```
1080 UT$(0)="PECO
1090 UT$(1)="BELL OF PA
1100 BL$(0)="CHARGES
1110 BL$(1)="GASOLINE
1120 BL$(2)="UTILITES
1130 BL$(3)="MISCELLANEOUS
1140 CH$(0)="BAMBERGERS
1150 CH$(1)="GIMBELS
1160 CH$(2)="PENNEYS
1170 CH$(3)="PNB
1180 CH$(4)="SEARS
1190 CH$(5)="STRAWBRIDGES
1200 CH$(6)="WANAMAKERS
1210 MI$(0)="MORTGAGE
1220 MI$(1)="TAX
1230 MI$(2)="PAPER
1240 MI$(3)="EXTERMINATOR
1250 MI$(4)="AUTO EXPENSE
1260 MI$(5)="ENTERTAINMENT
1270 M$(1)="JAN
1280 M$(2)="FEB
1290 M$(3)="MAR
1300 M$(4)="APR
1310 M$(5)="MAY
1320 M$(6)="JUN
1330 M$(7)="JUL
1340 M$(8)="AUG
1350 M$(9)="SEP
1360 M$(10)="OCT
1370 M$(11)="NOV
1380 M$(12)="DEC
1390 Z1$="RECORD ALL DATA?(Y/N)
1400 Z$="DO YOU WANT TO CHANGE THE LIST?(Y/N)
1410 PRINT"{CLEAR}";"BILLING LIST":PRINT"------------"
1420 FORI=0TO3
1430 PRINTI+1;BL$(I);" (";BL(I);")"
1440 NEXTI
1450 PRINT" 5 END PROGRAM
1460 T=5
1470 GOSUB2440:REM* LIKE TO SEE*
1480 F=A-1:ONAGOTO1490,1720,1950,2200,2430
1490 GOSUB 2880:REM* PRINT BILLING LIST COMPONENT *
1500 FORI=0TO6
1510 PRINTI+1;CH$(I);"(";C(I);")"
1520 NEXTI
1530 PRINT" 8 BACK TO BILLING LIST
1540 T=8
1550 GOSUB2440:REM* LIKE TO SEE*
1560 IFA=8THEN1410
1570 I=A-1
1580 PRINT"{CLEAR}";CH$(I);"(";C(I);")":PRINT"---------
1590 GOSUB2770:REM* MONTHLY PRINTOVERFLOW*
1600 GOSUB2910:REM* "CHANGE LIST?" *
1610 IF F1<>0THENF1=0:GOTO1490
1620 GOSUB2630:Q(F,I,A)=V+Q(F,I,A):REM* INPUT AMT*
1630 C(I)=0:GOSUB2970:C(I)=X:REM*ADD TOTALS *
1640 BL(F)=0:FORK=0TO T-2
1650 BL(F)=BL(F)+C(K):NEXTK
1660 GOSUB2840:REM * PRINT MONTH-AMT *
1670 PRINT:PRINTZ1$:REM* "RECORD?"*
1680 GOSUB2510:REM* YES-NO*
1690 IFA$="N"THENGOTO1490
1700 GOTO58000
1710 GOTO1490
1720 PRINT"{CLEAR}":PRINTBL$(F);"(";BL(F);")"
1730 FORI=0TO4
1740 PRINTI+1;GA$(I);"(";G(I);")"
1750 NEXTI
1760 PRINT" 6 BACK TO BILLING LIST
1770 T=6
1780 GOSUB2440
1790 IFA=6THEN1410
1800 I=A-1
1810 PRINT"{CLEAR}";GA$(I);"(";G(I);")":PRINT"---------
1820 GOSUB 2770:REM* MONTHLY PRINTOVERFLOW*
1830 GOSUB2910:REM* "CHANGE LIST?" *
1840 IFF1<>0THENF1=0:GOTO1720
1850 GOSUB2630:Q(F,I,A)=V+Q(F,I,A):REM* INPUT AMT*
1860 G(I)=0:GOSUB2970:G(I)=X:REM* ADD TOTALS *
1870 BL(F)=0:FORK=0TOT-2
1880 BL(F)=BL(F)+G(K):NEXTK
1890 GOSUB2840
1900 PRINT:PRINTZ1$
1910 GOSUB2510
1920 IFA$="N"THENGOTO1720
1930 GOTO58000
1940 GOTO1720
1950 GOSUB 2880:REM* PRINT BILLING LIST COMPONENT *
1960 FORI=0TO1
1970 PRINTI+1;UT$(I);"(";U(I);")"
1980 NEXTI
1990 PRINT" 3 BACK TO BILLING LIST
2000 T=3
2010 GOSUB2440:REM* LIKE TO SEE*
2020 IFA=3THEN1410
2030 I=A-1
2040 PRINT"{CLEAR}";UT$(I);"(";U(I);")":PRINT"---------
2050 GOSUB2770:REM* MONTHLY PRINTOVERFLOW*
2060 GOSUB2910:REM* "CHANGE LIST?" *
2070 IF F1<>0THENF1=0:GOTO1950
2080 GOSUB2630:Q(F,I,A)=V+Q(F,I,A):REM* INPUT AMT*
2090 U(I)=0:GOSUB2970:U(I)=X:REM*ADD TOTALS *
2100 BL(F)=0:FORK=0TOT-2
2110 BL(F)=BL(F)+U(K):NEXTK
2120 GOSUB2840:REM * PRINT MONTH-AMT *
2130 PRINT:PRINTZ1$:REM* "RECORD?"*
2140 GOSUB2510:REM* YES-NO*
2150 IFA$="N"THENGOTO1950
2160 GOTO58000
2170 GOTO1950
2180 GOTO58000
2190 GOTO1950
2200 GOSUB 2880:REM* PRINT BILLING LIST COMPONENT *
2210 FORI=0TO5
2220 PRINTI+1;MI$(I);"(";MI(I);")"
2230 NEXTI
2240 PRINT" 7 BACK TO BILLING LIST
2250 T=7
2260 GOSUB2440:REM* LIKE TO SEE*
2270 IFA=7THEN1410
2280 I=A-1
2290 PRINT"{CLEAR}";MI$(I);"(";MI(I);")":PRINT"---------
2300 GOSUB2770:REM* MONTHLY PRINTOVERFLOW*
2310 GOSUB2910:REM* "CHANGE LIST?" *
2320 IF F1<>0THENF1=0:GOTO2200
2330 GOSUB2630:Q(F,I,A)=V+Q(F,I,A):REM* INPUT AMT*
2340 MI(I)=0:GOSUB2970:MI(I)=X:REM*ADD TOTALS *
2350 BL(F)=0:FORK=0TOT-2
2360 BL(F)=BL(F)+MI(K):NEXTK
2370 GOSUB2840:REM * PRINT MONTH-AMT *
2380 PRINT:PRINTZ1$:REM* "RECORD?"*
2390 GOSUB2510:REM* YES-NO*
2400 IFA$="N"THENGOTO2200
2410 GOTO58000
2420 GOTO2200
2430 GOTO58000
2440 REM*** WHAT WOULD LIKE TO SEE ***
2450 PRINT: PRINT"WHAT WOULD YOU LIKE TO SEE? INPUT 1 TO";T
2460 GETA$:IFA$=""THEN2460
2470 A=VAL(A$)
2480 IFA<1ORA>TTHEN2460
2490 RETURN
2500 :
2510 REM*** YES- NO QUESTION ***
```

```
2520 GETA$:IFA$=""THEN2520
2530 IFA$<>"Y"THENIFA$<>"N"THEN2520
2540 RETURN
2550 :
2560 REM*** WHAT MONTH ***
2570 PRINT:PRINT"WHAT MONTH? INPUT 1 TO 12":PRI
    NT"THEN HIT RETURN KEY
2580 GOSUB2650
2590 A=V
2600 IFA<1ORA>12THEN2580
2610 RETURN
2620 :
2630 REM *** INPUT AMOUNT ***
2640 PRINT:PRINT"INPUT AMOUNT. THEN HIT RETURN
    KEY
2650 AA$=""
2660 OPEN1,0
2670 GET#1,A$
2680 IF A$<>CHR$(20)THEN2710
2690 IFLEN(AA$)-1 <0THEN2670
2700 AA$=LEFT$(AA$,(LEN(AA$)-1)):PRINT"{LEFT} {
    LEFT}";:GOTO2670
2710 PRINTA$;
2720 AA$=AA$+A$
2730 IFA$<>CHR$(13)THEN2670
2740 V=VAL(AA$)
2750 CLOSE1:RETURN
2760 :
2770 REM*** MONTHLY PRINTOVERFLOW ***
2780 FORJ=1TO6
2790 PRINTJ;M$(J);"...";TAB(9);Q(F,I,J);TAB(20)
    ;(J+6);M$(J+6);"...";TAB(28);
2800 PRINTQ(F,I,J+6)
2810 NEXTJ
2820 RETURN
2830 :
2840 REM*** PRINT MONTH-AMT ***
2850 PRINTM$(A);"...";Q(F,I,A)
2860 RETURN
2870 :
2880 REM***PRINT BILLING LIST ***
2890 PRINT"{CLEAR}":PRINTBL$(F);"(";BL(F);")":R
    ETURN
2900 :
2910 PRINT:PRINTZ$:REM*"CHANGE LIST ?"*
2920 GOSUB2510:REM* YES-NO*
2930 IFA$="N"THEN F1=-1:RETURN
2940 GOSUB2560:REM* WHAT MONTH*
2950 GOSUB2840:RETURN
2960 :
2970 REM *** ADD TOTALS ***
2980 X=0
2990 FORJ=1TO12
3000 X=X+Q(F,I,J):NEXTJ:RETURN
3010 FORK=0TO T-2
3020 BL(F)=BL(F)+C(K):NEXTK
3030 RETURN
3040 :
3050 :
58000 REM-SAVE PROGRAM BY HOWARD BICKING
58010 PRINT"{CLEAR}{02 DOWN}":FORI=2TO6 STEP2
58020 N4=I*5:GOSUB58190:N5$=N4$
58030 N4=PEEK(40+I):GOSUB58190:N6$=N4$:N4=PEEK(4
    1+I):GOSUB58190
58050 PRINT"59"+N5$" POKE"40+I","N6$":POKE"41+I"
    ,"N4$:NEXT
58060 PRINT"58130 POKE42,"N6$":POKE43,"N4$":END
58080 PRINT"GOTO 58110
58090 POKE 158,5:FORI=0TO7:POKE623+I,13:NEXT:PRI
    NT"{HOME}":END
58110 PRINT    :PRINT"{CLEAR}{REV}{03 DOWN}{03 RI
    RIGHT}YOU MAY NOW SAVE THIS PROGRAM
58130 POKE42,016:POKE43,032:END
58190 N4$=RIGHT$("00"+RIGHT$(STR$(N4),LEN(STR$(N
    4))-1),3):RETURN
58200 GOSUB 59010:END
59010 POKE 42 ,187:POKE 43 ,022
59020 POKE 44 ,057:POKE 45 ,023
59030 POKE 46 ,016:POKE 47 ,032
59090 RETURN
```

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VIC High-res Plotter

Sal Raciti

If you need to illustrate something graphically, few options are superior to plots. This program, especially useful to students studying algebra, creates a high res olution picture of a mathematical equation. After seeing a plot, press the RUN/STOP and RESTORE keys at the same time to return the screen to its normal state.

"Y=F (X) Plot Program" is a high resolution plot program for a 5K VIC-20. It plots equations in the form Y=F (X), e.g., Y=SIN (X). It is basically written as a high school level educational program to allow a student to select an equation, envision how it plots, and select the X and Y axes limits. If the student selects the axes limits incorrectly, he can try again. The program builds VIC's custom characters "on the fly" as values of Y are computed. Prior to the plot, it draws on the screen the X and Y axes limits selected by the student.

The program breaks the VIC-20 screen into 20 columns of characters, 20 characters high, in the upper left corner of the screen. It further subdivides each character column into eight dot columns, creating a matrix of 160 dots by 160 dots, or a total of 25,600 dots.

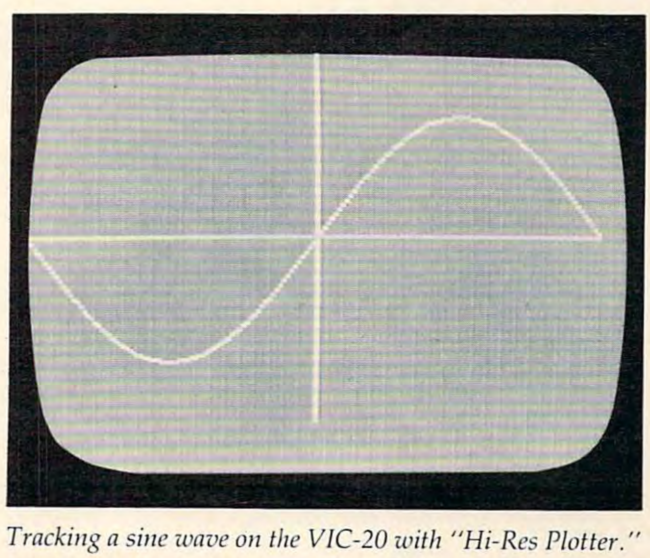
Lines 1 through 7 are the initial setup of the program. Lines 3 and 4 clear the custom character section of the RAM to all blank characters, i.e., 512 locations starting at 7168. Lines 6 and 7 set up the screen to allow selection of the equation to be plotted at location 550. *The program is restarted by typing RUN 9.*

Lines 9 through 47 allow selection of X and Y axes limits by the user through the use of INPUT prompts. These steps also do reasonableness checks on the inputs and prompt if there is an error. Lines 30 and 40 enter the X axis limits as string variables C$ and D$. This was done because of an idiosyncrasy of the VIC-20 that does not accept the π key as a numeric entry. Subroutine 5000 is used to convert the allowed values of π to numerics. Line 47 activates subroutine 6000 when Y is typed. Subroutine 6000 will be explained below.

Lines 48 through 230 plot the X axis using the INPUTted values of A, B, C and D from lines 10, 20, 30 and 40. Lines 50-80 calculate the numeric distance between horizontal dots. Line 90 tests if the axis is off the screen and skips to line 191. Lines 92-130 calculate the position of the X axis in numbers of characters from screen bottom and number of dots left over. Lines 140-230 create the 0 "TH" custom character and POKE it across the screen. Line 85 selects the screen and border color. Line 192 and 195 select character color (in this case, dot color). Line 191 invokes the custom character RAM locations.

Lines 240-440 plot the Y axis. Line 250 skips the entire routine if the Y axis is off the screen. Lines 255-330 create the 1 "TH" custom character, i.e., a vertical line at the correct dot column. Lines 340-440 POKE the 1 "TH" custom character vertically at the correct screen position. As this is accomplished, each POKE location is tested to see if it's not blank, that is, to test where the crossing of the X axis occurs. When this is sensed, the 1 "TH" custom character is logically ORed with the 0 "TH" custom character to create the 2 "TH" character. This is accomplished by lines 380-430.

The equation's high-resolution plot is executed by lines 490-780. Calculation of Y amplitude (YA) is treated as dot columns within character columns. For each character column, custom characters are made up "on the fly" as necessary by lines 520-770. The amplitude of Y (YA) is calculated by line 560 in numbers of dots from screen bottom. Line 570 finds the number of characters from screen bottom and 580 finds the excess number of dots. 600 calculates the character screen position and the dot row at the dot column being processed. 610-765 logically OR this dot with any other dots on the screen at the character location



Tracking a sine wave on the VIC-20 with "Hi-Res Plotter."

being processed. These dots were on the screen from previous calculations of Y or the X and Y axis plot.

Avoiding Screen Clutter

If at line 47 Y was typed, then line 775 invokes subroutine 6000. The VIC-20 is limited to 64 custom characters. If the equation to be plotted is very complicated, e.g., Y=SIN (2X), the 64 characters are used up; then the program starts using screen RAM locations as custom locations, and the screen clutters. Subroutine 6000 starts a search of the screen RAM to see if any custom characters with character column just completed are identical to previously generated characters; if so, they are replaced by the earlier generated character. Subroutine 6000 finds the last custom character ("N"TH) created and sets the scan direction. Subroutine 8000 is called by 6000 and does the actual character comparisons and replacement.

Note: The π(pi) characters in lines 25 and 5000-5110 are obtained by holding down the SHIFT key and typing the ↑(up arrow) key.

```
1 REM INTIALIZATION
3 FORG=7168+32*8 TO 7168+32*8+7
4 POKEG,0:NEXTG
6 PRINT"{CLEAR}";:PRINTSPC(1);:PRINT"Y=F(X) ~
    PLOT PROGRAM"
7 PRINT"{03 DOWN}";:PRINT"ENTER Y=F(X) @ 550
    AND THEN RUN9"
8 LIST550
9 PRINT"{CLEAR}";:PRINTSPC(1);:PRINT"Y=F(X) ~
    PLOT PROGRAM{02 DOWN}"
10 INPUT"Y-MIN VAL";A
20 INPUT"Y-MAX VAL";B
23 IFA>=BTHENPRINT"{03 DOWN}AXIS INCORRECTLY ~
    INPUT-START OVER!":STOP
25 PRINT"{02 DOWN}REM TRIG FUNC LENGTH  OF X-
    AXIS <=2π. SELECT +OR-2π,π,π/2, OR NU
    M-BER.
26 PRINT"{02 DOWN}"
30 INPUT"X-MIN VAL";C$
40 INPUT"X-MAX VAL";D$
43 GOSUB5000
45 IFC>=DTHENPRINT"{03 DOWN}AXIS INCORECTLY I
    NPUT-START OVER!":STOP
47 INPUT"PLOT BREAK? TYPE Y  N{03 LEFT}";Z$
48 REM X-AXIS PLOT
50 YS=ABS(B-A)
60 XS=ABS(D-C)
80 XD=XS/160
85 POKE36879,104
90 IF(A<0ANDB<0)OR(A>0ANDB>0)THENGOTO191
92 AA=ABS(A)
95 YA=INT(24+8*20*(AA)/YS)
121 T=7168:V=7175:GOSUB2000
127 NB=INT(YA/8)
130 ND=YA-8*NB
140 N=7175-ND
150 POKEN,255
190 CD=22-NB
191 POKE36869,255:PRINT"{CLEAR}"
194 FORG=38400TO38905
195 POKEG,1:NEXTG
197 IF(A<0ANDB<0)OR(A>0ANDB>0)THENGOTO250
200 Q=7680+CD*22
210 FORQ=QTOQ+19
220 POKEQ,0
230 NEXTQ
240 REM Y-AXIS PLOT
250 IF(C<0ANDD<0)OR(C>0ANDD>0)THENGOTO500
255 CC=ABS(C)
260 XA=INT(8*20*CC/XS)
270 NB=INT(XA/8)
280 ND=XA-8*NB
290 T=7176:V=7183
310 GOSUB4000
320 FORM=TTOV
330 POKEM,R:NEXTM
340 FORZ=7680+NBTO8098+NBSTEP22
350 IFPEEK(Z)<>32THENGOTO380
360 POKEZ,1
370 GOTO440
380 FORS=0TO7
390 Y=PEEK(S+7176)
410 X=PEEK(7168+S)
420 POKE(T+8+S),(XORY)
425 NEXTS
430 POKEZ,2
440 NEXTZ
490 REM Y=F(X) PLOT
500 N=2
510 X=C-XD
520 FORD=0TO19
525 R=256
530 FORE=0TO7
535 R=R/2
540 X=X+XD
550 Y=(X*X)
560 YA=INT(20*8*(Y-A)/(B-A))
570 NB=INT(YA/8)
580 ND=YA-8*NB
590 IFNB>=20ORNB<0THENGOTO770
600 Z=8098+D-22*NB
605 ND=ND+1
610 O=PEEK(Z)
620 IFO<NORO=32THENGOTO720
640 IFPEEK(Z)=NTHENGOTO750
720 N=N+1
723 IFN=32THENN=N+1
734 FORM=0TO7
735 J=PEEK(7168+8*O+M)
736 POKE(7168+8*N+M),J
737 NEXTM
750 J=PEEK(7168+8*N+8-ND)
760 POKE(7168+8*N+8-ND),(JORR)
765 POKEZ,N
770 NEXTE
775 IFZ$="Y"THENGOSUB6000
780 NEXTD
930 END
2000 FORW=TTOV
2010 POKEW,0:NEXTW
2020 RETURN
4000 R=256
4010 FORP=1TOND
4020 R=R/2:NEXTP
4030 RETURN
5000 IFC$="-2π"THENC$="-6.2832
5010 IFC$="-π"THENC$="-3.1416"
5020 IFC$="-π/2"THENC$="-1.5708"
5040 IFD$="π/2"ORD$="+π/2"THEND$="1.5708"
5050 IFC$="π"ORC$="+π"THENC$="3.1416"
5060 IFD$="2π"ORD$="+2π"THEND$="6.2832"
5070 IFC$="π/2"ORC$="+π/2"THENC$="1.5708"
5080 IFD$="π"ORD$="+π"THEND$="3.1416"
5100 IFD$="-π/2"THEND$="-1.5708"
5110 IFD$="-π"THEND$="-3.1416"
5200 C=VAL(C$):D=VAL(D$):RETURN

6000 MM=0
6010 IFMM=0THENQQ=0:SS=418:TT=22
6020 IFMM=1THENQQ=418:SS=0:TT=-22
6030 FORBB=QQTOSSSTEPTT
6040 CC=8098+D-BB
6050 DD=PEEK(CC)
6060 IFDD=32ORDD<3GOTO6090
6070 IFDD<NANDDD>2ANDMM=0THENBB=418:NEXTBB:MM=1
    :GOTO6020
6080 IFDD=NANDDD>2THENGOSUB8000
6090 NEXTBB
```

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You must decide who you want to fly for. You then get to pick a target and your experience level. $9.95

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You have three bases and you must destroy as many space ships as you can before you run out of missiles. $9.95

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The tank is moving back and forth along the base and you must shoot the UFO before it shoots you. $9.95

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Pacman for the VIC. $24.95

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Destroy the alien invaders from space as they attack your planet. Requires 3K memory expander. $9.95

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V299 A CAT HAS NINE LIVES
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V300 PSYCHIC MISSILES
The object of the game is to guess where the target will be, then fire the missile! This program will exercise your psychic ability. Requires $9.95
By Richard Leiman

V301 BEECHA GOTCHA
Play "Beecha Gotcha." If the harpoon hits the monster fish, I "beecha." If the monster eats the boat, I "gotcha." Requires 3K expander. $9.95
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```
6100 RETURN
8000 FORGG=DTO0STEP-1
8003 IFMM=0THENUU=0:VV=19:WW=1
8004 IFMM=1THENUU=19:VV=0:WW=-1
8010 FORRR=UUTOVVSTEPWW
8020 HH=8098+GG-22*RR
8030 II=PEEK(HH)
8040 IFII=32ORII=NTHENGOTO8120
8050 FORJJ=1TO8
8060 KK=7167+8*II+JJ
8070 LL=7167+8*N+JJ
8090 IFPEEK(KK)<>PEEK(LL)THENJJ=8:GOTO8110
8100 IFJJ=8THENPOKECC,II:N=N-1:IFN=32THENN=31
8105 IFJJ=8ANDMM=0THENRR=19:GG=0
8106 IFJJ=8ANDMM=1THENRR=0:GG=0
8110 NEXTJJ
8120 NEXTRR
8130 NEXTGG
8140 RETURN
```

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The Atari Cruncher

Andrew Lieberman

Many longer programs could benefit from this memory-saving technique, which saved 7,000 bytes in the music DATA within the author's music program.

Programs are written every day using DATA statements. Often the numbers in these statements are for SOUND and PLOT commands, and happen to be in the range of 0 to 255. Frequently, the program loads these numbers into a matrix. This method of DATA storage is inefficient; it wastes *lots* of memory.

There is, however, a way to solve this problem, and an easy way to change already existing programs to a more compact form. Using the "Cruncher," I knocked 7K – that's right, 7000 bytes – off a music program. It took about 40 minutes, and that includes debugging. Many programs can easily be done in half that time.

Each character on the Atari has an ATASCII value ranging from 0 to 255. Look in your *BASIC Reference Manual*, Appendix C. Take, for example, the letter A. Its corresponding number is 65. By using this code, we can convert each number (using one to three digits) to a single character using only one character. It would be a very tedious process if we took each number, looked it up on the chart, and then replaced the number in a program with a single character.

That's where the Cruncher comes in. It won't do all of the work, but it will do most of it. We can further save memory by condensing all of these single characters into one large string instead of a matrix. This is the big memory saver: each character in a matrix takes about seven bytes, but in a string takes only one. So, pull out a program with a lot of numbers and let's get to work. (*Note:* This is a standard procedure. Your program may require modifications of the process of conversion. Read through the procedure and think about what you are doing; otherwise, you may find yourself hopelessly lost.)

First, type the following subroutine into your Atari, and LIST it to cassette or disk. This way you can load it on top of the program to be converted.

