin, Stalin, etc. The last display says that if you want to continue the course, "purchase *Everyday Russian*. Stock #0137R."

The tape is interesting, but the author missed a major opportunity to help the user. He could have provided voice recordings of the proper pronunciations, right on the same cassette tape. Perhaps this can even be done as part of the program, with a voice pronouncing each letter after it is displayed, and a machine-language subroutine turning the cassette recorder on and off at the right times.

This would eliminate the need for pronunciation "helps" such as for the letter that looks like "bl" and which is "like the l in 'sin' but pronounced with the lips almost closed."

Everyday Russian

The second Russian tape provides names of foods (drinks, entrees, desserts, etc.), places to eat (restaurant, cafe, etc.), signs, and types of stores. Then it shows the Cyrillic alphabet, and turns the TRS-80 keyboard into a "Russian typewriter"; you press the keys, and Cyrillic characters appear on the screen, so you can write Russian words.

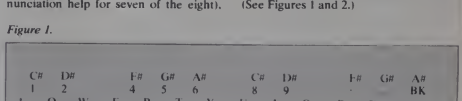
This, and the drill provided for each group of words are the unique features of these two cassettes; the rest can be studied easier, more cheaply and more extensively in a textbook. If the author had provided voice pronunciations on the tape, then these two cassettes could be highly recommended to computerniks. As it is, you're better off buying a record or cassette designed to teach spoken Russian. Nyet pravda?

Music Master

A third $9.95 cassette from Instant Software is *Music Master*, which contains a quartet of programs that will run on the 16K Model-I Level-II or Model-III TRS-80.

Micro Organ provides four octaves and three voices. The second display shows which keys go with which notes and which keys control which octaves and voices. (See Figures 1 and 2.)

Figure 1.



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TRS-80, continued...

The keys sound, as you play them, through your cassette recorder speaker or an external amplifier/speaker combination. The three voices don't sound at all like the instruments whose names they bear, but more like the trumpet, trombone and flute voices, respectively, of an inexpensive electronic organ. Which in this case isn't bad at all.

Figure 2.

Octaves:	Voices:
A - Lowest (1 Voice)	Z-Organ
B - Middle C (3 Voices)	X-Harpsichord
C - Highest (3 Voices)	C-Piano

Kaleidopy is a combination kaleidoscope and player piano. The computer displays a four-way kaleidoscope graphics pattern and then "plays" that pattern, which sounds somewhat like the random "beep-boop-bop" of space movie robots.

You can change the pattern (and the sound too) either by the menu choices you make, or by rewriting certain lines in the Basic program. The brief booklet also shows how to change the machine language subroutine that creates the sound.

Composer permits generating somewhat random music "in any of fifteen different scales and three tempos," according to the leaflet, which also shows how to alter the machine language sound routine. Interesting, but don't play it very long around computerphobes or Mozart lovers.

Keymania is a game for up to four people very much like the hand-held game that challenges you to remember and repeat a short random tune played by the computer.

Three parameters can be controlled: level of difficulty (selects from 4, 8, or 13 notes); duration of sound (from short to long, with five choices); and interval between notes (from short to long, 1 to 5).

The computer asks how many people are playing, how many notes (from 10 to 50) are to be played each round, and whether you want the notes printed out as you press the keys while trying to duplicate the tune played previously.

Although *Kaleidopy* and *Composer* are mainly of interest to computer music buffs, and *Micro Organ* can be enjoyed by almost anyone, *Keymania* is not only a fascinating game, but can be used for ear-training in teaching music. The computer repeats the group of notes until you press the right keys.

Cheaper TRS-80 Computers

You've probably noticed those ads, in *Creative Computing* and other personal computer publications, offering TRS-80 computers at considerably less than the prices listed in the Radio Shack catalogs.

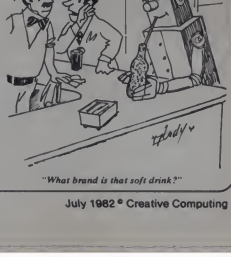
The 32K Model III with RS-232C interface and two disk drives, which lists at $2495, is advertised variously at $2059, $2100, and $2049.

A 16K Color Computer with Extended Basic, which lists for $599, is available at $459, $495, and $455.

No, they're not Radio Shack stores, these places in small towns in Massachusetts, Michigan, Georgia and elsewhere that advertise these cut-rate prices. That is, they are not owned by the Fort Worth-based company. They are franchised dealers in towns that Radio Shack considers too small to support a regular Radio Shack store. There seem to be about two "dealer and franchise locations in the USA" for every three "USA company stores."

Some Radio Shack catalogs carry a "Radio Shack USA Store/Dealer Directory," with an asterisk beside about 20 to 90 percent of the town names, depending on whether the state is California or Arkansas, for example. The asterisk refers to a line at the bottom of the page: "A Radio Shack Authorized Dealer is located in This Town – May Not Stock Every Item in This Catalog."

Just below is another line: "Retail Prices in this Catalog May Vary at Individual Stores and Dealers." I presume, perhaps wrongly, that all Radio Shack-owned stores charge catalog prices, whereas the dealers set their own prices.



"What brand is that soft drink?"

A Radio Shack dealer, if he sells mail order only, may decide to sell only Radio Shack products. If he has a store, he usually sells Radio Shack products along with non-Radio Shack items, such as hi-fi equipment, or even nuts-and-bolts hardware. Look again at the ads, and you'll see that the cut-rate advertisers are all in small towns, such as Littleton, MA; Milford, NH; Perry, MI; or Cairo, GA.

A Radio Shack company-owned store isn't supposed to sell you a TRS-80 at less than catalog price, or the manager is in trouble, as I understand it. But a franchised Radio Shack dealer, sometimes called a "Radio Shack authorized dealer," can sell a TRS-80 for any price he chooses, even for less than it cost him.

A franchised Radio Shack dealer, located in a small town in Georgia or New England or wherever, and selling mail order, has lower expenses, and can probably make more profit selling a TRS-80 PC-2 at $240 or whatever, than most large Radio Shack stores can at $280.

