the user and interfacing the device to the computer.

4) How to form a message as selections are made, and how to get attention paid to special messages.

5) Besides selecting from a list, how to decide on other options in order to improve the speed of communication, as well as the ease of computer use.

By dedicating a separate article to each of these five areas, we can concentrate on identifying alternatives to be considered in each area. For those readers who are in need of such a communications program, this will provide the means to create an individualized, tailor-made version. We will be allowing time in between articles for reader feedback. Tell us what requirements you, your friends, relations, or neighbors have for such a program. We will then pick the most requested option for that section to show how to incorporate it into the communications program. By carefully analyzing this process in the articles, it should make it possible for readers to do similar adjustments to the program for any other alternatives that meet their needs, as well as imitate the process for other computers. We would also like to have readers share their knowledge and opinions with us about any communications devices or programs so that other readers can be informed of their respective pros and cons.

The next article will be in two months, and will analyze the possibilities involved in picking the words, statements, or characters that become the menu from which communication is derived. The most requested arrangement will be implemented in the first part of the communications program. In exchange for $9.95, we would be glad to send our current version of the communications program for the PET/CBM computer that uses either the keyboard or user port input on four levels to anyone desiring it. This will help some readers who may want a completed program immediately and do not want to participate in an anticipated 12-month genesis of a tailor-made program. It may also be desirable by those readers who want a finished version of the program with which to follow along while we develop alternatives to the five major areas of the program. This way different options can be tried out with the whole program to evaluate what works best for individual circumstances.

But, this is not required. For the end result of the sequence of articles will be a communications program individualized by the greatest needs identified in each area. We hope this approach will accomplish what teaching someone to farm does in comparison to just providing that same person with produce. The teaching method is definitely more time-consuming and difficult, but we feel the end result of helping people with the creation of their own solutions is a desirable and worthwhile endeavor.

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```
YOU ARE  BAD SLEEP WORK  HOSPITAL

I   AND  THE COLD  CANDY BATHROOM ETHROA

MOM HAVE MY  SICK  GAME  PLAYROOM .ISDLH

DAD DID  AT  BOOK  PLAY  SCHOOL   ;CFPMY

WHY IS   HOT FOOD  HOME  INSIDE   ?GWVBX

HOW LOVE BIG DR.   DRUG  OUTSIDE  ,QUKJZ

HI  EAT  OF  WHAT  STORE DOWN     -12345

HE  GET  OUR TIME  BOY   KITCHEN  67890$

WE  GOTO IT  DRINK GIRL  BEDROOM   +%!()

I AM SICK. CALL MY DR. AT 824-3400!
```

©

Here is a program which will let you measure frequencies, or time intervals in microseconds, using only an inexpensive phototransistor or two and your CBM/PET.

Using The PET/CBM In The High School Physics Lab

Peter Spencer
West Hill, Ontario

You are lucky. You are a Science teacher with a microcomputer. Its word processing ability alone justifies its cost to you. But, "what do you use it for in the classroom?" Hmmm...., at present, nothing that would make an administrator or a school trustee want to ensure that all Science departments should have one.

But there are hopeful rumors. You hear of magical digital to analog, and analog to digital (D/A and A/D) happenings in far-off TERC land (1) where someone has been tinkering with a beautiful printed circuit board that will interface to the PET, APPLE, AIM, SYM, or KIM. But, when you phone, the cleverly-synthesized voice says "Microinstrument II is not available yet." Then the budget troll descends on you in a nightmare, caresses your hopes with a trash compactor, and whispers lovingly in your ear "Even if it or any other A/D-D/A board were available, you'd first have to fight three dragons and then wait one and a half years in order to get one." You make an appointment for next February 29th.

In the meantime, what *can* you do with your microcomputer, your yearly issue of two metres of bell wire from Central Stores, and the $3.50 left in your budget?

Surprisingly, quite a bit. You can use your PET/CBM to time, in microseconds, how long a photocell is darkened or illuminated, to time how long a switch is open or closed, to time an object accelerating down an incline, or to measure the frequency of a stroboscope or other flashing light. In other words, you can use it as a photocell or switch-operated interval timer in either pulse or gated modes, and as a frequency meter. The only catch is that to do any of these well requires that you program in machine language. A week of fasting, flagellation, and Rodnay Zaks (2) later, you set to work.

You use a Fairchild FPT-100 phototransistor hooked across pin PA0 and ground of the PET's parallel user port. The FPT-100 is so inexpensive you can buy two of them on your budget, and Fairchild claims a rise time of 2.8 microseconds, which is really good (3).

Figure 1 shows a program that lets you use the phototransistor and computer as a microsecond timer. A disassembly of the machine language timing routine is included in lines 500 to 820. (4) Note that the first thing that MUST be done in any machine language timing routine is to set the interrupt disable (via the SEI instruction) so that the hardware-generated interrupt to refresh the screen every sixtieth of a second is shut off. There is nothing more embarassing than to time ten seconds, and get an answer of eight.

Where did the 43 in line 300 come from, you ask? That is the length of time in microseconds that it takes to traverse the machine language counting loop shown in lines 670 to 790. Multiplying the number of loop traversals (stored in bytes 823, 824, and 825) by the time for one traversal gives the elapsed time.

The machine language routine waits until pin PA0 of the PET's parallel user port is disconnected from ground, that is, until the light beam to the phototransistor is cut. Once into the timing loop, it increments byte $0337 (decimal 823) by one on each run around the loop, putting any carry into byte $0338 and eventually byte $0339. The machine language loop ends when PA0 is grounded again, meaning when the phototransistor is re-illuminated. The interrupt is re-enabled (via the CLI instruction) and control returned to BASIC. Hence, with only a $1.50 phototransistor, some wire, and a printed-circuit board connector, you have a timer accurate to a tenth of a millisecond! Do you remember what you paid for the last millisecond timer you bought for your lab, or what you would have paid had the funds been approved? (5)

The program in Figure 1 can be easily modified to time how long the phototransistor is illuminated rather than darkened. Simply change the 255 in line 210 to a 254, and change the 254 in line 490 to a 255.

If you don't need high accuracy, or if you are timing events longer than the approximately twelve second maximum of the program in Figure 1, you can use the BASIC wait statement, as shown in Figure 2. This second program is accurate to no better than a tenth of a second, but it *will* run for a full twenty four hours. It, too, times how long the phototransistor is darkened.

Want to time a cart rolling down an incline? That is, do you want a timer that is started by something interrupting the light to one phototransistor,

80 COLUMN GRAPHICS

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

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

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NOW 80 COLUMN PETS CAN HAVE MTU HIGH RESOLUTION GRAPHICS

and then stopped when the something passes by a second phototransistor? My, you have extravagant tastes – now you need *two* illuminated phototransistors wired in series between pin PA0 and ground, plus the program in Figure 3. Now that Figures 1, 2, and 3 have shown you examples of how to go about it in machine language, you may even dream of seven or eight photocells along a track, and automatic display of a distance-time graph.

Can't afford two phototransistors? Never mind, you can still have a frequency meter, a really useful instrument that is usually quite expensive and thus rarely found in the high school lab. You hook your one phototransistor across pin PA0 and ground as before, and run the program in Figure 4.

The machine language part of Figure 4 is slightly more tricky than the first three programs. You must maintain two sets of accumulators – one to count pulses, and one to count loop traversals. When you count a pulse, that is, a bright light on the phototransistor, you must wait until it is over until you count again. To do this, the program stores the value of PA0 in location $188. On the next run around the loop, it compares the new value of PA0 with what is in $188. If there is no change, nothing is added to the count accumulators CLOW and CMID. If there *is* a change and it is from bright to dark (i.e., from PA0 equals 0 to PA0 equals 1), one count is generated by knocking the PA0 bit off (ROR A instruction) into the carry flag, and then dumping the carry flag into register CLOW (ADC #0, STA CLOW instructions).

All this activity can be very time consuming. In order to get the time down to fifty-seven microseconds per loop traversal, the program uses zero-page instructions, with zero-page locations chosen (see lines 1 to 5 in Figure 4B) that are unlikely to be clobbered by BASIC 2.0 in the rest of the program.

You cannot use the program of Figure 4 for pulses with a half cycle shorter than fifty-seven microseconds. That is, not for pulses with a period less than 114 microseconds, which means not for frequencies greater than 8.7 kiloHertz. However, since most of the things – such as calibrating your xenon strobe (which only goes to 300 Hz), or measuring the frequency of a pendulum as a function of amplitude – that you want to do have frequencies nowhere near 8 kHz, you are more than safe. For even higher frequencies, you should investigate the PET's built-in timers $E848 and $E849 (6), but you will probably need a phototransistor with an even shorter rise time than the FPT-100 has.

Now, about February 29th....

References:

(1) Technical Education Research Center, 8 Eliot Street, Cambridge, MA 02138. Phone (617)547-3890. See the Spring 1980 edition of their publication "Hands On!" for a description of Microinstruments I and II.

(2) Programming the 6502, *by Rodnay Zaks, Sybex Incorporated, 1978. Also see* MCS6500 Microcomputer Family Programming Manual *by MOS Technology, Inc., 1976.*

(3) Sometimes such unusual conditions are used to get "good" specifications that realistic behavior is much worse. However, even if the FPT-100's rise time is as long as 28 microseconds, that is still good.

(4) This program was originally inspired by the pioneering "Gravity Timer" program of Don Whitewood, Oakwood Collegiate Institute, Toronto, Ontario.

(5) Also, the last commercial photogate that I purchased, made by a popular educational supplier, has a rise time of 1000 microseconds! Try using that to time a 3 cm wide object going at 10 m/s.

(6) PET Machine Language Guide, *by Arnie Lee, Abacus Software, 1979.*

Figure 1.

```
10 REM:  SET UP MACHINE LANGUAGE T
   IMER
20 FOR I=826 TO 888
30 READ A
40 POKE I,A
50 NEXT I
60 :
70 REM  DARK TIMER
80 POKE59468,14
90 PRINT"{CLEAR}{REV}DARK TIMER{OF
   OFF}         PETER SPENCER
   "
100 REM  WRITTEN FOR BASIC 2.0
110 REM  USES THE SECOND CASSETTE B
    UFFER
120 PRINT"{DOWN}TIMING STARTS WHEN
    THE CONNECTION BETWEEN PA0
     AND GROUND IS OPEN
130 PRINT"{DOWN}(THAT IS, WHEN THE
    PHOTOTRANSISTOR IS IN THE
    DARK)"
140 PRINT"{DOWN}TIMING STOPS WHEN T
    HE PA0-GROUND CONNECTION I
    S SHORTED"
150 PRINT"{DOWN}(THAT IS, WHEN THE
    PHOTOTRANSISTOR IS ILLUMIN
    ATED)"
160 :
170 PRINT"{DOWN}TIMER RESETS TO ZER
    O AFTER ABOUT 12 MINUTES"
180 REM:  43*(255+255*256+255*256*2
    56)/1000000 IS LARGEST MIC
    ROSECOND TIME
190 :
200 POKE59459,0:REM  SETS PORT FOR
    INPUT
210 POKE822,255:REM  SETS MASK FOR
    INPUT LINE PA0
220 :
230 PRINT"{DOWN}{REV}PUSH ANY KEY W
    HEN THE PHOTOTRANSISTOR IS
     PROPERLY CONNECTED"
```

```
240 GET AN$ :IF AN$="" THEN 240
250 :
260 PRINT"{DOWN}{REV}YOU MAY START ~
    NOW
270 :
280 SYS826
290 :
300 MS=43*(PEEK(823)+PEEK(824)*256+
    PEEK(825)*256*256)
310 S=MS/1000000
320 PRINT"{DOWN}{REV}ELAPSED TIME"
330 PRINT MS;"MICROSECONDS "
340 PRINT MS/1000;"MILLISECONDS"
350 PRINT S;"SECONDS"
360 PRINT"{DOWN}NOT ALL DIGITS ARE ~
    SIGNIFICANT!
370 PRINT"TIME THE SAME EVENT SEVER
    AL TIMES TO GET AN ESTIMAT
    E
380 PRINT"OF THE RANGE OF UNCERTAIN
    TY"
390 :
400 PRINT"{DOWN}TYPE {REV}R{OFF} TO
     RESET TIMER
410 GETA$:IFA$<>"R"GOTO410
420 GOTO260
430 :
440 DATA 24,162,1,142,53,3,169,0,14
    1,55,3
450 DATA 141,56,3,141,57,3,120,234,
    234,174,79,232
460 DATA 236,54,3,208,245,24,173,55
    ,3
470 DATA 109,53,3,141,55,3,173,56,3
    ,105,00
480 DATA 141,56,3,173,57,3,105,00,1
    41,57
490 DATA 3,174,79,232,224,254,208,2
    23,88,96
500 :
510 REM:   INITIALIZATION
520 REM:   033A 18          CLC
530 REM:   033B A2 01       LDX #$01

540 REM:   033D 8E 35 03    STX $033
    5
550 REM:   0340 A9 00       LDA #$00

560 REM:   0342 8D 37 03    STA $033
    7
570 REM:   0345 8D 38 03    STA $033
    8
580 REM:   0348 8D 39 03    STA $033
    9
590 :
600 REM:   WAIT UNTIL PA0 GOES HIGH
610 REM:   034B 78 EA EA    SEI
620 REM:   034E AE 4F E8    LDX $E84
    F
630 REM:   0351 EC 36 03    CPX $033
    6
640 REM:   0354 D0 F5       BNE $034
    B
650 :
660 REM:   TIMING LOOP
670 REM:   0356 18          CLC
680 REM:   0357 AD 37 03    LDA $033
    7
690 REM:   035A 6D 35 03    ADC $033
    5
700 REM:   035D 8D 37 03    STA $033
    7
710 REM:   0360 AD 38 03    LDA $033
    8
720 REM:   0363 69 00       ADC #$00

730 REM:   0365 8D 38 03    STA $033
    8
740 REM:   0368 AD 39 03    LDA $033
    9
750 REM:   036B 69 00       ADC #$00
760 REM:   036D 8D 39 03    STA $033
    9
770 REM:   0370 AE 4F E8    LDX $E84
    F
780 REM:   0373 E0 FF       CPX #$FE

790 REM:   0375 D0 DF       BNE $035
    6
800 :
810 REM:   0377 58          CLI
820 REM:   0378 60          RTS
```

Figure 2.

```
10 REM  DARK STOPWATCH
20 PRINT"{CLEAR}{REV}STOPWATCH{OFF
   OFF}                   PETER
    SPENCER
30 REM  TIMES HOW LONG PHOTOCELL I
   S DARKENED
40 REM  INTERCHANGE LINES 100 AND ~
   130 TO TIME PHOTOCELL ILLU
   MINATION
50 PRINT"{DOWN}DISCONNECT PA0 FROM
    GROUND TO START TIMER
60 PRINT"{DOWN}SHORT PA0 TO GROUND
    TO STOP"
70 POKE59459,0 :REM  SET PORT FOR ~
   INPUT
80 PRINT"{DOWN}{REV}PUSH ANY KEY W
   HEN APPARATUS IS PROPERLY ~
```

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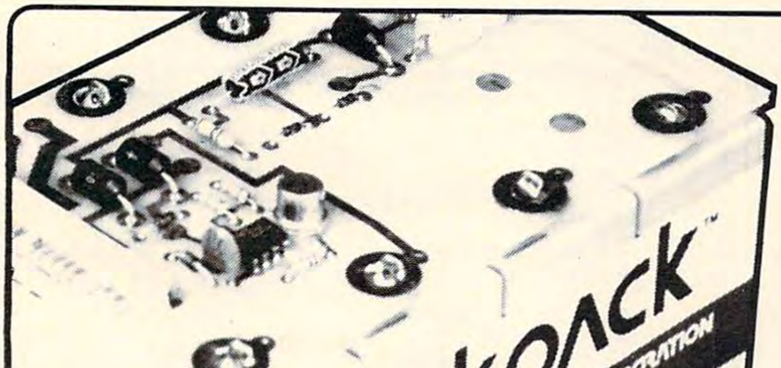

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```
    CONNECTED TO USER PORT"
90 GET IN$ :IF IN$="" GOTO 90
100 WAIT59471,1,0 :WAITS UNTIL 0 GO
    ES HIGH (IE, PHOTOCELL DAR
    K)
110 TIME$="000000"
120 PRINT"{REV}TIMER ON"
130 WAIT59471,1,1 :WAITS UNTIL 0 IS
     CONNECTED TO GROUND (IE,
    PHOTOCELL BRIGHT)
140 T2=TI
150 PRINT T2;"SIXTIETHS OF A SECOND

160 PRINT T2/60;"SECONDS
170 PRINT"{DOWN}PUSH {REV}R{OFF} TO
     RESET
180 GETA$:IFA$<>"R"GOTO180
190 GOTO80
```

Figure 3-A.

```
10 REM  PULSE-GATED MICROSECOND TI
    MER
20 FOR I= 826 TO 922  :READ M :POK
    E I,M :NEXT I
30 DATA 24 , 169 , 0 , 141 , 151
40 DATA 3 , 141 , 152 , 3 , 141
50 DATA 153 , 3 , 120 , 174 , 79
60 DATA 232 , 224 , 254 , 208 , 24
    9
70 DATA 174 , 79 , 232 , 224 , 255

80 DATA 208 , 249 , 24 , 173 , 151

90 DATA 3 , 105 , 1 , 141 , 151
100 DATA 3 , 173 , 152 , 3 , 105
110 DATA 0 , 141 , 152 , 3 , 173
120 DATA 153 , 3 , 105 , 0 , 141
130 DATA 153 , 3 , 174 , 79 , 232
140 DATA 224 , 254 , 208 , 224 , 24

150 DATA 173 , 151 , 3 , 105 , 1
160 DATA 141 , 151 , 3 , 173 , 152
170 DATA 3 , 105 , 0 , 141 , 152
180 DATA 3 , 173 , 153 , 3 , 105
190 DATA 0 , 141 , 153 , 3 , 174
200 DATA 79 , 232 , 224 , 255 , 208

210 DATA 224 , 88 , 96 , 107 , 95
220 DATA 0 , 237 , 237 , 237 , 237
230 PRINT"{CLEAR}{REV}PULSE-GATED M
    ICROSECOND TIMER"
240 PRINT"{DOWN}
     PETER SPENCER"
250 REM:  WAIT UNTIL PA0 IS SHORTED
     (IE, PT ILLUMINATED)
260 REM:  TIMING STARTS WHEN PA0 GO
    ES HIGH (IE, PT DARK)
270 REM:  KEEP TIMING AS YOU WAIT F
    OR PA0 TO GO LOW AGAIN
280 REM:  THEN TIME UNTIL PA0 GOES
    HIGH (DARK) AGAIN
290 POKE59459,0
300 PRINT"{DOWN}{REV}PUSH ANY KEY W
    HEN THE APPARATUS IS PROPE
    RLY CONNECTED TO THE PORT"

310 GET IN$ :IF IN$="" THEN 310
320 SYS826
330 SE=41*(PEEK(919)+256*PEEK(920)+
    256*256*PEEK(921))
340 PRINT"{DOWN}{REV}ELAPSED TIME
350 PRINTSE;"MICROSECONDS"
360 PRINTSE/1000000;"SECONDS"
370 PRINT"{DOWN}{REV}DIGITS ARE NOT
     ALL SIGNIFICANT"
380 PRINT"TIME THE SAME EVENT SEVER
    AL TIMES TO GET AN ESTIMAT
    E OF THE RANGE OF"
390 PRINT"UNCERTAINTY"
400 PRINT"{DOWN}TYPE {REV}R{OFF} TO
     RESET TIMER
410 GETA$:IFA$<>"R"GOTO410
420 GOTO300
```

Figure 3-B: Source code for machine language part of Pulse-Gated Microsecond Timer Program.

```
*=826   !pulsed timer
clc
lda #0  !initialize registers"
sta lowt
sta midt
sta hight
sei
loop1  ldx 59471   !pa"
       cpx #254    !pa0 shorted?"
       bne loop1
start  ldx 59471
       cpx #255    !is pao high"
       bne start
loop2  clc !timing loop"
       lda lowt
       adc #1
       sta lowt
       lda midt
       adc #0
       sta midt
       lda hight
       adc #0
       sta hight
       ldx 59471
       cpx #254       !pa0 low again?
       bne loop2
loop3  clc
       lda lowt
       adc #1
       sta lowt
       lda midt
       adc #0
       sta midt
```

```
        lda hight
        adc #0
        sta hight
        ldx 59471
        cpx #255      !pa0 high again?
        bne loop3
cli
rts
lowt=*
nop
midt=*
nop
hight=*
nop
.end
```

Figure 4-A.

```
10 REM  FREQUENCY METER PROGRAM
20 FOR I= 826 TO 906   :READ M :POK
   E I,M :NEXT I
30 DATA 120 , 24 , 169 , 0 , 133
40 DATA 138 , 133 , 139 , 133 , 13
   6
50 DATA 133 , 137 , 169 , 254 , 14
   1
60 DATA 67 , 232 , 169 , 1 , 133
70 DATA 188 , 173 , 79 , 232 , 197

80 DATA 188 , 133 , 188 , 240 , 33

90 DATA 234 , 234 , 234 , 106 , 16
   5
100 DATA 136 , 105 , 0 , 133 , 136
110 DATA 165 , 137 , 105 , 0 , 133
120 DATA 137 , 24 , 165 , 138 , 105

130 DATA 1 , 133 , 138 , 165 , 139
140 DATA 105 , 0 , 133 , 139 , 144
150 DATA 216 , 88 , 96 , 169 , 0
160 DATA 76 , 91 , 3 , 16 , 65
170 DATA 128 , 0 , 27 , 126 , 0
180 DATA 0 , 67 , 79 , 0 , 0
190 DATA 0 , 0 , 0 , 70 , 0
200 PRINT"{CLEAR}{DOWN}{REV}FREQUEN
    CY METER{OFF}     PETER SPE
    NCER"
210 PRINT"{DOWN}TYPE {REV}G{OFF}O T
    O START SAMPLING PA0 INPUT
    "
220 GETA$:IFA$<>"G"GOTO220
230 PRINT"RUNNING...
240 SYS826
250 COUNT=PEEK(136)+256*PEEK(137)
260 F=COUNT/((256+256*256)*(57E-6))

270 PRINT"{DOWN}{REV}COUNT
280 PRINTCOUNT
290 PRINT"{DOWN}{REV}FREQUENCY
300 PRINT F;"HERTZ"
310 PRINT"{DOWN}{REV}WARNING:  DIGI
    TS ARE NOT ALL SIGNIFICANT
    "
320 PRINT"MEASURE THE FREQUENCY SEV
    ERAL TIMES"
330 PRINT"TO GET AN ESTIMATE OF THE
     RANGE OF"
340 PRINT"UNCERTAINTY"
350 GOTO 210
```

Figure 4-B: Source code for machine language part of frequency meter program.

```
clow=136"   !first count register
cmid=137"   !second count register
ltime=138"  !first time register
mtime=139"  !second time register
pa0v=188"   !previous PA0 value
*=$033a"
sei"
clc"
lda #0 '!initialization"
  sta ltime"
  sta mtime"
  sta clow"
  sta cmid"
  lda #254"
  sta 59459  !pa0=input"
  lda #1"
  sta pa0v"
loop1=*" !check if PA0 has changed
  lda 59471"
  cmp pa0v"
  sta pa0v"
  beq stall !if not,add 0 to count
  nop"
  nop"
  nop"
else ror a !if yes,kick value into carry
  lda clow"
  adc #0"
  sta clow"
  lda cmid"
  adc #0"
  sta cmid"
  clc  !count loop traversals
  lda ltime"
  adc #1"
  sta ltime"
  lda mtime"
  adc #0"
  sta mtime"
  bcc loop1  !end of count loop traversals
  cli"
  rts"
stall lda #0"
      jmp else"
.end"
```

©

This technique is described for the Apple, PET/CBM, and Atari computers. It could prove quite useful for educational, user-friendly databases, and other programming.