```
0 A=PEEK(136)+PEEK(137)*256:? "WHAT L
  INE";:INPUT X:TRAP 32003:GOTO 32000
32000 LI=PEEK(A)+PEEK(A+1)*256:IF LI<
      >X THEN A=A+PEEK(A+2):GOTO 3200
      0
32001 A=A+1:IF PEEK(A)=90 THEN READ D
      :POKE A,D
32002 GOTO 32001
32003 END
```

Second, load the program to be converted. Put in a DIM statement and DIMension a string, say A$, to the number of numbers in the DATA statements. If your program READs the DATA and then puts it in a matrix, get rid of the READ statements. Otherwise, change a routine like this:

```
100 FOR I=1 TO 100:READ A,B:PLOT A,B:
    NEXT I
```

to this:

```
100 FOR I=1 TO 100:A=ASC(A$(I,I)):B=A
    SC(A$(I+1,I+1)):PLOT A,B:NEXT I
```

or better yet:

```
100 FOR I=1 TO 100:PLOT ASC(A$(I,I)),
    ASC(A$(I+1,I+1)):NEXT I
```

If your program handles the DATA in a different way, then it's up to you to figure out the rest of that part on your own.

Now we are almost ready to convert the DATA. Before we can put the characters into A$, we must have an A$. It is already DIMensioned, but we must add space for the characters in the program. Get an idea as to approximately how many numbers are to be converted, say 200. Then type something like this into your program:

```
50 A$(1,50)="ZZZZZZZZZZZZZZZZZZZZZZZZZ
   ZZZZZZZZZZZZZZZZZZZZZZZZZ"
52 A$(51,100)="ZZZZZZZZZZZZZZZZZZZZZZZ
   ZZZZZZZZZZZZZZZZZZZZZZZZZZZ"
54 A$(101,150)="ZZZZZZZZZZZZZZZZZZZZZZ
   ZZZZZZZZZZZZZZZZZZZZZZZZZZZZ"
56 A$(151,200)="ZZZZZZZZZZZZZZZZZZZZZZ
   ZZZZZZZZZZZZZZZZZZZZZZZZZZZZ"
58 A$(201,225)="ZZZZZZZZZZZZZZZZZZZZZ
   ZZZZ"
```

It doesn't hurt to put in some extras; you can always take them out later. To easily duplicate a line, just type it, press RETURN, move the cursor back to the line number, change it, and press RETURN. (*NOTE:* You *must* use capital Z's.) Once you have done this, type RUN. Tell the computer what line your Z's start at (in our sample, 50). Now, wait while the computer figures everything out. When READY appears, LIST the program and see what happens. Voilà! The Z's now look like a lot of garbage!

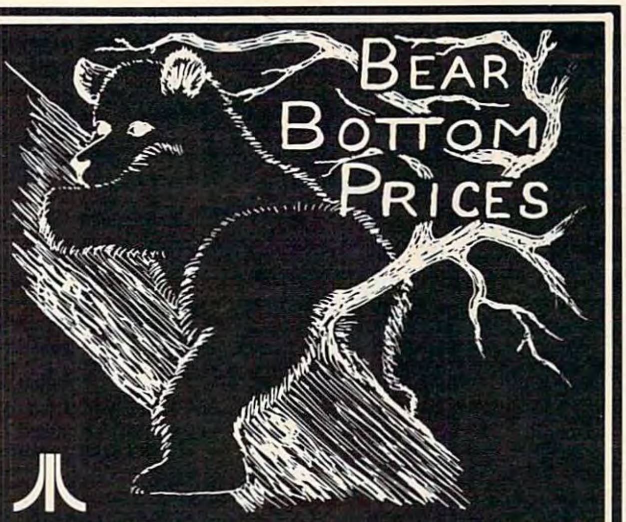
Fourth, and last, get rid of any extra Z's and delete line 0, lines 32000 to 32003, and all of the numerical DATA statements. Now type RUN and watch your program run faster than ever. Sit back and say to yourself, "Gee, that was easy. What program should I fix next?"

The Mystery Revealed

For those of you who would like to know how this program works, I will explain it step by step. The first thing the computer does is find out where the program is stored in RAM. By PEEKing addresses 136 and 137, the Cruncher finds out the first address of the program. The TRAP is so that when the computer is out of DATA, it ENDs without an error.

Next, the computer finds line X. The first three bits of each line give very important information. The first two tell the line number, and the third tells the length. To check if we are at line X, we first find out at which line we are. If LI isn't equal to X, we must advance the pointer to the next line. We do this by adding the length of the line to our original number and trying again.

Now the conversion process begins. A loop begins that checks each address to see if it is 90, or a Z. If it is, the program READs a piece of DATA and POKEs it into the program. We then loop back and continue the process. When we run out of DATA, the TRAP is sounded and the program ENDs. ©



Super Shell Sort For PET/CBM

John W. Ross

There are many programs which would benefit from an extremely fast sorting subroutine. This one is among the fastest ever written for a micro: it sorts 1000 names in less than 30 seconds. The version here is for PET/CBM's with 32K of memory.

One approach a programmer can take to gain an increase in sorting speed involves the use of more sophisticated sorting algorithms. This approach is useful to a point, but has ultimate limitations, not the least of which is the limit imposed by the use of an interpretive language like BASIC.

Suppose you finally do get around to writing that non-recursive version of Quicksort, and you find that it isn't quick, or at least not as quick as you had hoped.

This is the problem that faced me recently. The answer for me (and you, I hope) turned out to be a switch to machine language programming. This resulted in a really dramatic increase in speed. In one typical application, my sorting time went from 54 seconds to less than two seconds!

There are other machine language sorts around – why should you consider this one? It has several features that I believe make it unique. First of all, it is very convenient to use. It sorts any character array, in place. You do not have to move your data to a special location or assign the array a particular name. It can be incorporated into any program without disturbance.

Second, it uses a Shellsort algorithm which is quite efficient as sorts go – certainly far better than the oft-encountered bubble sort. Finally, it is modular in design – the actual sorting part of the program can be extracted from the framework and replaced with something more efficient if you are feeling ambitious.

To get a feel for how the thing works, let's look at a sample application, such as the one shown in Program 1.(You might want to try this out on your favorite BASIC sort first to establish a benchmark.) Lines 100-220 set up a random array of 1000 elements, each one between one and five characters long. This is the array to be sorted.

Lines 300-330 transfer parameters to the sort program. In lines 300 and 310, we POKE the ASCII codes for the letters of the name of the array we want to sort into memory locations 32160 and 32161. If the array name has only one letter, 128 is POKEd for the second letter. For instance, if we wanted to sort the array CD$ we would use:

POKE 32160,67 : POKE 32161,68

In lines 320-330 we POKE a two-byte encoding of N into locations 32162 and 32163, where N is the number of elements to participate in the sort. Element zero is never sorted, so it may be used for special applications. That's all there is to it. The subroutine is called in line 350.

An error code is returned in location 32164. This is zero if all goes well, one if the array name cannot be found, and two if an attempt is made to sort a multi-dimensioned array.

You will note that the program lives at the top of user memory, from $7DA0 to $7F5F including variable storage. Thus, before loading the program, you must reset the top of memory pointer – line 130 in Program 2. This sets the pointer to $7D9F (32159 decimal).

Program 1.

```
100 REM MACHINE CODE SORT TEST PROG
    RAM
110 N=1000
120 DIM A$(N)
125 REM CREATE TEST ARRAY
130 FOR I=1 TO N
140 :   N1=INT(RND(0)*5+1)
150 :   A$=""
160 :   FOR J=1 TO N1
170 :       B$=CHR$(INT(RND(0)*26+65)
    )
180 :       A$=A$+B$
190 :   NEXT
200 :   A$(I)=A$
210 NEXT
220 PRINT CHR$(7)
300 POKE 32160,65
310 POKE 32161,128
320 N2=INT(N/256) : POKE 32163,N2
330 N1=N-N2*256   : POKE 32162,N1
340 T1=TI
350 SYS 32179
360 T2=TI
370 EC=PEEK(32164)
380 IFEC=1THENPRINT"ERROR - ARRAY N
    OT FOUND": GO TO 420
390 IFEC=2THENPRINT"ERROR - DIMENSI
    ON NOT = 1": GO TO 420
400 FOR I=1 TO N : PRINTA$(I) : NEX
    T
410 PRINT:PRINT N"ELEMENTS SORTED I
    N"(T2-T1)/60"SECONDS"
420 END
```

Program 2.

```
100 REM MACHINE CODE SORT LOADER
110 REM
120 REM LOWER TOP OF MEMORY POINTER

130 POKE53,125:POKE52,159:CLR
140 REM LOAD PROGRAM
150 GOSUB 30000
160 END
30000 READN,L:FORI=1TON:READX:POKEL,X
    :L=L+1:NEXT:RETURN
30010 DATA429,32179
30020 DATA173,160,125,41,127,141,160,
    125,173,161,125,9,128,141,
    161,125
30030 DATA169,0,141,164,125,165,44,13
    3,84,165,45,133,85,160,0
30040 DATA177,84,205,160,125,208,8,20
    0,177,84,205,161,125,240,4
    2
30050 DATA160,2,177,84,141,165,125,20
    0,177,84,141,166,125,24,16
    5
30060 DATA84,109,165,125,133,84,165,8
    5,109,166,125,133,85,197,4
    7
30070 DATA144,207,240,205,169,1,141,1
    64,125,76,224,126,160,4,17
    7
30080 DATA84,201,1,240,8,169,2,141,16
    4,125,76,224,126,24,165
30090 DATA84,105,7,133,84,165,85,105,
    0,133,85,173,162,125,141
30100 DATA177,125,173,163,125,141,178
    ,125,173,178,125,208,12,17
    3,177
30110 DATA125,240,4,201,1,208,3,76,22
    4,126,78,178,125,110,177
30120 DATA125,56,173,162,125,237,177,
    125,141,175,125,173,163,12
    5,237
30130 DATA178,125,141,176,125,162,0,1
    38,141,168,125,141,169,125
    ,173
30140 DATA177,125,141,170,125,173,178
    ,125,141,171,125,238,168,1
    25,208
30150 DATA3,238,169,125,173,169,125,2
    05,176,125,240,4,176,85,14
    4
30160 DATA10,173,168,125,205,175,125,
    240,2,176,73,238,170,125,2
    08
30170 DATA3,238,171,125,160,3,165,84,
    133,88,133,90,165,85,133
30180 DATA89,133,91,24,165,88,109,168
    ,125,133,88,165,89,109,169

30190 DATA125,133,89,24,165,90,109,17
    0,125,133,90,165,91,109,17
    1
30200 DATA125,133,91,136,208,223,32,2
    25,126,173,167,125,240,163
    ,48
30210 DATA161,32,80,127,162,1,76,115,
    126,138,208,129,76,52,126
30220 DATA96,160,0,140,167,125,177,88
    ,141,172,125,177,90,141,17
    3
30230 DATA125,200,152,205,172,125,240
    ,2,176,15,205,173,125,240,
    25
30240 DATA144,23,169,1,141,167,125,76
    ,79,127,205,173,125,240,2
30250 DATA176,64,169,255,141,167,125,
    76,79,127,140,165,125,160,
    1
30260 DATA177,88,133,86,200,177,88,13
    3,87,172,165,125,136,177,8
    6
30270 DATA141,174,125,140,165,125,160
    ,1,177,90,133,86,200,177,9
    0
30280 DATA133,87,172,165,125,177,86,2
    00,205,174,125,208,3,76,24
    0
30290 DATA126,144,180,76,15,127,96,16
    0,2,177,88,72,177,90,145
30300 DATA88,104,145,90,136,16,243,96
```

©

Atari Line Range Manipulator

Chuck Beach

This will enhance your BASIC editor by allowing you to copy, delete, or move entire line ranges. The utility takes about 4K and was written in the upper line range (from 30000 to 31000), allowing you to use the lower 30000 for work.

The principles involved in this utility have been demonstrated in several **COMPUTE!** publications. An article in *COMPUTE!'s First Book of Atari* ("The Ouch in Atari BASIC") described some Atari BASIC limitations and inspired me to put together a line range manipulation utility. Another article in the same book ("Inside Atari BASIC") showed how to PEEK at the line number of your BASIC program. And it was the June 1982 issue of **COMPUTE!** ("A Self-Modifying P/M Graphics Utility") that first demonstrated to me the technique which let a program manipulate itself.

There are two methods you can use to incorporate this utility in your programs. One way is to simply type up the lines into your program for each and every use. Another, more desirable method is to type up the utility separately, LIST it to a device, then use the ENTER command to merge the LISTed into your BASIC program. Be sure that the line range for the utility is free to use so you don't lose some nifty routine. Another caution: check that your program won't accidentally fall into the utility logic.

The Options

To use the utility, just enter GOTO 30000. The utility will enter a menu and allow you to select whether you want to Copy, Move, Delete, or Count a range of lines. Select an option and follow the directions.

For the DELETE option, you'll be asked for a range. The specified range is then deleted.

For MOVE, you'll be asked a source range to be moved. After verifying that the range is valid, you'll be prompted for a target line number (where the source range is to be moved) and an increment value. The source range is then copied to the target line number, with each copied line incremented by the value specified. As each line is copied, it is also deleted from the source range.

For the COPY option, you'll be asked for a source range. After verifying that the line range is valid, you'll be prompted for a target line number and an increment value.

For a COUNT operation (spelled KOUNT in the menu), you are asked for a line range. The utility will then return the number of lines within that range.

The END option interrupts the utility with a STOP command. It was designed so you can interrupt the utility, do some other function (further editing, saving the file, etc.), then issue the CONT to reenter the utility menu. Of course, if you execute any other code, this will change the "next line" pointer, and you'll have to reenter the utility through more conventional methods.

For all operations (except COUNT and END), the source range is limited to 100 lines. This was an arbitrary figure. Since line numbers are stored in an array, a larger range capacity would require more storage. The utility already takes up about 4K; if it took up any more, the overhead might make it impractical for an 8K computer. Feel free to expand the arrays by changing the D value in line 30005.

You will find that, unlike other self-modifying programs, this one allows you to watch the modifications in action. Not only do you have something to watch, but you can also get some idea how far along a particular operation is. Don't expect this thing to whiz through a 100 line move in a couple of seconds. In a large program, one line change means a lot of shifted text. In fact, the speed of the changes increases noticeably as more lines are deleted from the program.

Other Uses

You can also use this utility to renumber program lines. The simplest method would be to MOVE the source range to an unused target range, then MOVE it back using the desired increment. In some instances, however, you can renumber in one operation. The reason is that the MOVE precalculates all source line numbers and moves each line one at a time.

Therefore, if you have a range of lines that is incremented by X, you can safely MOVE that range to the same beginning line number with any increment smaller than X. There are many

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situations in which the MOVE can be used as a renumber operation, but try to gain an understanding of just how the utility is doing it before trying anything fancy.

You may also use this utility for interspersing lines. For instance, if the target range starts at 100 and is incremented by 10, you can safely MOVE or COPY to 105 with an increment of 10.

For all MOVE and COPY functions (where the source and target overlap), please remember that the program does not ensure that unintended lines won't be deleted. Back up your file often as you work with this until you get the hang of it.

Techniques In The Program Itself

Some of the techniques used in this program may not be immediately apparent. If you do not have the **COMPUTE!** articles handy for reference, here is an explanation of some of the tricks used:

- Making the computer accept commands from screen.

  This is done by modifying the IOCB.

  POKE 842,13 – Sets the IOCB to accept input only from the screen starting at the cursor position.

  POKE 842,12 – Resets the IOCB to resume normal input modes.

  If the IOCB is not reset to 12, either by a screen command or, in this case, by the program, your computer will lock up and be slightly less useful than the "MEMO PAD" mode. Not even SYSTEM RESET will help you now. Your only alternative is to re-IPL with the ON/OFF switch.

  To ensure that the IOCB is reset, the last screen command is a CONT instruction. The utility is then reentered at the line following the last STOP instruction. At this point, the IOCB is reset for normal input. (This utility actually puts two CONT statements on the screen as a precaution.)

  One cautionary note: *please* practice with it before using it on something you've spent a while developing. Though errors in programs are always annoying, an error in a self-modifying program can be positively disastrous!

- Finding the BASIC line numbers.

  Location 136/137 of BASIC memory contains the LH (low/high) address of the first line of the program. Each tokenized line contains its line number in the first two bytes in the usual LH format. The third byte contains the displacement from the beginning of the line to the beginning of the next line.

- Trapping and displaying an error number.

  When the TRAP is sprung, the error number may be found at location 195 in memory.

Program Description

Lines 30000-30005 – Start of utility. Define arrays. Set variables.
Lines 30010-30015 – Menu to options.
Lines 30020-30040 – Determine user selection and branch to desired code.
Lines 30060-30070 – END option stops and is followed by branch to menu to allow user to enter CONT to continue.
Line 30090 – Subroutine to set screen up for self-modify code.
Lines 30091-30092 – Subroutine to invoke self-modification.
Line 30095 – Subroutine to retrieve next line address and number.
Lines 30100-30150 – DELETE subroutine.
Lines 30200-30250 – MOVE subroutine.
Lines 30300-30350 – COPY subroutine.
Lines 30400-30490 – KOUNT subroutine.
Lines 30500-30530 – Subroutine to get source line range.
Lines 30550-30560 – Subroutine to get target line number and increment value.
Line 30580 – Error trap.