"Radio Shack prices are reasonable," says an observer of the personal computing scene. "There's another reason why mail order prices are low; they tell you to go to the manufacturer if you have a problem with your TRS-80 during the warranty period."

One way a franchised dealer can make even more profit is, for example, to install cheaper, non-Radio Shack disk drives in the Model III, or to sell you the drive kits and let you do the installation. The dealer will have to service such a machine, as Radio Shack won't. If you have a problem with the keyboard of such a Model III, and take it to a Radio Shack Computer Center, they can refuse to service the keyboard until the "foreign" drives are removed.

If you doubt this, read the service policy at the back of the Model III manual: "If any Radio Shack computer equipment has been modified so that it is not within manufacturer's specifications, including, but not limited to, the installation of any non-Radio Shack parts, components, or replacement boards, then Radio Shack reserves the right to refuse to service the equipment, void any remaining warranty, remove and replace any non-Radio Shack part found in the equipment, and perform whatever modifications are necessary to return the equipment to original factory manufacturer's specifications."

A call to Mark Daniels, president of Computer Discount of America, in West Milford, NJ, brought out this information: If you buy a TRS-80 from CDA and it needs fixing, you "take it to any Radio Shack store." This includes a Model III with disk drives, because CDA sells the III with Radio Shack drives. If you buy a

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CIRCLE 131 ON READER SERVICE CARD

TRS-80, continued...

TRS-80 with non-Radio Shack drives, says Daniels, you must return it to the place from which you bought it if you have problems, because Radio Shack won't service it.

This manifesto was expressed in the Sept. 1981 *TRS-80 Microcomputer News*, in an article by Jon Shirley, vice president of computer merchandising at Radio Shack, who said, in part, "Let's face it, mail order houses do not have local service if they have any at all. They offer a warranty, but to take advantage of it you must ship what you bought back to them. With a Model III disk drive kit, what do you send, the kits you just installed or the entire Model III? It's this lack of convenient service and retail store space that gives them the low overhead and low prices. Or in other words, you get about what you paid for. So caveat emptor," which means 'let the buyer beware.'

What are the advantages of buying from a franchised dealer? Lower prices, says Daniels, plus "you avoid the state tax, if you buy from out-of-state."

One item that adds to the overhead of a company owned store is the commission that salemen get, says Daniels. A mail order dealer pays no commission, thus increasing his profit.

Note that Radio Shack makes the same profit whether, for example, a PC-2 is sold by a dealer for $240 or by a company owned store for $280. Also, it's easier for Radio Shack to ship twenty TRS-80 computers to a dealer than two or three to a company-owned Radio Shack store; this seems to be the usual ratio, according to Daniels.

Sharp Pocket Computer Manuals

The 124-page 26-3501 manual that comes with the Radio Shack PC-1 Pocket Computer (now $159.95, in the RSC-7 catalog) is written too compactly for most beginners, and is best suited for those with previous programming experience.

The six "Sample User's Programs" make a curiously eclectic mix: biorhythm, guess-a-number game, series-circuit impedance, days between dates, random numbers, and normal distribution and percentile. So Radio Shack brought out a $1.95 book of "50 ready-to-run programs in Pocket Basic. Business, education, and home applications." Not having seen this book, I can't comment on the programs or the mix.

However, I have seen the three books that come with the PC-1211 Pocket Computer from Sharp Electronics Corp. The PC-1211 is the same as the PC-1; Sharp makes both; the only difference is the labels.

The 46-page "Beginner's Textbook for Basic" provides the ABC's of Basic, and has a total of two dozen exercises at the end of three chapters, with solutions. This book is quite simple, with only one flow-chart and nothing more complex than a one-dimensional array.

The 101-page "Instruction Manual" has many pages that are very much like those in the Radio Shack manual, and in general contains just about the same information, but without the six sample programs.

These six, and 128 more, are contained in the 307-page "Applications Manual," which divides the programs into ten groups: mathematics (simultaneous equations, eigenvalue, etc.), statistics (Poisson distribution, exponential regression), surveying (stadia calculation, closed and fixed traverse), civil engineering (stress, ridge deflection), electronics (series-circuit impedance, self-inductance), more civil engineering (velocity of flow, bending stress), mathematics (points of intersection of two circles, circle tangent to two lines), financial(present value of annuity, depreciation), chemical engineering (viscosity index, heat conduction), and games (cannon shot, treasure hunt). These are all presented in the same compact format as the six sample programs.

The manual for the TRS-80 Pocket Computer has been edited by someone with a more fluent and colloquial knowledge of English than whoever translated the Sharp PC-1211 Instruction Manual from the Japanese. Perhaps someone in Fort Worth reworked the Sharp manual into a lighter, more conversational style. The PC-1211 manual has some odd-sounding or stilted phrases, such as "in case of a number beyond above range" and "be sure to have occasional cleaning of the recording head." However, the translation is excellent most of the time.

All four manuals are printed in Japan, on paper and with typefaces and layouts that look a little odd to Western eyes. Which is not to detract from their being quite good—for the experienced computer user.

The three Sharp manuals are available at some Sharp dealers, at prices set by the individual dealer. The Sharp PC-1211 was available in the spring, from some New York dealers, for $139.95. For $254.95, they were also offering the Sharp PC-1500, identical with the PC-2 that Radio Shack offers for $279.95 in the RSC-7 catalog. As for what manuals accompany the PC-1500 and PC-2, I haven't seen them yet.

Short Program #31: Screen Saver

From Lowell, IN, Jim Peterson sent this:

"I am writing in reference to the *Storing Graphics* subroutine by W.A. Fronek in the Jan. 1982 *Creative* (p. 178). While this program will work, I have a faster routine.

which uses less memory (dimensioning one array instead of two), and will save any alphanumeric characters as well as graphics.