Intelligent Input Routines

R. M. Smythe
Burlington, Canada

First there was the INPUT statement. You used it and put up with error messages. "The user shouldn't have typed a comma anyhow," you said. "Served him right." Then all the magazines came up with their Input Anything Subroutines using the GET statement. You've been using that and found that your programs are remarkably well protected against bad input. You made the input routine ignore inappropriate keystrokes. Now it's time for the next advance: Intelligent Input Subroutines (IIS). Rather than simply ignore faulty data input, the IIS attempts to figure out what the user meant and correct what was typed. Often users won't even know they mistyped an entry!

IIS: PET Examples

There are numerous uses for such a routine. Here is a simple one. The PET's "programmer's keyboard" differs from the standard keyboard in that the top row characters (from exclamation point to brackets) are obtained without shifting. On a typewriter you must shift for these characters. If the touch typist using your program shifts to hit the brackets, a weird graphics symbol appears, which will cause an error or, if caught at the time, have to be deleted.

A sophisticated input subroutine could monitor keystrokes, detect and intercept the shifted bracket, and replace it with the intended symbol before it appears on the screen.

Or suppose you have transferred to the lowercase alternate character set. You are inputting people's names. The IIS can capitalize the first character, and every character after a space, whether the user shifted or not.

But the real power of an IIS is revealed when it's used for specialized formatting of input. To illustrate, I will show examples that apply to education, that could be used to improve programs which have appeared in **COMPUTE!**.

Have you seen copper (II) sulfate printed by a computer this way: CUS04 ? Or students are told to input a quadratic as X2+2X-3 ; or, worse, as X"2+2*x-3. Programs displaying chemical formulae without lower case and subscripts, and mathematical expressions that do not display exponents are not examples of good user-oriented programs. Just by typing these characters: X,2+,2,X,-, and 3 a student *should see on the screen* x^2+2x-3, and the program should understand what was input. Anything else is pandering to the convenience of the computer (and the programmer) in the worst way.

Let's see how to devise an intelligent subroutine to accept algebraic expressions. The first step is to have an *Input Anything Routine* as your foundation. In brief, such a subroutine can use a GET statement to detect keystrokes. Each character is checked against allowed characters. Undesirable characters (e.g. cursor control characters, graphics symbols, etc.) are rejected, and the user sees nothing happen on the screen in response to such a keypress.

Suitable characters are added to the growing collection string (RESP$ in the accompanying examples) and printed to the screen. In the event the key pressed was DELETE, appropriate action must be taken. The routine keeps looping back to the GET statement until a CHR$(13) (RETURN) arrives, whereupon the subroutine returns to the main program. (This whole routine replaces INPUT RESP$ (and any accompanying error checking), but the final product is worth the extra coding!)

We will modify the Input Anything Subroutine in PET Program 1 to accept and display mathematical expressions. The first step is to plan what we want.

1. Allow lower and upper case variables.

2. Raise exponents to the line above.

3. Accept numerals, letters, +, -, (and = if equations are anticipated.)

4. Accept and process DELETE and RETURN.

5. Reject everything else.

Since both coefficients and exponents are numbers, the computer must find some way to tell the difference. It is obvious that exponents always follow variables, which are letters (we won't allow exponents on the coefficients) so the IIS watches for numbers following letters.

One way it could do this is to set a flag (VAR = 1) when a letter is hit. If the flag is set when a number is typed, an exponent is intended. A +, -, or RETURN could reset the flag (VAR = 0). This is very flexible, but complicated, especially when you realize that you must provide for "unsetting" the flag if the user deletes a just-entered variable to

correct an error. A routine which uses flags to advantage appears later.

In this case, if we restrict exponents to one digit, we can use a simpler method. When a number comes in from the keyboard, we need only look at the last character in RESP$. If it is a letter, we raise the exponent. This is done by printing a cursor-up, the number, then a cursor-down to return us to the input line.

The routine is in statements 1000-1290 of PET Program 2. It is contained in a little program to illustrate its use. Note how alternate correct answers can be provided. Unless an Intelligent Printing Subroutine (which can be part of the Intelligent Input Subroutine) is used, you must also read in a form of the answer containing cursor controls for screen display. One thing you must do when you code for the pressing of the DELETE key is to provide for erasure of the character on the line above the cursor as well as just to the left on the same line: the character to be removed might be an exponent.

In PET Program 3 we use an IIS for chemical formulae. Here we put any numeral on the line below. You can make the routine more flexible. For example, to allow for hydrates, which require non-subscripted coefficients, the routine could check for a dot (period) immediately preceding the arrival of a number, and act accordingly.

PET Program 4 shows an IIS for going the other way – formula to name. Here the use of flags is demonstrated. Normally we use lowercase, but, after brackets are opened, the routine promotes everything to uppercase whether the user shifts or not. The bracket flag (BFLAG%) is reset when brackets are closed. Note also how the routine makes allowances if the trained typist, by habit, shifts to hit brackets.

Not only will the use of Intelligent Input Subroutines make your programs more user-proof, but well designed subroutines can also give them a professional look. Your programs should always adapt to the user, not force them to conform to the computer.

Notes regarding the listings:

1. Spaces were inserted for clarity. If they are omitted, the statements will fit into 80 character lines, except for a couple of statements with extra-long REMs which you will have to truncate.

2. The letters "REM" were used only where necessary. Note the places where you can make REM-less comments (save space!).

Apple Routines

Here are some designs for Apple routines.

There have been some excellent "input anything" subroutines for Apple published. The problem, of course, was to get around the EXTRA IGNORED response and accompanying loss of part of the input when a comma or colon was included. One of the shortest I've seen is by Ben Colley (*NIBBLE*, volume 2, number 1, page 59).

Program 1 (Apple Version) shows the BASIC Input Anything Subroutine in action. The subroutine starts at line 100, and is amplified by many REMarks. Every character entered is collected in R1$. A count is made of characters, R1. Usually, of course, R1 will equal the length of R1$., but, if there is a deletion, instead of lopping off the last character of R1$, we decrease R1. By doing this we can regain previously typed in characters, as we must if we are allowing for the use of the right-arrow key. We just increase R1 again. There is a problem with providing for deleting, though. Since control characters do not show on the screen, if you have typed a control character in your string, and do some deletions, then what is on the screen might not be what is in the final version of R1$, which becomes RESP$ upon exiting from the subroutine. This is actually an Input *almost* Anything Subroutine, because line 155 rejects control characters. However, you can do it one better by using an IIS that actually prints the control characters, if there is a need for them, in inverse video.

Sometimes it is useful to allow the user to exit from a routine without finishing the input: for example, the user might make an incorrect choice at a menu, wind up in an undesired routine, and want out. Line 120 accomplishes this by using the ESCape key. Alternatively, line 220, which rejects a RETURN if there has been no input, can be the early exit. Change it to IF R1 = 0 THEN RETURN and check for R1 equalling zero in line 1010.

Program 2 is an IIS designed around a simpler Input Anything Subroutine. This time, when a character is deleted using the left-arrow key, it is erased on the screen. Thus there is no need to save characters for use of the right-arrow key. We can fill RESP$ directly, without the use of the intermediary R1$ and character counter R1.

This IIS accepts and displays chemical formulae. Called by the main program at line 10010, it begins at line 1000. The first job is to look for a RETURN, in line 1050. Letters are processed in lines 1050 and 1060. In lines 1070 to 1090, numbers are placed in the line below, as subscripts should be. First the vertical cursor position is found (CV%), and we VTAB to the line below it. (Mathematicians: just change the + to a minus in the VTAB expression to put your exponents above the line. You will have to check that the previous character input (the last one in RESP$) was a letter so you'll be sure that the number was not a coefficient.) Next, the

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routine checks to see if brackets had been input. Acting under the assumption that the user would never need to type an eight or nine in a chemical formula, these are promoted to the bracket corresponding to SHIFT-8 or SHIFT-9. Deletion is accomplished by shortening RESP$ in line 1160, after being careful to erase the previous character on the same line and below. (Remember, you could be erasing a subscript.) At this point the routine would check for and process any other desired input characters. However, if we wish to reject all other characters, we just go straight to line 1500.

Program 2 is actually a little routine to test out the subroutine (as is Program 1). It contains one other small subroutine of interest. If this were part of a program where the computer, as well as the user, were required to print out a formula, you would need a formatting routine. This one, appearing in lines 2000 to 2030, is quite simple. Send the formula to the subroutine as B$, and the formula is displayed with subscripts in their proper places. Again, just a minor adjustment is needed to turn this into a mathematical expression formatting subroutine. (See the example and discussion above on IIS's for PET: the logic is the same. Only the cursor control procedures are different.)

There is no doubt that Intelligent Input Subroutines are more difficult to devise and require more coding than simple INPUT statements. Their use, however, should lead to programs which are more user-oriented, a direction that we programmers should be heading as computer usage becomes more widespread.

Program 1: PET Version

```
1 REM  LISTING1
           :
2 REM IAS
        :
10 REM FOR INPUT, GOSUB 1000
20 :
30 REM *** MAIN PROGRAM ***
        :
40 GOSUB1000:IF RESP$="END" THEN E
   ND
50 PRINT"{DOWN}YOU JUST TYPED THIS
    ";RESP$
60 PRINT"{03 DOWN}TYPE SOMETHING E
   LSE OR ENTER ";CHR$(34)"EN
   D"CHR$(34)
70 GOTO40
80 :
90 REM ******************
997 :
998 REM INPUT SUBROUTINE  USES A$,A
    %.
999 REM RETURNS WITH RESP$
        :
1000 RESP$=""
1010 PRINT"$̲{LEFT}";
1020 GETA$:IFA$=""THEN1020
1030 A%=ASC(A$):IFA%=13ORA%=141THENP
     RINT" ":RETURN
1035 REM RETURN PRESSED: ERASE CURSO
     R AND BACK TO MAIN PROGRAM

1040 IFA%<>20THEN1090:SKIP UNLESS DE
     LETE PRESSED
1050 IFLEN(RESP$)<1THEN1020:NOTHING
     TO DELETE
1060 RESP$=LEFT$(RESP$,LEN(RESP$)-1)
     :REMOVE LAST CHARACTER
1070 PRINT"{LEFT}  {02 LEFT}" ;:REM
     ERASE LAST CHARACTER AND C
     URSOR
1080 GOTO1010
1090 IF(A%>=161ANDA%=<169)THENA$=CHR
     $(A%-128):A%=ASC(A$):GOTO1
     110
1095 REM UNSHIFT UPPER ROW (UNLESS Y
     OU
1096 REM WANT TO ACCEPT THE GRAPHICS

1097 REM CHARACTERS
1100 IFA%<31ORA%>160THEN1020
1105 REM OF COURSE 1100 RESTICTS THE
       INPUT A BIT...IF YOU WAN
     T TO BE ABLE
1106 REM TO INPUT TOP ROW GRAPHICS
     SYMBOLS, REMOVE 1100
1110 IFA%=34ORA%=96THENPRINTCHR$(34)
     ;CHR$(34)"{LEFT}";:GOTO113
     0
1120 PRINTA$;
1130 RESP$=RESP$+A$:GOTO1010
```

Program 2: PET Version

```
10 POKE59468,14:REM ALLOW LOWER CA
   SE
20 FORI=1TO3:READQUEST$(I),A1$(I),
   A2$(I),A3$(I)
30 NEXTI:REM   READS IN QUESTION A
   ND TWO POSSIBLE UNFORMATED

40 REM    ANSWERS, AND A FORMATTED
     ANSWER FOR SCREEN DISPLAY

90 REM    ASK THREE QUESTIONS
100 FORI=1TO3
110 PRINT"{CLEAR}{03 DOWN}":PRINTQU
    EST$(I);"{03 DOWN}":PRINT"
          ";
120 GOSUB1000
```

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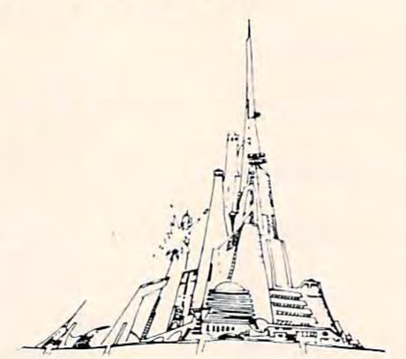

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OSI COLOR-80

```
130 IFRESP$=A1$(I)ORRESP$=A2$(I)THE
    N200
140 REM TAKE CARE OF INCORRECT RESP
    ONSE
150 PRINTTAB(20);"{03 DOWN}NO, THAT
    'S WRONG"
160 FORJ=1TO2000:NEXT
170 PRINT"{05 DOWN}          ANSWER
    IS ";A3$(I):GOTO210
190 REM   ACKNOWLEDGE CORRECT RESPO
    NSE
200 SC=SC+1:PRINTTAB(20);"{03 DOWN}
    GOOD"
210 FORJ=1TO4000:NEXTJ
220 NEXTI
290 REM  POSTMORTEM
300 PRINT"{CLEAR}{06 DOWN}YOUR SCOR
    E IS";SC
310 PRINT"{02 DOWN}":END
999 REM  INPUT ROUTINE
1000 RESP$=""
1010 PRINT"${LEFT}";:REM  ANY CURSOR
     PROMPT YOU WANT
1020 GETA$:IFA$=""THEN1020
1030 LAST%=0:IFRESP$<>""THENLAST$=RI
    GHT$(RESP$,1):LAST%=ASC(LA
    ST$)
1040 IFASC(A$)=13 OR ASC(A$)=141THEN
    PRINT" ":RETURN
1045 REM 1040 -  IF RETURN PRESSED, ~
    ERASE PROMPT AND RETURN
1050 IFASC(A$)<>20THEN1100:SKIP UNLE
    SS DELETE PRESSED
1060 IFLEN(RESP$)<1THEN1010:NOTHING ~
    TO DELETE
1070 RESP$=LEFT$(RESP$,LEN(RESP$)-1)
    :REMOVE LAST CHARACTER
1080 PRINT"{LEFT}  {02 LEFT}{UP} {DO
    DOWN}{LEFT}";:GOTO1010
1090 REM PRINT CHARACTER
1100 IFA$="("THENA$="(":REM UNSHIFT ~
    BRACKET
1110 IFA$=")"THENA$=")":REM UNSHIFT ~
    BRACKET
1120 IFA$="("ORA$=")"ORA$="="ORA$="+
    "ORA$="-"THEN1180
1130 REM ABOVE ARE THE ONLY SYMBOLS ~
    ALLOWED
1140 B%=ASC(A$)
1150 IFB%<49ORB%>59THEN1170
1160 IF(LA%>64ANDLA%<91)OR(LA%>192AN
    DLA%<219)THENPRINT" {LEFT}
    {UP}";A$;"{DOWN}";:GOTO119
    0
1170 IF(B%<49OR(B%>=91ANDB%<=192)ORB
    %>219)THEN1010
1180 PRINTA$;
1190 :RESP$=RESP$+A$:GOTO1010
9997 :
9998 REM  DATA
9999 :
10000 DATA(X+1)(Y-1) = ,XY-X+Y-1,XY+Y
    -X-1,XY-X+Y-1
10010 DATA"FACTOR:  X{UP}2{DOWN} - Y{
    UP}2{DOWN} =",(X-Y)(X+Y),(
    X+Y)(X-Y),(X+Y)(X-Y)
10020 DATA"WHAT'S THE SQUARE OF A+B?"
    ,A2+B2+2AB,A2+2AB+B2,"A{UP
    UP}2{DOWN}+2AB+B{UP}2{DOWN
    DOWN}"
```

Program 3: PET Version

```
0 POKE59468,14:GOTO99
1 REM LISTING III                  ~
           :
2 I.I.S. FOR INPUT OF CHEMICAL FO
   RMULA  :
3 GOSUB 1000 TO RECEIVE A FORMULA
            :
98 ******  MAIN PROGRAM ******     ~
         :
99 PRINT"{CLEAR}"
100 PRINT"ENTER CHEMICAL FORMULA."
110 PRINT:PRINT"TYPE "CHR$(34)"END"
    CHR$(34)" TO END"
120 PRINT:GOSUB1000
130 PRINT"{02 DOWN}":IFRESP$="END"T
    HENPOKE59468,12:END
140 GOTO100
150 :
160 ***************************    ~
         :
1000 RESP$=""
1010 PRINT"${LEFT}";: REM ANY CURSOR
     PROMPT YOU WANT
1020 GETA$:IFA$=""THEN1020
1030 A%=ASC(A$):IFA%=13ORA%=141THENP
    RINT" ";:RETURN : ERASE CU
    RSOR AND RETURN
1040 IFA%<>20THEN1090:SKIP TO 1090 U
    NLESS DELETE PRESSED
1050 IFLEN(RESP$)<1 THEN 1020: NOTHI
    NG TO DELETE
1060 RESP$=LEFT$(RESP$,LEN(RESP$)-1)
    :REMOVE LAST CHARACTER
1070 PRINT"{LEFT}  {02 LEFT}{DOWN} {
    UP}{LEFT}";:REM ERASE ON A
    ND BELOW LINE, CURSOR, THE
    N BACK UP
1080 GOTO1010
1090 IF(A$>="A"ANDA$<="Z")OR(A$>="A"
     AND A$<="Z")THEN 1170: IT
    'S A LETTER
1100 IFA$="("THENA$="(":GOTO1170
1120 IFA$="("THEN1170
1130 IFA$=")"THENA$=")":GOTO1170
```

```
1140 IFA$=")"THEN1170
1150 IFA$>"1"ANDA$<="9"THENPRINT" {L
    LEFT}{DOWN}";A$;"{UP}";:GO
    TO1180:NUMBER SUBSCRIPTED
1160 GOTO1020:REJECT ANYTHING ELSE
1170 PRINTA$;:REM PRINT LETTER
1180 RESP$=RESP$+A$:GOTO1010
```

Program 4: PET Version

```
0 POKE59468,14:PRINT"{CLEAR}":GOT
    O100
10 LISTING IV  I.I.S. CHEMICAL NAM
    ES     :
20 GOSUB 1000. USES A$,A%.
30 RETURNS WITH RESP$.
40 ACCEPTS LETTERS, BRACKETS, SPAC
    E.
50 UNSHIFTS BRACKETS.
60 CAPITALIZES ROMAN NUMBERALS
89 :
90 ****** MAIN PROGRAM *****
91 :
100 PRINT"TYPE A CHEMICAL NAME"
110 PRINT"{02 DOWN}";:GOSUB1000
115 PRINT:PRINT"{DOWN}RESP$ = ";CHR
    $(34)RESP$CHR$(34)
120 IFRESP$="END"THENPOKE59468,12:E
    ND
130 PRINT:PRINT"{03 DOWN}TRY ANOTHE
    R.  TYPE "CHR$(34)"END"CHR
    $(34)" TO END"
140 GOTO110
150 :
160 **************************
    :
1000 BFLAG%=0:RESP$=""
1005 PRINT"${LEFT}";:REM ANY CURSOR
    PROMPT YOU LIKE
1010 GETA$:IFA$=""THEN1010
1020 A%=ASC(A$):IFA%=13 OR A%=141 TH
    EN PRINT" ";:RETURN
1030 IFA%<>20THEN1090:SKIP UNLESS DE
    LETE PRESSED
1040 IF LEN(RESP$)< 1 THEN 1020:NOTH
    ING TO DELETE
1050 IFRIGHT$(RESP$,1)="("THENBFLAG%
    =0:REMCLEAR BRACKET FLAG I
    N ERASING BRACKET
1060 RESP$=LEFT$(RESP$,LEN(RESP$)-1)
    :REMOVE LAST CHARACTER
1070 PRINT"{LEFT}$ {02 LEFT}";:REM E
    RASE OLD CURSOR & REPLACE
    LAST CHARACTER WITH CURSOR

1080 GOTO1010
1090 IF(A%>64ANDA%<91)ORA%=32ORA%=16
    0ORA%=201ORA%=214THEN1150:
    SKIP IF LETTER
1095 REM ALLOWS LOWER CASE LETTERS O
    NLY, EXCEPT ROMAN NUMBERAL
    S, AND SPACE
1100 IFA$<>"("ANDA$<>")"ANDA$<>"("AN
    DA$<>")"THEN1010:REJECT AL
    L BUT BRACKETS
1110 IFA$="("THENA$="("
1120 IFA$=")"THENA$=")"
1130 IFA$="("THENBFLAG%=1:GOTO1180
1140 IFA$=")"THENBFLAG%=0:GOTO1180
1150 IFBFLAG%=0THEN1180
1160 IFA$="I"THENA$="I":GOTO1180
1170 IFA$="V"THENA$="V"
1180 PRINTA$;:RESP$=RESP$+A$:GOTO100
    5
```

Program 1: Apple Version

```
1  HOME : PRINT "TYPE ANY STRING
     AND HIT RETURN": PRINT ("TOU
     CH ESC TO EXIT"): VTAB 6: GOTO
     1000
97 :
98  REM  THE BASIC SUBROUTINE
99 :
100 RESP$ = "":R1$ = "":R1 = 0
110  GET A$
117 :
118  REM  ESCAPE
119 :
120  IF A$ =  CHR$ (27) THEN  RETURN

127 :
128 : REM  DELETE
129 :
130  IF A$ =  CHR$ (8) THEN 200
137 :
138  REM  RETURN
139 :
140  IF A$ =  CHR$ (13) THEN 220
147 :
148  REM  RIGHT ARROW COPY
149 :
150  IF A$ =  CHR$ (21) THEN 250
152 :
153  REM  REJECT CONTROL CHARACTE
     RS
154 :
155  IF  ASC (A$) < 27 THEN 110
157 :
158  REM  ALLOW ANYTHING ELSE
159 :
160  IF R1 = 0 THEN R1$ = A$: GOTO
     190
170  IF  LEN (R1$) <  = R1 + 1 THEN
```

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```
     R1$ =  LEFT$ (R1$,R1) + A$: GOTO
     190
180 R1$ =  LEFT$ (R1$,R1) + A$ +
      RIGHT$ (R1$, LEN (R1$) - R1

      - 1)
190 R1 = R1 + 1: PRINT A$;: GOTO
     110
197 :
198  REM  PERFORM DELETION
199 :
200  IF R1 >  = 1 THEN R1 = R1 -
     1: PRINT A$;: GOTO 110
210  GOTO 110
217 :
218  REM  HANDLE RETURN
219 :
220  IF R1 = 0 THEN 110
230 RESP$ =  LEFT$ (R1$,R1): FOR
     A = 1 TO  LEN (R1$) - R1: PRINT
     " ";: NEXT
240  PRINT : RETURN
247 :
248  REM  RIGHT ARROW COPY
249 :
250  IF R1 = 0 OR  LEN (R1$) <  =
     R1 THEN 110
260 A$ =  MID$ (R1$,R1 + 1,1)
270  IF  LEN (R1$) = R1 + 1 THEN
     R1$ =  LEFT$ (R1$,R1) + A$: GOTO
     190
280 R1$ =  LEFT$ (R1$,R1) + A$ +
      RIGHT$ (R1$, LEN (R1$) - R1
      - 1): GOTO 190
997 :
998 : REM  MAIN PROGRAM
999 :
1000  GOSUB 100
1010  IF A$ =  CHR$ (27) THEN  PRINT
     "ESCAPED": END
1020  PRINT : PRINT "YOU TYPED ";
     RESP$: PRINT : PRINT : GOTO
     1000
```

Program 2: Apple Version