```
30000 REM --> LINE MANIPULATION UTILI
      TY <--
30005 D=100:DIM A(D),B(D),A$(1),L$(25
      ),ER$(5)
30010 TRAP 30580:? "{CLEAR}":? " LINE
       RANGE MANIPULATION UTILITY":?
      :? :? L$:? :? :L$=""
30015 ? "SELECT (D)ELETE, (M)OVE, (C)
      OPY,":? "{7 SPACES}(K)OUNT, OR
      (E)ND":? :? "SELECT ";:INPUT A$
30020 IF A$="D" THEN 30100
30025 IF A$="M" THEN 30200
30030 IF A$="C" THEN 30300
30035 IF A$="K" THEN 30400
30040 IF A$="E" THEN 30060
30045 L$(1,1)="’":L$(2,2)=A$:L$(3,25)
      ="’ UNKNOWN. REENTER.":GOTO 300
      10
30060 STOP
30070 GOTO 30010
30090 ? CHR$(125):? :RETURN
30091 ? :? :? "CONT":? "CONT":POSITIO
      N 0,0:POKE 842,13:STOP
30092 POKE 842,12:? CHR$(125):? :RETU
      RN
30095 ADDR=ADDR+PEEK(ADDR+2):LNUM=PEE
      K(ADDR)+PEEK(ADDR+1)*256:RETURN

30100 REM DELETE
30105 ? :? "DELETE";:GOSUB 30500:IF C
      =0 THEN 30150
30110 X1=INT(C/15):X2=C-(X1*15):IF X1
      =0 THEN 30120
30115 FOR Y1=0 TO (X1-1):GOSUB 30090:
      FOR Y2=1 TO 15:PRINT A(Y1*15+Y2
      ):NEXT Y2:GOSUB 30091:NEXT Y1
30120 IF X2=0 THEN 30130
30125 GOSUB 30090:FOR Y1=1 TO X2:PRIN
      T A(X1*15+Y1):NEXT Y1:GOSUB 300
      91
30150 L$(1,LEN(STR$(C)))=STR$(C):L$((
```

```
         LEN(L$)+1),25)=" LINES DELETED.
         ":GOTO 30010
30200 REM MOVE
30205 ? :? "MOVE";:GOSUB 30500:IF C=0
         THEN L$="NULL RANGE SPECIFIED.
         ":GOTO 30010
30210 ? :? "MOVE TO";:GOSUB 30550
30215 FOR X1=1 TO C:GOSUB 30090:LIST
         A(X1):POSITION 2,3:L1=LEN(STR$(
         A(X1))):L2=LEN(STR$(B(X1)))
30220 FOR Y1=1 TO L1:PRINT " ";:NEXT
         Y1:IF L2<=L1 THEN 30230
30225 FOR Y1=1 TO (L2-L1):PRINT "
         {INSERT}";:NEXT Y1
30230 POSITION 2,3:PRINT B(X1):? :? :
         PRINT A(X1):GOSUB 30091:NEXT X1
30250 L$(1,LEN(STR$(C)))=STR$(C):L$((
         LEN(L$)+1),25)=" LINES MOVED.":
         GOTO 30010
30300 REM COPY
30305 ? :? "COPY";:GOSUB 30500:IF C=0
         THEN L$="NULL RANGE SPECIFIED.
         ":GOTO 30010
30310 ? :? "COPY TO";:GOSUB 30550
30315 FOR X1=1 TO C:GOSUB 30090:LIST
         A(X1):POSITION 2,3:L1=LEN(STR$(
         A(X1))):L2=LEN(STR$(B(X1)))
30320 FOR Y1=1 TO L1:PRINT " ";:NEXT
         Y1:IF L2<=L1 THEN 30330
30325 FOR Y1=1 TO (L2-L1):PRINT "
         {INSERT}";:NEXT Y1
30330 POSITION 2,3:PRINT B(X1);"
         {4 DOWN}":GOSUB 30091:NEXT X1
30350 L$(1,LEN(STR$(C)))=STR$(C):L$((
         LEN(L$)+1),25)=" LINES COPIED."
         :GOTO 30010
30400 REM COUNT
30405 ? "COUNT RANGE (FROM,TO) ";:INP
         UT L1,L2:IF L2>32767 THEN L2=32
         767
30410 IF L2<L1 THEN ? " BAD RANGE. RE
         ENTER.":GOTO 30405
30415 ADDR=PEEK(136)+PEEK(137)*256:LN
         UM=PEEK(ADDR)+PEEK(ADDR+1)*256:
         C=0
30420 IF L1>LNUM THEN GOSUB 30095:GOT
         O 30420
30425 IF L2>LNUM THEN C=C+1:GOSUB 300
         95:GOTO 30425
30490 L$(1,LEN(STR$(C)))=STR$(C):L$((
         LEN(L$)+1),25)=" LINES COUNTED.
         ":GOTO 30010
30500 ? " RANGE (FROM,TO) ";:INPUT L1
         ,L2:IF L2>32767 THEN L2=32767
30505 IF L2<L1 THEN ? " BAD RANGE. RE
         ENTER.":GOTO 30500
30510 ADDR=PEEK(136)+PEEK(137)*256:LN
         UM=PEEK(ADDR)+PEEK(ADDR+1)*256:
         C=0
30515 IF L1>LNUM THEN GOSUB 30095:GOT
         O 30515
30520 IF L2<LNUM THEN RETURN
30525 IF C<D THEN C=C+1:A(C)=LNUM:GOS
         UB 30095:GOTO 30520
30530 L$="RANGE TOO LARGE FOR DIM.":P
         OP :GOTO 30010
30550 ? " RANGE (LINE #,INCRE) ";:INP
         UT L1,L2
30555 FOR X1=1 TO C:B(X1)=L1+(X1-1)*L
         2:IF B(X1)<32768 THEN NEXT X1:R
         ETURN
30560 ? " BAD LINE NUMBER IN RANGE. R
         EENTER.":GOTO 30550
30580 ER$=STR$(PEEK(195)):?"ERROR NU
         MBER ";ER$:POP :GOTO 30060
```

©

Easy Apple Editing

Roland Brown

This editor routine provides a powerful utility for Applesoft programmers: the ability to easily modify BASIC program lines.

The Apple II+ was created for its advanced BASIC. Programming in Applesoft is much better and easier than with integer BASIC. One main problem, however, with Applesoft is its editing. Some people invest in a ROM editor, others create their programs using a text editor, and others just suffer with the frustrating ESCape codes. Presented here is a 3/4K machine language program for the Apple II+ 48K or equivalent with DOS 3.3.

The BASIC Line Editor will not destroy the current BASIC program, but will destroy its strings. Once saved on disk as a binary file, Editor can be loaded into memory by the command:

]BRUN B.L.E.,A$9A00

To edit a BASIC program line, type

]& (line number)

for example,

] &100

This will clear the screen, display the line, and place the cursor at the top left of the screen. The line is displayed in a different format from Applesoft's. The differences are: the line is continuous instead of centered on the screen, there are no spaces in the line except between quotes, and all control characters are displayed in inverse.

In the Editor numerous commands are available to you. These commands edit the line:

CTRL-B	**block back**
-C	**convert hex to decimal**
-D	**delete**
-F	**block forward**
-H	**back arrow**
-I	**insert**
-M	**return**
-S	**search**
-T	**truncate**
-U	**forward arrow**
-V	**verbatim**
ESC	**return to BASIC**

CTRL-B moves the cursor back to the previous colon, or if there is no previous colon, the beginning of the line.

CTRL-C clears the bottom of the screen, places a $ prompt on the screen and allows a line to be input. This line is converted to decimal, printed, and the cursor is returned to its original position on the line. This can be used to convert bytes in hex that need to be POKEd/PEEKed.

CTRL-D deletes the character at the cursor.

CTRL-F moves the cursor to the next colon, or if there is no next colon, to the end of the line.

CTRL-H (back arrow) moves the cursor back one space.

CTRL-I inserts a space in the line at the cursor position. Note: CTRL-I will not insert at the top left of the screen.

CTRL-M (return) can be entered at any place in the line and the entire line will be entered into the program.

CTRL-S searches for the next character entered.

CTRL-T truncates the line at the cursor position, so the cursor is at the end of the line+1.

CTRL-U (forward arrow) moves the cursor forward one space.

CTRL-V allows raw control characters to be entered into the line. This can be used to enter returns or backspaces for easier printing control.

ESC will exit the Editor with the line untouched (so if you make a mistake, the line is not lost).

The Editor provides a ‹ at the left side of line 7 as a guide to where BASIC truncates its lines. This will not affect your line if you pass the line through it.

Typing It In

Program 1 is a BASIC program which loads the machine language for the Editor into memory. If the DATA statements have all been entered correctly, the program will provide instructions for saving the binary file to the disk, which should be done immediately. If an error is detected in the data, the program will stop. If this happens, check your DATA statements carefully, correct all mistakes, and run the program again.

Program Explanation

Loading the program resets the stack to the same level as BASIC does, sets up the ampersand vector ($3F5), clears the screen, moves the DOS buffers down so it is safe, prints the title and restarts BASIC.

The entry of the program uses BASIC routines to read in the line and find the line in memory. If the line is not there, the program returns to

BASIC.

The line is disassembled into the input buffer ($200-$2FF) by using a modified version of CHRGET. If the character is text, CHRGET places it in the line. If the character is one representing a command, CHRGET looks it up in the table of BASIC commands and puts the command name in the buffer. Once the end of the line is reached, CHRGET enters the edit section of the program.

The edit program displays the line, gets a character from the keyboard, and processes it. Explanations of the different commands would take too long, but fairly adequate documentation of the program's workings can probably be understood by many Apple owners. If you do not understand any of the Editor commands, just experiment with them for a while.

```
100  FOR I = 39424 TO 40065: READ A:CK = CK +
     A: POKE I,A: NEXT
110  IF CK <  > 88754 THEN  PRINT "ERROR IN
     DATA STATEMENTS": STOP
120  HOME : PRINT : PRINT "BASIC LINE EDITOR
      INSTALLED AT": PRINT "LOCATIONS 39424-
     40065 ($9A00-9C81)": PRINT
130  PRINT "TYPE 'BSAVE B.L.E.,A$9A00,L$282'
     ": PRINT "TO STORE BINARY FILE": PRINT
140  PRINT "TYPE 'CALL 39424' TO ACTIVATE"
150  NEW
200  DATA  162,251,154,169,76,141,245,3
210  DATA  169,43,141,246,3,169,154,141
220  DATA  247,3,32,88,252,169,153,141
230  DATA  1,157,32,212,167,169,12,133
240  DATA  36,169,112,160,156,32,58,219
250  DATA  76,208,3,32,12,218,32,26
260  DATA  214,176,1,96,165,155,133,184
270  DATA  165,156,133,185,32,88,252,32
280  DATA  224,158,104,104,32,95,156,32
290  DATA  95,156,170,32,95,156,32,36
300  DATA  237,162,5,189,0,4,41,127
310  DATA  157,0,2,202,16,245,162,6
320  DATA  134,36,32,95,156,240,61,48
330  DATA  7,157,0,2,232,76,98,154
340  DATA  160,208,132,254,132,255,160,0
350  DATA  41,127,133,253,240,15,177,254
360  DATA  8,200,208,2,230,255,40,16
370  DATA  245,198,253,208,241,177,254,8
380  DATA  200,208,2,230,255,157,0,2
390  DATA  232,40,16,241,41,127,157,255
400  DATA  1,76,98,154,134,252,170,133
410  DATA  250,133,251,32,88,252,160,0
420  DATA  185,0,2,201,32,144,2,9
430  DATA  128,32,240,253,200,196,252,144
440  DATA  239,169,188,141,0,7,165,250
450  DATA  133,36,165,251,32,90,156,32
460  DATA  12,253,201,136,208,22,202,198
470  DATA  250,16,230,160,39,132,250,198
480  DATA  251,16,222,232,160,0,132,250
490  DATA  230,251,240,213,201,149,208,30
500  DATA  164,250,200,132,250,232,228,252
510  DATA  144,7,134,252,169,32,157,0
520  DATA  2,192,40,144,188,160,0,132
530  DATA  250,230,251,76,193,154,201,141
540  DATA  208,20,166,252,169,0,157,0
550  DATA  2,32,81,168,32,88,156,162
560  DATA  255,160,1,76,68,212,201,137
570  DATA  208,39,224,0,240,32,134,249
580  DATA  166,252,230,252,240,20,189,0
590  DATA  2,157,1,2,202,228,249,176
600  DATA  245,232,169,32,157,0,2,76
610  DATA  171,154,166,249,198,252,76,193
620  DATA  154,201,132,208,24,228,252,176
630  DATA  245,198,252,134,249,189,1,2
640  DATA  157,0,2,232,228,252,144,245
650  DATA  166,249,76,171,154,201,130,208
660  DATA  38,224,0,240,18,198,250,16
670  DATA  17,160,39,132,250,198,251,16
680  DATA  9,160,0,132,251,132,250,76
690  DATA  193,154,202,240,250,189,0,2
700  DATA  201,58,208,225,76,193,154,201
710  DATA  134,208,12,228,252,176,232,169
720  DATA  58,32,58,156,76,193,154,201
730  DATA  147,208,11,32,12,253,41,127
740  DATA  32,58,156,76,193,154,201,150
750  DATA  208,18,32,12,253,201,160,176
760  DATA  109,41,127,157,0,2,32,240
770  DATA  253,76,240,154,201,148,208,5
780  DATA  134,252,76,171,154,201,131,208
790  DATA  66,134,249,162,0,189,0,2
800  DATA  157,0,187,232,208,247,169,8
810  DATA  133,37,160,0,32,66,252,169
820  DATA  164,133,51,32,103,253,32,199
830  DATA  255,32,167,255,32,142,253,169
840  DATA  189,32,240,253,165,63,166,62
850  DATA  32,36,237,162,0,189,0,187
860  DATA  157,0,2,232,208,247,166,249
870  DATA  76,193,154,201,155,240,21,201
880  DATA  160,144,11,32,240,253,41,127
890  DATA  157,0,2,76,240,154,32,226
900  DATA  251,76,193,154,32,88,156,76
910  DATA  208,3,133,255,164,250,200,132
920  DATA  250,192,40,144,6,160,0,132
930  DATA  250,230,251,232,228,252,176,7
940  DATA  189,0,2,197,255,208,229,96
950  DATA  169,15,133,37,76,34,252,230
960  DATA  184,208,2,230,185,160,0,177
970  DATA  184,56,233,48,56,233,208,96
980  DATA  194,193,211,201,195,160,204,201
990  DATA  206,197,160,197,196,201,212,207
1000  DATA  210,0
```

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"Stringing" Atari Machine Code

Edward C. Smith

Atari BASIC provides the user with page 6 of memory for storing machine code programs executed via the USR function. Page 6 is by definition hexadecimal locations 600 to 6FF (1536 to 1791 decimal). With the increasing use of machine code, the programmer is sometimes faced with the problem of an overcrowded page 6. (*See "Insight: Atari" this month for further comments on this topic – Ed.*) What are the alternatives?

One solution is to float programs in memory by transferring machine code bytes from data statement lines to an Atari string which then becomes addressable with the ADR function. To qualify for "stringing," the machine code must be fully relocatable – no JMP's, no JSR's and no data tables may be enclosed within it. In addition, the first byte of the machine code must be the start of execution.

This utility (Program 2) provides a means for placing into a string machine language that meets the above criteria. It also inserts necessary statement lines and LISTs the modified version of your program to disk. The procedure for transferring data bytes into a string is based on information on the *Atari Assembler Editor User's Manual*.

The utility should be ENTERed after you have LOADed the program you want to modify. Please note that statement line 1 as well as the region 27000-30000 will be overlaid. Although five variables are dimensioned in line 1, only ML$ (the newly created machine code string) will be used with the modified program. A series of five prompts lead the user through the procedure. After each prompt the program comes to a STOP so that the user may LIST his program to the screen to make indicated changes or determine replies to questions.

To begin with, the user is reminded that the first argument of each USR function must be the address of the machine code string (to make the string fully relocatable) and also that all statement lines that POKE bytes onto page 6 must be deleted. The computer then uses input data to create the string and calculate the number of statement lines that will have to be inserted.

The number of lines is dependent upon the length of the string and the occurrence of two special hex codes: 22 (decimal 34) and 9B (decimal 155). When creating the string, these codes are temporarily replaced with hex code 20 (decimal 32) to avoid confusing the BASIC interpreter. After the statement line defining the string is established, the original values are restored.

Next a suitable location for the insertion of statement lines is requested. Since the first of these lines is a dimension statement, a location near the beginning of the program should be chosen. Care must be taken so that no existing lines are overlaid. Finally, a statement line number for the last line of the modified program is requested. This will allow the user to exclude the data statement lines containing the machine code, provided that they occur at the end of the original program.

A Practical Test

Program 1 is an example of a program that uses page 6 to store machine code bytes (in this case 70 bytes). To demonstrate the use of the utility program, type Program 1 and SAVE to disk; then type Program 2 and LIST to disk. Next LOAD Program 1 and ENTER Program 2. Now change the first argument of each USR function in lines 62 and 66 from "M" to "ADR(ML$)". Next, delete line 40 and type RUN. Answer "Y" to the first two questions because you have just made these changes.

Respond to the third prompt with "9000" and then "70". Next, you are asked for a starting line number for the insertion of *two* statement lines. In reviewing the listing of Program 1, you will see that there is room for extra lines between line 30 and line 50. Type CONT and respond with "35". Answer the last prompt with "78". The computer will now automatically create Program 3 and LIST it to disk as "D:PROGRAM3.LST". When the LISTing is completed type NEW, then ENTER Program 3 and RUN. The result should be the same as when Program 1 is RUN.

Description Of Program 2

Line #		
1	DIM ML$(300)	- allows up to 300 bytes to be placed in a string. At 90 bytes/line, up to four statement lines of machine code can be inserted.
	DIM Q$(300) and DIM R$(300)	- keep track of the occurrence of ASC 34 (double quotation marks) and ASC 155 (RETURN) in the machine code. Allows up to 100 34's and 100 155's.

DIM P$(3)	- used for formatting Q$ and R$.	
DIM M$(100)	- will hold up to three instructions per line for restoring CHR$(34) and/or CHR$(155) in the machine code string.	

27100-27625	First three user prompts.
27630-27650	Develop machine code string ML$ with CHR$(32) replacing CHR$(34) and/or CHR$(155).
27660-27690	Determine number of statement lines to be inserted.
27700-27732	Last two user prompts.
27800-27830	Format input value P to a three-byte left-justified value.
29100	Establishes DIM for ML$.
29170-29270	Establish ML$ (90 bytes per statement line).
29330-29800	Develop statement lines for restoring CHR$(34) and/or CHR$(155).
29900-29910	LIST modified program to disk.

Program 1.

```
30 DIM Y2$(30),Y1$(30)
40 M=1536:FOR I=M TO M+69:READ A:POKE
   I,A:NEXT I
50 Y2$="{4 SPACES}software{5 SPACES}"
   :Y1$="{5 SPACES}title{7 SPACES}"
54 GRAPHICS 18:POSITION 0,0:? #6;"***
   *****************":POSITION 0,10:?
   #6;"********************"
58 FOR I=1 TO 9:POSITION 0,I:? #6;"*"
   :POSITION 19,I:? #6;"*":NEXT I:I=0
62 I=I+1:A=USR(M,ADR(Y2$),LEN(Y2$),I)
   :POSITION 2,3:? #6;Y2$:GOSUB 78:IF
   I<18 THEN 62
65 SOUND 0,0,0,0:I=0
66 I=I+1:A=USR(M,ADR(Y1$),LEN(Y1$),I)
   :POSITION 2,6:? #6;Y1$:GOSUB 78:IF
   I<18 THEN 66
77 SOUND 0,0,0,0:GOTO 77
78 SOUND 0,230/I,10,10:SETCOLOR 0,I+2
   ,9:RETURN
9000 DATA 104,104,133,204,104,133
9010 DATA 203,104,104,133,205,133
9020 DATA 206,104,104,133,207,201
9030 DATA 1,208,22,160,255,200
9040 DATA 177,203,153,218,6,169
9050 DATA 32,145,203,198,205,165
9060 DATA 205,201,0,240,2,208
9070 DATA 236,216,56,165,206,229
9080 DATA 207,168,162,255,232,200
9090 DATA 189,218,6,145,203,198
9100 DATA 207,165,207,201,0,240
9110 DATA 2,208,239,96
```

Program 2.

```
1 DIM ML$(300),Q$(300),P$(3),M$(300),
  R$(300):SETCOLOR 2,12,1:GOTO 27000
27000 REM
27010 REM ****************************
27020 REM *{6 SPACES}UTILITY for
      {8 SPACES}*
27030 REM *{6 SPACES}'STRINGING'
      {8 SPACES}*
27040 REM *{5 SPACES}MACHINE  CODE
      {7 SPACES}*
27050 REM *{10 SPACES}by{13 SPACES}*
27060 REM *{4 SPACES}Edward C. Smith
      {6 SPACES}*
27070 REM *{4 SPACES}Harrisburg, Pa.
      {6 SPACES}*
27080 REM *{5 SPACES}OCTOBER 1982
      {8 SPACES}*
27090 REM ****************************
27095 ? CHR$(125);"{TAB}{3 SPACES}UTI
      LITY FOR 'STRINGING'":? "{2 TAB}
      MACHINE CODE"
27098 ? :? "This utility program shou
      ld be ENTEREdafter program you
      want to modify has  been LOADed
       into memory."
27100 ? :? "1)Has the first argument
       of each USR{3 SPACES}instructi
      on in your program been
      {6 SPACES}replaced with ";
27110 ? "'ADR(ML$)'  (Y/N)";:INPUT P$
27112 IF P$<>"Y" THEN ? :? "  Please
      LIST your program and make
      {5 SPACES}the necessary changes
       - then type{5 SPACES}CONT"
27114 IF P$<>"Y" THEN STOP
27120 ? :? "2)Have you deleted STATEM
      ENT LINE(S){4 SPACES}in your pr
      ogram that read DATA and
      {4 SPACES}POKE onto page 6 ";
27130 ? "of memory (Y/N)";:INPUT P$
27132 IF P$<>"Y" THEN ? :? "  Please
      LIST your program and delete
      {3 SPACES}these lines - then ty
      pe CONT":STOP
27610 ? :? "3)Scan program listing to
       determine{5 SPACES}data statem
      ent line number where the  mach
      ine code bytes ";
27612 ? "begin and count{4 SPACES}num
      ber of bytes.":? "  Type CONT t
      o resume program":STOP
27615 ? "  Enter data statement line
      #";:INPUT MACHINECODE
27620 TRAP 27620:? "  Enter NUMBER of
       machine code bytes{4 SPACES}to
       be placed into a STRING ";:INP
      UT NUMBYTES
27625 TRAP 40000
27630 RESTORE MACHINECODE:FOR I=1 TO
      NUMBYTES:READ A
27635 REM CHECK FOR 34 OR 155 DATA BY
      TES AND CHANGE TO A SPACE (32)
27640 IF A=34 THEN P=I:GOSUB 27800:Q$
      (LEN(Q$)+1)=P$:ML$(I)=CHR$(32):
      GOTO 27650
27643 IF A=155 THEN P=I:GOSUB 27800:R
      $(LEN(R$)+1)=P$:ML$(I)=CHR$(32)
      :GOTO 27650
27645 ML$(I)=CHR$(A)
27650 NEXT I
27655 REM DETERMINE NUMBER OF STATEME
      NT LINES TO BE INSERTED.
27660 M$=Q$:GOSUB 27920:NQ=N
27670 M$=R$:GOSUB 27920:NR=N
27680 NN=INT(NUMBYTES/90)+1:IF INT(NU
      MBYTES/90)=NUMBYTES/90 THEN NN=
      NN-1
27690 NUMLN=1+NN+NQ+NR:P$=STR$(NUMLN)
      :FOR I=1 TO LEN(P$):P$(I,I)=CHR
      $(VAL(P$(I,I))+176):NEXT I
27700 ? :? "4)Now scan your program l
      isting to{6 SPACES}determine an
       area where ";P$;
27710 ? " statement{3 SPACES}lines ca
      n be inserted."
27712 ? "  Select an insertion point
      near the{4 SPACES}beginning of
      the program."
27715 ? :? "  Type CONT to resume pro
      gram ":STOP
27720 ? "  Enter the FIRST  stateme
      nt  line{4 SPACES}number for th
      is insertion ";:INPUT LN
27730 ? :? "5)Next determine number f
      or LAST state  ment line of mod
```