Figure 3.

```
5000 DIM P(1024)
5010 Z=1
5020 FOR A=15360 TO 16383
5030 IF PEEK(A)=32 OR PEEK(A)=128
     THEN 5040 ELSE P(Z)=PEEK(A):
     GOTO 5060
5040 IF PEEK(A+1)=32 OR
     PEEK(A+1)=128 THEN 5070
5050 P(Z)=A+1
5060 Z=Z+1
5070 NEXT A

5100 CLS: INPUT "PRESS ENTER TO
     DUPLICATE SCREEN";A$

5200 P=15360
5210 FOR A=1 TO Z-1
5220 IF P(A)<192 THEN POKE P,P(A):
     P=P+1 GOTO 5240
5230 P=P(A)
5240 NEXT A
```

"Purpose: This subroutine will save anything displayed on the screen. The codes for characters and graphics are transferred from video memory to the P array. Duplication is very fast when much of the screen is blank. The more the screen is filled, the slower the duplication. Saving all of the screen generally takes about 30 seconds.

"Function: Scans video memory and stores the codes in the P array. Blank screen space is stored merely as the last blank location. When the duplication routine (5200-5240) finds a number in P larger than 255 (highest possible code in memory), it skips down to this location and continues with duplication. Unless every screen location is full, P will not be filled.

"This routine can be used with any of the saving routines shown with Fronek's program. Simply write Z and the P array to tape."

If you use Jim's routine, don't forget to add

```
135 B$=INKEY$: IF B$="" 
    THEN 140 ELSE 5000
```

if using the first wandering-pixel program (in the Jan. 1982 column), in which 130 is the SET line and 140 is the following line. Actually, this INKEY line can be inserted almost anywhere in the program, but somehow it seems to fit best, logically, after the SET line that puts a pixel on the screen. □

"*Human history becomes more and more a race between education and catastrophe.*"

H.G. Wells

m...software legal forum...so

The comments and opinions of the author are given for educational purposes only and are not meant to be legal advice. Specific legal questions should be referred to your personal attorney.

Harold Novick

Politics and Patentable Programs

In the January Software Legal Forum, it was announced that the Patent and Trademark Office (PTO) had capitulated in its fifteen-year general opposition to the patentability of computer programs. Simply stated, the PTO decided to issue formal guidelines to its corps of examiners on what type of computer programs were patentable.

Because the PTO's previous vociferous opposition seemed to have political overtones, it must be speculated that the present Reagan administration with its new Commissioner of Patents and Trademarks, Gerald Mossinghoff, had a great deal to do with this amazing reversal of policy.

However, this month's Forum is to be neither a political nor a historical commentary. Nor will it be a rehash of previous discussions of patent law. Rather, we will discuss the new PTO guidelines and the view today for the application of those guidelines to the criteria for making business decisions.

Harold Novick, Patent Attorney, Larson and Taylor, Arlington, VA 22202

The question of whether computer programs were patentable subject matter or unpatentable algorithms—an unpatentable tool of science, if you will—was last addressed by the Supreme Court of the United States in the case of *Diamond, Comm'r of Pat. and Trademarks v. Diehr*, 209 U.S. P.Q. 1 (1981).

In what seems to be simply a change of mind, the Court through five of the nine justices held that the patent claim under consideration was "drawn to an industrial process for the molding of ruhber products" (patentable) and was not "seeking patent protection for (a mathematical) formula in the abstract" (unpatentable). *Diehr*, 209 U.S.P.Q. at 10.

This holding was made in the face of a stinging dissenting opinion written for the remaining four justices by Justice Stevens, the author of the previous Supreme Court Case, *Parker, Acting Comm'r of Pat. and Trademarks v. Flook*, 437 U.S. 584, (98 U.S.P.Q. 193 (1978).

Flook held, according to Justice Stevens, that "unpatentable subject matter was not limited . . . to claims which wholly pre-empted an algorithm . . ."; and that an improved method of calculation, even when employed as part of a physical process, is not patentable subject matter . . ." *Diehr*, 209 U.S.P.Q. at 15.

In spite of the closeness of the decision (and the fact that one of the Justices voting in favor of the patent, Justice Potter Stewart, has been replaced by another, Justice Sandra Day O'Conner), the PTO has proposed that "claims seeking coverage for a computer program would be nonstatutory . . . only if, when considered as a whole, they merely recite a mathematical algorithm or a method of calculation." MPEP Sec. 2110.

This proposition, drafted in large part by Supervisory Primary Examiner Mark Nusshaum, appears as a new section 2110 (Patentable Subject Matter-Mathematical Algorithms or Computer Programs) to Chapter 2100 (Patentability) of the Manual of Patent Examining Procedure. The PTO says that "This Manual is published to provide Patent and Trademark Office patent examiners, applicants, attorneys, agents, and representatives of applicants with a reference work on the practices and procedures relative to the

prosecution of patent applications before the Patent and Trademark Office."

However, the magnitude of this shift in PTO position can only be realized when the recent *Diehr* decision is analyzed and the extremity of the prior PTO position is examined. Only two years ago, the PTO had advocated that computer programs were unpatentable subject matter. On what basis you ask? On two different bases, a legal one and a technical one.

In a legal argument, before its reviewing court, the PTO said that the Supreme Court has forbidden patents on algorithms and that "the word *algorithm* as applied by the Supreme Court in [patentable subject matter] cases is not limited to mathematical algorithms, but extends to the general meaning of the word which connotes a step-by-step procedure to arrive at a given result" (emphasis original) *in re Walter*, 205 U.S.P.Q. 397, 405 n.4 (CCPA 1980). This argument was wisely rejected by the Court on the basis that all processes are a step-by-step procedure to arrive at a given result. Thus, such a definition would preempt all processes from being patentable subject matter contrary to the explicit inclusion in the patent laws of process patents as being patentable subject matter.

In a technical argument, the PTO has suggested that *all* computer programs are inherently mathematical and everyone agrees that you cannot patent a mathematical formula. Ergo, all computer programs are unpatentable. The PTO reasoned that all computer programs at their most fundamental level "must necessarily be carried out employing the radix or radices imposed by the architecture of the computer used, binary, binary coded decimal, or the like." *Walter*, 205 U.S.P.Q. at 403.

Again the PTO's reasoning was wisely rejected by the Court. "This statement, if accepted," opined the Court, "would suffice to remove all computer-arts inventions from the scope of [patentable subject matter]. It is itself misleading because it ignores what the computer is doing, concentrating instead on how it is being done . . . An overall characterization of these operations as mathematical is too broad because in concentrating on the minutiae, it ignores the whole." *Walter*, 205 U.S.P.Q. at 408.