```
1  GOTO 10000
997 :
998  INPUT SUBROUTINE
999 :
1000 RESP$ = ""
1010  POKE  - 16368,0
1020  GET A$:A =  ASC (A$): IF A <
     > 13 THEN 1050
1030  IF RESP$ = "" THEN 1020
1040  RETURN
1047 :
1048  REM  TAKE CARE OF LETTERS
1049 :
1050  IF A < 65 OR A > 90 THEN 10
     70
1060 RESP$ = RESP$ + A$: PRINT A$
     ;: GOTO 1020
1067 :
1068 : REM  TAKE CARE OF NUMBERS
1069 :
1070  IF A < 49 OR A > 55 THEN 11
     00
1080 CV% =  PEEK (37) + 1: VTAB (
     CV% + 1)
1090 RESP$ = RESP$ + A$: PRINT A$
     ;: VTAB (CV%): GOTO 1020
1097 :
1098  REM  BRACKETS SHIFTED?
1099 :
1100  IF A$ = "8" OR A$ = "(" THEN
     RESP$ = RESP$ + "(": PRINT "
     (";: GOTO 1020
1110  IF A$ = "9" OR A$ = ")" THEN
     RESP$ = RESP$ + ")": PRINT "
     )";: GOTO 1020
1117 :
1118  REM  DEAL WITH DELETE
1119 :
1120  IF A <  > 8 THEN 1500
1130  IF RESP$ = "" THEN 1020: REM
      NOTHING TO DELETE
1140 H% =  PEEK (36): HTAB (H%): PRINT
     " ";: HTAB (H%):CV% =  PEEK
     (37) + 1: VTAB (CV% + 1): PRINT
     " ";: VTAB (CV%): HTAB (H%)
1150  IF  LEN (RESP$) = 1 THEN RE
     SP$ = "": GOTO 1020
1160 RESP$ =  LEFT$ (RESP$, LEN (
     RESP$) - 1): GOTO 1020
1175 :
1180  REM  PUT ANY OTHER SPECIAL
     CHECKS FOR SPECIFIC INPUT
     HERE (EXAMPLE: HANDLE ESCAPE
     KEY (CHR$(27)) IF YOU WISH
     IT TO HAVE A SPECIAL
     FUNCTION).
1185 :

1500  GOTO 1020: REM  REJECT
       ANYTHING ELSE
1510 :
1997 :
1998  REM  PRINT OUT FORMULA
1999 :
2000  FOR II = 1 TO  LEN (B$):A$ =
     MID$ (B$,II,1)
2010  IF  ASC (A$) > 64 OR  ASC (
```

7 ATARI PRODUCTS

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The Monkey Wrench is a machine language ROM cartridge which extends the operating capability of the ATARI 800 computer. The Monkey Wrench provides 9 new BASIC commands. They are:

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```
     A$) < 49 THEN  PRINT A$;: NEXT
     : RETURN
2020 CV% =  PEEK (37) + 1: VTAB (
     CV% + 1): PRINT A$;: VTAB (C
     V%)
2030  NEXT : RETURN
2040 :
9997 :
9998  REM  *** MAIN PROGRAM ***
9999 :
10000  HOME : PRINT "TYPE IN CHEM
     ICAL FORMULAS": PRINT : PRINT
     "(TYPE " CHR$ (34)"END" CHR$
     (34)" TO END.)": POKE 34,4
10010  VTAB 15: GOSUB 1000: PRINT

10020  IF RESP$ = "END" THEN  POKE
     34,0: END
10030  PRINT : PRINT "YOU TYPED I
     N ";:B$ = RESP$: GOSUB 2000:
      PRINT
10040  FOR I = 1 TO 5: CALL  - 91
     2: NEXT : GOTO 10010
```

Program 1: Atari Version

Here's an "input anything" subroutine for Atari users. It will accept upper or lowercase, punctuation, and numbers. It will not accept any editing or cursor controls except BACK S (backspace). Line 1080 zeroes out the system's inverse video flag to cancel reverse field, and line 1120 traps bad characters. Programmer's note: Line 1060 shows one way to safely DIMension an array from within a subroutine without worrying about an error message. If INIT is zero, the array should be dimensioned, and INIT is set to one, preventing the array from being redimensioned unless INIT is reset with CLR. This prevents you from having to use a TRAP statement here.

```
10 PRINT "TYPE IN A LINE AND HIT RETURN:
":GOSUB 1000
20 PRINT "YOU TYPED:":? I$
30 END
1000 REM "Input (Almost) Anything"
1010 REM Subroutine for Atari
1020 REM Traps CTRL characters
1030 REM reverse field, all cursor
1040 REM controls except BACK S.
1050 REM Length of string limited by LN
1060 IF INIT=0 THEN DIM I$(100):LN=100:O
PEN #1,4,0,"K:":INIT=1
1070 LNS=1
1080 GET #1,A:POKE 694,0:REM Kill RVS
1090 IF A=155 THEN ? :RETURN
1100 IF A=126 AND LNS>1 THEN LNS=LNS-1:I
$(LNS)=" ":PRINT CHR$(A);
1110 IF LNS>LN THEN 1080
1120 IF A<32 OR A=96 OR A>122 THEN 1080
1130 I$(LNS,LNS)=CHR$(A):? CHR$(A);:LNS=
LNS+1
1140 GOTO 1080
```

Program 2: Atari Version

This program will let the user enter a chemical formula as described in the article, with numbers subscripted after capital letters. This routine only accepts uppercase letters, and changes a typed "9" or "0" to "(" and ")", respectively. There is an "intelligent printing routine" in the main program. Note that BACK S deletes the character behind and under the cursor, requiring two lines of space on the screen.

```
10 PRINT "ENTER CHEMICAL FORMULA:"
20 GOSUB 1000:PRINT
30 PRINT "I$=";CHR$(34);I$;CHR$(34):PRIN
T
40 PRINT "YOU TYPED:"
45 REM Intelligent Print Routine
50 FOR I=1 TO LEN(I$)
60 A=ASC(I$(I,I)):T=ASC(I$(I-(I>1)))
70 IF A>48 AND A<57 AND (T>64 AND T<91 O
R T=41) THEN ? "{DOWN}";CHR$(A);"{UP}";:
GOTO 90
80 PRINT CHR$(A);
90 NEXT I
100 PRINT :PRINT
110 END
1000 REM Modified Input Subroutine
1010 REM for chemical formulas.
1020 REM Shifts subscripts down,
1030 REM changes 9 and 0 into
1040 REM left and right brackets.
1050 REM
1060 IF INIT=0 THEN DIM I$(100):LN=100:O
PEN #1,4,0,"K:":INIT=1
1070 LNS=1:I$=" "
1080 GET #1,A:POKE 694,0:REM Kill RVS
1090 IF A=155 THEN ? :RETURN
1100 IF A=126 AND LNS>1 THEN LNS=LNS-1:I
$(LNS)=" ":PRINT "{LEFT} {DOWN}{LEFT} {L
EFT}{UP}";
```

```
1110 IF LNS>LN THEN 1080
1120 IF A<32 OR A>90 THEN 1080
1130 T=LNS-(LNS>1):T=ASC(I$(T,T))
1135 IF (T>64 AND T<91 OR T=41) AND A>48
 AND A<57 THEN ? "{DOWN}";CHR$(A);"{UP}"
;:GOTO 1170
1140 IF A=57 THEN A=40
1150 IF A=48 THEN A=41
1160 ? CHR$(A);
1170 I$(LNS,LNS)=CHR$(A):LNS=LNS+1
1180 GOTO 1080
```

©

Machine Language: Jump To It!

Jim Butterfield
Toronto, Canada

The 6502 Jump (JMP) has advantages over the various Branch instructions. For one thing, it may go anywhere in memory, where the Branches can hop only a hundred and twenty locations or so either way. Sometimes it's useful that Jump is unconditional: you want to go somewhere and your condition flags are not definitely known.

Jump has its limitations, too. It takes up one more byte than a Branch. You cannot use it conditionally. And a Jump is not "truly relocatable." If you had a program with no Jumps, only Branches, and you decided to move it to a new location in memory, the Branches would still work. After all, Branches use relative addressing which says to hop ahead or back a number of bytes; so when the program is moved, the Branches are still valid in their new place. Not so with the Jump: when your program moves, all Jumps to within that program must be changed.

Often, Jump and Branches can be used together to give advantages of each: the conditional test of the Branch, and the unlimited reach of the Jump. It's not uncommon to see coding like:

```
        BEQ NEXT
        JMP NOTEQ
NEXT    ....
```

The effect is a little like "inverting" the Branch instruction. The code continues if the equals condition is found (BEQ goes to NEXT and continues); but jumps away if not-equals is the case. It seems backwards: the Equals text causes us to change direction if we find not-Equals; but it works well without fuss or bother.

Jump Tables

Jump Tables are a collection of Jump instructions, one behind the other, arranged in some part of memory. They tend to baffle the beginning expert.

"Beginning experts," by the way, are programmers who have learned all the instructions, but haven't yet absorbed the wisdom that comes with programming experience. When confronted with a Jump table, the reasoning goes as follows: "I am asked to go to this location, which will immediately Jump somewhere else. What's the point? I can go directly to the destination and save myself a few microseconds and perhaps a few bytes of memory."

The concepts of microsecond and bytes can be quite valid in certain environments. But most of us should be placing the emphasis elsewhere. Machine language is plenty fast for most applications; you won't have time for an extra cup of coffee in those five hundred microseconds of time you save. Memory is cheap and plentiful; you're unlikely to run out of space in the average machine language program you code. A sound program will probably be economical of space and time, but the main objective is to have a well-constructed program.

What's the purpose of a Jump table? To give the program a standard set of locations through which it can access other programs. This can be very useful in providing easy testing and easy compatibility between different machines.

Suppose, for example, you were writing a program that did quite a bit of screen output. If you wrote for a PET/CBM and then wanted to transfer it to an Apple, AIM or Atari, you might have to change every call to the output routine; there might be dozens of these. On the other hand, if you arranged your code so that every output call went to your own location PRJUMP which in turn jumped to the PET/CBM output routine, you'd need to change only the address of your PRJUMP instruction to switch output for the other machine.

Additionally, building a Jump table encourages you to identify in advance those program connections that might need changing. When it's complete, you'll have an easily identifiable list of those connection points, laid out neatly in your program.

Commodore has carefully laid out a Jump table near the top of ROM memory for the use of Machine Language programmers. Every model of PET, CBM and VIC uses the same entry points, so that the user with experience on one model can easily move to the other. This also makes for a great deal of compatibility between machines; many programs will transport directly without change from one to the other. The "difficult" machines for compatibility are the very first model PET and the VIC: the Jump table is still the same, but differing zero page allocations make it hard to transfer programs without change.

The most important Jump table elements are: $FFD2, for output; $FFE4, for GET; $FFE1, for testing the STOP key. These give you input and output control, and allow you to "guard" loops during debugging.

JSR $FFD2 sends the contents of the A register, a PET-ASCII character, to the output. This is normally the screen, although it can be switched to send to other devices. All registers – A, X, and Y – are preserved.

JSR $FFE4 gets one character and places it into the A register as a PET-ASCII value. It normally gets from the keyboard buffer, but can be switched to receive from other devices. All registers might be changed.

JSR $FFE1 does nothing unless the RUN/STOP key is depressed; in which case it exists to BASIC READY. It's very handy if your program gets stuck in a loop; remember that the JSR $FFE1 must also be in the loop to work. The A register will be changed.

The PET/CBM Switch

We can switch the input or output to devices other than keyboard/screen. Providing the new devices have been OPENed previously (probably in BASIC), we may switch to them by using the logical file number – not the device number.

If we had previously opened a disk file for reading with OPEN 1,8,5,"INFILE,S,R" we may now switch the input to this file with LDX #$01 : JSR $FFC6; later we may restore normal keyboard input with JSR $FFCC. Between these two, we may place as many GET calls (JSR $FFE4) as we wish to receive from the disk file; at a later time, we may switch the file in again and receive more data.

In the same way, we might have opened a printer file for output with OPEN 2,4 and may at any time switch output to the printer with LDX #$02 : JSR $FFC9; later we may switch back to screen output with JSR $FFCC. In between, the JSR $FFD2 call will send to the printer rather than to the screen.

Files may be switched in and out repeatedly as desired. Don't switch input and output at the same time – you would hopelessly confuse the IEEE bus. And remember that when you're finished and return to BASIC, you should CLOSE all open files.

Jump tables, which are seemingly excess code, can greatly enhance program organization and portability. Get into the habit of constructing your own on larger programs. And make a point of knowing the ones provided by your computer manufacturer. ©

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Built on a

PETASCII To ASCII Conversion

Brian Niessen
Chemainus, B.C.

This very useful machine language routine is well worth its weight in gold when it comes to using your PET/CBM wth ASCII devices such as MODEMS and printers. It's short length (56 bytes) and ease of use make it very easy to add to any existing programs. The assembler listing included is for BASIC 3.0 ROM's. The changes needed for BASIC 2.0 ROM's and BASIC 4.0 ROM's are listed below.

For BASIC 2.0, change COMMA to $CE11 from $CDF8, change EVAL to $CCB8 from $CC9F, and change PTR to $96 from $44. For BASIC 4.0, change COMMA to $BEF5 from $CDF8 and change EVAL to $BD98 from $CC9F. The PTR location is the same for BASIC 4.0 as it is for BASIC 3.0, as Commodore promised it would be.

The machine language program works as follows. It is invoked with a SYS(NNN),A$ statement. The (NNN) is the first location of the ML routine and the string variable A$ is the string to be converted. The ML program then jumps to the routine COMMA, which checks for – you guessed it – the comma which seperates the SYS(NNN) and the A$. The next jump is to a subroutine called EVAL which looks at the variable A$ and puts its location in PTR and PTR + 1.

CBM/PET identifies characters somewhat differently than the industry standard, the ASCII code. In ASCII, the number 65 means uppercase "A," as it does to PET BASIC. However, if you POKE 32768,65, the screen will either display a spade or lowercase "a," depending on whether you are in "text" or "graphics" mode at the time. Everything is kept straight for you by BASIC, but when you try to communicate with a device outside the computer (a MODEM or a printer), some adjustments may need to be made. This is why wordprocessors like WordPro always first ask you to indicate whether you are using a Commodore printer, an ASCII printer, etc. Mr. Niessen's machine language program does the translating. It takes the CBM/PET character codes and modifies them to conform to ASCII. Within the article, he provides the necessary changes to make the program work on all CBM models: Original (2.0), Upgrade (3.0), and BASIC (4.0).

By using an indirect indexed addressing mode, you can get the length of the string by loading the Y register with zero and executing a LDA(PTR),Y. The length of the string is then transferred into the accumulator and saved into location STRLEN. Next, the Y register is incremented so it has a value of one, and another LDA(PTR),Y is executed. This time the LO byte of the beginning of the actual string in memory is returned. This is saved in the location STRLO. Again the Y register is incremented and the LDA(PTR),Y instruction is executed again, returning the HI byte of the location of the string, which is saved in STRHI.

Now knowing the location and length of the string to be converted, the routine can convert it from PETASCII to ASCII on a character by character basis, beginning with the last one and working forward. It uses the following algorithm:

```
IF(A)> =65 AND (A)< =90 THEN (A)=(A) OR 32
ELSE IF (A)> =193 AND (A)< =219 THEN (A)=(A)
   AND 127
```

Characters above $7B have no ASCII equivalent and are left as is.

The subroutine then returns to BASIC, with the contents of the string A$ converted to ASCII. The string can now be printed normally.

One thing to remember is that the original contents of the string are changed. If the string were dynamically declared, as in the following example, it will be changed within the program:

```
10 A$="STRING":SYS(NNN),A$
```

because the PET, to save memory space, sets the pointers to the actual string in the program. Instead use:

```
10 A$="STRING"+" ":SYS(NNN),A$
```

which will cause the string to be stored away in high memory.

I hope this will prove as useful to others as it chips...chips...chips...chips...chips...chips...

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has been to me. It was tested on the EPSON MX-80 printer.

References:

Commodore User's Reference Manual – PN 321604
Page E-1, Paragraph 1

The PET Revealed
Nick Hampshire, Computabits Ltd, P.O. Box 13, Yeovil, Somerset, England

PET/CBM Personal Computer Guide
Adam Osborne-Carroll S. Donahue
Osborne/McGraw-Hill

```
LOC   CODE       LINE
0000             ;***********************************
0000             ;* PETASCII TO ASCII SUBROUTINE    *
0000             ;* BY: BRIAN NIESSEN.              *
0000             ;*                                 *
0000             ;* BOX 571                         *
0000             ;* CHEMAINUS, B.C.   VOR 1KO       *
0000             ;* (604) 246-4556                  *
0000             ;***********************************
0000             ;* TO USE: SYS(NNN),A$             *
0000             ;* WHERE (NNN) IS START LOCATION   *
0000             ;* A$ IS STRING TO BE CONVERTED    *
0000             ;***********************************
0000             ; LOCATIONS FOR 2001 (BASIC 3.0)
0000             COMMA  = $CDF8
0000             EVAL   = $CC9F
0000             STRLO  = $DA
0000             STRHI  = $DB
0000             STRLEN = $F9
0000             PTR    = $44             ;POINTER USED IN EVAL ROUTINE
0000                    * = 634           ;STARTING LOCATION FOR ROUTINE
027A  20 F8 CD          JSR COMMA         ;CHECK FOR COMMA
027D  20 9F CC          JSR EVAL          ;EVALUATE EXPRESSION
0280  A0 00             LDY #0            ;SAVE STRING LOCATION
0282  B1 44             LDA (PTR),Y
0284  85 F9             STA STRLEN
0286  C8                INY
0287  B1 44             LDA (PTR),Y
0289  85 DA             STA STRLO
028B  C8                INY
028C  B1 44             LDA (PTR),Y
028E  85 DB             STA STRHI
0290             ; PROCESS STRING ONE CHARACTER AT A TIME.
0290  A4 F9             LDY STRLEN        ;GET STRING LENGTH
0292  B1 DA      LOOP   LDA (STRLO),Y
0294  C9 41             CMP #$41          ; IF $41<=A<=$5A THEN A=A OR $20
0296  90 12             BCC DONE          ; IF 'A <=A<= 'Z THEN A=A OR 32
0298  C9 5B             CMP #$5B
029A  B0 04             BCS SECOND
029C  09 20             ORA #$20
029E  D0 0A             BNE DONE          ;JUMP ALWAYS
02A0             SECOND                   ;FIRST FAILED-TRY SECOND
02A0  C9 C1             CMP #$C1          ;IF $C1<=A<=$DA THEN A=A AND $7F
02A2  90 06             BCC DONE
02A4  C9 DB             CMP #$DB
02A6  B0 02             BCS DONE
02A8  29 7F             AND #$7F
02AA  91 DA      DONE   STA (STRLO),Y
02AC  88                DEY
02AD  C0 FF             CPY #$FF
02AF  D0 E1             BNE LOOP
02B1             ;
02B1  60                RTS               ;RETURN TO BASIC
02B2                    .END
```

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Telecommunications:

How To Use A Modem

Michael E. Day
Chief Engineer, Edge Technology

So you finally went out and bought that MODEM you wanted. Now what do you do?

First of course *read the manual!* This is especially important with MODEMs, as their operation differs from manufacturer to manufacturer. You should read the entire manual even if you don't understand some of it, you will need the information later. You should go back and read it completely again (after you have used your MODEM). Much of the information it contains which may be undecipherable the first time through will be clearer.

One of the first things you will want to do is see if the MODEM works, and how it works. To do this you will need to call a computer so that you can communicate with it.

If you don't have a computer to call, a good way to start is to call one of the Computerized Bulletin Board Systems (or message systems) that is probably in your area. If you don't have a number, ask your local computer store, or go to a computer club meeting and ask someone.

The bulletin board systems are useful in several ways. First, they give you something to do with your MODEM immediately. Second, they tend to hold your interest for a rather long period of time. The first session on a message system often lasts thirty minutes to an hour or more. This can be rather expensive if the call is long distance! Assuming that the call is local, (or you don't care, if that is possible) the long time spent is useful. It will exercise your MODEM, and give you a good sense of how it works.

There are two major ways to communicate via a MODEM. The method just discussed (using a bulletin board system) is referred to as the *conversational mode.* This is because you are, in a sense, "conversing" with the computer. You ask it for some information, or request a specific function, and it responds directly to that request. You are interacting directly with the computer. The other means of communication via the MODEM is the *data transfer mode.* In this mode of operation, the computer is in control of the communications. This is generally used to transfer programs or text between two computers.

The Conversational Mode

The conversational mode is where you are in direct communication with the remote computer. This is similar to sitting in front of your own computer and writing a program. In fact, the only difference is that the computer is at the other end of the phone line.

There are different types of conversational modes employed depending on the system involved. The most common is echoplexing. Echoplexing is often referred to by the physical means of implementing it (full duplex). Although this is common practice, it is not valid since any of the communications methods can be implemented with a full duplex setup. Echoplexing means that, when you type a character, it gets sent out of the MODEM, the remote computer receives it, and echoes it back to you. This way you can verify that it was properly received, since you see every character exactly as the remote computer sees it.

A problem with echoplexing is that if the phone line is weak, noisy, or has excessive propagation delays, (such as very long distance calls) the character that is echoed back can be destroyed or lost by its own reflection, or by the next character that is transmitted. This is solved by not echoing the character. Instead, the character is echoed locally either by the MODEM itself, (this is what the half duplex switch is for on some MODEMs) or by the local computer or terminal. This is referred to as local echo. Although it is often referred to as half duplex, this is not the proper term since half duplex, by definition, is the way the system hardware is set up and not the way the system echoes characters. In fact, if the MODEM is "103 compatible" it is always in full duplex mode even if it has a half duplex switch on. By the way, if you are communicating with an echoplexing (full duplex) system and you have the switch set to half duplex, you will get two characters for every one you type. This is because the MODEM is echoing the character back, and the remote computer is also echoing it back.

Finally, there is a special mode that has grown up on the true half duplex systems. This is referred to as *conversational half duplex*. This is a modified version of local echo. In local echo mode, any character can be sent at any time. In true half duplex communications, only one computer can communicate at any one time, so the local computer cannot respond while the remote computer is transmitting. This can be a problem if the remote computer is sending a bunch of data or stuck in a loop – there is no way to stop it.

This problem is usually corrected in one of two ways. The first method is to add some more hardware in the form of a reverse channel or supervisory channel (a special signal that can be sent back over the phone lines without interfering with the data). It cannot carry any large amount of information and, in fact, is normally only used to request the remote computer to stop what it is doing and return control to the local computer.

The other way that the communications problem is solved is by program control. After the remote computer sends a specific amount of data, it waits for the local computer to indicate if it has received the data or if it wants the data to be sent again, or to have control returned to it. This has the advantage over the reverse channel type systems of being able to send any data again that was improperly received; but it has the disadvantage of being slower.

A response-expected type system is used in packet switching systems (they are, by nature, half duplex type systems) because the response can be shifted in time. That is, several groups of data can be sent with the response to be returned later. In fact, the response can sometimes lag behind the sent data by a number of data groups. This, of course, means that it is important that the groups be properly identified so that it is known which one was bad and needs to be resent.

The data transfer mode is normally seen as having two subdivisions: the send mode and the receive mode. It might be noted at this point that there is another mode that is often grouped with the send and receive modes: the local mode. The local mode is not a form of communication, but rather a mode of non-communication. The local mode is any operation that occurs locally such as preparing the text or program to send, or preparing the computer to receive data. Specifically, if the action involved does not use the MODEM to interact with the other computer, it is a local operation.

When operating in the send or receive modes, one computer must be in the send mode, and the other must be in the receive mode. Except in the case of fully-automated computer systems, the specific mode is normally selected by the user at the beginning of the operation while in local mode. The computer then takes over and establishes communication with the other computer and transfers the desired information.

The operation of the data transfer mode can be quite complex. The first action must be the establishment of synchronization with the other computer. This is done by the designated primary computer (depending on the system involved, this could be the sending computer or the receiving computer) by sending out a periodic request to the other computer. When the other computer answers, they then become synchronized. This means that the two computers are now listening to each other and are in a position to respond to requests from the other.