```
        ified program - then  type CONT
        .":STOP
27732 ? "  Enter number for LAST line
        ";:INPUT LL
27790 GOTO 29000
27800 P$=STR$(P):ON LEN(P$) GOTO 2781
        0,27820,27830
27810 P$(LEN(P$)+1)="  ":GOTO 27830
27820 P$(LEN(P$)+1)=" "
27830 RETURN
27920 IF INT(LEN(M$)/9)=LEN(M$)/9 THE
        N N=LEN(M$)/9:GOTO 27940
27930 N=INT(LEN(M$)/9)+1
27940 RETURN
28000 REM ADD STATEMENT LINES THAT CO
        NTAIN CHR$(34) (QUOTATION MARK
        CODE).
28050 SETCOLOR 2,0,0:? CHR$(125):POSI
        TION 2,2:? M$:? :? :? "CONT":PO
        SITION 0,0:POKE 842,13:STOP
28100 POKE 842,12:RETURN
29000 REM ADD DIMENION LINE DEFINING
        LENGTH AS EQUAL TO THE NUMBER O
        F MACHINE CODE BYTES.
29100 M$=STR$(LN):M$(LEN(M$)+1)="DIM
        ML$(":M$(LEN(M$)+1)=STR$(NUMBYT
        ES):M$(LEN(M$)+1)=")":LN=LN+1:G
        OSUB 28000
29150 REM ADDING STATEMENT LINE(S) CO
        NTAINING 'STRINGS' OF MACHINE C
        ODE.
29170 JM=NUMBYTES/90:IF INT(NUMBYTES/
        90)=NUMBYTES/90 THEN JM=JM-1
29180 FOR J=0 TO JM
29190 SETCOLOR 2,0,0:? CHR$(125):POSI
        TION 2,2
29210 A=90*J+1:B=A+89:IF B>NUMBYTES T
        HEN B=NUMBYTES
29220 ? J+LN;"ML$(";A;",";B;")=";CHR$
        (34);
29230 FOR I=A TO B:? CHR$(27);ML$(I,I
        );:NEXT I
29260 ? CHR$(34):? :? :? "CONT":POSIT
        ION 0,0:POKE 842,13:STOP
29270 POKE 842,12:NEXT J
29300 REM REPLACING 34'S AND 155'S
29330 IF LEN(Q$)=0 AND LEN(R$)=0 THEN
         29900
29335 QQ=34:T=1
29340 IF LEN(Q$)<>0 AND LEN(R$)=0 THE
        N 29400
29350 IF LEN(Q$)<>0 AND LEN(R$)<>0 TH
        EN T=2:GOTO 29400
29360 IF LEN(Q$)=0 AND LEN(R$)<>0 THE
        N QQ=155:Q$=R$
29400 L=0:XM=LEN(Q$)/3
29420 L=L+1:M$=STR$(LN+J+L-1):M$(LEN(
        M$)+1)="ML$("
29440 IF XM>2 THEN A=LEN(Q$)/3-XM+1:B
        =A+2:XM=XM-3:GOTO 29520
29460 IF XM>0 THEN A=LEN(Q$)/3-XM+1:B
        =LEN(Q$)/3:XM=0:GOTO 29520
29500 GOTO 29800
29520 FOR X=A TO B
29550 M$(LEN(M$)+1)=Q$(3*X-2,3*X):M$(
        LEN(M$)+1)=",":M$(LEN(M$)+1)=Q$
        (3*X-2,3*X):M$(LEN(M$)+1)=")="
29560 M$(LEN(M$)+1)="CHR$(":M$(LEN(M$
        )+1)=STR$(QQ):M$(LEN(M$)+1)=")"
29570 M$(LEN(M$)+1)=":ML$(":NEXT X
29600 M$=M$(1,LEN(M$)-5):GOSUB 28000
29650 IF XM>0 THEN 29420
29800 IF T=2 THEN T=0:QQ=155:Q$=R$:LN
        =LN+NQ:GOTO 29400
29900 ? :? "Now  LISTing  modified  v
        ersion  of{3 SPACES}PROGRAM 1 t
        o disk as D:PROGRAM3.LST"
29910 LIST "D:PROGRAM3.LST",2,LL
```

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The Expanded/ Unexpanded VIC

Gary L. Engstrom

As more and more VIC owners add expansion memory to their computers, there is an increasing need for programs which run on all VICs, of any memory size. Here's how to write them.

The "where's my memory located now" problem can be overcome by careful programming. With or without an 8K or 16K VIC RAM expansion in place, you should be able to run any of your own programs that require 3.58K or less of RAM. Of course, you will have to put up with removing and installing the expansion cartridge when using programs written by others, but you can have the convenience of universal VIC programs you write yourself.

For programs to be universal, they need to fulfill three requirements:

1. The program must not need more than 3.58K of memory. You just cannot squeeze more than that into the unexpanded VIC-20.

2. The program must contain memory location information for both the expanded and unexpanded VIC-20.

3. The program must be able to determine if expansion is in place and be able to choose between the two sets of memory locations.

To understand how a program can conform to these last two requirements, you need to understand that when the VIC-20 is turned on, its operating system goes through an initialization procedure. During initialization, one of the tasks that the operating system does is check to see if memory expansion is in place.

If so, the operating system sets certain pointers to one set of memory locations; if there is no memory expansion, these pointers are set to a different set of memory locations. If you have 8K or 16K RAM memory expansion for your VIC-20, you should be familiar with three of these memory locations (see the table below). The computer uses the correct locations because, during initialization, pointers are set to the correct locations. It is the knowledge of the alternate memory locations and the existence of these pointers that make universal programs possible.

Table 1.

	Unexpanded	Expanded
Screen Memory	7680-8191	4096-4607
Color RAM	38400-38911	37888-38399
User BASIC Area	4096-7679	4608- *
	*The end of user BASIC Area in an expanded VIC-20 depends on the size of the expansion memory.	

Establish Alternate Values

Memory locations used as pointers can be used by a BASIC program to run on either an expanded or an unexpanded VIC-20. I chose memory location 43-44 ($002B-$002C), the pointer to the start of the BASIC program in memory. When the VIC-20 is not expanded, the decimal value of the high bit (location 44) is 16; when the VIC-20 is expanded, the decimal value of the high bit is 18.

This gives us enough information (using a PEEK statement) to create two paths for alternate memory values in a BASIC program. Thus we can assign the values for the beginning of screen memory and of color RAM for the expanded and unexpanded VIC-20 (see Program 1).

Program 1: Alternate Values

```
10 PRINT "[CLR]" : REM *SET ALTERNATE VALUES*

20 IF PEEK (44)=18 GOTO 70: IF MEMORY IS IN P
   LACE
30 SM=7680 : REM SCREEN MEMORY FOR UNEXPANDED
    VIC
40 CM=38400 : REM COLOR MEMORY FOR THE UNEXPA
    NDED VIC
50 CS2=242 : REM CHARACTER SET 2 POINTER FOR ~
   THE UNEXPANDED VIC
60 GOTO 110 : REM SKIP
70 SM=4096 : REM SCREEN MEMORY FOR THE EXPAND
    ED VIC
80 CM=37888 : REM COLOR MEMORY FOR THE EXPAND
    ED VIC
90 CS2=194 : REM CHARACTER SET 2 POINTER FOR ~
   THE EXPANDED VIC.
```

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You might have noticed that I threw in an extra value. If you want to POKE characters from Character Set 2 to the screen, you have to POKE the character set pointer to the alternate set. The character set pointer is at memory location 36869. I have included the character set pointer value to demonstrate that you might want to use other alternate values in some of your programs.

Enter Common Values

After the alternate values have been set, you can set the values that are common to both the expanded and unexpanded VIC-20 (see Program 2). Of course, if you are not going to use a particular value, it can be left out.

Program 2: Common Values

```
100 REM *SET COMMON VALUES*
110 SB=36879 : REM SCREEN/BOARDER COLOR
120 V=36878 : REM VOLUME
130 S1=36874 : REM SPEAKER 1
140 S2=36875 : REM SPEAKER 2
150 S3=36876 : REM SPEAKER 3
160 S4=36877 : REM SPEAKER 4
```

Another benefit of using this method is that you don't have to constantly look up these memory locations or reenter these numbers each time you are going to use them. Every time you can avoid reentering a number, you are avoiding the possibility of an entry error.

Crunch And Save

Program 3 is a "crunched" version of Programs 1 and 2. Enter Program 3, then SAVE and VERIFY it on tape. Every time you start a new program, LOAD these four lines before you start to enter your own listing. When you write your program, start with line 100. Lines 50-90 can be used for defining variables and constants for your program.

Program 3: Lines 10 to 160 "Crunched"

```
10 PRINT"[CLR]":IFPEEK(44)=18GOTO30
20 SM=7680:CM=38400:CS2=242:GOTO40
30 SM=4096:CM=37888:CS2=194
40 SB=36879:V=36878:S1=36874:S2=36875:S3=3687
   6:S4=36877
```

Try It Out

When all the values have been set, you can start to create your program. Program 4 is a short program that you can enter to demonstrate the flexibility of Program 3.

Program 4: Demonstration Program

```
100 REM *DEMONSTRATION PROGRAM*
110 POKE SB,120 : REM SET YELLOW SCREEN AND BL
    ACK BOARDER
120 POKE 36869,CS2 : REM POINT TO CHARACTER SE
    T 2
130 SS=INT(RND(1)*128)+128 : REM RANDOM VALUE
```

```
     FOR SPEAKER
140 CV=INT(RND(1)*8) : REM RANDOM COLOR VALUE
150 VS=INT(RND(1)*15)+1 : REM RANDOM VALUE FOR
      VOLUME
160 X= INT(RND(1)*22) : REM RANDOM VALUE FOR X
      COORDINATE
170 Y=INT(RND(1)*23) : REM RANDOM VALUE FOR Y ~
     COORDINATE
180 POKE SM+X+22*Y,95 : REM POKE CHARACTER TO ~
     SCREEN
190 POKE CM+X+22*Y,CV : REM POKE COLOR TO SCRE
     EN
200 POKE V,VS : POKE S1,SS : POKE S2,SS : POKE
      S3,SS : POKE S4,SS : REM SOUND
210 FOR T=1 TO 10 : NEXT T : REM PAUSE
220 GOTO 130 : REM REPEAT
```

Once you have entered Programs 3 and 4, SAVE and VERIFY the resulting program. Then, try it on both your expanded and unexpanded VIC-20. (Don't forget to turn the computer off before installing and removing the memory expander.) The program will adjust to the correct alternate set of values and work correctly with either configuration.

Practice POKEing

Using labels in place of actual numbers for POKEing might be confusing at first. However, once you get used to the labels, programming will be quicker and more accurate. To help you make the transition, I will explain two ways that labels can be used to POKE color and characters to the screen.

Method 1: X/Y Coordinates

The X/Y coordinate method for POKEing characters to the screen takes advantage of the 22 columns and 23 rows of the VIC-20 screen. Refer to the chart below. The 22 columns are labeled X and are numbered 0 to 21; the 23 rows are labeled Y and numbered 0 to 22. All of the screen locations can be identified by column (X) and row (Y). For example, the center of the screen is at X=11 and Y=11; the lower left-hand corner is at X=0 and Y=22. To POKE characters to the screen, you

Table 2: Memory Map

X=	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Y=0	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
2	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65
3	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87
4	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109
5	110	111	112	113	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128	129	130	131
6	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153
7	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175
8	176	177	178	179	180	181	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197
9	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218	219
10	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241
11	242	243	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263
12	264	265	266	267	268	269	270	271	272	273	274	275	276	277	278	279	280	281	282	283	284	285
13	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304	305	306	307
14	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329
15	330	331	332	333	334	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351
16	352	353	354	355	356	357	358	359	360	361	362	363	364	365	366	367	368	369	370	371	372	373
17	374	375	376	377	378	379	380	381	382	383	384	385	386	387	388	389	390	391	392	393	394	395
18	396	397	398	399	400	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417
19	418	419	420	421	422	423	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439
20	440	441	442	443	444	445	446	447	448	449	450	451	452	453	454	455	456	457	458	459	460	461
21	462	463	464	465	466	467	468	469	470	471	472	473	474	475	476	477	478	479	480	481	482	483
22	484	485	486	487	488	489	490	491	492	493	494	495	496	497	498	499	500	501	502	503	504	505

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must use the following formula: POKE SM + X + 22 * Y,N where SM = 7680 for the unexpanded VIC-20, SM = 4096 for the expanded VIC-20, and N is the character code.

You can POKE color to the screen in the same way: POKE CM + X + 22 * Y,N where CM = 38400 for the unexpanded VIC-20, CM = 37888 for the expanded VIC-20, and N is the color code.

LOAD Program 3 and then enter the following POKE statements (Program 5).

Program 5: X/Y Coordinate Practice

```
100 X=0 : Y=0 : REM SET VALUES FOR X AND Y
110 POKE SM+X+22*Y,81 : POKE CM+X+22*Y,6 : REM
    BLUE BALL--UPPER LEFT
120 X=21 : Y=0 : REM SET VALUES FOR X AND Y
130 POKE SM+X+22*Y,83 : POKE CM+X+22*Y,2 : REM
    RED HEART--UPPER RIGHT
140 X=11 : Y=11 : REM SET VALUES FOR X AND Y
150 POKE SM+X+22*Y,90 : POKE CM+X+22*Y,0 : REM
    BLACK DIAMOND--CENTER
160 X=0 : Y=22 : REM SET VALUES FOR X AND Y
170 POKE SM+X+22*Y,65 : POKE CM+X+22*Y,4 : REM
    PURPLE SPADE--LOWER LEFT
180 X=21 : Y=22 : REM SET VALUES FOR X AND Y
190 POKE SM+X+22*Y,88 : POKE CM+X+22*Y,5 : REM
    GREEN CLOVER--LOWER RIGHT
```

To make a character move on the screen, add a +1 to the value of X for right movement, add a -1 to the value of X for left movement, add a +1 to the value of Y for down movement, and add a -1 to the value of Y for upward movement. The limits of the screen are defined by X = 0 to 21 and Y = 0 to 22. Experiment by changing the values for X and Y in Program 5.

Method 2: Direct Method

There are 506 screen locations for both color and characters. The first location is SM (for Screen Memory) and CM (for Color Memory). The first location is the upper left-hand corner of the screen. The second location is to the right of the first location and has a value of SM + 1 (for character placement) or CM + 1 (for color placement).

We can continue to add values to the labels until we are at the bottom right-hand corner of the screen, where the values are SM + 505 and CM + 505. Therefore, any position on the screen can be addressed by adding the values of 0 through 505 to the labels SM or CM (see the memory map). LOAD the Alternate Values Listing (Program 3) and then enter the following practice POKE statements (Program 6).

Program 6: Memory Location Practice

```
100 POKE SM+0,81 : POKE CM,6 : REM BLUE BALL--
    UPPER LEFT-HAND CORNER
110 POKE SM+21,83 : POKE CM+21,2 : REM RED HEA
    RT--UPPER RIGHT-HAND CORNER
120 POKE SM+253,90 : POKE CM+253,0 : REM BLACK
     DIAMOND--CENTER
130 POKE SM+484,65 : POKE CM+484,4 : REM PURPL
```

```
   E SPACE--LOWER LEFT-HAND CORNER
14Ø POKE SM+5Ø5,88 : POKE CM+5Ø5,5 : REM GREEN
    CLOVER--LOWER RIGHT-HAND CORNER
```

To make a character move on the screen, add a +1 for right movement, add a -1 for left movement, add a +22 for down movement, and add a -22 for upward movement. The limits of the screen are defined by SM+505 and SM (for character placement) and CM+505 and CM (for color placement). Experiment by changing the values added to SM and CM in Program 6.

To demonstrate how the direct method works in a program, replace lines 260 through 290 in Program 4 with the following lines (Program 7).

Replace lines 260 through 290 in Program Listing 3 with the following lines:

Program 7: Alternate To Program 3

```
26Ø M=INT(RND(1)*5Ø5) : REM RANDOM SELECTION O
   F MOVEMENT
28Ø POKE SM+M,95 : REM POKE CHARACTER TO SCREE
   N
29Ø POKE CM+M,CV : REM POKE COLOR TO SCREEN
```

Which Method Is Best?

At this point you may be wondering which method for POKEing should be used. Each method has its place, depending on the requirements of your program. Generally, the direct method requires fewer commands for some applications and runs faster than the X/Y coordinate method. However, it is much easier to define complex screen boundaries using the X/Y coordinate method.

For example, let's place a five-character by five-character square on the screen. We'll use the X/Y coordinate method to place a square in the center of the screen, and the direct method to place a square in the lower left-hand corner. LOAD Program 4 and then enter Program 8.

Program 8.

```
1ØØ REM X/Y COORDINATE METHOD
11Ø FOR X=9 TO 13 : FOR Y=9 TO 13 : REM SET VA
   LUES OF X AND Y
12Ø POKE SM+X+22*Y,16Ø : POKE CM+X+22*Y,8 : RE
   M POKE CHARACTER AND COLOR
13Ø NEXT Y : NEXT X : REPEAT
14Ø REM DIRECT METHOD
15Ø L=396 : REM BEGINNING VALUE OF M
16Ø FOR M=L TO L+4 : REM RANGE OF M FOR ONE LI
   NE
17Ø POKE SM+M,16Ø : POKE CM+M,8 REM POKE CHARA
   CTER AND COLOR FOR ONE LINE
18Ø NEXT M : REM REPEAT TO END OF LINE
19Ø L=L+22 : IF L>488 THEN END : IF AT END OF
   LAST LINE END
2ØØ GOTO16Ø: REPEAT
```

When RUNning this program, you might have noticed that the second square was printed a little faster than the first one. In applications where speed is important, it is useful to know that the direct method does run quite a bit faster than the X/Y coordinate method.

This can be best illustrated by Program 9. In this program, the entire screen is filled with characters by using both methods. An added feature is that each segment of the program is timed by the VIC-20 built-in timer. LOAD Program 4 and then enter the following lines:

Program 9: Fill Screen Test