Thus, the PTO had its hand slapped twice by the reviewing Court. In the past, however, that did not stop it. The PTO simply appealed those decisions to the Supreme Court (and won!); limited what the reviewing Court said to the particular case and refused to apply that concept generally; or ignored that Court and relied on its own interpretation of the decisions of the higher Supreme Court. But after the *Diehr* case, the PTO reversed course. What did that case say that caused this momentous shift?

In the *Diehr* case, the Supreme Court concluded only that "a claim drawn to subject matter otherwise statutory does not become non-statutory simply because it uses a mathematical formula, a computer program, or digital computer." *Diehr*, 109 U.S.P.Q. at 8. Note, the Supreme Court stated the patentability of computer programs in the negative. Just because a computer program was involved, did not render the invention unpatentable. This does not say that computer programs themselves were patentable. But that is exactly the way the PTO has interpreted the case.

As readers of this Forum know, this author has been saying for a long time that certain pure computer programs should be patentable subject matter. The difficulty now, however, is that politics is the only apparent reason for the complete reversal of the PTO's position and its complete acquiescence to the decisions of its reviewing Court. What Caesar has given, Caesar can take away.

Furthermore, the Supreme Court is not beyond a complete reversal of a prior position based solely on a change in the membership on the Court. Should Justice O'Conner side with the majority in Flook, who were the minority in *Diehr*, the whole Pandora's box can be opened again. At least the PTO will not be opening the box since it has said that it will not bring the question to the Supreme Court again for what would have been a sixth time.

In any event, the position of many has been vindicated and legalized. It is hoped that this position can survive infancy.

New Guidelines

This brings us to the second part of this month's Forum. What are the new PTO guidelines? But first, a quick review of some important terms.

One can patent any new and unobvious invention that is directed at patentable subject matter. To do so, the invention must be completely and fully described so that one of ordinary skill in the area to which the invention pertains would be able to make and use the invention.

In addition the particular metes and bounds, the circumference of the invention, the Venn universe, must be stated in a single sentence in the English language. This sentence is called a "claim," and that term has been repeatedly used above.

For example, the computer invention could be an automated, textual information input, storage and retrieval system accessible by free-form narrative questions. The claim could then be as follows:

Legal Forum, continued...

"I claim: A process comprising the steps of
- storing textual information and dividing it into information units, each unit having a unique numhcr;
- matching the text using a match criteria with a plurality of common words (e.g., I, was, on);
- compiling and storing a general purpose synonym directory and for the stored test a searchonym directory;
- storing and comparing a natural language question concerning the stored text with the common words and saving the mismatched words;
- matching the saved word and its synonym from the question against each word and its searchonym from the text;
- and presenting logical information units according to a priority criteria thereby answering the question. (Developed from the Asija patent 4,270,182 granted May 26, 1981).

This claim cannot be fully understood until each of the words used in it is understood in light of the complete description of the invention. However, it does define what is included in the patent and what is not. It also indicates what changes have to be made to the description of a subsequent invention so that the subsequent invention can be made, used or sold without infringing the patent.

In any event, this claim is not directly or indirectly addressed to a mathematical algorithm. The use of a match criterion or assigning weighted values to an item should also not transform the claim as one being directed to a mathematical algorithm.

Another computer invention, this one for oil prospecting, is directed at producing a cross-sectional geological map depicting the position and shape of subsurface formations from sonic wave signals.

One claim essentially called for a system for converting amplitude-versus-time seismic traces into a number of amplitude-versus-depth traces. The system included data processing means for producing a number of sonograms identified and indexed through respective horizontal pivot coordinates and a represented movement; and automated means for machine dividing each of said individual sonograms into a series of segments in accordance with a seismic velocity function and for placing, storing and indexing also in accordance with the seismic velocity function the series of segments into a series of subsurface zonelets. As thus claimed, it has been conceded that by reciting indexing and storing in accordance with the seismic velocity function, a mathematical algorithm has been indirectly recited. The question: is the claimed invention patentable?

According to the new PTO guidelines, the claim must be considered as a whole. If the claim contains a mathematical formula, directly or indirectly, implements that formula in a structure or process which, when considered as a whole, transforms or reduces an article to a different state or thing, then the claim is directed to patentable subject matter.

However, if the claim is seeking patent protection for the formula in the abstract, it would not be directed to patentable subject matter. It would be unpatentable even if the formula is limited to a particular technological environment, such as oil prospecting.

Similarly, insignificant post-solution activity that is claimed would not be enough. Thus resetting an alarm set point in a computer program that performed a new mathematical equation useable for monitoring the rising temperature in a chemical process is not enough. (This was the *Flook* case.)

In the *Diehr* case, the claimed post-solution activity was to open automatically a rubber molding press, a step clearly tied in with the physical process of rubber molding; thus, patentable subject matter.

On the other hand, preliminary data gathering steps with no significant post-solution activity will not make patentable that which is not. Such a step would be, for example, simply measuring the temperature or the time.

However, if the data gathering is influenced by the mathematical algorithm, then presumably the subject matter as a whole would not be merely directed to solving that equation; hence patentable subject matter.

What about the prospecting claim set forth above? Patentable subject matter? Obviously the claimed information system is for patentable subject matter because no mathematical equation is involved.

On the other hand, one is involved in the prospecting claim. Nevertheless, this claim has been held to be for patentable subject matter. Here, the claimed invention converts one physical thing (a seismic time section) into another physical thing (a seismic depth section). See *In re Sherwood*, 204 U.S.P.Q. 537 (CCPA 1980). Nobody ever said it would be easy.

So, do you rush to the PTO with a patent application for your computer program related invention? The answer is yes if the cost for obtaining a patent (it could easily exceed $5000) is less than the expected economic return or the worth of the computer program. Thus, the computer program would have to be quite valuable, capable of being useable for a long time, desired by others, and fundamental enough so that it cannot be easily circumvented.