The next action is dependent upon the type of system involved. In a non-automatic system, it is assumed that the information has been predefined at both computers and no information needs to be sent to define it. In an automatic system, the predefinition is not assumed, and so the information must be transferred. Generally this consists of the program (or file) name of the data to be transferred.

Next, the data itself is sent. It is usually broken up into small pieces during the sending process. The reason for breaking up the data is to reduce the retransmission time involved if an error is encountered. This way, only a small piece has to be retransmitted if an error occurs, not the entire program.

Normally, the size of these pieces is related to the computer, and typical sizes are 128, 256, or 1024 bytes. The piece of information is referred to as a *record*. The exact structure of the record varies from system to system; there is no standard yet developed. In time a common standard will develop. Until then, we will have to live with what is out there.

In my next column I will describe a specific application of program transfer with a MODEM. ©

Customizing Apple's COPY Program

Roger B. Chaffee
Menlo Park, California

How many times have you used the COPY or COPYA program from the Apple DOS Master Disk? How many times have you had to tell the program that you wanted Slot 6, Drive 1, even though you have only one drive, and it's *always* in Slot 6, Drive 1? Every time, right?

Well, the nice people at Apple who brought you the COPY programs have made a system that works well, and is also easy to modify. Many programs, like Muffin and the DOS itself, are written in machine language (ML), and are very difficult to modify, or even to examine and understand. The main routines of COPY and COPYA, however, are written in BASIC, and only the nitty-gritty of buffer management and interface with the RWTS routine are done in ML.

Take a look at COPYA, which is written in AppleSoft BASIC, or at COPY if you want to use Integer BASIC. To look at the program, type LOAD COPYA [LOAD COPY] and then LIST. You can also list specific line numbers or ranges. Here's an explanation of some of the program lines. Later, we'll look at how to change them to fit your own system.

(Some of the information in this article depends on which program you are looking at, as in the LOAD commands above. When this is true, the information given is for the COPYA program, and the information for COPY follows it in brackets.)

Line 70 [90]: Load in the ML routines. (There is a hidden CTRL-D in this line, which will disappear if you use the BASIC editor to replace the line.)

Line 90 [120]: CALL 704 to initialize the ML routines. CS gets the current slot number, which is probably six, and location 720 gets the current drive number, either one or two. The values come from the IOB used by the DOS.

Lines 100,110 [130,140]: Set locations 715, 716 to the page numbers of the first and last pages that the ML routines will use for buffer space. They are different for AppleSoft and Integer because the two BASICs use memory and pointers differently.

Line 130 [150]: Call subroutines to ask the user for the slot and drive of the Master ("Original") diskette. MS gets the Master Slot number (zero to seven), and MD gets the Master Drive number (one or two).

Line 132 [160]: Call subroutines to ask the user for the slot and drive of the Slave ('Duplicate') diskette. SS gets the Slave Slot number (one to seven), and SD gets the Slave Drive number (one or two).

Line 165 [190]: Here's where the program stops asking for information, and starts copying the disk. Do not modify anything from here through the END statement in Line 305 [420] unless you are very sure of what you are doing! Before this line, MS and MD must be set to the slot and drive numbers for the Master diskette, and SS and SD must be set to the slot and drive numbers for the Slave diskette.

Line 310 [430]: This subroutine asks for a slot number, and is called for both Master and Slave slots. It also prints information on the screen, so you shouldn't simply replace it by a RETURN statement.

Line 320 [440]: This subroutine asks for a drive number, and is called for both Master and Slave slots. Again, don't just remove it, because it prints as well as asking you for the number.

Line 330 to 340 [450 to 460]: This subroutine gets a one-digit number, from L to H, from the keyboard. If RETURN is pressed, it uses the number already in N.

Line 350 [470]: This subroutine prints "DEFAULT=" and then puts on a flashing cursor.

Line 360 [480] to the end: This subroutine prompts you to change diskettes, if MS=SS and MD=SD. Otherwise, it just returns, with no action.

Okay, so that's how COPY gets it's parameters. But how can you change things so that it works just right for your own Apple system, which has a fixed number of drives in fixed slot locations?

Case 1: One Drive

The first case assumes you have only one drive, which is always in slot 6, drive 1. There is no choice. You always want slot 6, drive 1. The simplest way to make this happen is probably to replace lines 130 and 132 [150 and 160] by the statement

```
MS=6: SS=6: MD=1: SD=1
```

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but that won't give you the nicely formatted screen to tell you what's happening. Here's a better way: replace the subroutine which gets the input values.

```
AppleSoft:    330 K=141
[Integer:     450 REM]
```

Then when any value is needed, the default will be used. To make it work just right, you also need to go back to line 132 [160] and replace the statement N=3-MD by the statement N=MD, which will set the slave drive to the same value (1) as the master drive.

Case 2: Two Drives The Easy Way

Suppose you have two drives, and you want the program to decide which gets the master and which gets the slave diskette. Make the same subroutine replacement as before:

```
AppleSoft:    330 K=141
[Integer:     450 REM]
```

Now whichever drive you used most recently will be the master, and the other will be the slave.

Case 3: Two Drive The Right Way

Finally, suppose you have two drives, both in the same slot, but you want to be able to choose which one will be the master. This time you can't just remove the subroutine which gets the numbers, because you want the program to ask you for the drive number. Instead, you can stop the program from asking you for the slot numbers:

AppleSoft:
Change GOSUB 330 to GOSUB 340 in Line 310.
[Integer:
Change GOSUB 450 to GOSUB 460 in Line 430.]

In this last case, to make sure that the slave drive is the "other" one, that is the one you didn't specify for the master, the simplest change is this:

```
AppleSoft:
  Move statement 330 to 331
  Insert
    330 IF LEFT$(I$,1)="D" THEN 340
[Integer:
  Move statement 450 to 451
  Insert
    450 IF I$(1,1)="D" THEN 460
```

Leave the rest of the line alone.

Apology And Exhortation

As you read this, it probably sounds more complicated than it really is. If you have done any BASIC programming on your Apple, you already know how to modify programs, and COPY is just another BASIC program. There's no reason that you should stick with a general-purpose program, when it is easy and maybe even instructive to fit the Apple's general program to your specific needs. ©

Odds And Ends

With each CBM/PET disk drive comes a program to simplify using disk files. It's popularly called "The Wedge."

The Bug In The Universal Wedge

Keith Peterson
Kansas City Computers Inc.
Independence, MO

Most people are familiar with Universal Wedge, the program for easier disk access that comes on the disk with all of Commodore's disk drives. But most people don't realize that there is a bug in the Wedge that can cause some trouble when the Wedge is used on a 4.0 BASIC system.

The real cause of the problem is a small number of Original BASIC systems that required special handling when loading a file. These systems had what is known as the -04 ROMs, and several of the first Original BASIC PETs had them.

Universal Wedge checks a location in the BASIC system to see if it contains the -04 ROMs. If so, the Wedge increments the end of BASIC pointer by one, fixing the -04 ROM bug.

All this is fine until you use the Wedge in a 4.0 BASIC system. Then the Wedge, looking for the -04 ROMs, finds in the 4.0 BASIC ROM what it thinks is an indication of the Original BASIC -04 ROM, and increments the end of BASIC pointer accordingly. So now the program is one byte too long.

After loading a program, changing it, and saving it back out several times, a large number of extra bytes accumulates on the end of the program. This can interfere with or crash certain machine language routines, use up memory, and cause some confusion when you're looking for the end of the program. It will also cause some append routines to fail to function.

What's the fix? Simple. Just follow these steps:

1. Type: LOAD "universal wedge",8
2. Type: POKE 2109,133
3. Type: SAVE "fixed wedge",8

You now have a version of Universal Wedge called "fixed wedge" that will work correctly on either Original BASIC or 4.0, and with the -04 ROMs as well. ©

This helpful POKE will work on any CBM/PET with Toolkit installed.

Improving The Toolkit's TRACE Function

Robert Lenoil
Brooklyn, NY

Don't all you Toolkit owners wish that you could turn TRACE and STEP on and off from within your programs? After all, why TRACE an entire program, when you only need to debug one small section? Well, here's good news: The TRACE and STEP functions can be turned on and off from BASIC, by means of a simple POKE command! Here's why:

The Toolkit uses memory location 124 (206 for small keyboard PETs) as a flag for the status of the TRACE function: 0 = off, 2 = trace, 3 = step. All you have to do is POKE 124 (206) with the proper number, to accomplish the corresponding Toolkit function. In other words:

```
POKE 124,0 = OFF
POKE 124,2 = TRACE
POKE 124,3 = STEP
```

One caution: if the Toolkit is not initialized, any of the above POKEs will crash the PET. Therefore, it would be wise to execute this line before any of the POKEs:

```
IF PEEK(124) = 10 THEN SYS xxxxx
```

(where xxxxx is the number used to initialize your Toolkit). ©

This program uses the Atari's NOTE and POINT commands (which permit fast reading and writing with the disk drive). The program runs on an Atari 400/800 with at least 16K of RAM, an Atari 810 disk drive, and an optional printer.

Atari Mailing List Program

Garry J. Patton
Romulus, NY

This program is written to take advantage of the NOTE and POINT capabilities of the Atari. It is relatively fast and requires the 810 disk drive with DOS II and 16K (if only 75 records are desired). On a single diskette, 750 records can be accessed if needed. This requires 24K. The program is versatile and can be used for any home use for maintaining a list of important addresses. One of my gripes about current commercial mailing list programs is the time required to get at an address quickly. By the time the machine is powered up, the program loaded, and the list searched, as much as two to three minutes have gone by. That seems a little excessive. This program stores all addresses on the diskette and can access them quickly. It doesn't require loading in the program and then loading in the data file. It also doesn't search every file – only until it finds the appropriate address. It then stops and prints the name.

For most of us, 50-100 names are all that are required to keep up our Christmas list. However, if you have an exhaustive list up to 750 addresses can be stored on a single diskette if desired. As the number of addresses on file increases, the initial start up time increases; thus, you lose the advantage of quickly finding that missing address. So only create the number of files that you think you will need. Presently the program is set for 100 names.

Because of its uniform file structure, this program can easily be adapted to search for any major field and to sort by each field. However, these niceties are not generally required by most of us. In order to keep RAM to a minimum, these "extras" were not included.

The program has several error trapping features. If you encounter an error, just type GOTO MENU and try again. The TRAP command is an excellent tool to prevent those unwanted crashes. When writing a program, this command can help keep your program out of trouble.

The heart of this program is the FILE$. The Atari has excellent string handling capabilities which are used to our advantage here. Each subset of the FILE$ is a major field. As mentioned above, each of these fields could easily be searched for individually and sorted or manipulated as desired with only the addition of a short additional subroutine. The FILE$ is structured:

FILE$(1,15) = LAST NAME
FILE$(16,25) = FIRST NAME
FILE$(26,49) = STREET ADDRESS
FILE$(50,69) = CITY
FILE$(70,71) = STATE
FILE$(72,81) = ZIP
FILE$(82,95) = PHONE
FILE$(96,116) = EXTRA

A data file called MAILDATA.FIL is created to store each record. An error trapping routine alerts you if the data file is not on your diskette, and then it asks if you want to create one. Be sure you have enough sectors left on your diskette before creating the file. (It requires .94 SECTORS for each record. Thus, if you want 100 records, have 94 SECTORS left.) The number of records created is controlled by line 87. Set the FOR/NEXT loop to the number desired if you want different than 100 records. (CAUTION! Be sure then that lines 13, 87, 352, 604, and 2501 all match! These lines all have references to the number of records.) If you want more or fewer records, be sure to change the appropriate lines.

Each record's position in the file is stored in two arrays named SECTOR and BYTE. The reason for the need for increased memory for more records is that these arrays must be DIM'ed for the proper amount. This requires memory. The more records created (say 750 instead of 100) the more memory you will need. Remember, too, that your start-up time will increase because at initialization each record must be counted and its location stored in the appropriate array.

Lines 10-30 – Initializes the program, opens the screen editor, the keys, and MAILDATA.FIL

Lines 75-89 – if MAILDATA.FIL is not located on the diskette, you are given the choice of creating the file or ending. 100 records are created with a dummy FILE$ of +'s. Each record's position is NOTED and stored in the arrays SECTOR and BYTE for future reference. POKE 559,0 turns off ANTIC (the screen goes blank because ANTIC controls the screen updating). With ANTIC off 6502 can go merrily about its way doing the task at hand without interruptions from ANTIC. This can save up to 30% of the time required for com-

THE MOSAIC 32K RAM FOR ATARI

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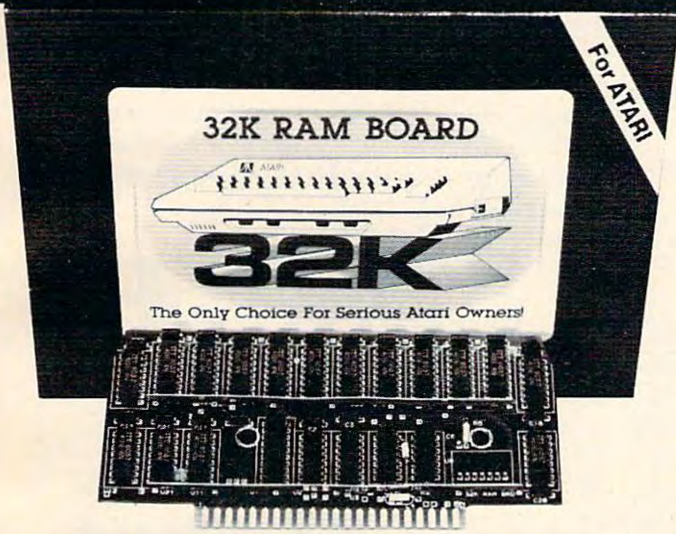

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pletion. POKE 559,34 turns ANTIC back on. MAILDATA.FIL is now created and ready to receive your entries.

Lines 100-354 – This is the heart of the program. With the appropriate prompts each field of FILE$ is created here. A short subroutine at 1000-1010 causes the cursor position to flash, advances the cursor, and assigns the ATASCII value of the key struck to the variable XX. If the delete key (126) is struck, the flag Q is set; then the entire field is erased, and you start again. If the return key (155) is struck, this terminates the entry to the field.

Each field is assigned a discrete length and is protected to that length. If you go over, an error message routine at 700-708 tells you of your error, and you start again. If the field you enter is less than the prescribed length, the field is padded with blanks until it equals the proper length.

EDIT is a flag that says you've come here from some other subroutine in the program and allows return to that area. Flags allow one to give a program versatility and to reduce RAM useage as an area of your program can be used for several purposes. This reduces repetition. You'll find flags used throughout this program to direct you in and out of various areas smoothly depending on your needs.

You'll note that this program is "with the times" and allows for the new ZIP + four, go ahead and use it. If not, it will be here soon. Space is reserved for the additional + *four*. So you can add it later.

Line 344 allows you to change your mind before the record is committed to the disk. If you keep the file, the next free space is POINTED to by the SECTOR/BYTE arrays, and your file is now stored for your future use.

Lines 500-570 – This is the main MENU giving you your choice of options to operate the program. Each choice sends you to the appropriate subroutine to complete your task as requested.

Lines 600-610 – At initialization, if MAILDATA.FIL is available on the disk, each record is looked at to determine each record's position, to determine the number of names on file to date, and to create the SECTOR/BYTE arrays for future use.

Lines 2000-2504 – This subroutine allows you to search for a name. You can search by last name only or first and last names. Using last name only allows faster execution time because fewer manipulations are required, but, if you have ten Smith's, the first and last names will be needed to return the correct one. Otherwise, the first Smith encountered will be printed.

Lines 2390-2410 look at the console keys and allow you to page through the data file, record by record. This is a nice convenience that will allow you to occasionally page through your listings and find outdated files or the names of "ex-friends" whose name you don't want any longer.