```
1ØØ REM *FILL SCREEN TEST*
11Ø REM FILL SCREEN USING SCREEN MEMORY LOCATI
   ONS
12Ø PRINT "[CLR]" : REM CLEAR SCREEN
13Ø TI$="ØØØØØØ" : REM ZERO TIMER
14Ø FOR J=CM TO CM+5Ø5 : REM SET VALUES FOR CO
   LOR MEMORY
15Ø POKE J,8 : REM POKE COLOR
16Ø NEXT J : REM REPEAT
17Ø FOR I=SM TO SM+5Ø5 : REM SET VALUES FOR SC
   REEN MEMORY
18Ø POKE I,16Ø : REM POKE CHARACTER
19Ø NEXT I : REM REPEAT
2ØØ T1$ = TI$ : RECORD TIME
21Ø REM FILL SCREEN USING X/Y COORDINATES
22Ø PRINT "[CLR]" : REM CLEAR SCREEN
23Ø TI$="ØØØØØØ" : REM ZERO TIMER
24Ø FOR Y=Ø TO 22 : FOR X=Ø TO 21 : SET VALUES
    FOR X AND Y
25Ø POKE CM+X+22*Y,8 : REM POKE COLOR
26Ø POKE SM+X+22*Y,16Ø : REM POKE CHARACTER
27Ø NEXT X : NEXT Y : REPEAT
28Ø T2$=TI$ : REM RECORD TIME
29Ø PRINT "[CLR]" : CLEAR SCREEN AND PRINT RES
   ULTS
3ØØ POKE SB,157 : REM CHANGE SCREEN AND BORDER
    COLOR
31Ø PRINT "DIRECT METHOD   "T1$ : REM PRINT TI
   ME
32Ø PRINT "X/Y COORDINATES "T2$ : REM PRINT TI
   ME
33Ø END
```

As you can see, the direct method RUNs about twice as fast as the X/Y coordinate method. If you are writing a program using a lot of POKEs, you might consider using the direct method wherever possible. This will help to speed up your program. However, the X/Y coordinate method remains the most useful when defining complex screen boundaries.

By using alternate values for screen memory and color memory, you are not only able to POKE characters and colors to the screen easily and accurately, but you will also be able to run your programs (3.58K or less) with or without your 8K or 16K expansion cartridge. ©

Left-handed Atari Joysticks

P. E. Thompson

If you're left-handed, ordinary joysticks are awkward to use. A simple adjustment (all you need is a screwdriver) can fix them.

Several of my friends and family members are left-handed and have complained vociferously about the "right-handed" Atari joysticks. They are especially frustrated when trying to control the spaceship with the left hand, fire at the Zylons with the right hand, and firmly hold the joystick with the other hand (try it sometime, you right-handers!). As the proud owner of the computer which is causing this distress, I am the one who is expected to answer the question, "If you're so smart, why can't you make this thing work right?"

If you, as a right-hander, hold the joystick in the right-handed position (i.e., top away from you), you will see that the fire button is located on the left-hand side. In order to satisfy left-handers, the fire button must be on the right-hand side, which means that the directions of the joystick motions must be rotated as follows:

Direction	Becomes
Forward	Right
Backward	Left
Right	Backward
Left	Forward

In other words, if you hold a hypothetical left-handed joystick the right-handed way, then when the joystick is pushed for the forward direction, movement would be to the right. Similarly, the directions would change for all other motions.

Before tackling this seemingly simple task of creating a left-handed joystick, I realized that two obstacles stood in the way of possible solutions:

1) A software patch was impossible since my knowledge of assembly language programming can't get past my confusion as to the difference between a bit, a byte, and a nybble.

2) Any sort of hardware fix was impossible since my soldering ability is limited.

At this point, I decided to make do. I took the joystick apart, hoping to figure out some way of rearranging its mechanism, and was indeed able to convert it for left-handed use.

Before starting, make sure that the joystick is disconnected from the computer and then remove the four screws in the bottom which hold it all together.

Once the screws are removed, place the base on a table and carefully lift off the top. (See Figure 1.) Now set aside the pieces of the fire button (the red button and a spring) in a container. The wires inside are attached by slip-on connectors and you can slip them off and on without damaging anything.

Notice that on each side of the circuit board with silver dots are three wires. The left side wires are ORG (orange), WHT (white), and GRN (green), while the right side wires are BRN (brown), BLU (blue), and BLK (black). This color coding of the wires and the circuit board with silver dots is a fortunate feature of the Atari joystick because it provides the guide to proper (right-hand) reassembly of the joystick. After you have connected the wires according to the arrangement shown in Figure 2, the joystick becomes left-handed.

Finally, reassemble the joystick in the reverse order in which it was taken apart. Here's how:

1) Hold the top of the joystick upside down. The top is the part with the stick.

2) Place the red fire button into its hole in the top. It's easy to see that the fire button goes in upside down too, since that's the only way it fits.

3) Put the spring onto the post in the center of the fire button. Make sure that the spring is completely clean of any dust it may have accumulated since it was removed. In this case, the spring doesn't have an upside down since it's the same on both ends.

4) Be sure that all the connectors are firmly attached to the circuit board with silver dots.

5) Lay the circuit board into the top so that the two posts in the top come through the hole in the board. Top and bottom are easy to determine since these pieces fit only one way.

6) Fit the bottom onto the rest of the assembly. Be careful that the wires are not between the circuit board with silver dots and the posts for the mounting screws. These parts also fit together only one way.

Figure 1.

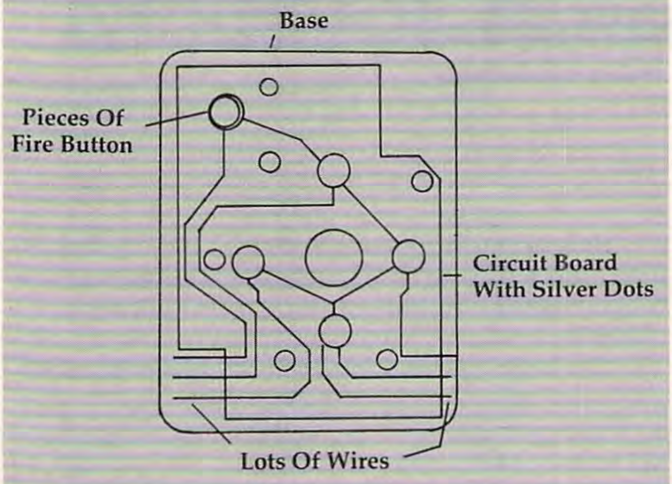
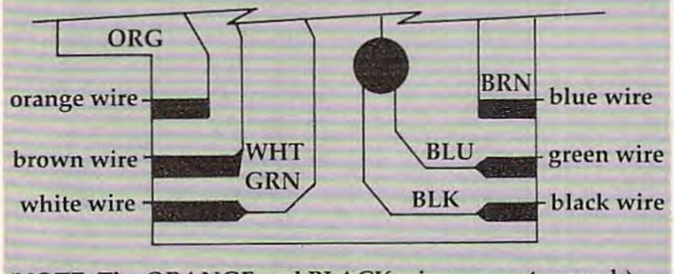


Figure 2.



(NOTE: The ORANGE and BLACK wires are not moved.)

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Beginners: See special program typing instructions on page 249.

UFO Pilot:

VIC Custom Characters For Game Graphics

Bud Banis

The current high score in the game "UFO Pilot" is 3411. While seeing if you can top that, you also have the opportunity to learn a good deal about using the VIC "multicolor mode" in your own games.

Commodore's VIC-20 has outstanding color graphics capabilities. However, the unexpanded machine has limited memory to take advantage of these capabilities, and the average computerist who is trying to justify "buying more than a video game" has to provide his family with a reasonable amount of entertainment without buying a lot of expensive memory expansion.

Two options have been offered for designing game graphics characters:

1. The Commodore graphics keys can be used to build multiple space characters. These take up a lot of space and are cumbersome to move around.

2. Custom characters can be drawn if you're willing to give up valuable RAM instead of taking existing characters from ROM. Basically, whole sets of characters are moved from ROM to RAM, and then some of the characters can be redefined by a series of POKEs to RAM. Because the pointer indicating the start of character memory has to be reset (36869), this is an all or nothing process. Any standard characters you want to use must also be relocated from ROM to RAM.

As an alternative, some perfectly acceptable single space characters can be created from standard characters in ROM just by POKEing their screen locations into multicolor mode. This approach uses no memory and gives a wide variety of "new" characters (about four million) to choose from.

This article describes the use of multicolor mode in detail, includes a program to find interesting characters, and concludes with a game demonstrating the technique.

How Characters Are Stored

In order to explain multicolor mode, it's important to first describe how characters are formed on the screen in the first place. The *VIC-20 Programmer's Reference Guide* (pp. 82-94) has several errors in its description of this process.

Characters are stored in memory as an 8x8 grid of dots. Each dot (bit) is turned either "on" or "off." Each eight-bit line (byte) can be represented by a number which uniquely turns some bits "on" and others "off." Each bit is represented by a number which is a power of two if "on" or by zero if "off." The value assigned to the byte is the sum of the values of its eight bits.

bit number	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
value of 2^N	**128**	**64**	**32**	**16**	**8**	**4**	**2**	**1**

Thus, if only bit zero is "on," the value of the byte is $2^0=1$. If only bit four is "on," the value of the byte is $2^4=16$. If bits zero and four are both "on" and all the others are "off," then the value of the byte is 2^0 and $2^4=1+16=17$. If all eight bits are "on," then the value of the byte is $128+64+32+16+8+4+2+1=255$. A whole character takes eight lines or eight bytes of memory. For example, the letter A is:

bit no.	7	6	5	4	3	2	1	0	value of byte
byte 1	0	0	0	1	1	0	0	0	$2^4+2^3=24$
2	0	0	1	0	0	1	0	0	$2^5+2^2=36$
3	0	1	0	0	0	0	1	0	$2^6+2^1=66$
4	0	1	1	1	1	1	1	0	$2^6+2^5+2^4+2^3 \quad +2^2+2^1=126$
5	0	1	0	0	0	0	1	0	$2^6+2^1=66$
6	0	1	0	0	0	0	1	0	$2^6+2^1=66$
7	0	1	0	0	0	0	1	0	$2^6+2^1=66$
7	0	0	0	0	0	0	0	0	0

Custom characters can be stored in RAM locations by POKEing the desired values into the individual memory locations (bytes).

The unexpanded VIC-20 has room for 5000

bytes in RAM or about 3.6 thousand (K) bytes user available RAM after buffers and screen memories, etc., are allocated. Since each character takes up eight bytes, moving 64 characters from ROM to RAM, available for use or modification in the custom character mode, uses 64 * 8 = 512 bytes of RAM and makes it unavailable for other uses.

Multicolor Mode

Storing multicolor characters. In multicolor mode, characters are stored in the same way, but bits are read two at a time to specify one of four colors in a two-dot space. Taking two bits at a time allows four possibilities, as opposed to the two ("on" or "off") when bits are taken one at a time.

bit pair	colors selected	memory location (POKE)
00	16 background colors	36879, bits 4-7
10	8 character colors	38400-38911, bits 0-2
01	8 border colors	36879, bits 0-2
11	16 auxiliary colors	36878, bits 4-7

Thus, if you were custom designing a flag with alternating background color and border color stripes, a character color square in the upper left-hand corner, and an auxiliary color pole, the stored data might look something like this:

	bit pairs	value of byte (POKE)
byte	1 (10) (10) (01) (01)	128+32+4+1=165
	2 (10) (10) (00) (00)	128+32=160
	3 (10) (10) (01) (01)	128+32+4+1=165
	4 (00) (00) (00) (00)	0
	5 (01) (01) (01) (01)	64+16+4+2=86
	6 (11) (00) (00) (00)	128+64=192
	7 (11) (00) (00) (00)	128+64=192
	8 (11) (00) (00) (00)	128+64=192

This character wouldn't be very interpretable in ordinary, single color, mode.

Once a character is stored in memory in this way, in order to print it on screen in its full multicolor glory, we need to first specify multicolor mode in that screen location, then choose the appropriate colors for border, background, character, and auxiliary use. By POKEing these other reference locations, we can make substantial changes in the character. For example, if the auxiliary color is the same as the background color, the flagpole disappears.

Selecting Colors

Specifying colors is a little more complicated than just POKEing a number into a memory location (byte). The reason is that the color codes use only specific bits, and the rest of the bits in the byte are used for something else. For example, the auxiliary color code uses only bits 4-7 in memory location 36878. The other four bits (0-3) are used for setting volume on the sound. Selection of multicolor mode for a given screen location involves turning on a single bit in the memory for that space on the screen. The other bits hold other information.

Choosing Border and Background Colors

By now, you should be pretty well versed in this operation, and you have probably tried some of the combinations listed in Appendix E (p. 134) of the book that came with your VIC. It seems simple enough – POKEing a number out of the table into memory location 36879 gives you the indicated combination of screen and border colors. Actually, byte 36879 specifies three things which could be referenced independently.

Border colors are specified by bits 0-2. The decimal translation is values 0-7, to give eight possible choices (0 is all "off," 7 is all "on"): 0 is black, 1 is white, 2 is red, etc., in the same sequence as the color keys. Bits 4-7 specify background, or screen, colors. The values associated with these bits are multiples of 16. For example, if bit four is turned "on," its decimal value is $2^4 = 16$; if all four bits 4-7 are turned "on," the combined decimal value of these bits is $2^4 + 2^5 + 2^6 + 2^7 = 16 + 32 + 64 + 128 = 240$.

A little fooling with the numbers should convince you that these four bits can give you any multiple of 16 from 0 * 16 to 15 * 16, or 16 possibilities. This corresponds to the 16 choices of screen color in the order listed in Appendix E of the book *Personal Computing on the VIC-20* (p. 134). Casual inspection of this table reveals that some possible values are not listed – for example, 0-7, 16-23, etc. The lowest value listed is 8. What this means is that bit number three, decimal value $2^3 = 8$, is always "on" when one of the values in the table is used. If you POKE 36879, X, where X is a value not in the table, bit three is turned "off," and the screen is put in the *inverted* mode, which makes all the printing appear in the reverse.

Thus, byte 36879 contains three separate memory references: bits 0-2 for border color (eight colors); bit 3 for inverted mode (when "off"); and bits 4-7 for screen color (16 colors from 0 * 16 to 15 * 16).

Setting Character Color And Selecting Multicolor Mode

Character color is specified separately for each location on the screen (see pp. 143-144 in *Personal Computing on the VIC-20*) or can be specified before printing a series of characters by using the control color keys. Character color is specified separately for each screen location by POKEing locations between 38400 and 38905 with values from 0-7 to give the familiar sequence of black to yellow character colors (eight choices). Values from 0-7 represent bits 0-2.

If bit three is turned "on," i.e., values from 8 to 15 are used instead of 0-7, the screen location is put into multicolor mode and the bits are evaluated two at a time to give the results described above

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VIC-20® is a registered trademark of Commodore under "Storing multicolor characters." In multicolor mode, the character color code is (value-8). For example, POKE 38400, 8 puts the first space into multicolor mode with character color black (0). POKE 38422,15 puts the twenty-second space (first space, second row) into multicolor mode with character color yellow (7).

Bits 4-7 are used for something else which is not clear from the manuals. Randomly POKEing these bits eventually gives peculiar results such as "out of memory" errors. This can be avoided by ANDing POKEs with 15.

Boolean Operators

There is a way to read and write to specific bits within a byte without disturbing other bits which might carry other information. Unless you've been exposed to set theory before, the action of Boolean operators OR and AND may seem strange. These operators are used to combine information from two sets.

When AND is used, the result includes only that information which is included in *both* sets. For example, if all eight bits in a byte were turned "on," the decimal value of that byte would be 255. If another byte had only the first four bits turned "on," its decimal value would be 15. The result from ANDing bytes one and two would have only "on" bits that were "on" in *both* sets. This gives the peculiar result that 255 AND 15=15.

If you wanted to know the status of only a single bit, you could screen out extraneous information by ANDing with the decimal value for that bit: PRINT PEEK (38400) AND 8 would return 8 if the third bit is "on" or 0 if the third bit is "off." The status of other bits doesn't matter.

The OR operator combines sets so that the result includes all bits "on" which were "on" in *either* set. Thus, 255 OR 15=255; 248 OR 15=255. These operators can be used to POKE a given bit "on" or "off" without disturbing other information in the byte. For example, suppose we wanted to POKE bit three (decimal value 8) in 38400 "on." We could do this by POKE 38400, 8 OR PEEK (38400). To turn bit three "off," POKE 38400, 247 AND PEEK (38400). 247 is the decimal value for a byte with all bits "on" except for bit three.

Setting Auxiliary Color

The fourth color available in multicolor mode is called auxiliary color, and is set by POKEing values into the upper four bits of memory location 36878. The lower four bits are used to set volume on the sound. There are 16 colors available, in the same order as the 16 screen colors. As with the screen colors, values POKEd into the upper four bits are multiples of 16.

For example, POKE 36878, 1 * 16 sets auxiliary color white; POKE 36878, 15 * 16 sets auxiliary color light yellow. These POKEs would also set sound volume to 0. If you wanted to set auxiliary color red at the same time as keeping volume at the maximum, 15, you could POKE 36878, 15+2 * 16, or, to leave the sound volume alone, use the Boolean operators: POKE 36878, 2 * 16 OR (PEEK (36878) AND 15).

Sampler – A Program To Find Interesting Characters

Given the above detail on multicolor mode, the first program listing, "Sampler," should be self-explanatory. Ten characters are displayed, with the middle eight in multicolor mode to show the range of character colors. The cursor keys can be used to look at the next or previous characters. Cursor down and cursor up act as "fast forward" and "fast reverse," respectively. Cursor right and cursor left can also be used to give a time delay (lines 70 and 90) in the display before changing characters.

After finding an interesting character, press F1 to explore the effects of the 128 different combinations of screen and border colors. The space bar allows a rapid perusal. F3 gives another dimension, again using the space bar (or "any key") to run through the 16 available auxiliary colors. To look at character set 2 (*Personal Computing on the VIC-20*, Appendix H, pp. 139-142), press the SHIFT and COMMODORE keys simultaneously.

Including reverse mode and both character sets, there are about 255 characters which can be modified through use of multicolor mode. With 8 border colors, 16 screen colors, 8 character colors and 16 auxiliary colors, the number of combinations for your selection is roughly 255 * 8 * 16 * 8 * 16 or about four *million* "new" characters to choose from!

UFO Pilot – A Game Demonstrating Multicolor Mode Graphics

Having progressed through the theory to empirical selection, it seems logical to come to the point of this article. "UFO Pilot" is a game demonstrating the use of multicolor mode to make "new" game graphic characters. The program uses about 2K RAM and the only expansion required is a $9 Atari joystick.

Character 88 (the club) is transformed to a multicolor UFO which you pilot using the joystick. The objective is to achieve the longest flight without running into your own trail of white dots or the warplane (character 62) that's in constant pursuit. A collision results in an explosion (character 42 taken through a series of character color changes in lines 9500-9510) and a return to the demonstration mode at the beginning of the program.

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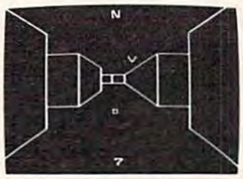

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can watch this display run through all the possible color combinations. The pause in midscreen in which the UFO "flashes its lights" is a demonstration of changing auxiliary colors (line 10). Otherwise, auxiliary color 0 (black) is used throughout the game – specified by POKE 36878, 15 (high volume). If the demonstration mode begins to wear on you and you want to concentrate on the game, change line 9530 to GOTO19.

Fortunately, the warplane erases dots to keep the screen less cluttered and to make higher scores possible. After a few months of high scores in the range of 200-400, my wife discovered a pattern giving the current high of 3411.

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Program 1.

```
2 PRINT"{CLEAR}SAMPLER,SHOWS SOME      STANDA
    RD CHARACTERS      IN MULTICOLOR MODE."
4 PRINT:PRINT"USE THE CURSOR KEYS    TO CHANG
    E CHARACTERS, F1,F3 TO CHANGE COLORS
6 PRINT:PRINT"HIT A KEY"
8 GETC$:IFC$=""THEN8
10 N=0:GOTO130
20 GETC$:IFC$=CHR$(17)THEN80
30 IFC$=CHR$(29)THEN70
40 IFC$=CHR$(145)THEN100
50 IFC$=CHR$(157)THEN90
55 IFC$=CHR$(133)THEN400
57 IFC$=CHR$(134)THENGOSUB600
60 GOTO20
70 FORTT=1TO300:NEXT
80 N=N+1:IFN=256THEN10
85 GOTO130
90 FORTT=1TO300:NEXT
100 N=N-1:IFN=-1THEN10
110 GOTO130
130 PRINT"{CLEAR}":PRINT
140 FORI=2TO20STEP2
150 POKE7680+22+I,N
160 POKE38400+22+I,((I/2+6)AND15)
170 NEXT
180 PRINT:PRINT"CHARACTER NO.";N
190 PRINT:GOTO20
400 PS=8+16*INT(CC/8)+CS
410 POKE36879,PS:PRINT"{HOME}{05 DOWN}SCREEN C
    OLOR= {LEFT}";PS:PRINT"AUX COLOR=0
    "
420 GETC$:IFC$=""THEN420
430 IFC$=CHR$(134)THENGOSUB600
450 CC=CC+1:CS=CCAND7:IFPS=255THENPOKE36879,27
    :CC=0:CS=0:GOTO20
460 GOTO400
600 FORAN=0TO15
610 POKE36878,16*AN
650 PRINT"{HOME}{05 DOWN}SCREEN COLOR= {LEFT}"
    ;PS:PRINT"AUX COLOR=   {02 LEFT}";AN
660 GETC$:IFC$=""THEN660
670 NEXT:POKE36878,0
680 PRINT"{HOME}{06 DOWN}AUX COLOR=    {02
    LEFT}0"
690 GETC$:IFC$=""THEN690
700 RETURN
```


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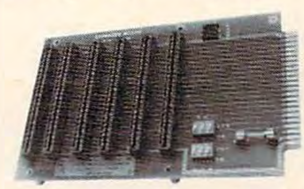

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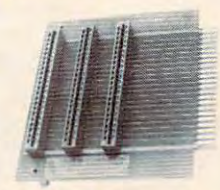

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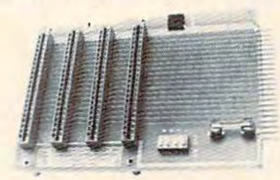

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Program 2.