But more on the application of the PTO guidelines later. In all cases, however, good patenting. □

Bit Pit

Chas Andres

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APPLE-COMPATIBLE 5-1/4" DISK DRIVE

A.M. Electronics Inc. has announced a 5-1/4" disk drive for Apple computer systems.

The suggested retail price for the 40-track disk drive is $395. An 80-track version is priced at $495.

A.M. Electronics Inc., 3446 Washtenaw Ave., Ann Arbor, MI 48104. (313) 973-2312.

CIRCLE 300 ON READER SERVICE CARD

TV STAND

BYTM Systems, Inc. announces Clear Stand, a TV/Monitor stand for Atari 400/800 and Apple II computers.

The stand is made of clear polished high-impact acrylic. It holds a TV/Monitor up to 15" in screen size. $59.95.

BYTM Systems, Inc., 389 Fifth Ave., (Suite 400), New York, NY 10016.

CIRCLE 301 ON READER SERVICE CARD

LIGHT PEN FOR ATARI

Symtec announces a light pen for the Atari 400/800 and the VIC-20 home computers. The pen is programmable and can activate any software command the Atari or VIC can handle.

The barrel is stainless steel and has a touch-ring that sends a signal to the computer with the touch of a finger or by tapping a metal clip. $150.

Software Etc., 20828 Vermander, Mt. Clemens, MI 48043. (313) 792-3391.

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COMPLETE SYSTEM ON A SINGLE S-100 BOARD

A complete S-100 computer system on a single S-100 board has been introduced by Advanced Micro Digital Coporation. The Super Net board consists of a 64K bank select dynamic RAM, Z-80A CPU, 2716 (2K) monitor EPROM, 5 1/4" and 8" floppy disk controller, two serial and two parallel interface ports and Z-80A CTC for real-time interrupts. Full DMA operation is supported and it meets IEEE-696 specifications and operates under both CP/M and MP/M. $1125.

Advanced Micro Digital Corp., 7201 Garden Grove Blvd., Suite E, Garden Grove, CA 92641. (714) 891-4004.

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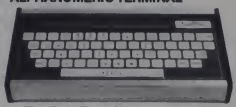
THE PORTABLE ALPHANUMERIC TERMINAL



The TransTerm 2 is an alphanumeric keyboard/display terminal intended for portable and/or remote communication environments.

The TransTerm 2 consists of a single line 80-character liquid crystal display and a 58-key TTY style membrane keyboard packaged in a 1.75" high by 12.75" wide by 6.9" deep case.

The unit communicates in full duplex RS-232 serial asynchronous ASCII with 20 ma current loop or RS-422 available as options. One of eight baud rates (110-9600) can be switch selected as can the character parity (even/odd/mark/space) at seven data bits per character.

Computerwise, Inc., 4006 East 137th Ter., Grandview, MO 64030. (816) 765-3330.

CIRCLE 304 ON READER SERVICE CARD

PERSONAL INFORMATION TERMINALS

A line of personal information terminals, with prices starting at under $500, has been introduced by Tymshare, Inc. Called Scanset, the terminals are designed for one-button information access by non-computer professionals.

The Model 410, with automatic computer log-in, sells for $495. The Model 415, with built-in modem, automatic telephone dialer, and automatic computer log-in, is priced at $649.

Built for flexibility and ease of use, the terminals feature user programmable function keys, a 9" diagonal screen with 24 lines of text and 40 or 80-character line lengths; and limited graphics capability.

Up to 12 user-defined tasks can be assigned to the programmable keys, giving the user easy access to host computers or frequently used data bases.

The autodialer feature of the Model 415 can dial up to 36 phone numbers stored in the terminal memory, automatically connecting the terminal to computers or data bases.

Tymshare, 20705 Valley Green Dr., Cupertino, CA 95014. (408) 446-6000.

CIRCLE 305 ON READER SERVICE CARD

New Products, continued...

BUSINESS COMPUTERS

Eagle Computer, Inc. announces the addition of two computer systems featuring integral hard disk storage to its line of products for business use.

The Eagle IV offers 7.5 megabytes of formatted hard disk storage capacity and the Eagle V provides 15 megabytes of formatted hard disk storage. The new models are priced at $8995 and $9995 respectively.

The Eagle products incorporate in a single enclosure the CPU, keyboard, full numeric keypad, 12" monitor and floppy and hard disk drives. User storage in the two systems is the equivalent of 5,000 and 10,000 standard 8.5" x 11" pages of typewritten material.

The Eagle systems use the CP/M operating system.

Eagle Computer, 501 Vandell Way, Campbell, CA 95008, (408) 379-5004.

CIRCLE 306 ON READER SERVICE CARD

MEDICAL BUSINESS SYSTEM

Computers and Information Management, Inc. has a medical business system.

Intern supports clinical records for the doctor; provides scheduling and patient data access for the receptionist; handles billing, general ledger, insurance forms and claims collection for the bookkeeper or accountant; and maintains treatment and medical history information on each of up to 3000 patients. $15,000.

LCIM, 1377 Route 206, P.O. Box 800, Rocky Hill, NJ 08553, (609) 924-8640.

CIRCLE 307 ON READER SERVICE CARD

Z80 OFFICE COMPUTER

Sage Distribution offers Sundance, a Z80-based microcomputer system which incorporates a 5 1/4" rigid disk drive, single board processor, and high density 10-megabyte cartridge tape drive in a compact enclosure designed for the office environment.

The Sundance is fully integrated into a terminal with either 80-character or selectable 80/132-character optional line length. It has 64K dynamic RAM using 16K chips. Parity is automatically generated and checked on each transfer.

Sage Distribution, 5711 Slauson Ave., Culver City, CA 90230, (213) 642-6614.

CIRCLE 308 ON READER SERVICE CARD

CATALOG OF COMPUTER BOOKS

Camelot Publishing Company announces a two-color, 40-page catalog describing their computer books, materials and teacher aids.

Sixty items are described for use by elementary and secondary school teachers, and college instructors. Available for free.

Camelot Publishing Company, P.O. Box 1357, Ormond Beach, FL 32074, (904) 672-5672.