Lines 4000-4055 – This subroutine is used for the printer. You can print out one record at a time or you can choose to print out all of the addresses you have stored on file. You will be asked how many lines you want between records (1-9). This will allow for labels to be printed to cut down the drudgery of addressing all those Christmas cards.

```
1 REM ***  MAILING LIST PROGRAM  ***
2 REM ***          by             ***
3 REM ***      GARRY PATTON       ***
4 REM ***       PO BOX 137        ***
5 REM *** ROMULUS, NY 14541+0137 ***
6 REM
7 REM
10 DIM FILE$(116),LN$(16),FN$(11),ST$(25
),PHONE$(15),C$(21),STATE$(3),ZIP$(11),E
XTRA$(22),TAB$(39)
13 DIM SECTOR(100),BYTE(100):TAB$="
                                 "
20 OPEN #3,4,0,"S:":OPEN #1,4,0,"K:":Z=1
4:MENU=500:EDIT=0
30 TRAP 75:OPEN #2,12,0,"D:MAILDATA.FIL"
:TRAP 40000:RN=0:GOTO 600
75 ? CHR$(253):? :? "MAILDATA.FIL IS NOT
 ON THIS DISK":POKE 752,1:? "DO YOU WANT
 TO CREATE MAILDATA.FIL"
76 ? "(Y or N)"
78 GET #1,K:IF K<>78 THEN IF K<>89 THEN
75
81 IF K=78 THEN END
82 TRAP 95:CLOSE #2:OPEN #2,8,0,"D:MAILD
ATA.FIL"
83 POKE 559,0:FILE$="":FOR ZZ=1 TO 116:F
ILE$(ZZ,ZZ)="+":NEXT ZZ:FOR ZZ=1 TO 100:
NOTE #2,S,B
89 SECTOR(ZZ)=S:BYTE(ZZ)=B:? #2;FILE$:NE
XT ZZ:POKE 559,34:CLOSE #2:OPEN #2,12,0,
"D:MAILDATA.FIL":GOTO MENU
95 POKE 559,34:? CHR$(253):? :? "  ERROR
!!":END
100 REM CREATE FILE$
110 FILE$="":? "{CLEAR}"
112 O=0:LN$="":X=2:Y=4:POSITION X,Y:? "L
AST NAME: ":FOR ZZ=14 TO 28:POSITION ZZ,
Y:? "-":NEXT ZZ
```

```
114 POSITION Z+O,Y:GET #3,W:GOSUB 1000:I
F Q=1 THEN Q=0:GOTO 112
115 IF XX=155 THEN 130
119 LN$(LEN(LN$)+1)=CHR$(XX):IF LEN(LN$)
>15 THEN GOSUB 700:GOTO 112
126 GOTO 114
130 IF LEN(LN$)<15 THEN LN$(LEN(LN$)+1)=
" ":GOTO 130
136 IF EDIT THEN RETURN
140 FILE$(LEN(FILE$)+1)=LN$
150 O=0:FN$="":Y=5:POSITION X,Y:? "FIRST
 NAME: ":FOR ZZ=14 TO 23:POSITION ZZ,Y:?
 "-":NEXT ZZ
154 POSITION Z+O,Y:GET #3,W:GOSUB 1000:I
F Q=1 THEN Q=0:GOTO 150
156 IF XX=155 THEN 162
158 FN$(LEN(FN$)+1)=CHR$(XX):IF LEN(FN$)
>10 THEN GOSUB 700:GOTO 150
161 GOTO 154
162 IF LEN(FN$)<10 THEN FN$(LEN(FN$)+1)=
" ":GOTO 162
166 IF EDIT THEN RETURN
170 FILE$(LEN(FILE$)+1)=FN$
176 O=0:ST$="":Y=6:POSITION X,Y:? "STREE
T: ":FOR ZZ=14 TO 37:POSITION ZZ,Y:? "-"
:NEXT ZZ
180 POSITION Z+O,Y:GET #3,W:GOSUB 1000:I
F Q=1 THEN Q=0:GOTO 176
186 IF XX=155 THEN 194
188 ST$(LEN(ST$)+1)=CHR$(XX):IF LEN(ST$)
>24 THEN GOSUB 700:GOTO 176
192 GOTO 180
194 IF LEN(ST$)<24 THEN ST$(LEN(ST$)+1)=
" ":GOTO 194
196 IF EDIT THEN RETURN
200 FILE$(LEN(FILE$)+1)=ST$
204 O=0:C$="":Y=7:POSITION X,Y:? "CITY:
":FOR ZZ=14 TO 33:POSITION ZZ,Y:? "-":NE
XT ZZ
208 POSITION Z+O,Y:GET #3,W:GOSUB 1000:I
F Q=1 THEN Q=0:GOTO 204
216 IF XX=155 THEN 224
218 C$(LEN(C$)+1)=CHR$(XX):IF LEN(C$)>20
 THEN GOSUB 700:GOTO 204
220 GOTO 208
224 IF LEN(C$)<20 THEN C$(LEN(C$)+1)=" "
:GOTO 224
226 IF EDIT THEN RETURN
230 FILE$(LEN(FILE$)+1)=C$
234 O=0:STATE$="":Y=8:POSITION X,Y:? "ST
ATE: ":POSITION Z,Y:? "--"
236 POSITION Z+O,Y:GET #3,W:GOSUB 1000:I
F Q=1 THEN Q=0:GOTO 234
242 IF XX=155 THEN 250
243 STATE$(LEN(STATE$)+1)=CHR$(XX):IF LE
N(STATE$)>2 THEN GOSUB 700:GOTO 234
244 GOTO 236
250 IF LEN(STATE$)<>2 THEN ? CHR$(253):P
OSITION X,Y:? TAB$:GOTO 234
256 IF EDIT THEN RETURN
260 FILE$(LEN(FILE$)+1)=STATE$
264 O=0:ZIP$="":Y=9:POSITION X,Y:? "ZIP:
 ":POSITION Z,Y:? "-----+----"
266 POSITION Z+O,Y:GET #3,W:GOSUB 1000:I
F Q=1 THEN Q=0:GOTO 264
270 IF XX=155 THEN 274
271 ZIP$(LEN(ZIP$)+1)=CHR$(XX):IF LEN(ZI
P$)>10 THEN GOSUB 700:GOTO 264
273 GOTO 266
274 IF LEN(ZIP$)<10 THEN ZIP$(LEN(ZIP$)+
1)=" ":GOTO 274
275 IF EDIT THEN RETURN
276 FILE$(LEN(FILE$)+1)=ZIP$
280 O=1:Y=10:POSITION X,Y:? "PHONE: ":PH
ONE$="(---) --- ----":POSITION Z,Y:? PHO
NE$
282 POSITION Z+O,Y:GET #3,W:GOSUB 1000:I
F Q=1 THEN Q=0:GOTO 280
284 IF XX=155 THEN 294
287 IF O=4 THEN PHONE$(O,O)=CHR$(XX):O=6
:GOTO 282
288 IF O=9 THEN PHONE$(O,O)=CHR$(XX):O=1
0:GOTO 282
292 PHONE$(O,O)=CHR$(XX):IF O<14 THEN 28
2
294 IF LEN(PHONE$)<14 THEN PHONE$="(---)
 --- ----"
300 IF EDIT THEN RETURN
304 FILE$(LEN(FILE$)+1)=PHONE$
310 O=0:EXTRA$="":Y=11:POSITION X,Y:? "E
XTRA: ":FOR ZZ=14 TO 34:POSITION ZZ,Y:? "
-":NEXT ZZ
314 POSITION Z+O,Y:GET #3,W:GOSUB 1000:I
F Q=1 THEN Q=0:GOTO 310
318 IF XX=155 THEN 332
322 EXTRA$(LEN(EXTRA$)+1)=CHR$(XX):IF LE
N(EXTRA$)>21 THEN GOSUB 700:GOTO 310
328 GOTO 314
332 IF LEN(EXTRA$)<21 THEN EXTRA$(LEN(EX
TRA$)+1)=" ":GOTO 332
334 IF EDIT THEN RETURN
336 FILE$(LEN(FILE$)+1)=EXTRA$
340 IF LEN(FILE$)<>116 THEN ? CHR$(253):
? :? "ERROR IN FILE$!!":FOR DELAY=1 TO 5
00:NEXT DELAY:GOTO 100
344 POSITION 3,15:? "File as shown (Y or
 N)?":POSITION 3,16:? "N cancels this pr
inting.":GET #1,K
346 IF K<>78 THEN IF K<>89 THEN 344
348 IF K=78 THEN ? "{CLEAR}":GOTO MENU
352 RN=RN+1:IF RN>100 THEN ? CHR$(253):G
OTO 400
```

```
353 POINT #2,SECTOR(RN),BYTE(RN):PRINT #
2;FILE$:GOTO MENU
354 PRINT #2;FILE$:GOTO MENU
400 ? "{CLEAR}":POSITION 4,10:? "I'm sor
ry, but MAILDATA.FIL is full!":FOR D=1 T
O 500:NEXT D:GOTO MENU

500 ? "{CLEAR}":POSITION 7,3:? "CHOOSE A
PPROPRIATE NUMBER":POSITION 12,0:? "RECO
RDS ON FILE ";RN
510 POSITION 4,5:? "1 Add New Name":POSI
TION 4,6:? "2 Edit Name":POSITION 4,7:?
"3 Delete Name"
520 POSITION 4,8:POKE 752,1:? "4 Print N
ame":GET #1,K
530 IF K<>49 THEN IF K<>50 THEN IF K<>51
 THEN IF K<>52 THEN 500
532 IF K=51 THEN 4000
534 IF K=49 THEN 100
536 IF K=50 THEN 3000
540 POSITION 4,12:? "WILL YOU BE USING P
RINTER (Y or N)?":GET #1,KK
541 IF KK=78 THEN 2000
542 POSITION 4,14:? "WILL YOU LPRINT ALL
 OR SOME (A or S)":GET #1,KKK
543 IF KKK=65 THEN GOTO 5000
570 GOTO 2000
600 REM COUNT RECORDS ON FILE
604 TRAP 95:POKE 559,0:FOR NR=1 TO 100:N
OTE #2,S,B:SECTOR(NR)=S:BYTE(NR)=B
606 INPUT #2,FILE$:IF FILE$(1,5)<>"+++++
" THEN RN=RN+1
610 NEXT NR:POKE 559,34:TRAP 40000:GOTO
MENU
700 ? CHR$(253)
704 FOR ZZ=1 TO 4:POSITION X,Y:? TAB$:FO
R D=1 TO 30:NEXT D:POSITION X,Y:? "ITEM
TOO LONG! STAY WITHIN -'S!"
708 FOR D=1 TO 100:NEXT D:NEXT ZZ:POSITI
ON X,Y:? TAB$:RETURN
1000 POSITION Z+O,Y:? CHR$(W)
1004 IF PEEK(764)=255 THEN POSITION Z+O,
Y:? " ":GOTO 1000
1006 GET #1,XX:IF XX=126 THEN Q=1:RETURN

1010 POSITION Z+O,Y:? CHR$(XX):POKE 764,
255:O=O+1:RETURN
2000 REM PRINT NAME
2010 ? "{CLEAR}":POSITION 3,5:? "DO YOU
WANT TO SEARCH FOR:":POSITION 10,7:? "1
Last name only"
2020 POSITION 10,9:? "2 Last name and fi
rst name"
2030 GET #1,K:IF K<>49 THEN IF K<>50 THE
N 2000
2040 POSITION 3,12:? "LAST NAME: ";:INPU
T LN$
2050 IF LEN(LN$)>15 THEN ? CHR$(253):POS
ITION 3,12:? TAB$:POSITION 3,12:? "NAME
TOO LONG!":FOR D=1 TO 500:NEXT D
2051 IF LEN(LN$)>15 THEN POSITION 3,12:?
 TAB$:GOTO 2040
2070 IF K=49 THEN FN$=" ":GOTO 2200
2080 POSITION 3,14:? "FIRST NAME:";:INPU
T FN$
2090 IF LEN(FN$)>10 THEN ? CHR$(253):POS
ITION 3,14:? TAB$:POSITION 3,14:? "NAME
TOO LONG!":FOR D=1 TO 500:NEXT D
2091 IF LEN(FN$)>10 THEN POSITION 3,14:?
 TAB$:GOTO 2080
2200 FOR P=1 TO RN:POINT #2,SECTOR(P),BY
TE(P):INPUT #2,FILE$
2210 IF FILE$(1,LEN(LN$))=LN$ AND K=49 T
HEN POP :GOTO 2300
2220 IF FILE$(1,LEN(LN$))=LN$ AND FILE$(
16,15+LEN(FN$))=FN$ THEN POP :GOTO 2300
2225 NEXT P
2230 ? "{CLEAR}":POSITION 3,10:? "I'm so
rry but I do not find:":? :? "   ";FN$;"
 ";LN$
2240 FOR D=1 TO 500:NEXT D:GOTO MENU
2300 ? "{CLEAR}":POSITION 12,0:? "RECORD
 NUMBER ";P
2305 POSITION 2,4:? "LAST NAME: ":POSITI
ON 14,4:? FILE$(1,15)
2310 POSITION 2,5:? "FIRST NAME: ":POSIT
ION 14,5:? FILE$(16,25)
2320 POSITION 2,6:? "STREET: ":POSITION
14,6:? FILE$(26,49)
2330 POSITION 2,7:? "CITY: ":POSITION 14
,7:? FILE$(50,69)
2340 POSITION 2,8:? "STATE: ":POSITION 1
4,8:? FILE$(70,71)
2350 POSITION 2,9:? "ZIP: ":POSITION 14,
9:? FILE$(72,81)
2360 POSITION 2,10:? "PHONE: ":POSITION
14,10:? FILE$(82,95)
2370 POSITION 2,11:? "EXTRA: ":POSITION
14,11:? FILE$(96,116)
2372 IF KK=89 THEN KK=0:GOSUB 4500
2374 IF EDIT THEN RETURN
2378 POKE 53279,8
2380 POSITION 4,20:? "Press |OPTION| to
page forward":POSITION 4,21:? "Press |SE
LECT| to page back"
2384 POSITION 4,22:POKE 752,1:? "Press |
START|  to return to menu"
2390 IF PEEK(53279)=5 THEN P=P-1:GOSUB 2
500:GOTO 2300
2400 IF PEEK(53279)=3 THEN P=P+1:GOSUB 2
500:GOTO 2300
2410 IF PEEK(53279)=6 THEN GOTO MENU
```

```
2420 GOTO 2390
2500 IF P<1 THEN P=1
2501 IF P>100 THEN P=100
2504 POINT #2,SECTOR(P),BYTE(P):INPUT #2
,FILE$:RETURN
3000 REM EDIT
3010 EDIT=1:GOSUB 2000
3020 POSITION 10,13:? "|To EDIT| Choose
one":POSITION 4,15:? "1 LAST"
3030 POSITION 20,15:? "2 FIRST":POSITION
 4,16:? "3 STREET":POSITION 20,16:? "4 C
ITY"
3040 POSITION 4,17:? "5 STATE":POSITION
20,17:? "6 ZIP":POSITION 4,18:? "7 PHONE
":POSITION 20,18:? "8 EXTRA"
3050 POSITION 4,21:? "S |SAVE| as shown"
:POSITION 4,20:? "E |EXIT|"
3055 GET #1,K:IF K=83 THEN 3200
3060 IF K=49 THEN GOSUB 112:FILE$(1,15)=
LN$:GOTO 3020
3065 IF K=50 THEN GOSUB 150:FILE$(16,25)
=FN$:GOTO 3020
3070 IF K=51 THEN GOSUB 176:FILE$(26,49)
=ST$:GOTO 3020
3075 IF K=52 THEN GOSUB 204:FILE$(50,69)
=C$:GOTO 3020
3080 IF K=53 THEN GOSUB 234:FILE$(70,71)
=STATE$:GOTO 3020
3085 IF K=54 THEN GOSUB 264:FILE$(72,81)
=ZIP$:GOTO 3020
3090 IF K=55 THEN GOSUB 280:FILE$(82,95)
=PHONE$:GOTO 3020
3095 IF K=56 THEN GOSUB 310:FILE$(96,116
)=EXTRA$:GOTO 3020
3097 IF K=69 THEN EDIT=0:GOTO MENU
3110 GOTO 3055
3200 POINT #2,SECTOR(P),BYTE(P):FOR D=1
TO 50:NEXT D:PRINT #2;FILE$
3230 EDIT=0:GOTO MENU
4000 REM DELETE NAME
4010 EDIT=1:GOSUB 2000
4020 POSITION 4,15:? "Do you want to |DE
LETE| this file        (Y or N)?"
4030 GET #1,K:IF K<>78 THEN IF K<>89 THE
N 4020
4040 IF K=78 THEN EDIT=0:POSITION 4,18:?
 "File |NOT| deleted":FOR D=1 TO 500:NEX
T D:GOTO MENU
4050 POINT #2,SECTOR(RN),BYTE(RN):INPUT
#2;FILE$:POINT #2,SECTOR(P),BYTE(P):PRIN
T #2;FILE$
4055 FOR ZZ=1 TO 116:FILE$(ZZ,ZZ)="+":NE
XT ZZ:POINT #2,SECTOR(RN),BYTE(RN):PRINT
 #2;FILE$:RN=RN-1:EDIT=0:GOTO MENU
4500 T=0:FOR ZZ=16 TO 25:IF FILE$(ZZ,ZZ)
<>" " THEN T=T+1
4510 NEXT ZZ
4530 TT=0:FOR ZZ=50 TO 69:IF FILE$(ZZ,ZZ
)<>" " THEN TT=TT+1
4540 NEXT ZZ:LPRINT FILE$(16,15+T);" ";F
ILE$(1,15):LPRINT FILE$(26,49)
4570 LPRINT FILE$(50,49+TT);", ";FILE$(7
0,71);" ";FILE$(72,81):RETURN
5000 POSITION 4,16:? "HOW MANY LINES BET
WEEN ADDRESSES":POSITION 4,17:? "(1-9)":
GET #1,K:IF K<49 OR K>57 THEN 5000
5005 KKKK=K-48
5010 FOR ZZ=1 TO RN:POINT #2,SECTOR(ZZ),
BYTE(ZZ):INPUT #2;FILE$
5012 T=0:FOR QQ=16 TO 25:IF FILE$(QQ,QQ)
<>" " THEN T=T+1
5013 NEXT QQ
5014 TT=0:FOR QQ=50 TO 69:IF FILE$(QQ,QQ
)<>" " THEN TT=TT+1
5015 NEXT QQ
5020 LPRINT FILE$(16,15+T);" ";FILE$(1,1
5):LPRINT FILE$(26,49)
5030 LPRINT FILE$(50,49+TT);", ";FILE$(7
0,71);" ";FILE$(72,81)
5040 FOR ZZZ=1 TO KKKK:LPRINT :NEXT ZZZ
5050 NEXT ZZ:KK=0:KKK=0:KKKK=0:GOTO MENU
```
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Browsing The VIC Chip

Jim Butterfield
Toronto, Canada

The computer is called VIC, for Video Interface Computer ... but there's a chip inside which is also called VIC, for Video Interface Chip. The chip bears the number 6560 or 6561; it's used to make good things happen on your television screen.

Beginners often don't realize that memory addresses are used for more than memory storage. In the VIC computer, addresses 36864 to 36879 may be PEEKed or POKEd. These locations are not used for memory – they hold controlling information for the VIC chip. We're going to look through those addresses, experimenting as we go. We may learn some new things about our computer.

• *Location 36864* (Hex 9000). Values 0 to 127 set the position of the left border on your screen. The usual value is five. Try the following quick "slide change" line:

```
FOR J=5 TO 30:POKE 36864,J:NEXT J
  :FOR J=30 TO 5 STEP -1:POKE 36864,J:NEXT J
```

If you add 128 to the value in 36864, the screen will go into interlace mode. In most cases, all you'll notice if you POKE 36864,133 is a little "dither" in the screen detail. However, a few television sets are built in such a way that they won't work unless you set interlace mode with this POKE.

• *Location 36865* (Hex 9001). Value 0 to 255 set the position of the top border on your screen. The usual value is 25. Try making the screen "curtsy" with:

```
FOR J=25 TO 45:POKE 36865,J:NEXT J
  :FOR J=45 TO 25 STEP -1:POKE 36865,J:NEXT J
```

• *Location 36866* (Hex 9002). Part of this location tells the chip how many columns on the screen. This will always be 22. But there's an extra – a value of 128 may be added to set "alternate screen" mode. Normally, the 128 is added in, and you'll find 150 stored in this location. If you want to go to an alternate screen, remove the 128 element with POKE 36866,22 and the screen will now take its information from a new area. There are quite a few things you need to do if you wish to play with this – see "VIC: Alternate Screens" in *Home and Educational COMPUTING*, Fall, 1981.

• *Location 36867* (Hex 9003) is a busy one. In fact, it's always changing. Try typing ?PEEK(36867) several times and you'll see that you get different values – sometimes 46, sometimes 174. Let's ignore that extra 128 for the moment; we'll deal with it again when we describe the following location.

The basic value held in this location, normally 46, is the number of rows on the screen multiplied by two (23 rows, right?). You won't want to change this one.

There's one more thing hidden in this location, and it's important. If you add one to the value, the character generator will switch to "double character mode." This means that each character you type will occupy double the usual screen space.

This won't work automatically, however. If we want to draw characters that are twice as big, we must supply the VIC with "pictures" of the new characters; the old pictures won't do since they are not big enough to fill the new space. So prepare for a little confusion when you try this next experiment. Strange things will happen because we haven't built and connected up new character tables.

Type POKE 36867,47. The screen will go rather strange. Don't worry about it for the moment; just press the screen clear key (shifted, of course). The screen will clear, although the cursor looks rather odd. Not to worry, we'll forge right ahead.

The first character in the VIC's table of characters is the "@" symbol; the next is an "A," then a "B" and so on. Now: type the @ key. Instead of getting the first character, we get the first two, one above the other. Try typing the "A" and you'll get B-over-C, the next two characters in the list.

What's happening here? Each character you type is filling double its normal screen area. In doing so, it's grabbing twice as much information from the "character picture" table... and, since that table hasn't been changed, that means two characters. Since the VIC knows (or at least thinks) that the character pictures are twice as big, it reaches further into that table for each character that it needs.

When you decide to use this feature, you'll write your own character picture tables and everything will sort itself out. This feature is likely to be used most for high-resolution graphics. The elements of the character picture table will control individual dots, or pixels, on the screen.

You may bring your VIC back to normal by typing POKE 36867,46 but you'll need to type blind since the screen isn't much help. You might prefer to turn the computer off for a moment; when you turn on again, everything will be back as it was.

• *Location 36868* (Hex 9004). This location changes continuously. It's connected with the high-bit (128 value) in the previous location. In principle, it tells you precisely where on the screen the picture is being drawn at this instant. In practice, it's not much use to BASIC programmers – by the time

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you read it, a different part of the screen will be active.

● *Location 36869* (Hex 9005). This is a very important address. It controls the location of two tables: the table where screen characters are held, and the table which holds the character pictures. Let's take them one at a time.

The screen table holds the five hundred or so characters that are displayed on the screen. It's quite a job to calculate the screen address: let's take a shot at it.

Take the contents of location 36869, divide by 16, and throw away the remainder. That should give you a number from 8 to 15. Subtract 8 and double it, giving an even number from 0 to 14. Now: if the contents of 36866 are 128 or greater, add one to get a value from 0 to 15. Multiply the result by 512. At this point you should have a value from 0 to 7680. That's where your screen table is located; it will normally be at location 7680, but it might move if you add extra memory.

That's quite a calculation; some of the things it implies deserve a separate article. For the moment, let's observe that the screen table address must always be in the range of 0 to 7680, and must be a multiple of 512. If you wish to set up your own screen table within this range, do the calculation in reverse: divide by 512, subracting 1 if odd, dividing by two, adding eight, and, finally, multiplying by 16. Whew! We can see that the "alternate screen" bit (128 value) in 36866 is really part of the much larger screen address.

The character picture table address is also defined in this location. We'd need to change this if we wanted to define our own characters, single or double. Of course, we'd also need to define character pictures for all characters we wished to print. The computation of the address is complex.

Take the contents of location 36869 and divide by 16. Now take the remainder – not the quotient – and, if it's greater than seven subtract eight. On the other hand, if the remainder is not greater than seven, add 32. By this time, you'll have an adjusted remainder which is either less than seven or between 32 and 39. Multiply this value by 1024 and you've found your character picture table address. It will be in the range of either zero to 7168 or 32768 (the normal value) to 39936, and will be an exact multiple of 1024. If you wish to set up your own character picture table, you'll usually want it to point to a RAM address in the range of zero to 7168. In such a case, you'd reverse the calculation: take the address, divide by 1024 and add eight and you're there.

Don't forget that the screen table address and the character picture address are packed together into this location. You'll need to set them both at the same time. By the way, the official name for the two tables are the "Video Matrix" and the "Character Cell table."

Feel free to play with this location; POKE values as you wish. But, unless you plan carefully, all you'll get is a crazy screen.

This was a tough one ... now we can try some easier locations.

● *Locations 36870 to 36871* (Hex 9006 and 9007). Here's your input from a Light Pen. No, a light pen isn't a ballpoint that weighs less than half an ounce – it isn't a pen at all. It's a device that plugs into your VIC that looks a little like a pen. Point it at the screen, and these locations will tell you where you are pointing.

A standard Atari light pen may be used. It is expected that Commodore will manufacture their own light pen soon. Many light pens have either a button or a spring-loaded switch in the tip which signals whenever the light pen operator wants attention. The switch is implemented in the VIC computer, but is not connected to the VIC chip (you'll find it mixed in with other things in location 37151).

You can read the X and Y positions of the light pen in locations 36870 and 36871 respectively. You won't read row and column values: the numbers will vary between zero and 255, and you'll need to do some calibration for the particular model of light pen that you have fitted.

Watch for "jitter" on these values. Even though the light pen doesn't move, the readings may jump about a little on successive readings. Depending on what you're doing, you may wish to use an averaging technique to make the readings smoother. Another method is called "hysteresis"; in simple terms, it means that a value is ignored unless it differs from previous readings by more than a given threshold amount.

● *Locations 36872 to 36873* (Hex 9008 and 9009). These are paddle input values. Two paddles, similar to Atari paddles, may be connected and their values will be read here. You may not be able to track the full range of rotation of the paddles.

Once again, watch for jitter on the input values here.

To keep the record straight, a joystick can also be connected to the VIC ... but the position of its buttons are not detected by the VIC chip. They arrive in other locations (37151 and 37152).

● *Locations 36874 to 36876* (Hex 900A to 900C). These are VIC's voices. Setting a value of 128 or higher into any of these locations produces sound; the value you POKE produces the pitch. By POKEing two or three locations, you can produce harmony. All voices are controlled by the sound level which is set at address 36878; try POKE

36878,15 before you play with the voices so that you'll get good volume. A value of less than 128 in any of the voice locations makes that voice silent.

It's interesting to note that the voice controlled by 36874 is the softest, and the voice at 36876 is the sharpest. So you'd use 36876 to carry the melody, and the two other voices as the sidemen.

• *Location 36877* (Hex 900D). This is similar to the music voices, except that it generates noise. A value of 128 or more produces noise. The higher the value, the higher the pitch of the noise (from growl to hiss). Once again, this is controlled by the sound level of 36878.

• *Location 36878* (Hex 900E). If the number in here is less than sixteen, it represents the sound amplitude (see the four previous locations). If it's sixteen or more, an extra factor is at work: multi-color.

Normally, each character position on the VIC contains only two colors: background and foreground. If we decide to use multi-color, we can add an extra two colors to each character: the border color plus one more that we may select. We select this color in the high part of location 36878. If you divide the contents of this location by 16, discarding the remainder, you'll get the designation of the "auxiliary color."

Interestingly, each character on VIC's screen is independently selected as two-color or multi-color, allowing us to have a mixed screen. This is done in the color nybble table which sets each character's color. Try the following: Clear the screen and type the letter A in the upper left-hand corner. Now go to a new line and type POKE 38400,8. You'll see that the letter A has suddenly turned weird and multi-colored, but the rest of the screen is unchanged. Notice that we did not POKE the VIC chip, but an entirely different memory location that is keyed to the one screen address. To do the job properly, you'll need to define your own character pictures.

• *Location 36879* (Hex 900F). The last location in the VIC chip, but a busy one. Let's break it down into its three elements.

Divide the contents of this location by 16, and note the result as "Screen Background Color." Now take the remainder; if it's eight or more, subtract and note: Foreground/Background = ON. The remaining value of zero to seven can be labelled "Frame Color."

The Frame Color is a favorite of mine; it's an easy signal to the user of some situation I want to tell him about without affecting the contents of the screen itself. If there's a danger, an error, or a game explosion, I can flip the border to red with POKE 36879,26 and later restore it with POKE 36879,27. Another example: Rather than typing a PLEASE WAIT message, I might walk the border through a range of colors so that the user can tell something is happening.

Screen Background color can be a very nice psychological support. If you set up a system so that accounts receivable can be done on one background color and accounts payable on a different one, the user can be "keyed" to recognize that he's in the right program. It's a little like decorating each floor of a building in a different color so that people won't get the wrong one. Try combinations such as POKE 36879,155 and see how you like the effect.

Now for the Foreground/Background business. Normally (F/B = On) we know that we can type characters of many colors on a single color background. Sometimes, it can be very handy to do the opposite; in other words, we want to type single color characters on a background whose color may vary from character to character.

Try POKE 36879,19. Now clear the screen and type a few characters. Change color and type some more. Do you see what's happening? You are changing the color of the background, not the color of the characters themselves.

By playing around with these locations, you can discover potential that you never knew existed. Once you know it's there, you can then exploit it for your own special effects.

There's a rich variety of controls and information available in the VIC chip. You may not need to use them all .. but isn't it fascinating to play around?

Table 1: VIC 6560 Chip

$9000	Interlace	Left Margin (=5)		36864
$9001	Top Margin (=25)			36865
$9002	Scrn Ad bit 9	# Columns (=22)		36866
$9003	bit 0	# Rows (=23)	Double Char	36867
$9004	Input Raster Value: bits 8-1			36868
$9005	Screen Address bits 13-10	Character Address bits 13-10		36869
$9006	Light Pen Input	Horizontal		36870
$9007	Light Pen Input	Vertical		36871
$9008	Paddle Inputs	X		36872
$9009	Paddle Inputs	Y		36873
$900A	ON	Voice 1	Frequency	36874
$900B	ON	Voice 2	Frequency	36875
$900C	ON	Voice 3	Frequency	36876
$900D	ON	Noise	Frequency	36877
$900E	Multi-Color Mode (=0)	Sound Amplitude		36878
$900F	Screen Background Color	Foregnd /Backg	Frame Color	36879

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When typing in this program, be especially careful when typing the numbers in the DATA statements and USR commands. A mistake could cause your machine to lock up, *that is, no longer respond to the external world, requiring a power-on reset.*

Using TextPlot For Animated Games

David Plotkin
Richmond, CA

If you're like me, the first thing you did when you bought your new Atari was run out to buy some games for it, probably with visions of multi-colored, arcade-style entertainment in mind. The computer store where I purchased my Atari also sells Apples. The wide assortment of exciting, machine language games available on the Apple and *not* on the Atari was a real disappointment. Time and time again I saw fascinating games which were not available to me. The recent release of many new Atari programs has somewhat alleviated this, but the problem still exists. To make things even more frustrating, many interesting games are not all that complex from a programming standpoint.