```
1 SS=24:POKE36879,63:POKE36878,15:DIMJS(2,2)
2 PRINT"{CLEAR}":PRINTSPC(5):PRINT"*********
   ****":PRINTSPC(5)
3 PRINT"**{REV}UFO PILOT{OFF}**":PRINTSPC(5)
   "*************":PRINT"     *  7-28-82
   *"
4 PRINTSPC(5):PRINT"*************":PRINT"{DO
   DOWN}      BY BUD BANIS";SPC(8);"BOUR
   BONNAIS,ILL.
5 PRINT"{03 DOWN}  SET DIRECTION OF ":PRINT"
     SHIP WITH THE"
6 POKE37139,0:DD=37154:PA=37137:PB=37152:PRI
   NT"      JOYSTICK"
7 PRINT"{DOWN}  DON'T RUN INTO YOUR":PRINT"
     OWN TRAIL OR HIT"
8 PRINT"      THE WARPLANE.":PRINT"{02 DOWN}
     HIT FIRE TO START
9 FORAA=0TO21:POKE7812+AA,88:POKE38532+AA,9:
   GOSUB9000:IFFRTHEN19
10 IFAA=10THENFORTY=0TO15:POKE36878,15OR16*TY
   :POKE36874,244:FORM=1TO50:NEXT:NEXT
11 POKE36878,15
12 POKE36874,234+AA:POKE36874,0:POKE7812+AA,3
   2:NEXT:CS=SSAND7
13 FORAA=0TO21:POKE7701-AA,60:POKE38421-AA,9:
   POKE7878+AA,62
14 POKE38598+AA,9:GOSUB9000:IFFRTHEN19
15 POKE36874,215:FORTT=1TO40:NEXT:POKE36874,0
   :POKE36875,255-5*AA
16 FORTT=1TO10:NEXT:POKE36875,0:POKE7878+AA,3
   2:POKE7701-AA,32:NEXT
17 PS=8+16*INT(SS/8)+CS:POKE36879,PS:SS=SS+1:
   IFPS=255THENSS=0
18 GOTO9
19 FORI=0TO2:FORJ=0TO2:READJS(J,I):NEXTJ,I
20 FF=505:PRINT"{CLEAR}{REV}
                                    "
22 XX=0:AD=0:GOSUB10000:IFSC>PHTHENPH=SC
24 POKE7680+FF,88:POKE38400+FF,9:GOSUB9000:IF
   JS(X+1,Y+1)=0THEN24
29 SC=0:YY=22:GOSUB10000
30 GOSUB9000:GOSUB8000:QQ=FF:XZ=ZX:ZX=XX+22*Y
   Y
31 PRINT"{HOME}{REV}                    ":PRINT"{
   HOME}{REV}  SCORE=";SC;"  "
32 IFJS(X+1,Y+1)THENAD=JS(X+1,Y+1):POKE36876,
   220
33 POKE36876,0
35 POKE7680+FF,46:POKE38400+FF,1
40 FF=FF+AD:IFFF<44THENFF=QQ:GOTO9500
42 IFPEEK(7680+FF)=62THEN9500
45 IFPEEK(7680+FF)=46THEN9500
46 POKE7680+FF,88:POKE38400+FF,9
47 IFFF=XZTHEN9500
50 IFFF>505THENFF=QQ:GOTO9500
55 BL=(255-INT(ABS(XX+22*YY-FF)/2)OR128)
56 POKE7680+XZ,32:IFPEEK(7680+ZX)=88THEN9500
58 POKE7680+ZX,62:POKE38400+ZX,9
59 POKE36874,BL:POKE36874,0
70 GOTO30
100 DATA-23,-22,-21,-1,0,1,21,22,23
8000 SC=SC+1:XX=XX+1:IFXX=22THENXX=0:YY=INT(FF/
   22)
8020 RETURN
9000 POKEDD,127:S3=-((PEEK(PB)AND128)=0):POKEDD
   ,255
9010 P=PEEK(PA):S1=-((PAND8)=0):S2=((PAND16)=0)
   :SO=((PAND4)=0)
9020 FR=-((PAND32)=0):X=S2+S3:Y=SO+S1:RETURN
9500 POKE36879,138:POKE36877,220:POKE7680+FF,42
   :FORZZ=1TO100
9510 POKE38400+FF,ZZAND15:POKE36878,INT(15-ZZ/7
   ):NEXT:POKE36877,0
9520 XX=0:RESTORE:POKE36879,57:POKE36878,15
9530 GOTO2
10000 PRINT"{HOME}{REV}                    ":PRINT"{
   HOME}{REV}  SCORE=";SC;"  "
10010 PRINT"{HOME}{DOWN}{REV}PREVIOUS HIGH=";PH:
   RETURN
```

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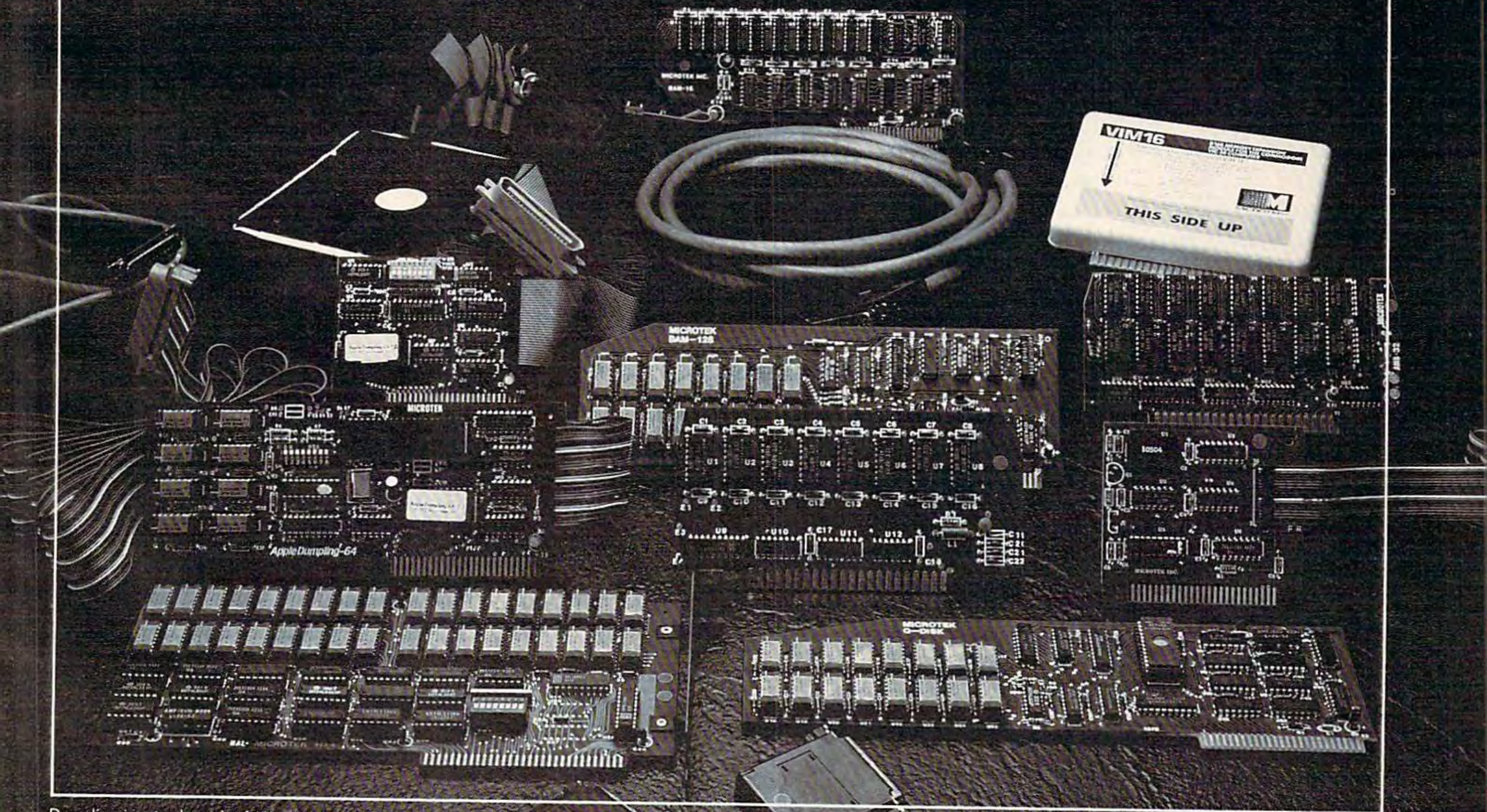

TELECOMMUNICATIONS

Michael Day

Part I:
Communication Errors

Success in transmitting information reliably can depend on the error-checking scheme being used. This is the first of a two-part column which surveys all of the major error-detection methods.

The world of telecommmunications is fraught with danger. Computer data is a very precise form of information that is intolerant of any form of distortion. The computer handles the problem internally by using a form of redundancy that provides for an error potential low enough to be ignored. The environment inside the computer can be controlled, and the data can be actively maintained. The environment outside the computer is much different.

Since little can be done to control the communications environment outside the computer, errors in the transferred data are of much greater concern.

Transmitted data can be distorted in a number of different ways, and the resulting types of errors need to be considered.

Parity Checking

One of these errors is the parity error. A parity error indicates that some portion of the transmitted data is incorrect, but does not say what the error is. The most common parity error check is Vertical Redundancy Checking (VRC). When a character is transmitted, it is sent as a series of on/off bits. When data is transmitted asynchronously, even parity is normally used if VRC is implemented. In even parity, an additional bit is added to the end of each character that is transmitted. If there are an odd number of ON bits in the character, the additional bit is turned ON to make the number of ON bits an even number. If the number of ON data bits is already an even number, then the additional bit will be OFF in order to keep an even number of ON bits.

When data is transmitted synchronously, odd parity is normally used. Odd parity works on the same principle as even parity: the difference is that an odd number of ON bits is desired. Odd parity is used for synchronous transmission to insure that at least one bit in the transmitted character is on, since this helps maintain synchronization in the older modems. (If all the bits of the character were OFF, there would be zero ON bits, an even number. The parity bit would have to be turned ON to make the total count odd.)

Another form of parity checking is the Horizontal Redundancy Check (HRC), sometimes referred to as block parity. HRC is similar to VRC, but, instead of checking vertically through the character, HRC performs a horizontal check through all the characters. Instead of adding up all of the bits on a single character, block parity adds up all of the "1" bits in bit position one of all the transmitted characters. The resulting parity bit forms bit one of the block parity character. (The block parity character is also referred to as the Block Check Character – BCC.) This procedure is repeated for all the bits of the transmitted characters. This form of parity is often implemented along with VRC to obtain a reasonably reliable method of error detection; the two forms complement each other, since each checks for error conditions that the other one ignores.

Spiral Redundancy Check (SRC), a modification of the HRC, adds together successively lower bits of successive characters to form the parity bits. That is, bit one of character one is added to bit two of character two, and so on. Although the SRC is more difficult to implement than the HRC, it more evenly distributes the parity testing throughout the data.

Improved Detection

Interleaving is not a form of parity, but it is a type of transmission used to increase error detection. In interleaving, a group of characters is re-formed: a new character is formed from the one bits of the characters, another one from all of the two bits, and so on until the entire group has been reformed. Normally used with VRC, this method often includes HRC as well.

Two major types of errors in telecommunications are line hits and noise bursts. A line hit disrupts only a single bit or two, but a noise burst disrupts large groups of bits. HRC and VRC can usually detect errors caused by line hits (the most common type of error) but often have difficulty with errors caused by noise bursts.

SRC increases error detection by spreading out the parity checking to cover a wider area of the transmitted data. Transmitted data tends to have rather consistent patterns. Unfortunately, communication errors also tend to occur in patterns. If the two patterns match, the error can often go undetected. Interleaving attempts to decrease undetected errors by purposely randomizing the transmitted data to reduce possible patterns.

VRC, HRC, SRC, and interleaving came to be used as means of error detection because they are easily performed in the hardware that actually does the transmission. The error detectors and parity generators were simply added to existing transmitters and receivers. Because SRC and interleaving are more difficult to do, they are not as common as VRC and HRC.

The HRC implementation is now often not found in the hardware, since the function can be easily done in software. The VRC, however, is very easy to do in hardware but somewhat more difficult in software. As a result, VRC is often provided in the hardware, generally a UART (Universal Asynchronous Receiver Transmitter), which converts the characters into the serial (or bit by bit) form needed for transmission over the telephone network or other communications system.

While the VRC can detect about 90% of the errors encountered, it is often desirable to be able to detect a greater percentage of the errors. This can be done by adding one of the previously mentioned error detection schemes, or some other type of error detection.

Echoplexing Problems

A very popular form of error detection is *echoplexing* (sometimes incorrectly referred to as full duplex). This form of error detection works by having each transmitted character returned to the transmitter by the receiving computer. This allows 100% error checking since each character is returned to the transmitter for verification. There are many disadvantages to this method, however.

First, it can generally be implemented in only one direction: the transmitter can detect any errors in transition, but the receiving computer has no way of insuring that the data it has transmitted is correct. Another problem is that it is a slow procedure – each character must be transmitted, received, processed, retransmitted, received by the originator, and checked for correctness.

Therefore, the actual transmission time (the processing time involved at each end) is reduced by more than one half the physical speed. If a human is at the transmitter end, we can improve things a bit. The human can check for errors and thereby decrease the amount of processing the computer has to do. (We also gain the superior detection abilities of the human.)

The main problem, as stated before, is that we can implement the echoplexing in only one direction. Another problem is that human error detection relies on the ability to detect pattern errors, rather than specific, individual types of errors. Consequently, if we intend to send computer data which is essentially random in nature, we cannot use the detection capabilities of the human and must implement some other form of error detection.

Although one or several of the previously mentioned error detection schemes could be implemented, they are generally not easy to do in software. It is also undesirable to add more hardware to the system to perform the error detection; in many cases, adding hardware is not possible.

Checksum

Since it is desirable to perform error detection in software, a different form of error detection more suitable to software implementation needs to be considered. A very common software-generated error checking routine is the checksum, a form of HRC that can be easily implemented in software. It is simply a sum without carry of all of the characters transmitted. The second character is added to the first character, the third character is added to the resulting sum, the fourth character is added to that sum, and so on. After all the data have been transmitted, the final sum is transmitted. The receiving computer checks the transmitted sum against the sum that *it* added up. If the two sums do not match, there is an error in the transmitted data. Using the checksum along with the VRC results in detection of approximately 99% of all errors.

An error detection rate of 99% in text is in general quite acceptable. Only about one error in every million characters transmitted over the telephone will get through undetected (about one error every 10 hours at 300 baud). For text this is an acceptable error rate; there will generally be far more errors than that embedded in the text to begin with. ©

Comets

Chris Williams

For Applesoft on a 48K Apple II, this simulation of a comet's motion in high-res allows you to alter several variables. You can even send the comet into deep space.

In this article we'll be concentrating on comets. Comets have a couple of characteristics that make them well-suited to illustrate several concepts embedded in the program.

The first of these is their long periods; you have plenty of time to see what's going on. Comets can take hundreds of years to complete one orbit. Fortunately, we won't have to wait that long.

Second, they have highly elliptical orbits. Large variances in the comet's distance from the star are a visual plus.

The program makes use of both these traits to demonstrate idiosyncrasies of cometary motion. It is written in Applesoft to run on an Apple II+ (48K). The Apple, of course, uses a BASIC interpreter. If areas of code (especially in the main execution loop) look strangely written, it's because the program was designed for speed. REM statements are also placed with speed in mind.

Newton's Laws

The program, unlike most celestial simulations, does not directly use Kepler's laws. Instead, Newton's gravity equations are applied in two dimensions to drive the movements of a high-res dot which represents the comet.

A delta time interval (DT) of 120 days is used to get things done in a reasonable amount of time. Having a 120 day DT has some interesting ramifications. But we'll touch on that later.

Operation of the program is straightforward. It opens with a brief introduction, and then gives some suggestions for input parameters that will produce a stable, visually pleasing orbit. After the last input parameter is entered, execution begins.

The screen goes into high-res, a sprinkling of stars appears to set the mood, and the update loop starts. A clicking sound with distance-dependent pitch is also produced, again merely for effect.

The values used for constants and variables are not arbitrary. All numbers in the program – those the user inputs and those displayed at the bottom of the screen – have meaning. The mass of the central bright star (cross) is equal to the sun's in all calculations. The comet's mass is a plausible 1000 kgs. The screen scaling is such that its edge represents a radius just outside Pluto's orbit.

One last point of interest. If you input the following parameters:

DX=5555
DY=0
VX=0
VY=1

you'll see some strange behavior. The comet will curve inbound, pass very close to the star, and then whip right off the screen.

You Can Lose The Comet

This can be traced back to the 120 day DT value mentioned previously. As the comet gets in close to the star, its velocity increases tremendously. As a result, there are passes through the execution loop in which a very large velocity is applied over 120 days. This yields a relatively large distance traveled from the star at the completion of that pass.

Gravity is an inverse-square relationship. With a large distance *and* a high velocity, there is not sufficient attractive force to keep the comet in orbit.

This doesn't happen in nature. It is simply a peculiar effect of large DTs in numerical integration. There are many cures, but I chose to leave it alone, as a demonstration.

Try it out and experiment. I've found some unusual input combinations that seem to be on the threshold of the above problem. They result in a semi-spiral until the comet gets too close to the star and streaks out of the system.

This doesn't happen in nature either. It's just another illustration of the need for care when creating an accurate simulation.

```
10  REM  *** COMETS ***
11  REM  BY CHRIS WILLIAMS
13  REM  **************
20  ONERR  GOTO 370
30  HOME
35  REM  GO TO INTRODUCTION SUBRO
     UTINE
40  GOSUB 350
45  REM  ENTER INPUT PARAMETERS
47  REM  AND SET UP THEIR UNITS
```

```
50  INPUT "ENTER DX(X 10^6 KM)";D
     X: PRINT
60 DX = DX * 10 ^ 9
70  INPUT "ENTER DY(X 10^6 KM)";D
     Y: PRINT
80 DY = DY * 10 ^ 9
90  INPUT "ENTER VX(KPS)";VX: PRINT
100 VX = VX * 10 ^ 3
110  INPUT "ENTER VY(KPS)";VY: PRINT
120 VY = VY * 10 ^ 3: HGR
125  REM  PLOT THE CENTRAL STAR A
     S A +
130  HCOLOR= 3: HPLOT 140,80: HPLOT
     141,80: HPLOT 140,81: HPLOT
     139,80: HPLOT 140,79
135  REM  NOW SPRINKLE STARS FOR
     MOOD
140  FOR RD = 1 TO 100:X =  RND (
     1) * 279:Y =  RND (1) * 159:
      HPLOT X,Y: NEXT
145  REM  SET GRAV. EQN. CONSTANTS
146  REM  AND DT=120 DAYS, ALSO
147  REM  HI RES SCALING
150 MS = 329390 * 5.98 * 10 ^ 24:
     G = 6.67 * 10 ^ ( - 11):DT =
     120 * 3600 * 24:SXCALE = 279
      / (2 * (5900 * 10 ^ 9)):SYC
     ALE = 159 / (2 * (5900 * 10 ^
     9))
155  REM  PLACE VARIABLE LABELS
156  REM  AT BOTTOM OF PAGE
160  VTAB 22: HTAB 25: PRINT "VX=
     ": VTAB 23: HTAB 25: PRINT "
     VY="
170  VTAB 22:: PRINT "DX=": VTAB
     23:: PRINT "DY=  "
175  REM  CM IS COMET MASS IN KGS.
177  REM  CR IS SCREEN SIZE IN ME
     TERS
179  REM  OTHER CONSTANTS FOR SPE
     ED
180 CM = 1000:CR = 5900 * 10 ^ 9:
     ZERO = 0:THREE = 3:T2 = 22:T
     3 = 23:FR = 4:T8 = 28:RE = 1
     .49 * 10 ^ 11:TLL = 9 * 10 ^
     11
185  REM  LOOP STARTS AT 190
186  REM  NO COMMENTS WITHIN
187  REM  FOR SPEED
190 SS = (DX * DX) + (DY * DY):SQ
      =  SQR (SS)
200 F = CM * MS * G / SS
210 AX =  - F * (DX / SQ) / CM
220 AY =  - F * (DY / SQ) / CM
230 VX = VX + (AX * DT)
240 VY = VY + (AY * DT)
250 DX = DX + (VX * DT)
260 DY = DY + (VY * DT)
270  VTAB T2: HTAB FR: PRINT DX;"
      ": VTAB T2: HTAB T8: PRINT
     VX: VTAB T3: HTAB FR: PRINT
     DY;" "
280  VTAB T3: HTAB T8: PRINT VY
290  HCOLOR= ZERO: HPLOT XNU,YNU
300 XNU = (DX + CR) * SXCALE
310 YNU = (DY + CR) * SYCALE
320  HCOLOR= TH: HPLOT XNU,YNU
325  GOSUB 700
330  GOTO 190
340  STOP
342  REM  GOSUB 700 AT 325
343  REM  IS "CLICK" ROUTINE
350  HTAB 17: PRINT "COMETS": PRINT
     : PRINT "   THIS PROGRAM IS
     A SIMULATION OF THE": PRINT
     : PRINT "ORBITAL TRAJECTORIES
      CHARACTERISTIC OF": PRINT :
      PRINT "COMETS."
352  PRINT : PRINT "SUGGESTED INP
     UTS:DX=5555,DY=0,VX=0,VY=3":
      PRINT : PRINT
355  REM  360 CONTAINS ASSMBLY
356  REM  LOAD OF CLICK ROUTINE
360  PRINT : PRINT "HIT ANY KEY W
     HEN READY": GET A$: HOME : PRINT
     : PRINT : FOR DP = 771 TO 78
     9: READ DA: POKE DP,DA: NEXT
     : RETURN
365  DATA  173,48,192,136,208,4,1
     98,1,240,8,202,208,246,166,0
     ,76,3,3,96
368  REM  370 IS WHERE YOU GO WHEN
369  REM  ERROR FROM OFF SCREEN
370  HOME : TEXT : FOR YY = 1 TO
     10: PRINT  CHR$ (7): NEXT YY
     : HOME :: PRINT : PRINT "OKA
     Y, PAL.  ONE OF THREE THINGS
      JUST": PRINT : PRINT "HAPPE
     NED.": PRINT
380  PRINT "EITHER YOUR INITIAL V
     ELOCITIES": PRINT : PRINT "W
     ERE TOO LARGE OR YOU PASSED
     TOO": PRINT : PRINT "CLOSE T
     O THE STAR.  PASSING TO CLOS
     E": PRINT : PRINT "TO THE ST
     AR CAUSES PROBLEMS WITH A": PRINT
     : PRINT "120 DAY LOOP INTERV
     AL."
390  PRINT : PRINT "OR PERHAPS YO
     U JUST MESSED UP.": PRINT : PRINT
     "IN ANY CASE, TRY AGAIN.": END
700  POKE 1,3: POKE ZE,(T8 * SQ /
     CR) + FR: CALL 771: RETURN
```

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FORTH PAGE

A FORTH/BASIC Benchmark Test

Michael F. Heidt

This article has a twofold purpose. First, it makes a timing comparison between FORTH and BASIC by comparing runtimes for a benchmark program. Second, it demonstrates FORTH's extensibility by the implementation of a simple integer array.

Benchmarks are frequently used in acceptance testing mainframe computers. The BASIC Benchmarks used by Rugg and Feldman (*Kilobaud,* June 1977) became so popular that they were frequently used in advertising implementations of BASIC. Benchmark 7 from the *Kilobaud* article (Program 1) is the most comprehensive and was chosen for this comparison.

A quick look will show you that the program doesn't actually do much. The variable K is used as a loop counter. M is a simple array into which the values calculated in line 510 are to be stored. The subroutine at line 820 doesn't do anything. The object here is to measure the overhead required by calling a subroutine. The print statements at lines 300 and 700 allow you to start and stop a stopwatch to time the benchmark. Program 2 is the FORTH equivalent of Program 1 (the BASIC program).

The Results

BASIC	FORTH
27.43	13.58

Benchmark 7 results (seconds)

The above figures show the speed comparisons for the two versions of Benchmark 7. The measurements were made on an OSI C4-P running a 6502 processor at two megahertz. Each benchmark was run ten times and the results then averaged. This was done to average out variations in reaction time in starting and stopping the stopwatch.

As you can see from the table, the FORTH version is twice as fast as the BASIC version. The FORTH version could be made even faster by leaving out error checking, an option not available in BASIC.

It should be noticed that the FORTH version does not have a GOTO statement. FORTH has no GOTO. The structure of the FORTH program is "bottom up." This means that the most primitive sections are built first, then the next level uses the primitives and so on until the desired functions are built. However, it is possible to do "top down" programming in FORTH.

In fact, this is really how it should be done. For example, I essentially wrote the word B7 first, then added the more primitive routines. By doing it this way, you know what primitives to write, what variables will be needed, and you get some idea of just how big the job is going to be.

If you're not familiar with FORTH, the program presented here may appear complicated compared to the BASIC version. However, you should keep in mind that in addition to creating the benchmark, I have extended FORTH here to include a general integer array capability that can be used by other programs.

Program 1.

```
10 REM BENCHMARK 7,
   Kilobaud #6 p66
300 PRINT"START"
400 K=0
430 DIM M(5)
500 K=K+1
510 A=K/2*3+4-5
520 GOSUB820
530 FOR L=1 TO 5
535 M(L)=A
540 NEXT L
600 IF K<1000 THEN
    500
700 PRINT"END"
800 END
820 RETURN
```

Program 2.