CP/M FOR APPLE

Lobo Drives offers software and hardware for implementation of CP/M on the Apple II. Lobo CP/M (an enhancement of Microsoft CP/M) supports standard, Apple-type mini-floppies, Lobo 8" single- or double-sided, double density floppy systems and Lobo 5 1/4" or 8" hard disk systems.

Features of the Lobo CP/M system include: No decrease in user RAM area; support of the Lobo 5202 and 8202 floppy disk systems; support of the Lobo 950 and 1850 hard disk system; support of standard Apple mini-floppies; and the ability to have all drive types on line at once.

Lobo Drives, 354 S. Fairview Ave., Goleta, CA 93017. (800)344-6103 or (800) 344-6104 from California; outside of California (800)235-1245.

CIRCLE 309 ON READER SERVICE CARD

SERIAL INTERFACE FOR MODEL III

The VR-RS-232C is a plug compatible serial interface for the TRS-80 Model III. It features a programmable baud rate generator from 50-19200 baud; programmable pin out to eliminate special cables (modem output standard); reverse polarity protection; programmable UART; and user prototyping area for special applications, such as, 20ma current loop, relays or lamp drivers.

No soldering or other component level work is required for installation.

VR Data Corp., 777 Henderson Blvd., N-6, Folcroft Industrial Park, Folcroft, PA 19032. (215) 461-5300.

CIRCLE 310 ON READER SERVICE CARD

GRAPHICS DIRECTORY

The 1982 computer graphics directory, covering suppliers of hardware, software, systems and services, is announced by Stanley Klein, directory publisher, who is also publisher/editor of The Harvard Newsletter on Computer Graphics.

A main section lists vendors alphabetically, giving such information as the year founded, address, telephone number, chief executive officer, person to contact, sales, and employees.

A second section is a cross-index, which lists the vendors under specific categories by products and services, type of technology employed, or applications served. $47.

Stanley Klein, Publisher, Computer Graphics Directory, 730 Boston Post Rd., P.O. Box 392, Sudbury, MA 01776. (617)443-4671.

BIBLIOGRAPHY OF COMPUTER-ORIENTED BOOKS

More than 300 new books are listed in the 15th edition of the *Annual Bibliography of Computer-Oriented Books*, recently released by the University of Colorado.

The section on micro and personal computing now contains 45 books.

Despite the deletions of all introductory-type books published prior to 1979, the bibliography contains more than 1,000 books from over 170 publishers. The bibliography separates the books into 63 categories and catalogs them according to type (reference, textbook, handbook) and style of presentation (programmed instruction, case study or narrative). $4.

Computing Newsletter, Box 7345, Colorado Springs, CO 80933.

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Steve Gray

Using the Radio Shack TRS-80 in Your Home, by Henniston W. Lord, Jr. Van Nostrand Reinhold Co., New York. 467 pages, hardcover $21.95.

The first 40 percent of the book consists of four chapters: The Computer—Space-Age Home Appliance, How Computers Work (fundamentals of Basic), Developing and Manipulating Data, and Screen Graphics. The last four chapters cover applications in education (repetitive drill, buzzword generator, speed reading), the home (shopping, pantry inventory, drink recipes, fuel-usage history and forecasting, chore reminder, auto maintenance), three games (slot machine, tic-tac-toe, bowling alley), and a personal accounts-payable system (608 lines long).

Chapter Two opens by teaching numeric variables A to Z as addresses of houses on a street. Lord manages to make this simple concept rather confusing, and then adds more confusion by entering these variables into a TRS-80 in calculator mode. Program lines are introduced on the ninth page of the chapter, but by then the average reader may be too confused to go on. If he does, he'll find math operators taught too briefly, relational operators taught with the aid of an overlong and confusing program, etc.

Very few of the application programs are really useful, and many (such as drink recipes) are a waste of computer time. Except for the chapter on graphics (which includes long programs that draw a supermarket floorplan and a chart for meal preparation), the book could just as well be about Microsoft Basic. No particular models of the TRS-80 are discussed, nor is disk memory. Not one RUN is shown; most of the book consists of page after page of listings. An $8.95 paperback edition might be of interest to some readers, but $21.95 is too much money for too little of value.

Operating Systems: Concepts and Principles, by John Zarella. Microcomputer Applications, Box E, Suisun City, CA 94585. 149 pages, paperback $8.95, 1979.

This is the first volume in the projected nine-volume Microprocessor Software Engineering Concepts Series, self-published by Zarella. At least two more have been written, on Word Processing and Text Editing (March 1981, p. 202) and System Architecture.

The series was written, according to the preface, because, "with the advent of microprocessors, of a need...for books which address a level intermediate...to those written for the computer science graduate student and for the programmer attempting to learn a language on a specific computer. The ...Series attempts to explore...topics in a manner that is easily comprehensible to any reader who has a general knowledge of digital computers and programming."

Operating systems are covered in eleven chapters: Introduction; Overview; Tasks, Processes and Concepts; System Services, System Support; Communication and Synchronization; Scheduling; Resource and Memory Management; Input and Output; File Systems; System Security. Two appendices provide a 34-page glossary and a page of ten reference works.

The writing is straightforward, and presents the ABCs of operating systems without getting mired in technical detail (there isn't much room for that, anyway, in only 101 pages of text), yet without writing down to the reader.

views...book

The book provides a basic understanding for those who want only that, and a jumping-off place for readers who want to look further into operating systems. There may well be no other book that treats the subject at this level; all ten of those referenced are fairly complex.

Law and the Computer, by Michael C. Gemignani. CBI Publishing Co., 51 Sleeper St., Boston, MA 02210. 252 pages, hardcover $19.95. 1981.

According to the dust-jacket flap, this book was "written for data processing managers, systems analysts, programmers, software and firmware managers and students in the computer sciences. It...enables you to recognize potential legal problems quickly, determine whether legal assistance is necessary, and communicate your problem effectively to legal counsel."

The six chapters cover an Introduction to the Nature of Law, Contracts, Computer Torts (negligence and malpractice, strict liability, etc.), Legal Protection of Software (copyright, patents, trade secrecy and contracts, etc.), Crime, and Evidence.