I decided to try my hand at programming these games myself. Having completed the book on how to program in BASIC, I charged ahead and wrote my first "Arcade-style" game, which I entitled "Space Rocks." It was a home-grown version of "Asteroids." The program had it all: graphics, sound, multiple missiles in flight at once, a fancy space ship, scoring, and music. It was also extremely slow. I had spent two weeks on it and each move took almost a minute. Ridiculous? Of course. I tried to speed it up by simplifying the graphics, but never did get it running very fast.

The next step was to try writing a program in a text mode. The Atari can manipulate text quickly, and so I met with a limited success. Using a custom designed character set also added to the text-mode games. Nevertheless, when there is more than one character to move, it can still be quite slow. I briefly considered learning machine language, but it's not something I'm eager to tackle.

The program "TextPlot" (**COMPUTE!**, November 1981, #18) is a first-rate gaming tool. As the author said, it allows you to use text and text characters in graphics modes. It also works with an alternate character set, as also mentioned briefly. But here's the kicker – since it draws the text character (and erases it also) using a machine language routine, it can be used to animate in high resolution graphics modes at machine language speeds. Thus, your character "A" ; redefined to a space ship or missile, literally zips across the screen, and five or ten "A's" can move across the screen without the frustrating BASIC's characteristic of "taking turns."

By drawing the non-moving portions of your picture in BASIC graphic mode, and the moving portion using TextPlot, you can write some colorful and challenging games. The program below demonstrates my own efforts in this regard, which I will tell you about shortly, but first some pointers:

1) Animation is done by drawing, erasing, and redrawing in a new position. The erasing can be done in two ways. You can call the USR command with the character ASCII code, but in the *background* color. Or you could call USR command with the ASCII code 32 (blank space) in *any* color. By looping and using a variable either in the color slot or in the ASCII code slot, drawing and erasing is easy. Increment the X and/or Y coordinates (such as MX1 and MY1 in the program) between erase and the redrawing, and the character moves smoothly across the screen. This incrementing, by the way, was done in BASIC (MX1 = MX + 1, etc.) and seems to be the limiting factor in how many characters can move across the screen at once without significant "taking turns."

2) It is possible to define a creature or object which consists of two or three refined characters which move together. It is best to increment the location of all three characters and then call the machine language routine to move them the most smoothly.

3) There is a large difference between vertical and horizontal resolution. Moving a character one space horizontally is equivalent to moving eight spaces vertically. Remember this when moving diagonally. Also, BASIC commands such as DRAWTO, PLOT, LOCATE etc. work on the graphic mode coordinate system. Thus, the horizontal location in mode seven can vary from zero to 159, but the X coordinate input to the USR call can vary only from zero to 19, normally. Therefore X coordinate = horizontal location/eight. The vertical resolution is the same as the Y coordinate.

Note that, in the program, I have varied the X coordinate from 60 to 79 instead of zero to 19. What this does is move the character down one pixel for each multiple of twenty (60 to 79 moves the character down three pixels from where it would be a zero to 19). A character moving horizontally will pass across the screen lower and lower

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From K-Byte
Get this collector's item while you can: It's the first non-Atari game in a ROM cartridge. Just slip the cartridge into the slot and you can instantly be playing this action-packed arcade game. The object is to move your Space Commander through the Alien Control Sectors, shoot the Alien Droids and escape from the sectors. The sectors are a maze of passages and barriers that can be used for protection, but don't let your commander touch them -- they're electrified!

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KAYOS SPACE WAR GAME

From Computer Magic
A machine language space game with plenty of action, graphics and sound. You have five base stations with which to fight off the invasion of Kayotians. They arrive in large Mother Ships which are a launching base for their attack ships. Knock out a mother ship and it simultaneously launches a 1000 point bonus ship and a destructive bomb. KAYOS has options to allow easier play for beginning and intermediate-level players.

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By Bob Stewart from On-Line
A powerful utility for creating graphics on the Atari. Using your joystick, you can make freehand designs in any of Atari's 14 graphics modes (including the undocumented multicolor modes). Your designs are automatically translated into basic code that you can incorporate into your programs. The package includes a graphics utility, a color utility, several programing examples written in BASIC, plus a comprehensive 36 page instruction booklet.
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Master Memory Map

From Santa Cruz Software
If you are serious about programming the Atari, this booklet could become one of your most important tools. A highly detailed map of the Atari's memory, it details thousands of locations and routines. Using this booklet makes easier the use of display list, player/missile, and interrupt graphics. The "Miscellaneous Notes" section contains a wealth of knowledge picked up by Santa Cruz in their explorations of the Atari. Also included are notes on the new GTIA graphics chip.
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at higher values of the X coordinate without changing the Y coordinate. This invalidates the relationships shown above between coordinates and screen position, which only work if the X coordinate is between zero and 19.

4) A LOCATE statement meant to find or detect one of the generated text characters does not care what the character is, only the color of the character. This is because the text character is just a series of pixels set to a particular color.

5) The alternate character set is located in an area of RAM protected by POKEing a lower number of pages into location 106, which stores the amount of pages (multiply by 256 to get bytes) available in memory. This is a fairly common technique of protecting memory, since the computer doesn't know about the memory above location 106 (see line 3200 in the program) and, thus, doesn't use it.

In the original version of the character generator, a step-back of five pages (1280 bytes) was used. The character set is four pages (1K) long, plus one extra. This works fine in Graphics mode zero, but does not work for this program. I found that the minimum step-back is 16 pages (4K), although any multiple of 4K (32 pages or 48 pages) will work. Intermediate values led to part of the screen being blank or runny dots and lines being displayed. I think this has to do with the display list not crossing a 4K boundary (the display list in Gr. 7 is right around 4K long, so it would have to be located *on* a 4K boundary) but I'm not sure. Perhaps a more advanced programmer could shed some light on this. A final point on this: after every GRAPHIC command, you need to include a POKE 756,PEEK(106)+1 to point the Character Base address to the redefined character set, since the GRAPHIC command resets the pointer to the ROM character set.

Rules Of The Game

Now to the program. You are chief gunnery officer of the Space Fortress Reliable, located at the outermost fringes of the Galactic Empire. Although the fortress is protected by shields, there are four "channels" through the shields to allow for supply ships and transportation of personnel. Since attacking vessels can also make use of these channels, a big laser is mounted to fire down each of the channels.

The channels are located directly above, below, left, and right of the fortress. Their width is such that only one ship at a time can attack from any direction. The laser is aimed in the appropriate direction by pushing the joystick in that direction. Once the laser is aimed, it fires automatically.

As the attack progresses, however, and energy is used up, the shields begin to withdraw towards the fortress to maintain integrity. The enemy ships can come out of hyperspace and begin the attack through the channels closer to the fortress, so you have less time to fire on them. Watch out especially for the ships to the left and right which, although they start farther away than the ships above and below, move eight times as fast. Good luck, and good hunting.

Program Line No.	Description
1-10	Go to the subroutines for redefining the character set and initializing TextPlot.
20	Initialize graphics, set character base address to redefined character set.
30	Initialize variables.
40-100	Draw the fortress and background.
110-120	Print "SCORE 000" on the screen.
130-170	Erase last gun position.
180-220	Read current joystick position.
230-280	Aiming and Firing sequence. The gun is drawn in the new position, and the laser is fired. If the ship is hit, then it explodes.
290-310	Updates the score on the screen, dight by digit. Jumps to the end of the game on high score.
320-350	If a ship was destroyed, then uses the random number generator to decide whether a new ship is to be launched. The starting position of the new ship is moved closer to the fortress as the score increases.
360-400	Moves each ship toward the fortress, if the fortress is hit by a ship then jumps to the end of game routine.
500-620	End of game routine when fortress is destroyed.
700-710	End of game routine on winning game.
20000-20430	Subroutine for Textplot.
32000-32160	Subroutine for redefining character set.

Variables

SC = Score J = joystick position

J1 = 1,2,3,4 depending on joystick position
MX1 to MX4 = X coordinate of enemy ships
MY1 to MY4 = Y coordinate of enemy ships
M1 to M4 = status of enemy ships; = 0 when ship is blown up
= 1 when ship is intact
Starx,Stary = X and Y coordinates of stars
ML = memory location
START = byte address of RAMTOP
Z,Y,STAR,N,W,I = loop variables.

If you do not want to punch the program in, I will be happy to generate a copy for you on tape (sorry, I don't have a disk drive yet, but there will be no protects on the tape copy, so you can easily transfer to disc). Send a cassette with a self addressed stamped (requires 40 cents postage) envelope and a check for $3 to:

David Plotkin
5720 Alameda Ave.
Richmond, CA 94804

```
1 GOSUB 32000:CLR
10 GOSUB 20000
20 GRAPHICS 7+16:POKE 756,PEEK(106)+1
30 SETCOLOR 2,3,4:SC=0:J1=1:MX1=0:MY1=0:
MX2=0:MY2=0:MX3=0:MY3=0:MX4=0:MY4=0:M1=0
:M2=0:M3=0:M4=0
40 COLOR 1:FOR Y=35 TO 45:PLOT 72,Y:DRAW
TO 95,Y:NEXT Y
50 PLOT 72,35:DRAWTO 69,32:PLOT 73,35:DR
AWTO 69,32:PLOT 72,36:DRAWTO 69,32
60 PLOT 72,45:DRAWTO 69,48:PLOT 73,45:DR
AWTO 69,48:PLOT 72,44:DRAWTO 69,48
70 PLOT 95,35:DRAWTO 98,32:PLOT 94,35:DR
AWTO 98,32:PLOT 95,36:DRAWTO 98,32
80 PLOT 95,45:DRAWTO 98,48:PLOT 94,45:DR
AWTO 98,48:PLOT 95,44:DRAWTO 98,48
90 FOR STAR=1 TO 80:STARX=RND(0)*158+1:S
TARY=RND(0)*94+1:PLOT STARX,STARY:NEXT S
TAR
100 COLOR 0:FOR X=73 TO 94 STEP 2:PLOT X
,40:NEXT X
110 D=USR(1536,83,3,0,0):D=USR(1536,67,3
,1,0):D=USR(1536,79,3,2,0)
120 D=USR(1536,82,3,3,0):D=USR(1536,69,3
,4,0):D=USR(1536,48,3,1,8):D=USR(1536,48
,3,2,8):D=USR(1536,48,3,3,8)
130 ON J1 GOTO 140,150,160,170
140 D=USR(1536,32,1,70,24):GOTO 180
150 D=USR(1536,32,1,72,34):GOTO 180
160 D=USR(1536,32,1,70,43):GOTO 180
170 D=USR(1536,32,1,68,34)
180 J=STICK(0):IF J=15 THEN GOTO 290
190 IF J=10 OR J=14 OR J=6 THEN J1=1:D=U
SR(1536,16,1,70,24):GOTO 230
200 IF J=7 THEN J1=2:D=USR(1536,17,1,72,
34):GOTO 230
210 IF J=5 OR J=13 OR J=9 THEN J1=3:D=US
R(1536,18,1,70,43):GOTO 230
220 IF J=11 THEN J1=4:D=USR(1536,19,1,68
,34)
230 COLOR 1:SOUND 0,25,10,8:SOUND 1,28,1
0,8:ON J1 GOTO 250,260,270,280
250 PLOT 84,27:DRAWTO 84,0:COLOR 0:PLOT
84,27:DRAWTO 84,0:IF M1=1 THEN M1=0:D=US
R(1536,15,3,MX1,MY1):SC=SC+2
255 GOTO 290
260 PLOT 104,40:DRAWTO 159,40:COLOR 0:PL
OT 104,40:DRAWTO 159,40:IF M2=1 THEN M2=
0:D=USR(1536,15,3,MX2,MY2):SC=SC+2
265 GOTO 290
270 PLOT 84,54:DRAWTO 84,95:COLOR 0:PLOT
 84,54:DRAWTO 84,95:IF M3=1 THEN M3=0:D=
USR(1536,15,3,MX3,MY3):SC=SC+2
275 GOTO 290
280 PLOT 63,40:DRAWTO 0,40:COLOR 0:PLOT
63,40:DRAWTO 0,40:IF M4=1 THEN M4=0:D=US
R(1536,15,3,MX4,MY4):SC=SC+2
290 SOUND 0,0,0,0:SOUND 1,0,0,0:SOUND 3,
0,0,0:IF SC>999 THEN GOTO 700
300 V1=INT(SC/100):V2=INT(SC/10-V1*10):V
3=SC-V1*100-V2*10:V1=V1+48:V2=V2+48:V3=V
3+48
310 D=USR(1536,V1,3,1,8):D=USR(1536,V2,3
,2,8):D=USR(1536,V3,3,3,8)
320 IF M1=0 THEN IF INT(RND(0)*2+1)=1 TH
EN M1=1:MX1=70:MY1=SC/75:D=USR(1536,20,2
,MX1,MY1)
330 IF M2=0 THEN IF INT(RND(0)*2+1)=1 TH
EN M2=1:MX2=79-SC/400:MY2=33:D=USR(1536,
21,2,MX2,MY2)
340 IF M3=0 THEN IF INT(RND(0)*2+1)=1 TH
EN M3=1:MX3=70:MY3=70-SC/75:D=USR(1536,2
2,2,MX3,MY3)
350 IF M4=0 THEN IF INT(RND(0)*2+1)=1 TH
EN M4=1:MX4=60+SC/400:MY4=32:D=USR(1536,
23,2,MX4,MY4)
360 IF M1=1 THEN D=USR(1536,20,0,MX1,MY1
):MY1=MY1+1:D=USR(1536,20,2,MX1,MY1):IF
MY1>=24 THEN GOTO 500
370 IF M2=1 THEN D=USR(1536,21,0,MX2,MY2
):MX2=MX2-1:D=USR(1536,21,2,MX2,MY2):IF
MX2<=72 THEN GOTO 500
380 IF M3=1 THEN D=USR(1536,22,0,MX3,MY3
):MY3=MY3-1:D=USR(1536,22,2,MX3,MY3):IF
MY3<=43 THEN GOTO 500
390 IF M4=1 THEN D=USR(1536,23,0,MX4,MY4
):MX4=MX4+1:D=USR(1536,23,2,MX4,MY4):IF
MX4>=68 THEN GOTO 500
400 GOTO 130
500 SOUND 0,50,8,8:SOUND 1,100,8,8:SOUND
 2,200,8,8:SOUND 3,5,8,8
510 D=USR(1536,15,3,68,34):D=USR(1536,15
,3,70,43):D=USR(1536,15,3,72,34):D=USR(1
536,15,3,70,24)
520 D=USR(1536,15,3,69,36):D=USR(1536,15
,3,69,40):D=USR(1536,15,3,70,30):D=USR(1
536,15,3,71,27)
530 FOR N=0 TO 3:SOUND N,0,0,0:NEXT N
540 FOR N=1 TO 150:NEXT N
550 FOR N=0 TO 3:SOUND N,N*80+5,8,8:NEXT
 N
560 COLOR 3:PLOT 84,40:DRAWTO 84,20:DRAW
TO 84,60:PLOT 84,40:DRAWTO 114,40:DRAWTO
 54,40:PLOT 84,40:DRAWTO 114,20
570 PLOT 84,40:DRAWTO 114,60:PLOT 84,40:
DRAWTO 54,60:PLOT 84,40:DRAWTO 54,20
580 FOR W=0 TO 15:FOR W1=1 TO 100:SETCOL
OR 2,W,5:NEXT W1:NEXT W
590 FOR N=0 TO 3:SOUND N,0,0,0:NEXT N
600 GRAPHICS 2+16:? #6;"GAME OVER..FINAL
":? #6;"SCORE ";SC:? #6;"TO PLAY AGAIN":
? #6;"PRESS TRIGGER"
```

```
610 IF STRIG(0)=1 THEN GOTO 610
620 GOTO 20
700 GRAPHICS 2+16:? #6;"GOOD GAME!!!":?
#6;"!YOU WON!!!!":? #6;"YOUR SPACE FORTR
ESS":? #6;"SURVIVED"
710 ? #6;"TO PLAY AGAIN":? #6;"PRESS !TR
IGGER!":GOTO 610
19999 END
20000 ML=1536:FOR I=0 TO 252:READ A:POKE
 ML+I,A:NEXT I:RETURN
20010 DATA 104,240,10,201,4,240
20020 DATA 11,170,104,104,202,208
20030 DATA 251,169,253,76,164,246
20040 DATA 104,133,195,104,201,128
20050 DATA 144,4,41,127,198,195
20060 DATA 170,141,250,6,224,96
20070 DATA 176,15,169,64,224,32
20080 DATA 144,2,169,224,24,109
20090 DATA 250,6,141,250,6,104
20100 DATA 104,141,251,6,104,104
20110 DATA 141,252,6,14,252,6
20120 DATA 104,104,141,253,6,133
20130 DATA 186,166,87,169,10,224
20140 DATA 3,240,8,169,20,224
20150 DATA 5,240,2,169,40,133
20160 DATA 207,133,187,165,88,133
20170 DATA 203,165,89,133,204,32
20180 DATA 228,6,24,173,252,6
20190 DATA 101,203,133,203,144,2
20200 DATA 230,204,24,165,203,101
20210 DATA 212,133,203,165,204,101
20220 DATA 213,133,204,173,250,6
20230 DATA 133,187,169,8,133,186
20240 DATA 32,228,6,165,212,133
20250 DATA 205,173,244,2,101,213
20260 DATA 133,206,160,0,162,8
20270 DATA 169,0,133,208,133,209
20280 DATA 177,205,69,195,72,104
20290 DATA 10,72,144,8,24,173
20300 DATA 251,6,5,208,133,208
20310 DATA 224,1,240,8,6,208
20320 DATA 38,209,6,208,38,209
20330 DATA 202,208,228,104,152,72
20340 DATA 160,0,165,209,145,203
20350 DATA 200,165,208,145,203,104
20360 DATA 168,24,165,203,101,207
20370 DATA 133,203,144,2,230,204
20380 DATA 200,192,8,208,183,96
20390 DATA 169,0,133,212,162,8
20400 DATA 70,186,144,3,24,101
20410 DATA 187,106,102,212,202,208
20420 DATA 243,133,213,96,0,1
20430 DATA 28
32000 POKE 106,PEEK(106)-16:GRAPHICS 0:S
TART=(PEEK(106)+1)*256:POKE 756,START/25
6:POKE 752,1
32020 FOR Z=0 TO 1023:POKE START+Z,PEEK(
57344+Z):SETCOLOR 2,0,RND(0)*255+1:NEXT
Z:RESTORE 32100
32030 READ X:IF X=-1 THEN RESTORE :RETUR
N
32040 FOR Y=0 TO 7:READ Z:POKE X+Y+START
,Z:NEXT Y:GOTO 32030
32100 DATA 632,145,82,44,222,57,52,74,13
7
32101 DATA 640,24,24,24,60,126,126,60,25
5
32102 DATA 648,128,176,248,255,255,248,1
76,128
32103 DATA 656,255,60,126,126,60,24,24,2
4
32104 DATA 664,1,13,31,255,255,31,13,1
32105 DATA 672,231,231,126,60,24,24,24,0

32106 DATA 680,3,7,15,252,252,15,7,3
32107 DATA 688,24,24,24,24,60,126,231,23
1
32108 DATA 696,192,224,240,63,63,240,224
,192
32109 DATA -1
```

©

Accurate Timing In Atari BASIC

John Navas, II
San Mateo, CA

Trying to accurately control time intervals in Atari BASIC is a frustrating experience. A FOR...NEXT loop is the method most often recommended to create a simple time delay. An example of this approach is:

FOR N = 1 TO 1000:NEXT N

By adjusting the TO value or expression to a smaller or larger number than 1000, the length of the time delay can be made shorter or longer. Unfortunately, however, this method has several drawbacks:

1. The exact time delay desired can only be found through a process of trial and error.
2. The time delay for a given TO value or expression will vary significantly, depending on where it is located in a program (shorter near the beginning and longer near the end).
3. The length of the time delay is significantly affected by the display mode (a given FOR ...NEXT loop takes about 30% less time in GRAPHICS 3 than in GRAPHICS 0).
4. Accurately timing more than one interval at the same time is very difficult.
5. The BASIC program can't do anything else during the time delay interval.

These BASIC problems can be easily overcome in machine language. Although machine language programs can use a similar loop counter approach, they also have ready access to a number of superior alternatives provided by ATARI's unique hardware and Operating System. These alternatives include the five system timers, the Real-Time CLOcK (RTCLOK), and the POKEY hardware timers (normally used to generate tones with the SOUND statement). Happily, there are simple ways to gain access to some of these facilities in Atari BASIC. This article describes how to use the system timers.

First, a short note on how system timers 3, 4 and 5 work. (Although there are five timers in all, only these three are readily useable in BASIC.) Each timer consists of a two-byte counter, CDTMV3-CDTMV5, and a one-byte flag, CDTMF3-CDTMF5. The actual hardware addresses are given in Program 1. To use a Timer, its flag must first be set to any non-zero value, and then its counter must be set to the value of the desired time interval. The operating system will subtract one from the counter every 1/60 second during the start of each new TV picture frame (VBLANK) until the counter reaches zero. At zero, the operating system changes the flag back to zero and stops counting. All the BASIC program needs to do once the timer is running is to PEEK at the flag periodically to see if the time interval has run out. Note that all three timers may be used at the same time, if desired.

The timer counters are typical 6502 two-byte binary numbers, with the least significant byte at the lower hardware address. This means that each count in the lower address byte is worth 1/60 second up to a maximum of 255 counts for 4.25 seconds; each count in the higher address byte is worth 256 counts in the lower address byte, or just over 4.25 seconds. Only the lower address byte need be set if the desired time intervals do not exceed 4.25 seconds. Otherwise, Program 1 gives a simple method of calculating the correct values for each byte given a desired time interval in seconds.

Setting the timers is a little tricky. There are two or three bytes to set and the Operating System must be prevented from starting the countdown until all of them are set. Fortunately, there is an easy way: setting the CRITIC flag to a non-zero value suspends a number of Operating System processes including system timer counting. Program 1 shows the recommended procedure to set system timer 4 using the CRITIC flag.

Important: Do not leave CRITIC set to a non-zero value any longer than necessary!

Although the system timers are extremely useful, they do have a few limitations:

1. The maximum time interval which can be set directly is a little more than 18 minutes (65535 counts of 1/60 second). Of course, longer intervals could be controlled by counting multiple runs of a timer.
2. Very small timer counts will be imprecise because the Operating System is synchronized to the TV display and not to the BASIC program.
3. When one timer is being set, the CRITIC flag stops the other timers. In multiple timer applications a small amount of time may be "lost".
4. The Operating System uses System Timer 3 to OPEN the 410 program recorder. Any

prior value in the timer will be lost.

5. System timers 3, 4 and 5 are stopped during I/O operations because the Operating System sets the CRITIC flag. Significant amounts of I/O will cause time to be "lost".

For many applications, these limitations do not present any real problems. The system timers are powerful tools which are almost as easy to use as relatively crude FOR...NEXT loops; give them a try! For those other applications with different timing needs, there are the other timing alternatives mentioned above.

References:

ATARI Personal Computer System OPERATING SYSTEM User's Manual, Atari Inc., Copyright 1980, Chapter 6.

Stewart, Ed, "Unleash the P ower of Your Atari CPU", **COMPUTE!**, April 1981 #11, p. 102.


```
5 GRAPHICS 3
10 CDTMV3=540:CDTMF3=554:REM TIMER 3
15 CDTMV4=542:CDTMF4=556:REM TIMER 4
20 CDTMV5=544:CDTMF5=558:REM TIMER 5
25 CRITIC=66:REM CRITIC FLAG
30 NONZERO=1:ZERO=0
35 TIME=30.5:REM TIME EXAMPLE (SEC.)
40 TIME=TIME*60:REM CNVRT TO 1/60 CNT
45 HI=INT(TIME/256):REM TIMER HI BYTE
50 LO=TIME-(HI*256):REM TIMER LO BYTE
55 POKE CRITIC,NONZERO:REM STOP TIMER
60 POKE CDTMF4,NONZERO:REM SET FLAG
65 POKE CDTMV4,LO:REM SET LO BYTE
70 POKE CDTMV4+1,HI:REM SET HI BYTE
75 POKE CRITIC,ZERO:REM START TIMER
80 PRINT "TIMER STARTED"
85 COLOR INT(RND(0)*3)+1:REM EXAMPLE
86 PLOT RND(0)*39,RND(0)*19:REM EXAM
87 SOUND 0,RND(0)*128,10,8:REM EXAMPL
90 IF PEEK(CDTMF4) THEN 85:REM CHECK
95 PRINT "TIME'S UP!"
```

©

Carl Moser's MAE Assembler for the Apple and PET has proven popular with machine language programmers. Here, Dr. Lindner demonstrates how you can add your own, custom pseudo op's.