```
SCR # 96
( BENCHMARK 7  WITH INTEGER ARRAYS                 MFH 1/11/81)
FORTH DEFINITIONS DECIMAL
: DIM <BUILDS DUP , 2 * 2 + ALLOT DOES> ;
: RANGE DUP ROT DUP ROT @ > ;
: READ RANGE IF ." RANGE ERROR " CR DROP @ (LEAVES MAX DIM
  IF ERROR )      ELSE 2 * + 2 + @ ENDIF ;
( READ WANTS ELEMENT NAME, E.G. E M READ - LEAVES CONTENTS )
: ADD RANGE IF ." RANGE ERROR" CR DROP DROP ELSE 2 * 2
 + + ! ENDIF ; ( WANTS VALUE ELEMENT NAME )
  0 VARIABLE K 0 VARIABLE A
: START ." START " ; : STOP ." END " CR CR ; : GOSUB ;
5 DIM M ( CREATE ARRAY M WITH 5 ELEMENTS )
: K+ K @ 1 + DUP K ! ; ( INCREMENT VARIABLE K BY ONE )
: B7 START 0 K ! BEGIN K+ DUP 2 / 3 * 4 + 5 - A ! GOSUB
        6 1 DO A @ I M ADD LOOP 1000 = UNTIL STOP ;
;S
```

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CAPUTE!

Modifications Or Corrections To Previous Articles

Commodore 64 Sprite Editor

In the program from the December 1982 issue, (p. 212), the following changes should be made:

```
LINE 74 - {F2} SHOULD BE {F3}
LINE 75 - {F3} SHOULD BE {F5}
LINE 76 - {F4} SHOULD BE {F7}
```

Also, the following modifications allow the menu to reflect changes in the sprite color options:

```
23 PRINT"1  MC 0-"A$(PEEK(V+37) AND 15)
24 PRINT"2  SC  -"A$(PEEK(V+41) AND 15)
25 PRINT"3  MC 1-"A$(PEEK(V+38) AND 15)
```

Atari TAG

Our thanks to reader Paul Havey who uncovered a bug which causes unpleasant results in the Atari version of TAG (October 1982, p. 76). Line 1090 should read as follows:

```
1090 DATA 26,208,142,9,212,162
```

VIC Pixelator

In Program 1 (October 1982, p. 144) the following changes should be made:

```
LINE 140 - {F2} SHOULD BE {F3}
LINE 500 - {F2} SHOULD BE {F3}
LINE 510 - {F3} SHOULD BE {F5}
LINE 520 - {F4} SHOULD BE {F7}
```

Also, author James Calloway notes that, in addition to the modifications noted last month in Capute!, the following changes permit the program to run on a VIC with an 8K expander added:

```
3570 IF S2>1 THEN POKE 36869,PEEK(36869) AND NO
    T 15 OR 2:GOTO 160
3580 POKE 36869,PEEK(36869) AND NOT 15:GOTO 160
```

We regret that we are no longer able to respond to individual inquiries about programs, products, or services appearing in **COMPUTE!** *due to increasing publication activity. On those infrequent occasions when a published program contains a typo, the correction will appear on this page, usually within eight weeks. If you have specific questions about items or programs which you've seen in* **COMPUTE!**, *please send them to Ask The Readers, P.O. Box 5406, Greensboro, NC 27403.*

COMPUTE! Back Issues

Here are some of the applications, tutorials, and games from available back issues of **COMPUTE!**. Each issue contains much, much more than there's space here to list, but here are some highlights:

February 1981: Simulating PRINT USING, Using the Atari as a Terminal for Telecommunications, Attach a Printer to the Atari, Double Density Graphing on C1P, Commodore Disk Systems, PET Crash Prevention, A 25¢ Apple II Clock.

May 1981: Named GOSUB/GOTO in Applesoft, Generating Lower Case Text on Apple II, Copy Atari Screens to the Printer, Disk Directory Printer for Atari, Realtime Clock on Atari, PET BASIC Delete Utility, PET Calculated Bar Graphs, Running 40 Column Programs on a CBM 8032.

June 1981: Computer Using Educators (CUE) on Software Pricing, Apple II Hires Character Generator, Ever- expanding Apple Power, Color Burst for Atari, Mixing Atari Graphics Modes 0 and 8, Relocating PET BASIC Programs, An Assembler In BASIC for PET, QuadraPET: Multitasking?

July 1981: Home Heating and Cooling, Animating Integer BASIC Lores Graphics, The Apple Hires Shape Writer, Adding a Voice Track to Atari Programs, Machine Language Atari Joystick Driver, Four Screen Utilities for the PET, Saving Machine Language Programs on PET Tape Headers, Commodore ROM Systems, The Voracious Butterfly on OSI.

August 1981: Minimize Code and Maximize Speed, Apple Disk Motor Control, A Cassette Tape Monitor for the Apple, Easy Reading of the Atari Joystick, Blockade Game for the Atari, Atari Sound Utility, The CBM "Fat 40," Keyword for PET, CBM/PET Loading, Chaining, and Overlaying.

October 1981: Automatic DATA Statements for CBM and Atari. VIC News, Undeletable Lines on Apple, PET, VIC, Budgeting on the Apple, Switching Cleanly from Text to Graphics on Apple, Atari Cassette Boot-tapes, Atari Variable Name Utility, Atari Program Library, Train your PET to Run VIC Programs, Interface a BSR Remote Control System to PET, A General Purpose BCD to Binary Routine, Converting to Fat-40 PET.

December 1981: Saving Fuel $$ (Multiple Computers: versions for Apple, PET, and Atari), Unscramble Game (multiple computers), Maze Generator (multiple computers), Animating Applesoft Graphics, A Simple Printer Interface for the Apple II, A Simple Atari Wordprocessor, Adding High Speed Vertical Positioning to Atari P/M Graphics, OSI Supercursor, A Look At SuperPET, Supermon for PET/CBM, PET Mine Maze Game.

January 1982: Invest (multiple computers), Developing a Business Algorithm (multiple computers), Apple Addresses, Lowercase with Unmodified Apple, Cryptogram Game for Atari, Superfont: Design Special Character Sets on Atari, PET Repairs for the Amateur, Micromon for PET, Self-modifying Programs in PET BASIC, Tinymon: a VIC Monitor, Vic Color Tips, VIC Memory Map, ZAP: A VIC Game.

February 1982: Insurance Inventory (multiple computers), Musical Transposition (multiple computers), Multitasking Emulator (multiple computers), Disassemble Apple Programs from BASIC, Plotting Polar Graphs on Apple, Atari P/M Graphics Made Easy, Atari PILOT, Put A Rainbow in your Atari, Marquee for PET, PET Disk Disassembler, VIC Paddles and Keyboard, VIC Timekeeping.

March 1982: Word Hunt Game (multiple computers), Infinite Precision Multiply (multiple computers), Atari Concentration Game, VIC Starfight Game, CBM BASIC 4.0 To Upgrade Conversion Kit, Apple Addresses, VIC Maps, EPROM Reliability, Atari Ghost Programming, Atari Machine Language Sort, Random Music Composition on PET, Comment Your Apple II Catalog.

April 1982: Track Down Those Memory Bugs (multiple computers), Shooting Stars Game (multiple computers), Intelligent Input Subroutines (multiple computers), Ultracube for Atari, Customizing Apple's Copy Program, Using PET/CBM In The High School Physics Lab, Grading Exams on a Microcomputer (multiple computers), Atari Mailing List, Renumber VIC Programs The Easy Way, Browsing the VIC Chip, Disk Checkout for PET/CBM.

May 1982: VIC Meteor Maze Game, Atari Disk Drive Speed Check, Modifying Apple's Floating Point BASIC, Fast Sort For PET/CBM, Extra Atari Colors Through Artifacting, Life Insurance Estimator (multiple computers), PET Screen Input, Getting The Most Out Of VIC's 5000 Bytes.

June 1982: Outpost Game (multiple computers), Apple Pascal Lister, Income Property (multiple computers), VIC Intelligent Videodisc System, Atari Disk Operating Systems, PET/Apple Search, A Self-modifying Atari P/M Utility, Use Atari Joysticks with VIC, VIC/PET Program Transfers.

July 1982: Gold Miner Game (Atari and VIC), IRA Planner (multiple computers), Atari Video Graphics, Apple DOS Changer, Super QuadraPET, VIC Overview, Maze Race (multiple computers), Direct Access File Editor (PET and Atari), VIC Super Expander Memory Map, Using The 6560 Video Interface Chip, PET Compactor, Headless FORTH Metacompilation, Test RAM Nondestructively (multiple computers).

August 1982: The New Wave Of Personal Computers, Household Budget Manager (multiple computers), Word Games (multiple computers), Color Computer Home Energy Monitor, Intelligent Apple Filing Cabinet, Guess That Animal (multiple computers), PET/CBM Inner BASIC, VIC Communications, Keyprint Compendium, Animation With Atari, VIC Curiosities, Atari Substring Search, PET and VIC Electric Eraser.

September 1982: Apple and Atari and the Sounds of *TRON*, Commodore Automatic Disk Boot, VIC Joysticks, Three Atari GTIA Articles, Color Computer Graphics, The Apple Pilot Language, Sprites and Sound on the Commodore 64, Peripheral Vision Exerciser (multiple computers), Banish INPUT Statements (multiple computers), Charades (multiple computers), PET Pointer Sort, VIC Pause, Mapping Machine Language, Editing Atari BASIC With the Assembler Cartridge, Process Any Apple Disk File.

Home and Educational COMPUTING! (Fall 1981 and Summer 1981 – count as one back issue): Exploring The Rainbow Machine, VIC As Super Calculator, Custom Characters, Alternate Screens, Automatic Line Numbers, Using The Joystick (Spacewar Game), Fast Tape Locater, Window, VIC Memory Map.

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How To Type COMPUTE!'s Programs

Many of the programs which are listed in **COMPUTE!** contain special control characters (cursor control, color keys, inverse video, etc.). To make it easy to tell exactly what to type when entering one of these programs into your computer, we have established the following listing conventions. There is a separate key for each computer. Refer to the appropriate tables when you come across an unusual symbol in a program listing. If you are unsure how to actually enter a control character, consult your computer's manuals.

Atari 400/800

Characters in inverse video will appear like: INVERSE VIDEO
Enter these characters with the Atari logo key, {⅄}.

When you see	Type	See	
{CLEAR}	ESC SHIFT <	↖	Clear Screen
{UP}	ESC CTRL -	↑	Cursor Up
{DOWN}	ESC CTRL =	↓	Cursor Down
{LEFT}	ESC CTRL +	←	Cursor Left
{RIGHT}	ESC CTRL *	→	Cursor Right
{BACK S}	ESC DELETE	◀	Backspace
{DELETE}	ESC CTRL DELETE		Delete character
{INSERT}	ESC CTRL INSERT		Insert character
{DEL LINE}	ESC SHIFT DELETE		Delete line
{INS LINE}	ESC SHIFT INSERT		Insert line
{TAB}	ESC TAB	▶	TAB key
{CLR TAB}	ESC CTRL TAB		Clear tab
{SET TAB}	ESC SHIFT TAB		Set tab stop
{BELL}	ESC CTRL 2		Ring buzzer
{ESC}	ESC ESC		ESCape key

Graphics characters, such as CTRL-T, the ball character ● will appear as the "normal" letter enclosed in braces, e.g. {T

A series of identical control characters, such as 10 spaces, three cursor-lefts, or 20 CTRL-R's, will appear as {10 SPACES}, {3 LEFT}, {20 R}, etc. If the character in braces is in inverse video, that character or characters should be entered with the Atari logo key. For example, {♥} means to enter a reverse-field heart with CTRL-comma, {5■} means to enter five inverse-video CTRL-U's.

Commodore PET/CBM/VIC

Generally, any PET/CBM/VIC program listings will contain bracketed words which spell out any special characters: {DOWN} would mean to press the cursor-down key; {3DOWN} would mean to press the cursor-down key three times.

To indicate that a key should be *shifted* (hold down the SHIFT key while pressing the other key), the key would be underlined in our listing. For example, <u>S</u> would mean to type the S key while holding the shift key. This would result in the "heart" graphics symbol appearing on your screen. Some graphics characters are inaccessible from the keyboard on CBM Business models (32N, 8032).

Sometimes in a program listing, especially within quoted text when a line runs over into the next line, it is difficult to tell where the first line ends. How many times should you type the SPACE bar? In our convention, when a line breaks in this way, the ~ symbol shows exactly where it broke. For example:

```
100 PRINT "TO START THE GAME  ~
    YOU MAY HIT ANY OF THE KEYS
    ON YOUR KEYBOARD."
```

shows that the program's author intended for you to type two spaces after the word *GAME*.

All Commodore Machines

Clear Screen	{CLEAR}	Cursor Left	{LEFT}
Home Cursor	{HOME}	Insert Character	{INST}
Cursor Up	{UP}	Delete Character	{DEL}
Cursor Down	{DOWN}	Reverse Field On	{RVS}
Cursor Right	{RIGHT}	Reverse Field Off	{OFF}

VIC/CBM 64 Conventions

Set Color To Black	{BLK}	Function Two	{F2}
Set Color To White	{WHT}	Function Three	{F3}
Set Color To Red	{RED}	Function Four	{F4}
Set Color To Cyan	{CYN}	Function Five	{F5}
Set Color To Purple	{PUR}	Function Six	{F6}
Set Color To Green	{GRN}	Function Seven	{F7}
Set Color To Blue	{BLU}	Function Eight	{F8}
Set Color To Yellow	{YEL}	Any Non-implemented Function	{NIM}
Function One	{F1}		

To enter any color code, hold down CTRL and press the appropriate color key. Use CTRL-9 for RVS on and CTRL-0 for RVS off.

8032/Fat 40 Conventions

Set Window Top	{SET TOP}	Erase To Beginning	{ERASE BEG}
Set Window Bottom	{SET BOT}	Erase To End	{ERASE END}
Scroll Up	{SCR UP}	Toggle Tab	{TGL TAB}
Scroll Down	{SCR DOWN}	Tab	{TAB}
Insert Line	{INST LINE}	Escape Key	{ESC}
Delete Line	{DEL LINE}		

When you see an underlined character in a PET/CBM/VIC program listing, you need to hold down SHIFT as you enter it. Since the VIC-20 and Commodore 64 have fewer keys than the PET/CBM, some graphics are grouped with other keys and have to be entered by holding down the Commodore key. If you see any of the symbols in the left column underlined in a listing, hold down the Commodore key and enter the symbol in the right column. Just use SHIFT to enter all other underlined characters.

!	K	←	*	1	E
"	I	↑	PI	2	R
#	T	.	S	3	W
$	@	-	Z	4	H
%	G	=	X	5	J
'	M	<	C	6	L
&	#	>	V	7	Y
\	-	,	D	8	U
;	F	/	P	9	I
?	B	*	N	@	SHIFT*
(	£	+	Q	[	SHIFT+
)	SHIFT-£	0	A	]	SHIFT-

Apple II / Apple II Plus

All programs are in Applesoft BASIC, unless otherwise stated. Control characters are printed as the "normal" character enclosed in brackets, such as {D} for CTRL-D. Hold down CTRL while pressing the control key. You will not see the special character on the screen.

TRS-80 Color Computer

No special characters are used, other than lowercase. When you see letters printed in inverse video (white on black), press SHIFT-0 to enter the characters, and then press SHIFT-0 again to return to normal uppercase typing.

Texas Instruments 99/4

No special control characters are used. Enter all programs with the ALPHA lock on (in the down position). Release the ALPHA lock to enter lowercase text.

Timex TS-1000, Sinclair ZX-81

Study your computer manual carefully to see how to enter programs. Do not type in the letters for each command, since your machine features single-keystroke entry of BASIC commands. You may want to switch to the FAST mode (where the screen blanks) while entering programs, since there will be less delay between lines. (If the blanking screen bothers you, switch to the SLOW mode.)

A Beginner's Guide To Typing In Programs

What Is A Program?

A computer cannot perform any task by itself. Like a car without gas, a computer has *potential*, but without a program, it isn't going anywhere. Most of the programs published in **COMPUTE!** are written in a computer language called BASIC. BASIC is easy to learn and is built into most computers (on some computers, you have to purchase an optional BASIC cartridge).

BASIC Programs

Each month, **COMPUTE!** publishes programs for many machines. To start out, type in only programs written for your machine, e.g., "TI Version" if you have a TI-99/4. Later, when you gain experience with your computer's BASIC, you can try typing in and converting certain programs from one computer to yours.

Computers can be picky. Unlike the English language, which is full of ambiguities, BASIC usually has only one "right way" of stating something. Every letter, character, or number is significant. A common mistake is substituting a letter such as "O" for the numeral "0", a lowercase "l" for the numeral "1", or an uppercase "B" for the numeral "8". Also, you must enter all punctuation such as colons and commas just as they appear in the magazine. Spacing can be important. To be safe, type in the listings *exactly* as they appear.

Brackets And Special Characters

The exception to this typing rule is when you see the curved bracket, such as "{DOWN}". Anything within a set of brackets is a special character or characters that cannot easily be listed on a printer. When you come across such a special statement, refer to the appropriate key for your computer. For example, if you have an Atari, refer to the "Atari" section in "How to Type COMPUTE!'s Programs."

About DATA Statements

Some programs contain a section or sections of DATA statements. These lines provide information needed by the program. Some DATA statements contain actual programs (called machine language); others contain graphics codes. These lines are especially sensitive to errors.

If a single number in any one DATA statement is mistyped, your machine could "lock up," or "crash." The keyboard, break key, and RESET (or STOP) keys may all seem "dead," and the screen may go blank. Don't panic – no damage is done. To regain control, you have to turn off your computer, then turn it back on. This will erase whatever program was in memory, so always SAVE a copy of your program before you RUN it. If your computer crashes, you can LOAD the program and look for your mistake.

Sometimes a mistyped DATA statement will cause an error message when the program is RUN. The error message may refer to the program line that READs the data. *The error is still in the DATA statements, though.*

Get To Know Your Machine

You should familiarize yourself with your computer before attempting to type in a program. Learn the statements you use to store and retrieve programs from tape or disk. You'll want to save a copy of your program, so that you won't have to type it in every time you want to use it. Learn to use your machine's editing functions. How do you change a line if you made a mistake? You can always retype the line, but you at least need to know how to backspace. Do you know how to enter inverse video, lowercase, and control characters? It's all explained in your computer's manuals.

A Quick Review

1) Type in the program a line at a time, in order. Press RETURN or ENTER at the end of each line. Use backspace or the back arrow to correct mistakes.

2) Check the line you've typed against the line in the magazine. You can check the entire program again if you get an error when you RUN the program.

3) Make sure you've entered statements in brackets as the appropriate control key (see "How To Type COMPUTE!'s Programs" elsewhere in the magazine.)

We regret that we are no longer able to respond to individual inquiries about programs, products, or services appearing in **COMPUTE!** *due to increasing publication activity. On those infrequent occasions when a published program contains a typo, the correction will appear on this page, usually within eight weeks. If you have specific questions about items or programs which you've seen in* **COMPUTE!**, *please send them to Ask The Readers, P.O. Box 5406, Greensboro, NC 27403.*

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Since their introduction in late 1979, the Atari 400/800 microcomputers have proven to be among the most popular personal computers ever made. **COMPUTE!** Magazine, one of the top publications in personal computing, was among the first to recognize the potential of the Atari computers and started regularly covering them from the beginning. Since then, **COMPUTE!** has published hundreds of articles on the Ataris and has become an indispensable resource for thousands of Atari users.

Most of those Atari users, however, joined the magazine's readership months after those early issues appeared. Many of those issues are now out of print. To satisfy the demand for those early articles, the magazine's editors have compiled the best of them into *COMPUTE!'s First Book Of Atari.*

In 192 pages, spiral bound for easy access to program listings, *COMPUTE!'s First Book Of Atari* includes chapters such as "Getting To Know Your Atari," "Beyond The Basics," "Graphics," "Programming Hints," "Applications," and "Peripheral Information." Informative articles concisely edited for smooth reading describe how Atari users can design their own graphics modes, add voice tracks to programs, and debug programming errors. There's even the classic article on player/missile graphics by Atari's own Chris Crawford.

As a bonus, the book also includes previously unpublished information such as a memory map.

And like **COMPUTE!** Magazine itself, *COMPUTE!'s First Book Of Atari* is written and edited to be useful to all computer enthusiasts – beginners and experts alike.

At only $12.95, less than most computer manuals, *COMPUTE!'s First Book Of Atari* is among the best resources an Atari owner can buy.

Available at computer dealers and bookstores nationwide. To order directly call TOLL FREE 800-334-0868. In North Carolina call 919-275-9809. Or send check or money order to **COMPUTE! Books**, P.O. Box 5406, Greensboro, NC 27403.

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COMPUTE!'s First Book Of VIC

Authors: **COMPUTE!** Magazine contributors
Price: $12.95
On Sale: Now

Finally, it's VIC's turn!

Users of other popular personal computers have been enjoying their **COMPUTE! Books**: *COMPUTE!'s First Book Of PET/CBM* ...the *First Book Of Atari* ...the *Second Book Of Atari* ... *Programming The PET/CBM* ... and others.

Now, there's a book devoted exclusively to the Commodore VIC-20 computer: *COMPUTE!'s First Book Of VIC.*

The editors of **COMPUTE!** Magazine – the leading resource for the VIC-20 – gathered together the best VIC-20 articles published since the summer of 1981 and added some new material. The result is more than 200 pages of valuable information – information that goes beyond the instruction manuals. In the **COMPUTE!** tradition, it is carefully edited to be easily understood and useful for beginners and experts alike.

COMPUTE!'s First Book Of VIC is spiral-bound to lie flat, and includes ready-to-type program listings and articles such as "The Joystick Connection: Meteor Maze," "STARFIGHT3," "Train Your PET To Run VIC Programs," "Renumber BASIC Lines The Easy Way," "High Resolution Plotting," "Custom Characters For The VIC," "VIC Memory – The Uncharted Adventure," and "A Simple Monitor For The VIC."

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COMPUTE!'s Second Book Of Atari

After only three years on the market, the Atari 400/800 microcomputers have become among the most popular personal computers ever made. So it was no surprise when *COMPUTE!'s First Book of Atari*, a collection of the best Atari articles published during 1980-81 in **COMPUTE!** Magazine, also became a "bestseller" with Atari enthusiasts. The first printing sold out in just a few months.

That's why we've followed up with *COMPUTE!'s Second Book of Atari*. Available immediately, the *Second Book of Atari* continues **COMPUTE!**'s tradition for personal computer users.

But the *Second Book of Atari* differs from the *First Book* in one important respect – all the articles are totally new and previously unpublished. The *Second Book of Atari* includes such interesting articles as "Page Flipping," "Fun With Scrolling," "Perfect Pitch," "Player-Missile Drawing Editor," and "TextPlot Makes a Game." Whole chapters are devoted to subjects such as "Advanced Graphics and Game Utilities," "Programming Techniques," and "Beyond BASIC." With 250 pages – more than 25 percent thicker than the *First Book* at the same price – the *Second Book of Atari* is crammed with information and ready-to-type program listings. And the book is spiral-bound to lie flat and is fully indexed for quick reference.

Best of all, *COMPUTE!'s Second Book of Atari*, like **COMPUTE!** Magazine itself, is written and edited to appeal to all computer enthusiasts – beginners and experts alike. Priced at only $12.95.

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NEWS&PRODUCTS

Speech Synthesizer For The Atari

The I Talk II is a speech synthesizer designed specifically for Atari's 400 and 800 computers. It is a complete unit ready to plug in within seconds of unwrapping. The I Talk II has four voice frequencies and unlimited vocabulary capabilities. Each unit comes with either a diskette or a cassette.

The I Talk II has many features:

1. It will speak while action graphics and sound effects are being executed.

2. It uses a utility that leaves system memory free for program use.

3. Complete, easy-to-read documentation allows beginners to incorporate speech into all their programs.

4. *Word Blaster*, an arcade-style educational spelling game, is free with the unit. The game can be easily programmed to challenge all age groups.

5. New games and programs for the unit are currently under development.

6. Volume and tone controls as well as a power on indicator light are standard.

7. The I Talk II never has to be disconnected. It will operate with cassette, disk and other accessories while connected.

8. Carries a full 12-month limited warranty.

9. I Talk II gives a starter dictionary of some of the most used words in the English language. You can add all the words you want. (This feature is not available on cassette.)

10. A complete phonetic speech dictionary to help you make almost any word or sound also comes with the unit.

Greenbrier Marketing International, Inc.
8225 East Rovey Ave.
Scottsdale, AZ 85253
(602)948-0005

Business Application Software For Commodore 64, VIC, And TRS-80

Powerbyte Software has released its application software for business and home use on the Commodore 64, VIC-20, and TRS-80 color computers. Over 64 applications are available on cassette tapes, ranging in price from $8.95 to $34.95. Disc versions are also available. Special emphasis is made for novice programmers with all programs using BASIC.

Available programs include: *The Accountant, Accounts Receivable/Payable, Business Inventory, Order Tracker, My Profit Margin, Business Calendar, Billing Solver, Client Tickler, Cash Flow Model, Linear Regression, Bar Chart, P.E.R.T., Phone Directory, Stock Ticker Tape, Checkbook, Home Budget, Club*

Lister, Medical Records, Mother's Recipes, Grade My Kids, and many more business and home utility programs. An advanced word processor for the 64 and VIC-20 is also now available. A free catalog is available upon request.

Powerbyte Software
2 Chipley Run
West Berlin, NJ 08091
(609)346-3063

The price for Financial Wizard *from Computari was incorrectly stated in the December issue. The correct price is $59.95, which also includes the disk storage case. If there are any questions about the product, call (405)751-2783.*

Film Series For Computer Literacy

Indiana University Audio-Visual Center recently released *Adventure of the Mind,* a six-film series that provides a step toward computer literacy. The films are available in either a 16mm version or in three video formats – ¾" U-matic cassette, ½" Betamax, and ½" VHS. The 16mm version is available for purchase ($240 each) or for rental ($15 each). The video formats are available for $150 each.

The six titles in the series are:

The Personal Touch (#BSC-183) shows the use of computers as personal tools to extend logical functions normally accomplished by the brain. Illustrations range from simple applications such as computer games, to finance control and decision-making, to more complex applications such as the experimental use of micro-electronics to influence the human nervous system through surgically implanted "neuro-pacemakers."

Hardware and Software (#BSC-184) begins with a look at the historical origins of the computer. A personal computer is disassembled to show the five major components of modern computers: input, control, arithmetic logic, memory, and output.

Speaking the Language (#BSC-185) demonstrates how the user communicates with the computer using BASIC. A simple example shows instructions used to store, list, and average the statistics of a basketball team. The film also briefly mentions other means of communication, such as light pens and voice commands.

Data Processing, Control, Design (#BSC-186) defines and demonstrates computer applications in terms of the three major categories indicated in the title. Illustrations include data processing to keep track of inventory and customer billing; buildings using computers to distribute energy efficiently, and an airport using a computer to sense weather conditions and give landing instructions to incoming pilots; and a computer simulation of a complex vehicle traffic problem.

For Better Or For Worse (#BSC-187) examines possible advantages and disadvantages resulting from the use of computers. A grocer explores the computer's benefits in eliminating tedious jobs, yet he is concerned about his dependence on the computer and about the possible misuse of his customer file. Another observer discusses concerns about the computer's impact on privacy, the quickly multiplying consequences of errors, and the increased sense of responsibility needed to prevent problems.

Extending Your Reach (#BSC-188) emphasizes computer use for special individual needs. Illustrations inside computer-assisted devices for the handicapped and the use of information resources via telephone lines. There is also a demonstration by a poet who uses a computer to explore the structure of his poems.

Preview prints of the films are available to perspective buyers at no cost other than return postage. Those requesting

preview should give a specific date, as well as two alternative dates.

Audio-Visual Center
Indiana University
Bloomington, IN 47405
(812)335-8087

Math Packages For The TRS-80

Bertamax Inc. has converted its math game package *Math Facts Games* I to run on the TRS-80 Color Computer, with 32K of memory. The game package provides practice in addition, subtraction, multiplication, or division, as the user chooses. The user can also select any one of four games to play: Count Down, Mystery Word, Tic-Tac-Toe, and Great Computer Challenge.

The player must correctly respond to each fact in order to take his turn at each game. Speed is important in some of the games, but the user may select the speed.

Each game provides immediate reinforcement of the user's input through the use of high-resolution color graphics, sound, or a combination of the two.

The package requires Extended BASIC, 32K of memory; price for tape is $39.50, for disk, $39.80.

This package is also available for the TRS-80 Model III, Apple II, and the Atari 800. Each program includes an extensive teacher's manual.

Also *Essential Mathematics Series* for grades 6 to 8 has been converted to run on the TRS-80 Color Computer. Already available for Apple and TRS-80 Model III computers, this drill-and-practice program contains lessons in addition, subtraction, multiplication, division, number concepts, fractions, decimals and percent, and pre-algebra skills.

This series features immediate reinforcement, a graded sequence of lessons, the use of skill-building techniques, on-screen directions and examples in key lessons, and sound and color reinforcers.

The series may be purchased as a complete set, or by concept strand. The price of the complete set is $225 for disk, $245 for tape. Each of the four concept strands – fractions, decimals and percent, number concepts, pre-algebra – is priced at $59.80 for the disk, $89.50 for the tape. Prices include the teacher's manual.

Bertamax Inc.
101 Nickerson, Suite 202
Seattle, WA 98109
(206)282-6249

Art Generation For The Apple

Visual Horizons has introduced *Computer Slide Express*, a service to turn any Apple computer into an art generating machine. With this new service, Apple computer owners can convert computerized charts, designs, graphs and graphics to 35mm color slides, standard size or enlarged color or black and white prints, or overhead transparencies.

The information can be transmitted over ordinary telephone lines or mailed to Visual Horizons in the form of a floppy disk which can hold material for up to 35 slides. All material is delivered through the mail.

It is a perfect system for someone who is writing a book and wants black and white or color charts. You can also word process material on your Apple computer, punch in *Computer Slide Express*, and get all the charts and graphs you need in color slide form.

Visual Horizon's Computer Slide Express.

Visual Horizons
180 Metro Park
Rochester, NY 14623

Word Processor For The VIC And Commodore 64

H. D. Manufacturing recently released the *Rapidwriter*, a word processor for the VIC and Commodore 64 computers. *Rapidwriter* gives flexibility to write, save, recall, edit, format, and print any kind of text. There are no limits to document length, or the variety of ways that texts may be mixed and recombined to produce labels, letters, reports, newsletters, scripts, or books.

Screen features. VIC-20 screen shows three full lines of text, plus line number and memory still available. CONTROL and OPTION menus display the full selection of control keys. Shows seven full lines of text on the 64, and 15 lines on the VIC with an 80-column board.

Editing features. Scrolling up and down; "goto line" to instantly position a line for editing. Uses cursor keys to position the cursor. Line gluing and single key formatting speed editing chores. Holds a full page of text in VIC with 8K expander, two more pages for each 8K, ten pages in the 64. Write, store, recall, move, edit, and print text in any order, at any time, in any quantity. Automatic word wraparound, line-length cut-off, and line feed, at typing speeds to 80 wpm.

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Rapidwriter is written in BASIC, can be used as a data-entry module with other programs and to format printout for other programs, and has a built-in programmable calculator function. The program comes with a complete reference manual and an easy-to-follow tutorial. Ongoing support (newsletter, new add-on programs, etc.) is provided. The cost is $39.95, tape or disk.

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Microcomputer Materials Catalog For 1982-83

The 1982-83 edition of the Scholastic Microcomputer materials Catalog has 100 new programs, including 24 new titles produced by the Minnesota Educational Computing Consortium (MECC), as well as top-selling programs like VisiCalc.

In addition to subject areas such as math, science, language arts, computer literacy, and social studies, software is offered in the new subject areas of music, art, and driver's education. A total of more than 300 titles is offered for the Apple, PET, TRS-80, Atari, and Texas Instruments microcomputers.

Scholastic Inc.
50 West 44th Street
New York, NY 10036
(212)944-7700

Maze Game For The Atari

Island Graphics has released *Tax Dodge*, a scrolling maze game for the Atari 400/800. *Tax Dodge*, designed and developed by Jon Freeman and Anne Westfall of Free Fall Associates, has vertical and horizontal scrolling, which allows the maze to be larger than the screen. *Tax Dodge* is written in assembly language.

Tax Dodge comes with diskette, manual, and product registration card. It is a 16K program and retails at $39.95 on diskette.

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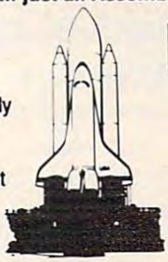

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The starter kit has a suggested retail price of $39.95.

CIS offers shopping and banking at home, electronic mail and realtime communications, current and historical stock market and commodities information, family information and education, up-to-the-minute news and weather, electronic games, bulletin boards, private user groups and computing power for programming activities.

CompuServe Incorporated
5000 Arlington Centre Boulevard
Columbus, OH 43220
(614)457-8600

Mass Storage Peripheral For Commodore 64 And VIC-20

Exatron has announced its Commodore 64 and VIC-20 compatible Stringy Floppy mass storage peripheral. The new system, named ESF-20/64, consists of two units: a miniature endless-loop tape cartridge and a precise electronically direct-drive transport mechanism which plugs into the serial bus connector on the Commodore 64 and VIC-20.

Major features include reliability, speed, compact size, and easy interfacing with no changes to the hardware or software of either computer. The commands used to operate the ESF-20/64 are incorporated into the Commodore 64 and VIC-20 and are fully explained in the *VIC-20 Computer Guide*.

The tape transport operates at a speed of five inches per second and has memory capacity of up to 64K bytes. Previously stored data is transferable to the ESF-20/64 storage via BASIC programming.

The end-user, single-unit price is $199.50. Starter kits, available for an additional $25, include the user's manual and ten 20-foot wafers (tape car-

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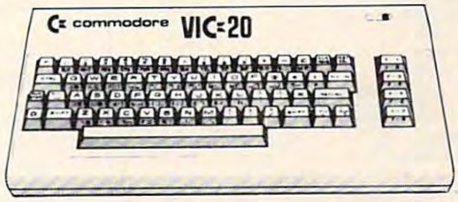

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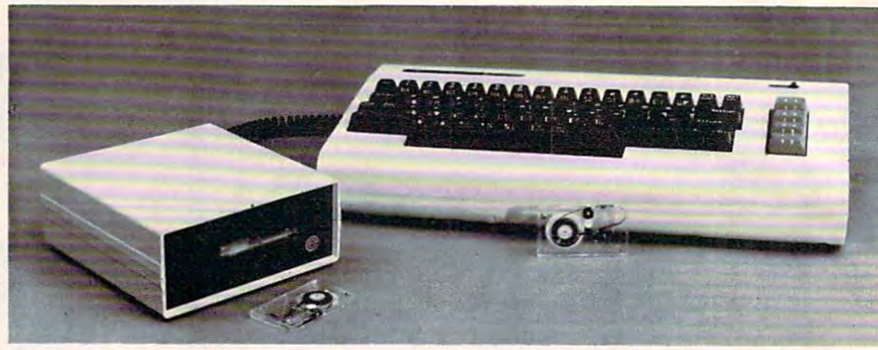

Exatron's stringy floppy mass storage peripheral for Commodore 64 and VIC.

tridges). The cost of individual wafers is about $3.

Exatron
181 Commercial Street
Sunnyvale, CA 94086
(408)737-7111
or outside CA (800)538-8559

Full-stroke Keyboard For The Atari 400

Inhome Software Incorporated has announced the B Key 400 full-stroke keyboard for the Atari 400 computer as an option to the existing membrane keyboard.

This new keyboard for the Atari 400 computer provides home computer users with all of the features of the full-stroke keyboard.

Inhome Software
2485 Dunwin Drive
Mississauga, Ontario L5L 1T1, Canada
(416) 828-0775

Inhome Software's B Key 400.

DB Master Accessory For The Apple

A statistical software package for *DB Master* users is being introduced by Stoneware, Inc. *DB Master Stat Pak* is an accessory for the *DB Master* data base management program for the Apple II or Apple II Plus.

The *Stat Pak* permits statistical analysis of data contained in *DB Master* files. *Stat Pak* is compatible with both the *DB Master* standard and Special Edition for hard disk systems.

DB Master uses values from any numeric, dollar/cents or computed fields. It also performs tests on selected records in a file, including: mean, standard deviation and standard error, co-efficient of variation, frequency of distribution, un-paired t-test, Mann Whitney U-test, Wilcoxen Paired Sample Test, linear regression, correlation and one-way analysis of variation (ANOVA) with Newman-Keuls Test and Chi Square Test (Chi Square can use alphanumeric data).

The hardware requirements are a 48K Apple or Apple II Plus with a minimum of one disk drive. The introductory price for the new *DB Master Stat Pak* is $99.

Stoneware, Inc.
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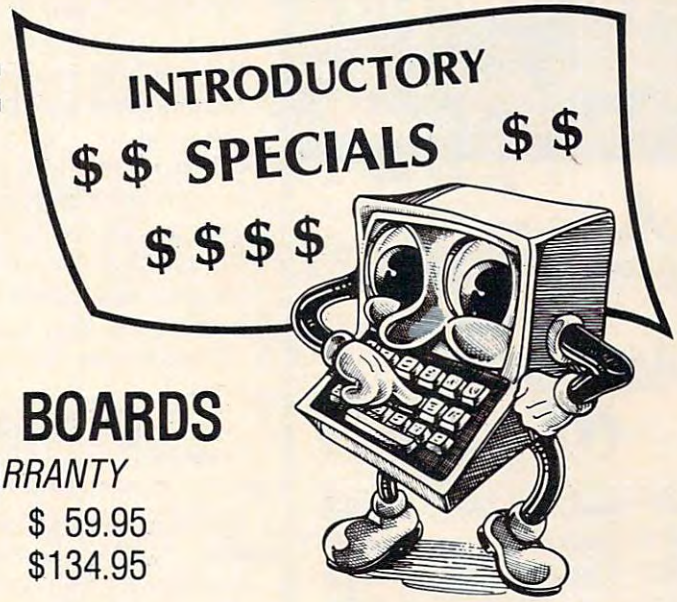

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anyone. Designed by Harry Moneyhun, the program enables the user to create and compile shapes that can be drawn on a medium-res grid in various colors, sizes, and angles. *Shapes in Color* (#13509) can be used to design shapes ranging from unique typography to animation. Shapes can be designed in the high resolution colors of green, violet, white, orange, blue, and black.

Graphic backgrounds can be "painted" with free-hand brushstrokes and then used with moving shapes to generate striking effects. Completed backgrounds and shapes are saved on disk to be reloaded for use in other programs. Detailed documentation describes techniques for writing original programs with the shapes and backgrounds created by the user.

The program requires Apple II disk and 48K, and costs $49.95.

Hayden Software Company
600 Suffolk Street
Lowell, MA 01853
(617)937-0200

CALENDAR

February 5, 1983, 10 AM-6 PM, Santa Clara County Fairgrounds, San Jose, California. Computer Swap America show, the first of three scheduled for 1983. Features sellers and buyers, both companies and individuals, from all over America, and from Mexico and Canada. Items sold: computers, consumer electronics, peripherals, software, books, magazines, etc. Admission is $5. Call (415) 494-6862 for Seller's Information Package.

March 18-20, 1983, Brooks Hall, San Francisco Civic Auditorium. The West Coast Computer Faire, a personal computing show for vendors and users. Admission is $15.

March 18-19, 1983, Seattle Pacific University (SPU) campus, Seattle, Washington. Sixth Annual Computers in Education Conference, designed for elementary and secondary educators and administrators interested in the changing role of the microcomputer in education. Co-sponsors: Pacific Northwest Associates for Computers in Education and SPU. For information or pre-registration forms, contact: Tony Jongejan, Everett High School, 2416 Colby, Everett, WA 98201; (206) 334-6965.

March 28-30, 1983, Tampa. Florida Instructional Computing Conference, for administrators and teachers. Conference includes exhibits of hardware and software, workshops on computer literacy, graphics, Logo, courseware evaluation, administrative uses of computers, etc., and program sessions (about 60). Each of the 14 workshops costs $15 in addition to the registration fee. Conference registration fee: $20 before March 15; $25 after March 15. Single day registration, $15. Registration packet includes a resources booklet. For special rates at the new Hyatt Regency Hotel call (800)228-9000. For registration information, write: Dianne Cothran, Florida DOE, Educational Technology Section, Knott Building, Tallahassee, FL 32301. Or call (904)488-0980 or 487-3104 (SUNCOM 278-0980 or 277-3104). Exhibitors call (904)878-4178.

COMPUTE! *welcomes notices of upcoming events and requests that the sponsors send a short description, their name and phone number, and an address to which interested readers may write for further information. Please send notices at least three months before the date of the event, to: Calendar, P.O. Box 5406, Greensboro, NC 27403.*

New Product releases are selected from submissions for reasons of timeliness, available space, and general interest to our readers. We regret that we are unable to select all new product submissions for publication. Readers should be aware that we present here some edited version of material submitted by vendors and are unable to vouch for its accuracy at time of publication.

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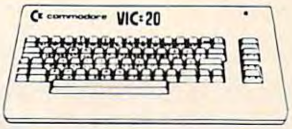

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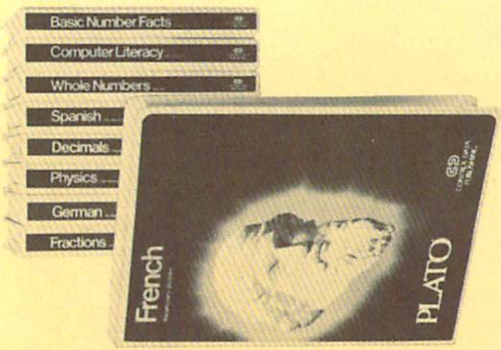

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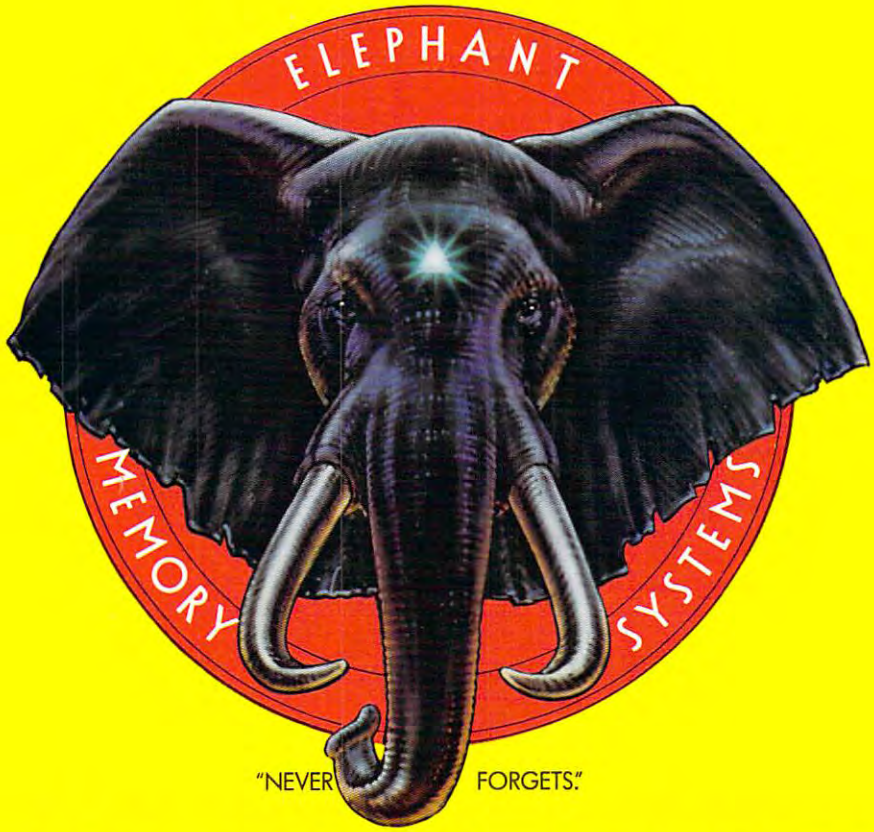

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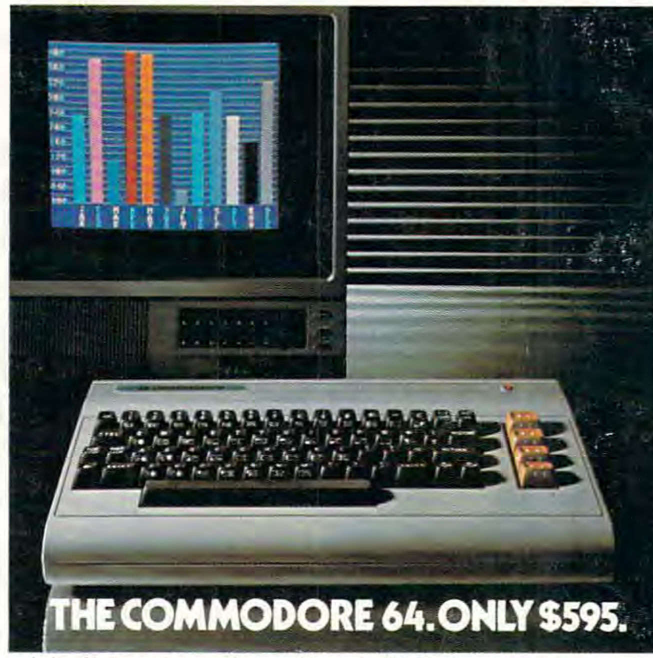

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