Seven appendices provide a guide to legal references and citations, selected sections of the 1976 copyright law, and summaries of five illustrative court cases.

The author writes as clearly and simply as possible, about a subject that could well be murky and complex in the hands of a less capable writer. Dr. Gemignani is chairman of the Dept. of Mathematical Sciences at Indiana Univ./Purdue Univ., and is a member of the Indiana Bar Association.

If you have any more than a passing interest in the law as it applies to computers, you probably won't find an easier and more worthwhile book on the subject, nor one that covers it as fully as this one.

Pet Games and Recreations, by Mac Oglesby, Len Lindsay and Dorothy Kunkin. Reston Publishing Co. (A Prentice-Hall Co.), Reston, VA. 255 pages, hardcover $14.95, paperback $9.95. 1981.

Five types of games are provided in this "grab-bag of diversions for computer games enthusiasts of all ages and occupations," according to the press release.

After an introductory chapter, you get Plan-Ahead Games (*Tic-Tac-Toe, Reverse, Motie* and six others), Games of Deductive Reasoning (*Hurkle, Martian Hunt* and four others), Games of Chance (*Acey-Ducey, Thrice Dice*), Language and Counting Skills Games (*How Many, Crossword Puzzle, Word Search*) and Recreations (*Starfill, Petsketch* and four others). The book ends with five tutorial "Lectures" by "Professor Whacko," who "introduces many of the mysteries of PEEKS, POKES, and Subroutines, stimulating you to experiment and explore."

Each game presentation starts with the opening CRT display, tells how to play the game, shows additional displays if necessary, then provides a very legible listing (the book contains 139 pages of game listings).

The "how to play" paragraphs are minimal but adequate. Nothing at all is said about how the program works, perhaps because that might have doubled the size (and price) of the book, which is a handy little volume for those who want two dozen games for as little as 35 cents each. For those who don't like to keyboard four to seven pages of Basic lines per game, Reston offers, for an unspecified price, a cassette of ten of the longer games.

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The Copyright Kit: How to Copyright Your Computer Software, by Noel D. Adler and Steven A. Hovani. National Attorneys' Publications Inc., Box 150, East Setauket, NY 11733. 58 pages, paperback $11.95. 1981.

Written by two members of the New York Bar, this a law-book publisher's "first entry into the computer publishing field...When the reader completes the booklet he should be able to copyright his computer program and the documentation that goes along with it," according to the press release.

The book includes a brief history of the copyright law, compares patents and trade secrets to copyrights, discusses your remedies if your copyright is infringed upon, etc. You are taken step by step through the copyright procedure; sample blank forms and filled-out forms are provided.

The five chapters are: What's It All About (copyright, patent, trade secrets, etc.); Copyrighting Your Software (notice, deposit and registration requirements, works made for hire); Protection from the Copykats (procedure, remedies, proof, permissible copies, fair-use doctrine); Filling Out Form TX; About the Copyright Office, Transfer of Copyright and Correcting Your Registration. Two appendices provide selected sections of the 1976 Copyright Act, and further references.

The language is simple: "Although the program is entitled to copyright protection automatically, it must be Registered in the Copyright Office before you can sue for copyright infringement." This may be the only publication of its kind, and if you write software for sale, it looks like a good investment.

Bugs, by Theodore Roszak. Doubleday & Co., New York. 352 pages, hardcover $14.95. 1981.

This is a curious science fiction mixture of a fairly well written story about the ultimate Luddite dream—shutting down all the computers—and the 1930's-type SF monster.

The basic plot is simple: the director of the government "storage bank for information on millions of citizens" (nicknamed "the Brain"), when interviewed on a children's TV show, jokes about computer "bugs," describing them as real, able to "eat you up...cost you days of work." An impressionable six-year-old girl on the show believes him; "possessing an extraordinary psychic power, she unwittingly materializes her fears into a horrible reality. Soon, workers at the Brain are complaining of itches and skin rashes. Before long, computer centers around the world are being attacked by a plague of killer bugs, tiny creatures that can eat you to the bone in seconds."

Half the story is written moderately well, except that the author doesn't know much about computers, writing of the Brain as consisting of "billions of microprocessors" with "two hundred years of Supreme Court history...reduced to several magnetic memory bubbles."

Science fiction today is far advanced beyond the BEM (Bug-Eyed Monster) plots of the 1930's, and much of it is based on possible or near-possible scenarios. However, the computer bugs are solid "white stuff," without cellular or biochemical structure. If you can suspend disbelief for 352 pages, you may find this novel interesting. But if you insist on being logical, it may exasperate you instead.

views...book

Data File Programming In Basic: A Self-Teaching Guide, by LeRoy Finkel and Jerald R. Brown. John Wiley & Sons Inc., New York. 344 pages, paperback $9.95. 1981.

As one of the latest additions to Wiley's Self-Teaching Guides in Computers and Computer Technology, which consists of 20 books, this is the fifth STG bearing the names of veteran authors Finkel and Brown. They write well, fluently, and often.

The eight chapters cover Basic, data-entry and error-checking routines, and sequential and random-access files. Three appendices provide a 36-page outline of Northstar Basic, a brief glossary of the Basic statements used in the book, and an ASCII chart.

Experienced Basic programmers can skip the first two chapters, which are very helpful for the beginner: Writing Basic Programs for Clarity, Readability and Logic (REMs, formats, modules, subroutines, prettyprinting); and a review of Basic statements.

From chapter three on, the reader learns about field length, null strings, disk storage, cassette files, copying files, changing file data, buffer fields, file conversion, etc. Utility programs are included for letter writing and personal money management.

Self-tests and answer keys take up a large portion of the book, 84 of the 295 pages of text, many of them partly or entirely blank, for writing long programs. Within the text are many additional questions requiring answers to be written in. For the reader willing to do the work, the authors provide a thorough grounding in data files, writing simply and with careful attention to detail.

Computer Consciousness: Surviving the Automated 80s, by H. Dominic Covvey and Neil Harding McAlister. Addison-Wesley Publishing Co., Reading, MA. 222 pages, paperback $5.95. 1980.