Extending MAE

Dr. Harald Lindner
Krefeld, West Germany

Carl Moser's excellent MAE macroassembler and text editor for the PET and the Apple is a very powerful program, but it can still be improved. I should like to describe how two new pseudo operation codes ".SL" and ".SH" can be added. These pseudo op's .SL "store low byte of a two byte address" and .SH "store high byte of a two byte address" may be used to generate jump-tables (e.g. the TOOLKIT, Commodore's BASIC-interpreter, and machine language monitor).

MAE's pseudo op's are contained in the table from 57C3 to 5834 (all addresses in hexadecimal). Each entry consists of four bytes. The first two bytes contain the ASCII-codes of the pseudo opcode name, and the last two bytes contain the address of the corresponding subroutine in the usual 6502-format low/high.

Fortunately, eight spare zero bytes (582B-5833) at the end of the table leave room for the addition of two new pseudo opcodes.

The Simple Solution

MAE contains two subroutines, Low at 5E39 and High at 5E4A, to evaluate the expressions "#L," and "#H," as in LDA #L,$B312 and LDY #H,$B312. The simple solution is to replace the eight zeros at 582B-5833 by:

```
582B  53  4C  39  5E  ;SI LOW
582F  53  48  4A  5E  ;SH HIGH
```

MAE will now handle the new pseudo op's .SL and .SH as expected. The only remaining problem is the relocating loader, which doesn't yet like these pseudo op's.

A Better Solution

Let us quickly consider the relocating information in MAE files. Assembler source files are program files, whereas MAE's OUTPUT command generates sequential files. The information for the relocating loader is contained in bytes whose low nibble is F (15 decimal). These bytes do not constitute valid 6502 instructions. After an ordinary machine language instruction such as LDA 4A or STX 6502 the bytes 0F to 7F have the following meaning:

0F: fixed address, do not alter.
1F: low byte of an address, the high byte follows.
2F: high byte of an address, the low byte follows.
3F: a byte value follows, do not alter.
4F: an address (2 bytes) follows, alter unless 0F follows.
5F: pseudo op .RS (resolve info set).
6F: pseudo op .RC (resolve info clear).
7F: pseudo op .DS (define storage).

Our new pseudo ops .SL and .SH will have to provide the following informations tó the relocating loader:

a byte value follows (via 3F),
this is the low or high, respectively,
part of an address (via 1F, 2F).

This is achieved by the following coding:

```
75BD  SL  JSR 6347
          LDA 49
          JSR 5B67
          JMP 5E41
75C8  SH  JSR 6347
          LDA 4A
          JSR 5B67
          JMP 5E52
```

This routine may be located conveniently at 75BD-75D2 which area is not occupied by MAE (at least not the PET version). MAE's pseudo op table is to be altered as follows:

```
582B  53  4C  BD  75
582F  53  48  C8  75
```

Finally, the relocating loader must learn to consider the directives 1F and 2F after a byte value (via 3F). This is easily done by replacing JMP 0584 with JMP 0639 at location 059A of the relocating loader (1979 version). Your MAE assembler will now handle the new pseudo op's .SL and .SH perfectly. ©

Last month, in Part I, a method of communicating with the disk drive in machine language was outlined. Here, the techniques are brought together into one program (a mixture of machine language and BASIC). The BASIC part is:

```
100 OPEN 6,8,15
110 PRINT #6, "I0"
120 OPEN 2,8,3, "#"
125 SYS 1200
190 CLOSE 2 : CLOSE 6
```

The article concludes with a program which will perform quality checks on disks and can also recover scratched disks. The Disk Checkout program will work on all disk units. For the new single-drive disk units, type S when you are asked for the Drive #.

Part II:

Disk Checkout For 2040, 4040, And 8050 Disks

Jim Butterfield
Toronto, Canada

Here's a listing of the complete machine language program:

```
  ; select command channel
04B0 A2 06            LDX #6
04B2 20 C9 FF         JSR SWITCHOUT
                          PUT
  ; send U1 message
04B5 A2 00            LDX #0
04B7 BD 0A 05 ULOOP   LDA UMESSAGE,
                          X
04BA F0 06            BEQ QUIT1
04BC 20 D2 FF         JSR OUTPUT
04BF E8               INX
04C0 D0 F5            BNE ULOOP
04C2 20 CC FF QUIT1   JSR RESTOREIO
  ; send B-P message
04C5 A2 06            LDX #6
04C7 20 C9 FF         JSR SWITCHOUT
                          PUT
04CA A2 00            LDX #0
04CC BD 19 05 BLOOP   LDA BMESSAGE,
                          X
04CF F0 06            BEQ QUIT2
04D1 20 D2 FF         JSR OUTPUT
04D4 E8               INX
04D5 D0 F5            BNE BLOOP
04D7 20 CC FF QUIT2   JSR RESTOREIO
  ; GET VALUES
04DA A2 02            LDX #2
04DC 20 C6 FF         JSR SWITCHINP
                          UT
04DF A2 00            LDX #0
04E1 20 E4 FF READ    JSR GET
  ; convert to hexadecimal
04E4 48               PHA
04E5 4A               LSR A
04E6 4A               LSR A
04E7 4A               LSR A
04E8 4A               LSR A
04E9 20 FD 04         JSR HXPRNT
04EC 68               PLA
04ED 20 FD 04         JSR HXPRNT
04F0 A9 20            LDA #$20
04F2 20 FF D2         JSR OUTPUT
04F5 E8               INX
04F6 E0 08            CPX #8
04F8 90 E7            BCC READ
04FA 4C CC FF         JMP RESTOREIO
  ; hex conversion subroutine
04FD 29 0F    HXPRNT  AND #$0F
04FF 09 30            ORA #$30
0501 C9 3A            CMP #$3A
0503 90 02            BCC NUM
0505 69 06            ADC #$06
0507 4C D2 FF NUM     JMP OUTPUT
  ; canned messages: U1 and B-P
050A 55 31 3a 33 20 30 20 31 38 20
     30 30 0d 00
0519 42 2d 50 3a 33 20 31 0d 00
```

Putting It Together

Type in the BASIC program first. Now, call the Machine Language Monitor with SYS4 and display

the desired part of memory with .M 04B0 0520 – you'll see whatever values are currently in memory. Ignore them; move the cursor back and type over so that you get:

```
04B0 A2 06 20 C9 FF A2 00 BD
04B8 0A 05 F0 06 20 D2 FF E8
04C0 D0 F5 20 CC FF A2 06 20
04C8 C9 FF A2 00 BD 19 05 F0
04D0 06 20 D2 FF E8 D0 F5 20
04D8 CC FF A2 02 20 C6 FF A2
04E0 00 20 E4 FF 48 4A 4A 4A
04E8 4A 20 FD 04 68 20 FD 04
04F0 A9 20 20 D2 FF E8 E0 08
04F8 90 E7 4C CC FF 29 0F 09
0500 30 C9 3A 90 02 69 06 4C
0508 D2 FF 55 31 3A 33 20 30
0510 20 31 38 20 30 30 0D 00
0518 00 42 2D 50 3A 33 20 31
0520 0D 00 00 00 00 00 00 00
```

Remember to press RETURN on each line to enter the values. One last change: display .M 0028 0028 and change what you see to:

```
.: 0028 01 03 22 05 22 05 22 05
```

You may now return to BASIC (with .X) and SAVE the program if you wish. If you have carefully proofread the code, type RUN and watch the program do the same thing as in BASIC. The values are output in hexadecimal rather than decimal.

You may have noticed that we have done a lot of work to produce a machine language program that is bigger than the BASIC one we wrote in the first place. For our example, speed isn't much of a factor.

In doing so, however, we've established that you can indeed work a disk from machine language. And sometimes that can be very useful indeed.

Disk Test

Before I take a diskette "on the road," there are two things that I often want assurance about. First, are all the files good? Secondly, are the empty blocks in good condition?

This program tests the disk for these two properties, and adds a third: it will reclaim one scratched file if desired – and if the file is still intact on disk.

The program is constructed to work on 2040, 4040 and 8050 disks. On 2040's, however, it can only usefully perform the first of the three activities.

Checking Files

There's more to checking a file than seeing if it is there. Some of the questions that need to be asked are:

–Are all the blocks of the file OK?
–Are all blocks allocated?
–Is there conflict with any other file?
–Is the block count correct?

This program checks all of the above. In doing so, it has turned up a minor bug in the disk system: files joined with CONCAT and APPEND are likely to have the wrong block count. This doesn't hurt anything, but gives you misinformation on your directory listing.

The files are shown on the screen as they are checked. If there is an error, the program will stop with an error notice. See the note below on errors.

Checking Blocks

If you plan to write on a disk, and aren't sure everything is in good order, option two, checking blocks, is convenient.

The program reads all blocks and ensures that they are in sound working order. 2040 type disks (DOS1) can't be checked in this way; when a 2040 diskette is new-ed, all blocks are not written. This program checks by reading, not by writing; it can't do a valid job if some blocks have never been written.

The blocks and sectors are shown on the screen as they are checked. If there is an error, the program will stop with an error notice. See the note below on errors.

Un-SCRATCHing

The program searches the directory for the names of scratched files and asks you whether you want to recover any file. When you say *yes*, you will be asked to identify the file type – this information was lost when the file was scratched. Then, a number of checks are very carefully made:

–Are all blocks good?
–Are all blocks free?
–Is the block count correct?

If the file passes all the above tests, the unscratching takes place, and the disk is asked to perform a VERIFY/VALIDATE/COLLECT which re-allocates the blocks.

Only one file can be reclaimed during a run. Multiple runs can unscratch many files, one at a time. The reason for this is related to the safety interlocks. When you reclaim a file, its blocks will be re-allocated. If you attempt to reclaim a second file and somehow its blocks conflict with the first file, this will be spotted: an allocated block will be found and the unscratch will not take place. If the program had been constructed so as to reclaim a whole series of files in one shot, this level of protection would have been lost.

The Program

The program is written entirely in BASIC, so a user can modify it to his particular needs. Except for a very small part of un-scratch, the program

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2905 Ports O'Call Ct. Plano, Texas 75075 214/867-1333 does not write to the disk; it only reads. Be aware, however, that closing a direct channel will force a BAM write to take place; this makes it desirable for a program to run through to completion rather than be stopped halfway through. See the error note below.

The Block Availability Map (BAM) is printed, and this may be an interesting thing to view for users who are not aware of the disk's organization. The centre track (track 18 or 39) is reserved for the directory, and file space is allocated close to this centre track where possible; this minimizes drive head movement. When a file is written on a track, it is not written to consecutive sectors, but "hops around" in order to optimize speed.

The program decides what sort of disk it has based on information supplied by the diskette itself. Thus, a 2040 diskette placed into a 4040 drive will be recognized as being 2040 format.

The directory is read from disk the "hard" way – as a bit map. This allows us to see things that a "normal" directory won't tell us, allowing us to find file starting locations and to see scratched files if we wish.

This program won't attempt to read a disk which is bad format. If you can't initialize a disk, this won't help you.

Error Procedures

If the program stops on an error, we have a delicate condition – an opened direct file. Unless you really know what you're doing, I would recommend removing the diskettes and turning the power off the disk unit.

If you find a problem on a disk, get it out of your inventory as quickly as possible. Copy the files you can salvage over to a fresh diskette. Diskette problems don't solve themselves: once a disk is in trouble, the errors can propogate and eventually harm your good files. It won't happen often; but none of us need to have it happen even once.


```
100 PRINT"DISK CHECKER  - JIM BUTTE
    RFIELD"
110 DIM A(255),C%(77,28),D%(1),N$(2
    24),T%(224,1),S%(224,1),L%
    (224),R%(77)
120 D%(Ø)=58:D%(1)=42:Z$=CHR$(Ø)
130 DATA 1,17,2Ø,24,19,3Ø,17,35,16,
    Ø
140 DATA 65,17,2Ø,24,18,3Ø,17,35,16
    ,Ø
150 DATA 67,39,28,53,26,64,24,77,22
    ,Ø
160 B$=CHR$(17):INPUT"DRIVE#";D$:IF
    D$="S"THEND$="Ø":B$=CHR$(3
    )
170 IFD$<>"Ø"ANDD$<>"1"GOTO16Ø
180 OPEN15,8,15,"I"+D$:GOSUB3Ø2Ø
190 OPEN3,8,3,"$"+D$:GOSUB3Ø2Ø
200 AØ=1:GET#3,A$:A=ASC(A$+Z$)
210 READA1:IFA=A1GOTO25Ø
220 F%=F%+1:IFF%=3GOTO29Ø
230 READA1:IFA1=ØGOTO21Ø
240 GOTO23Ø
250 READA1:IFA1=ØGOTO27Ø
260 READB1:FORJ=AØTOA1:R%(J)=B1:NEX
    TJ:AØ=J:GOTO25Ø
270 IFA=1ORA=65THEND1=1:T9=35:S9=3:
    D9=18
280 IFA=67THEND1=257:T9=77:S9=4:D9=
    39
290 IFT9=ØTHENCLOSE3:PRINT"?? DISK ~
    NOT RECOGNIZED ??":STOP
300 REM    GET AND PRINT BAM
310 PRINT"       FREE BLOCK MAP"
320 FORJ=1TOD1:GET#3,A$:NEXTJ
330 FORJ=1TOT9:T1=Ø
340 IFJ=51THENGET#3,A$,A$,A$,A$
350 GET#3,A$:C=ASC(A$+Z$)
360 PRINTRIGHT$(" "+STR$(J),2);" ";
370 K1=Ø:FORK=ØTOS9-1:GET#3,A$:A=AS
    C(A$+Z$)
380 FORL=ØTO7:A%=A/2:D1=A-A%*2:IFK1
    <=R%(J)THENC%(J,K1)=D1:PRI
    NTCHR$(D%(D1));
390 A=A%:T1=T1+D1:K1=K1+1:NEXTL,K:P
    RINT
400 IFT1<>CTHENPRINT"?";
410 NEXTJ
420 REM    DO SPECIFIC JOB
430 PRINT:CLOSE3:PRINT "    CHOOSE ~
    --"
440 PRINT "1. CHECK ALL FILES"
450 PRINT "2. CHECK FOR BAD SPOTS"
460 PRINT "3. RECOVER SCRATCHED FIL
    E"
470 PRINT "  YOUR CHOICE? ";
480 GETX$:IFX$=""GOTO48Ø
490 X=ASC(X$)-48:IFX<1ORX>3GOTO48Ø
500 PRINTX$:OPEN2,8,2,"#Ø":GOSUB3Ø2
    Ø
510 ONXGOTO52Ø,79Ø,89Ø
520 REM     CHECK FILES
530 T=D9:S=1
540 GOSUB2ØØØ
550 FORD=2TO255STEP32:IFA(D)<128GOT
    O59Ø
560 D3=D3+1:T%(D3,Ø)=A(D+1):S%(D3,Ø
    )=A(D+2):L%(D3)=A(D+28)+A(
    D+29)*256
570 IFA(D)=132THENT%(D3,1)=A(D+19):
```

```
     S%(D3,1)=A(D+20)
580 N$="":FORK=D+3TOD+18:N$=N$+CHR$
     (A(K)):NEXTK:N$(D3)=N$
590 NEXTD
600 T=A(0):S=A(1):IFT=D9GOTO540
610 FORD=1TOD3:L%=0
620 PRINTN$(D);
630 T=T%(D,0):S=S%(D,0)
640 IFT>T9ORS<0THENT=0
650 IFT<1ORS>R%(T)THENPRINT" BAD CH
     AIN":GOTO770
660 IFC%(T,S)=1THENPRINT" UNALLOCAT
     ED BLOCKS":GOTO770
670 IFC%(T,S)>1THENPRINT" CONFLICT ~
     ";N$(C%(T,S)-1):GOTO770
680 C%(T,S)=1+D
690 GOSUB3000
700 L%=L%+1
710 FORJ=0TO1:PRINT#15,"M-R";CHR$(J
     );B$:GET#15,A$
720 A(J)=ASC(A$+Z$):NEXTJ
730 T4=T:S4=S:T=A(0):S=A(1):IFT<>0A
     NDE=0GOTO640
740 T=T%(D,1):S=S%(D,1):T%(D,1)=0:I
     FT<>0GOTO640
750 IFL%<>L%(D)THENPRINT" INCORRECT
      BLOCK COUNT":GOTO770
760 PRINT:PRINT"{UP}                  ~
           {UP}"
770 NEXTD
780 PRINT:PRINTD3;"FILES":GOTO1270
790 REM   SCAN SECTORS
800 IFF%=0THENPRINT"SORRY .. CAN'T ~
     DO IT":GOTO1270
810 FORT=1TOT9:PRINT"TRACK";T
820 FORS=0TOR%(T)
830 PRINT"{UP}{10 RIGHT} SECT";S
840 GOSUB3000
850 NEXTS
860 PRINT"{UP}                      {
     UP}"
870 NEXTT
880 PRINT"DISK OK":GOTO1270
890 REM    UNSCRATCH
900 K=0:PRINT"I WILL LOOK FOR DISCA
     RDED FILES..."
910 T=D9:S=1
920 GOSUB2000
930 FORD=2TO255STEP32:IFA(D)<>0ORA(
     D+1)=0GOTO980
940 IFK=0THENPRINT"DO YOU WANT TO R
     ECOVER:"
950 GETX$:FORK=D+3TOD+18:PRINTCHR$(
     A(K));:NEXTK:PRINT"? ";
960 GETX$:IFX$<>"Y"ANDX$<>"N"GOTO96
     0
970 PRINTX$:IFX$="Y"GOTO1010
980 NEXTD
990 T=A(0):S=A(1):IFT=D9GOTO920
1000 PRINT"THAT'S ALL ":GOTO1270
1010 T6=T:S6=S:D6=D:T=A(D+1):S=A(D+2
     ):L%(0)=A(D+28)+A(D+29)*25
     6:L%=0
1020 GETX$:PRINT"IS THIS FILE:"
1030 PRINT" 1. SEQUENTIAL"
1040 PRINT" 2. PROGRAM"
1050 PRINT" 3. USR"
1060 IFA(D+19)=0GOTO1080
1070 PRINT" 4. RELATIVE"
1080 PRINT"  WHICH NUMBER? ";
1090 GETX$:IFX$=""GOTO1090
1100 X=ASC(X$)-48:IFX<1ORX>4GOTO1090

1110 PRINTX$:X=X+128
1120 IFX=132THENT%(0,1)=A(D+19):S%(0
     ,1)=A(D+20):IFT%(0,1)=0GOT
     O1020
1130 IFT>T9ORS<0THENT=0
1140 IFT<1ORS>R%(T)THENPRINT" BAD CH
     AIN!":GOTO1260
1150 IFC%(T,S)=0THENPRINT" ALLOCATED
      BLOCKS!":GOTO1260
1160 GOSUB3000:L%=L%+1
1170 FORJ=0TO1:PRINT#15,"M-R";CHR$(J
     );B$:GET#15,A$
1180 A(J)=ASC(A$+Z$):NEXTJ
1190 T4=T:S4=S:T=A(0):S=A(1):IFT<>0G
     OTO1130
1200 T=T%(0,1):S=S%(0,1):T%(0,1)=0:I
     FT<>0GOTO1130
1210 IFL%<>L%(0)THENPRINT" INCORRECT
      BLOCK COUNT!":GOTO1260

1220 T=T6:S=S6:D=D6
1230 GOSUB3000
1240 PRINT#15,"M-W";CHR$(D);B$;CHR$(
     1);CHR$(X)
1250 PRINT#15,"U2:2,";D$;T;S:GOSUB30
     20:GOTO1300
1260 PRINT "SORRY - IT WON'T WORK"
1270 CLOSE2
1280 INPUT"** GOT TIME TO VERIFY/COL
     LECT DISK";X$
1290 IFASC(X$)=78THENEND
1300 CLOSE2:PRINT#15,"V";D$:END
2000 REM    GRAB FULL DISK BLOCK
2010 GOSUB3000
2020 FORJ=0TO255:PRINT#15,"M-R";CHR$
     (J);B$:GET#15,A$
2030 A(J)=ASC(A$+Z$):NEXTJ:RETURN
3000 REM    READ BLOCK
3010 PRINT#15,"B-R:2,";D$;T;S
3020 REM   GET ERROR STATUS
3030 INPUT#15,E,E$,E1,E2
3040 IFE<>0THENPRINT"{REV}DISK ERROR
     :{OFF}"E;E$,E1;E2
3050 RETURN
```

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INSIGHT: Atari

Bill Wilkinson
Optimized Systems Software
Cupertino, CA

This month, I present a session on how to steal a system. Before all you kleptomaniacs rejoice, though, I should explain that I mean to show you how to take control of your Atari's software system when a user pushes the SYSTEM RESET button. This will, I hope, be useful to BASIC and assembly language programmers alike.

There will be more on the inner workings vs. outer appearances of Atari BASIC; and, as space permits, I will have my usual assortment of cute tricks and Did You Knows.

In a departure from the norm, I will review a product here. Since my company, Optimized Systems Software, both solicits and sells software for Atari (and Apple) computers, I do not think it would be fair for me to do software reviews. But, unless you and/or my dear editor object, I may, from time to time, discuss new and wondrous happenings in the world of Atari.

A Short Review

It generally strikes me as unfair for a magazine to carry a review of something it sells; but every other magazine does it, so I prevailed on **COMPUTE!** to let me review *COMPUTE!'s First Book of Atari*. I am doing so on the condition that the review must be run as I submit it. (Okay, okay, Richard...you can fix my punctuation.) I have to do a good review or they won't let me do it again (just kidding...I think).

First, let me say that I did not start reading **COMPUTE!** regularly until about December, 1980, so most of the material in the book was new to me. Boy was it new to me! Quite frankly, I had lulled myself into thinking that, until I started writing my column, the poor Atari user had no insight (an insight gag) into the workings of Atari BASIC, DOS, etc. *Not so!!* There was a *lot* of good stuff published in **COMPUTE!** during 1980.

I don't want to make this review sound like a whitewash, so let's get the bad stuff over with first. The first warning that needs to be given is that, in general, this is not a book for software hackers: there is little of interest to the assembly language programmer (but see below for some notable exceptions), and the person who has read *and understood* (!!) the technical manuals and, perhaps, *De Re Atari* won't find much he or she didn't know. However, for most people there is much useful material here. There are some bloopers in the material presented, things which probably wouldn't get past the current, more Atari-sophisticated, editorial staff. There's a little duplication of material. And there's a lot of stuff that has been updated by better articles which have appeared (usually in **COMPUTE!**) in 1981 and 1982. Actually, my biggest complaint is in a reprinted article titled "The OUCH in Atari BASIC": the article states, *and* the editorial lead-in agrees (and the lead-in was written recently – Oh, for shame!), that keywords can't be used in variable names. Yet, the very next article in the book says that all keywords can be used as variable names! (Still not quite true – "NOT" is poison as the first three characters of a name, and a few keywords, such as "TO" and "STEP" can't be used as-is. Oh well, this was 1979 and 1980. And, come to think of it, even *Atari's BASIC Reference Manual still* says not to use keywords as names. Of course, it also says that substrings are limited to 99 characters, so maybe it's not a good reference point.)