Part of the publisher's "Joy of Computing" series, this could be equally well titled "Computer Literacy" or "The ABCs of Computing." Written by two authors who are heavily involved in medical computing at a hospital and university in Toronto, the book is aimed at "consumers, business people, professionals, educators, and concerned citizens—people who have a stake in their own future" and who "can't afford to be ignorant of the computer technology that increasingly affects their daily lives," according to the back cover.

The dozen chapters are divided into four parts: Preliminaries (Introduction, Computer Systems), Hardware (input/output, memory, CPU, communications, summary), Software introduction, operating systems, languages and application packages), The Whole System (Computer Systems in the Medical Environment, Straining on the Tether of Technology). Each chapter concludes with a biography and a list of new words; a 16-page glossary ends the book.

The simple, largely non-technical "overview" text is enlivened by several dozen educational cartoons. This book would not satisfy the curiosity of most readers of *Creative*—who probably want something more technical and more extensive. However, it does provide what the authors aimed at, a "simple but adequate introduction to computer machinery and programming concepts to people who have no previous knowledge of the subject." □

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SOFTWARE

DOS PLUS — SPANISH VERSION — $169.95. For TRS-80 Computers 101, 101 Hollywood Fashion Center, Hollywood, Fla. 33023. (305) 981-1013. Looking for Dealers Distributors.

GENEALOGY — Unlimited system for Apple II. User Friendly Systems, Inc. 6135 Ross Rd., Fairfield, Ohio 45014.

TRS-80 SOFTWARE BOOKS. This month's special: UG other mysteries book $21.95 plus $2.00 shipping handling. Catalog $1.00. Send check money order to: Applied Software, 11 Dickens Ave., Dishills, N.Y. 11746 (518) 242-7899.

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USED COMPUTER TERMINALS. Printers, Modems. Surplus Electronic Parts. Catalog $1.00. SPECIAL: Dasy Wheel Printer $400.00. RONDURE COMPANY, THE COMPUTER ROOM. 2522-CC Butler St., Dallas, TX 75235. (214) 630-4621

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OMNI UNLIMITED: 105 S. Los Robles, Pasadena; 91101; 213 - 795-6664. Commodore, Zenith, Otrona, Victor, Supplies Peripherals.

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CAMPBELL — HEATHKIT ELECTRONIC CENTER, 2350 S. Bascom Ave., (408) 377-8920. Heath Zenith Computers, Software, Peripherals.

EL CERRITO — HEATHKIT ELECTRONIC CENTER, 6000 Potrero Ave., (415) 236-8870. Heath Zenith Computers, Software, Peripherals

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DENVER — HEATHKIT ELECTRONIC CENTER, 5940 W 38th Ave., (303) 422-3408. Heath Zenith Computers, Software, Peripherals

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COMPUTERWORKS — 1439 Post Rd., East Westport 06880; (203) 255-9096. 12-6 Tues.-Fri., 12-9 Thu., 10-5 Sat.

CONNECTICUT INFORMATION SYSTEMS — 218 Huntington Road, Bridgeport 06608; (203) 579-0472. Mon-Sat. 10am-5pm. Apple and CP/M-related products.

THE COMPUTER STORE, 21 Atlantic St., Stamford, 06901, (203) 356-1920. Apple, Zenith, Sanyo, Diablo, Epson.

THE COMPUTER STORE, 683 Silas Deane Hwy, Wethersfield, 06109. (203) 563-9000. Apple, Zenith, Sanyo, Diablo, Epson.

AVON — HEATHKIT ELECTRONIC CENTER, 395 W. Main St. (Rt 44), (203) 878-0323. Heath Zenith Computers, Software, Peripherals.

DELAWARE

THE COMPUTER STORE, 4010 Concord Pike, Rt. 202 North, Wilmington, 19803. (302) 478-7772. Apple, Zenith, Sanyo, Diablo, Epson.

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TAMPA — HEATHKIT ELECTRONIC CENTER, 4109 W. Hillsborough Ave., (813) 886-2541. Heath Zenith Computers, Software, Peripherals.

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ATLANTA — HEATHKIT ELECTRONIC CENTER, 5285 Roswell Rd., (404) 252-4341. Heath Zenith Computers, Software, Peripherals.

ILLINOIS

COMPUTER LAND DOWNERS GROVE — 136 Ogden Ave., Downers Plaza 60515; (312) 964-7762. 10-6 Mon.-Sat., 10-8 Tue., Thurs. Apple, Atari, Osborne, Xerox, IBM Personal Computer, Fortune.

FARNSWORTH COMPUTER CENTER — 1891 N. Farnsworth Ave., Aurora 60505; (312) 851-3886. 10-8 Mon.-Fri., 10-5 Sat. Apple, Hewlett-Packard series 80 systems. HP Calculators, IDS Printers.

LIBERTYVILLE VIDEO AND COMPUTER CENTER; 872 So. Milwaukee Ave; LIBERTYVILLE; (312) 367-3660; open 7 days; Atari Computers, Hardware and Software

THE COMPUTER ROOM, 638 North Michigen, Chicago, IL. 60611. (312) 337-6744. Apple, Televideo, Osborne Business Program Specialists.

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DATA DOMAIN OF SCHAUMBURG, 1812 E. Algonquin Rd., Schaumburg, 60195. (312) 397-8706. 12-9 Tues. - Fri., 10-5 Sat. Apple, Alpha Micro, Hewlett-Packard calculators. Largest book and Magazine selection.

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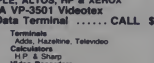

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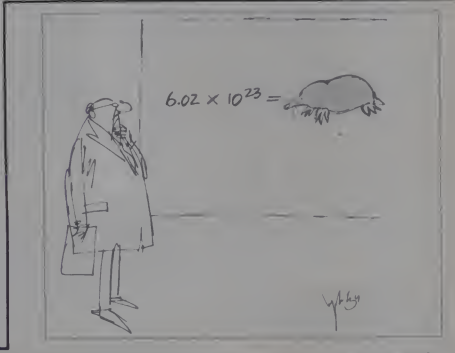

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