OK. So much for the bad stuff. "Not possible!" you scream? Sorry, but it's true. I really don't have any dirt to sling. Oh, some of the little example programs might now be found in the Atari manuals, etc., but they aren't *bad*, just not of as much value as the rest of the book. And I wish I had the time and space to correct every little goof I found. (But I gotta tell you *one:* the order and size of variables and their names has *no* impact at all on the speed of an Atari BASIC program. Honest.) With those caveats in mind, we examine the value of the book.

And the book is of value. If you had to choose between losing your left pinkie (not quite up to the left thumb, anymore), the *First Book,* and *De Re Atari,* you should really think about how useful a little pinkie is. If you *must* choose between *De Re* and *First Book,* let your experience level be your guide: if you almost understand the Atari technical manuals, you are probably ready for *De Re.* If you are just learning to program, stick with *First Book.* If you're in the middle, better let the little pinkie go.

My own favorite pair of articles from the book are "Inside Atari BASIC" and "Atari Tape Data Files," both by Larry Isaacs. I am just now getting to the point where I am discussing things in "Insight: Atari" that Larry explored over a year ago (there will be overlap, hopefully to your benefit). Other articles worth mentioning include the following (an asterisk indicates something of interest to assembly language buffs):

"Printing to the Screen from Machine Language"*
(not because of what the presented program does as much as for some of the techniques it introduces)

"The Fluid Brush"
(Ditto. And its ideas have been much copied.)

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#4: BASICS OF ANIMATION — Shows you how to animate simple shapes using the PRINT and PLOT commands, and also has nice little PLAYER/MISSILE Graphics demo to learn. This would be an excellent way to start making your programs come alive on the screen. Recommended for new owners.

#5 PLAYER MISSILE GRAPHICS — This complex subject is demonstrated by starting with simple examples, and building up to a complete game and also an animated business chart on multiple pages! As always, the computer does most of the calculations. Requires 32K disk or tape and costs **$29.95**

#6: SOUND — From explaining how to create single notes, to demonstrating complex four channel sound effects, this newest tutorial is great. Even those experienced with ATARI's sound capabilities will find the menu of sound effects a needed reference that can be used whenever you are in the need of a special sound for your programs. Everyone will learn something new! Written by Jerry White.

Tricky Tutorials (except #5) require 16K memory for cassette orders and 24K for disk. The price is $19.95each. You may order 1,2,3, & 4 for $64.95.All six in a colorful binder cost $99.95.

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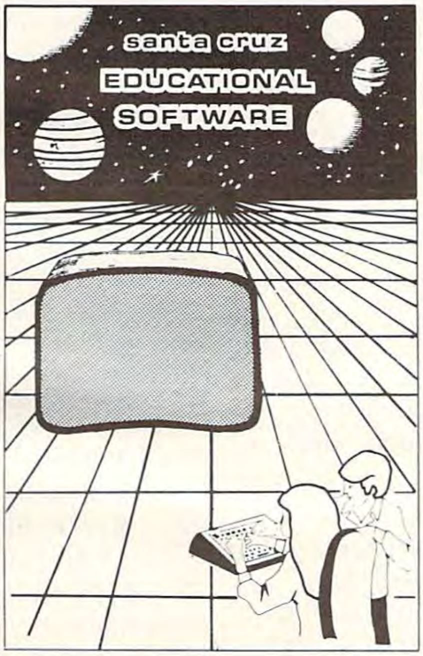

MINI-WORD PROCESSOR — This is for those of you who have a printer, but don't want to spend $100 or more for a fancy word processor. It is suitable for simple editing of text, accepts most control characters for your printer, and text is stored on disk for easy retrieval. Holds 2½ typed pages at a time. Requires 32K, disk or tape. **$19.95**

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FONETONE — For those who only want to store name and phone numbers and have the dialer feature as above, we offer this reduced version. Same memory requirements, but only costs **$14.95.** Don't forget you must have a touch-tone phone.

PLAYER PIANO — Turns your keyboard into a mini-piano and more. Multiple menu options provide the ability to create your own songs, save or load data files using cassette or diskette, fix or change any of up to 400 notes in memory, and play all or part of a song. The screen displays the keyboard and indicates each key as it is played from a data file or the notes you type. You don't have to be a musician to enjoy this educational and entertaining program. Requires 24K cassette or 32K disk. **$14.95**

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By the time you read this all computers (400/800) being produced should have the fabled GTIA chips included. ATARI service may upgrade older computers... call and ask (it's easy to do yourself). We have one and the improvements that graphics modes 9,10, and 11 offer are great!! To help you figure out what to do with the new modes a new Tricky Tutorial will be offered in March on Modes 9 to 11. Either give us a call or write around that-time.

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"Player/Missile Graphics" *
(by Chris Crawford. What more need I say?)
"Adding a Voice Track to Atari Programs" *
(This one was even swiped! There are more sophisticated methods shown in *De Re*, but this is adequate for many purposes.)
"Atari Memory Locations" *
(Just a table. You need to read the *Technical Manual* and/or *De Re* first, but this will serve as a handy reminder.)
"Input/Output on the Atari"
(I hesitated on this one: you should ignore what it says about XIO! It's misleading. Read my Atari I/O series.)

You'll note that most of that stuff is kind of heavyweight. Well, that's what appeals to me and, I think, to a large portion of **COMPUTE!**'s Atari readership. However, there are several little goodies, usable by virtually anyone, which deserve honorable mention. No commentary on these: their names tell it all and you just have to try them to appreciate them:

"Reading the Atari Keyboard on the Fly"
"Al Baker's Programming Hints"
"Atari Sounds Tutorial"
"Using the Atari Console Switches"
"Atari Meets the Real World"

You may have your own favorites, but my criterion for a good article (or good magazine-published program) is that it teaches you something. Thus I rate type-it-in-and-run-it games relatively low. (There are remarkably few of them that appear in the book.)

In final summary, I have to say that, for $12.95, you are unlikely to find this much (184 pages, including – can you believe it – a usable index) useful Atari material presented again (well...until the *Second Book* ?). Real software hackers will find some of the material too elementary, but they are probably the only ones that will be disappointed.

Stealing A System

During my series on Atari I/O (**COMPUTE!** November, 1981, through March, 1982, issues 18 through 21), I mentioned (more than once) the "proper" way to add device drivers to OS. I summarize it here again:

1. Inspect the system MEMLO pointer (at $2E7).

2. Load or relocate your routine at/to the current value of MEMLO.

3. Add the size of your routine to MEMLO.

4. Store the resultant value back in MEMLO.

5. If your routine is a device driver, connect it to OS by adding its name and address to HATABS.

6. Fool OS so that steps three through five will be re-executed if SYSTEM RESET is hit.

In **COMPUTE!** (January, 1982, #20) we added the driver for the "M:" device by following steps one through five as above. We discussed step six briefly, but did not show how to implement it. This month, we will show how to fool OS. And, rather than repeating the lesson about adding device drivers, we will take this opportunity to show how to give Atari BASIC some measure of control over what happens on RESET.

In particular, we "steal" the system in a way that the user who hits RESET will cause a TRAPpable error in the running BASIC program. In other words, if you write your BASIC program in a way that TRAP (to a line number) is always active, you will be able to detect when your user hits the RESET key, but your program will not stop running, will not lose its variable values, and will be impacted in the minimum possible way.

Some cautions are in order (it seems like I always have to say that): *before* vectoring through RAM (and thus allowing our little trick) Atari's OS ROMs perform several actions when SYSTEM RESET is hit. If you need to know exactly what happens, try to get hold of the CIO listings (they are moderately readable); generally, the following lists all that matters except to those who would make their own cartridges:

1. The system resets any memory size pointers (MEMLO, MEMTOP, etc.).

2. Most hardware registers are reset to zero ($D000-$D0FF, $D200-$D4FF).

3. OS clears its own RAM ($200-$3FF, $10-$7F). Note that this zaps all IOCB's for all files.

4. All the ROM-based device drivers are initialized (via their own initialize routines).

5. CIO's initialization is called, which effectively marks all files as properly closed.

6. Screen margins, etc., are reset and the E: device is opened on file channel #0 (which is equivalent to GRAPHICS 0 from BASIC).

7. The file manager's initialization routine is called via an indirect call through location DOSINIT ($0C).

8. *If* there are no cartridges installed, then DOS is invoked by an indirect jump through location DOSVEC ($0A). If a cartridge is installed and wants control, though, OS goes to the cartridge instead of DOSVEC.

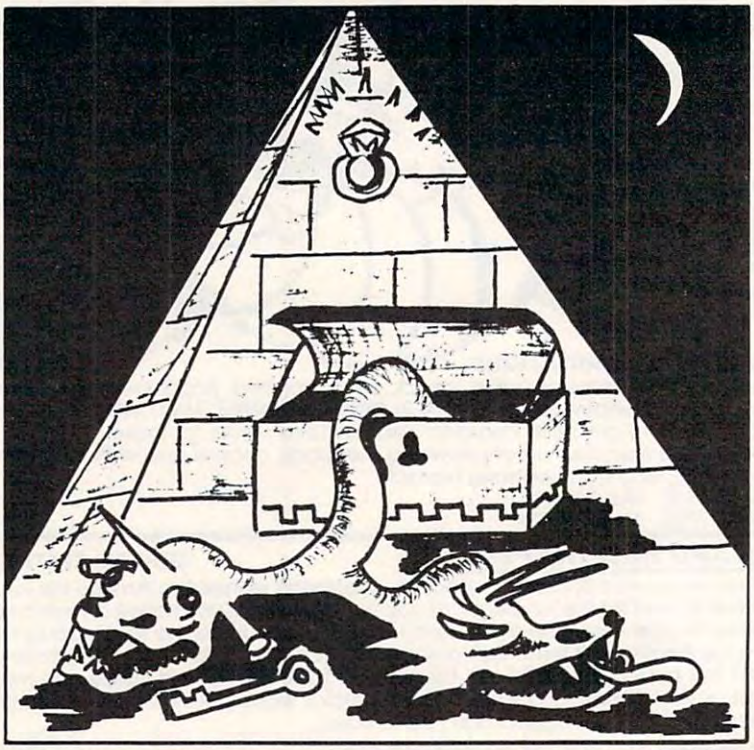
(NOTE: OS/A + uses a variation on 7., above, so don't bang your head against the wall trying what is written here with OS/A+. I will be glad to tell you of the differences if the manual is not clear enough.)

Program 1 takes into account not only all of the above, but also the requirements of Atari BASIC related to executing a pseudo-warmstart. I will not try to explain why the various JSRs and tests shown are needed; just take my word for it that they are indeed necessary (I found out the hard way). Actually, the part pertaining to stealing the DOSINIT vector is straightforward, as you may note, and changing MEMLO is trivial.

Once again, for space and time reasons, I have cheated with this program: I have assumed that my routine can load and execute at $1F00 and can move MEMLO to $2000. Those of you who want to do the whole thing right can follow the techniques I showed in **COMPUTE!** February, 1982, #21, for generating relocatable programs. Also, please note that the listing, as is, is designed to produce an AUTORUN.SYS file. You may need to do a little surgery to use it in other ways (e.g., remove the load-and-go vector at the end, JMP directly to the start of the BASIC cartridge, etc. – experiment).

The most important thing to note about this routine's implementation is how the address found in DOSINIT is moved into the JSR instruction (at the label RESET). Obviously, you could go look at the contents of DOSINIT and code the JSR directly, omitting the move of the address. And this will work as long as you use the same version of OS and DOS. *But* ... all too many Atari software developers fell into the trap of thinking that OS and DOS were immutable, only to have Atari announce DOS 2S and OS version B.

To Atari's credit, they have



carefully documented which locations, vectors, etc., are guaranteed to remain unchanged. If you write your code properly, you should never have to change it. Incidentally, another example of this same concept appeared in my last article: the vector from VVBLKD was preserved, rather than simply JuMPing to the routines in ROM.

Enough preaching: investigate the listing. But I leave you with one last freebee. If you change three lines of code in the listing (lines 1950 to 1970) to the following two lines, you will cause BASIC to reRUN the program currently in memory, rather than causing an error TRAP.

```
1950 JSR $B755
1960 JMP $A962
```

The following short BASIC program illustrates the use of our stolen pointer:

```
10 TRAP 100
20 PRINT "LOOPING AT
   LINE 20"
30 GOTO 20
40 STOP : REM

   can't get here from there...
   or anywhere

100 IF PEEK(195)<>255 THEN
    PRINT "HOW? WRONG
    ERROR CODE!":STOP
110 PRINT "RESET KEY WAS
    HIT...I WILL START
    AGAIN"
120 RUN
```

Note that you *can't* get out of this program with the RESET key! Now, if you also trap the BREAK key, the user is truly locked in your program. If you have BASIC A+, of course, you can trap the BREAK key via SET 0. If not, then refer to the listing titled "Idiot-Proofing the Keyboard" in *De Re Atari*. (Summary of that listing: since the BREAK key is one of the two IRQ's not vectored through RAM, you must change the system master IRQ vector to point to your own routine. In your routine, you check for and ignore BREAK key IRQ's and pass other IRQ's on unchanged. Not trivial, perhaps, but certainly less complicated than what we have done above.)

Inside Atari BASIC, Part 3: Enhancements

After skipping last month, we return to our discussion of the hows and whys of Atari BASIC. Recall that in **COMPUTE!** February, 1981, #21, we discussed how BASIC checks your entered line for correct syntax and produces a tokenized result. Let us begin this month with a discussion of how BASIC executes (RUNs) a program.

First, note that if you enter a direct line (one without a line number), BASIC arbitrarily assigns it to line number 32768 and then pretends that it is like any ordinary line. That means that even direct lines must go through the tokenizing and execution process. It also means that BASIC makes little or no distinction between statements (within a program) and commands (given directly); thus you can LIST or RUN or even CONTinue from inside a BASIC program.

Whenever a line is finished executing, BASIC checks to see if the next line exists (it doesn't if a direct line was just executed) or if the next line has a line number greater than 32767 (i.e., if the line executed is the last one prior to the direct line). If either condition prevails, BASIC pretends to itself that it got an "END" statement and, presto, you are back staring at the "READY" prompt.

But let us assume that the direct command given was "RUN." The execution of a RUN statement simply causes all BASIC's pointers and flags to be reinitialized, including setting BASIC's "next line" pointer to the beginning of the program. Then RUN returns to what we call "Execution Control" which decides that it needs to start executing the next line...which conveniently is the first line.

So far, so good. But how does BASIC know what to do with the tokens? The answer is that it doesn't, really. Recall that there are two separate kinds of execution (as opposed to variable) tokens: statements and operators. Each of these has a table of two-byte pointers residing in BASIC's ROM. Execute Control simply picks up the next byte of the program, assumes that it is a statement token (incidentally, in the range of \$00-\$7F), and uses double its value as an index into the table of statement pointers. It uses the address thus found as an indirect jump and goes to the appropriate statement execution routine.

In a non-syntaxed BASIC (i.e., Microsoft), much of the preceding applies virtually unchanged. But, when the statement execution routine gets control in such a BASIC, it has no idea what the next character or token in the program might be, so it must needs go through a set of checks to determine what is legal and what is not.

In Atari BASIC, though, the statement execution routine *knows* that the byte(s) that follow constitute legal syntax! So it need not waste time checking for legality. Since the bytes following the statement token may range from the non-existant (as in CONT, which has no following bytes) to the extremely complex (as in PRINT, in all its variations), each statement generally has responsibility for choosing what to do with these bytes.

With the exception of assignment-type operations (LET, READ, INPUT, etc.), file designators (PRINT #), and complex statements (FOR...TO... STEP), what follows the statement byte is generally a series of one or more expressions, separated by commas, equal signs, semicolons, etc. Thus it comes as no surprise that there is a major subroutine in Atari BASIC entitled "Execute Expression," which can evaluate virtually any numerical or string expression.

As a simple example, let us examine the mechanism of POKE. The syntax is properly "POKE <aexp>,<aexp>" (where <aexp> means Arithmetic EXPression). So POKE's statement execution routine simply calls Execute Expression for the first value, saves it away someplace safe, skips the comma (it *knows* the comma is there...the syntaxer said so!), calls Execute Expression for the second value, and stores the second into the memory location designated by the first. Now, in truth, POKE calls a variation on Execute Expression which is guaranteed to return a 16-bit (or 8-bit, as required) value; but the concept holds for most statements.

It is really beyond the scope of this article to try to explain the intricacies of Execute Expression. It will suffice to point out that it must worry about operator precedence ("*" before "+", etc.) and parentheses and subscripted variables and functions (SIN, RND, etc.) and more.

And that's about it. Except to note that when a statement is finished it usually simply returns to Execute Control, which checks for another statement on the same line and/or moves its pointer to the first statement of the next line.

Much of the point of this discussion has been to show why it is hard to fool BASIC into believing that it has a new statement to use. Even with the source, it is no easy task to make sure that the correct syntax for a new statement is entered into the syntax tables (which are actually a miniature language in their own right), the name tables, and the execution tables (to say nothing of writing the code to execute the statement). With Atari BASIC locked in ROM, the task is really impossible since BASIC makes use of no RAM-based pointers or indirect jumps throughout this process.

So how can we add features to Atari BASIC? Several ways:

1. Try the USR function as suggested last month. This really is the simplest, most straightforward, most guaranteed-to-work.

2. Make your own special device handler (a la "M:" in **COMPUTE!**, January, 1981, issue #20). Open a channel to it (OPEN #1,...). PRINT something to it. When your driver gets control, it can actually go in and look at the BASIC tokens and decide what to do from there. Cryptic, but it works.

3. If you are interested in commands, as opposed to statements, you can intercept BASIC's call to "E:" (for the next input line) and examine the line yourself (presumably as does Monkey Wrench). This implies that you must check syntax, find variables, convert ASCII to floating point, etc., in your routine. Tedious, but obviously feasible and usable.

As you can, no doubt, tell, I am much in favor of method 1. It is by far the easiest to do and requires the least knowledge of BASIC's internals.

Is there yet another way? A month ago I would have said *"no!"* But, now, I have discovered a crack in the door. It is complicated, prone to programmer error, fairly inflexible, and of doubtful value for anyone but professional software developers. To explain it would take a couple of more columns, and I'm simply not willing to write that much on a topic of dubious value. If you feel you absolutely *must* know, write me (care of OSS). If enough people write, I *may* make up a pamphlet and sell it at an outrageous price. Are you sure you can't live with method 1?

Easy Horizontal Joysticks

If you have an application (a polite way of saying game) that needs a joystick that moves only horizontally (or only vertically, if you are willing to hold your joystick turned 90 degrees from "normal"), then have I got a trick for you! Try this program, with joystick number 0 plugged in:

```
10 PRINT PTRIG(0)-PTRIG(1),
20 FOR J=1 TO 50 : NEXT J
30 GOTO 10
```

Now push the joystick in all directions. Neat? Pushing it left gives you a value of -1 and right gives you +1. And, of course, you can use A = PTRIG(2)-PTRIG(3) to read joystick number 1, etc.

Why does it work? Because the paddle triggers happen to use the same pins on the connector that the horizontal switches in the joystick use. I discovered that by reading the technical manual; so, you see, there is probably still buried gold in those books.

Unfortunately, no such happy coincidence exists for reading the vertical joystick switches. Incidentally, use of this trick does not affect STRIG in any way.

Dissonances

The algorithm Atari gives for figuring out what *actual* frequency will result from the divider FREQ in (for example) SOUND 0,FREQ,tone,volume is as follows:

$$\text{actual frequency} = \frac{63921}{FREQ + FREQ + 2}$$

This means that, at values for FREQ around 85 (the middle of the Atari's frequency range), the minimum actual frequency step is about 4 Hz. While adequate for solo parts, this kind of frequency resolution can really grate on your ears when there are three or four voices active. To illustrate the real meaning of this, try the following one-liner:

```
FOR F=255 TO 0 STEP -1 : SOUND 0,F,10,15 :
  NEXT F
```

The resultant sound is a smooth glide until you get near the top end, when you begin to really hear the steps.

For those of you with a keen ear and/or a strong sense of music, cheer up. Atari, once again, gave us a solution. The entire Atari audio system is controlled by hardware register AUDCTL ($D208). Normally, the audio channels are clocked by an oscillator running at 63921 Hz. But, the user may specify that channels zero and two (which Atari calls one and three in the *Technical Manual*... oh well) are to be clocked by a 1,789,790 Hz oscillator. If you change 63921 to 1789790 in the formula above and plug in 255 (the highest value) for FREQ, you will see that the *lowest* note thus playable is around 3000 Hz!

But we have yet another solution available via AUDCTL: instead of an 8-bit counter for a single audio channel, we use a pair of channels to produce a 16 bit counter. (Unfortunately, we then are limited to two sound channels.) The modified formula then becomes:

$$\text{actual frequency} = \frac{1789790}{FREQ + FREQ + 14}$$

Since FREQ now has values from 0 to 65535, it's obvious we have many more actual frequencies available to us. I present herewith two sample programs using this technique. Program 2 shows two voices doing very smooth glides. Program 3 shows a 9-octave chromatic scale (C, C#, D, D#, etc.). This compares to the 3-octave scale available

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via the standard SOUND commands.

Finally, if you simply need lower notes than you can get with SOUND, TRY POKEing AUDCTL to one. This has the effect of lowering *all* notes by

Program 1.

```
equates and commentary

0000         1000          .PAGE "equates and commentary"
             1010 ;
             1020 ; STEAL A RESET
             1030 ;
             1040 ; listing for COMPUTE! magazine, April, 1982
             1050 ;
             1060 ;
             1070 ; there are two parts to this listing:
             1080 ;   1. what happens when this is first loaded
             1090 ;      (which initializes everything)
             1100 ;   2. what happens when the user pushes
             1110 ;      SYSTEM RESET.
             1120 ;
             1130 ; Most of 1 is understandable.  Most of 2
             1140 ; is magic.  If it works, don't knock it.
             1150 ;
02E7         1160 MEMLO    =    $2E7        ; BOTTOM OF USABLE MEM
             1170 ;
00FF         1180 LOW      =    $FF
0100         1190 HIGH     =    $100
             1200 ;
             1210 ; EQUATES INTO BASIC ROM
             1220 ;
BD72         1230 SETDZ    =    $BD72       ; ENSURE OUTPUT TO CONSOLE
0092         1240 MEOL     =    $92         ;FLAG: LINE MODIFIED
BD99         1250 FIXEOL =      $BD99       ; UNMODIFY
00B9         1260 ERRNUM =      $B9         ; AT LEAST BASIC THINKS SO
B940         1270 ERROR    =    $B940       ; HANDLE ERRORS
00BD         1280 TRAPFLAG =    $BD
DA51         1290 INITBUF =     $DA51       ; SAFETY
0011         1300 BRKFLAG =     $11
BD41         1310 CLOSEALL =    $BD41       ; close IOCBs 1-7
000C         1320 DOSINIT =     $0C         ; see article
             1330 ;

SETUP THE RESET VECTOR

0000         1340          .PAGE "SETUP THE RESET VECTOR"
             1350 ;
             1360 ; We move the OS DOSINIT vector to point to ourselves
             1370 ;
             1380 ; *****  NOTE: change next line to suit!!! *****
0000         1390          *=   $1F00
             1400 CHANGEDOSINIT
1F00 A50C    1410          LDA  DOSINIT
1F02 8D231F  1420          STA  RESET+1
1F05 A50D    1430          LDA  DOSINIT+1 ; Self modifying code...nasty
1F07 8D241F  1440          STA  RESET+2
1F0A A922    1450          LDA  #RESET&LOW
1F0C 850C    1460          STA  DOSINIT
```

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```
1F0E A91F                LDA  #RESET/HIGH
1F10 850D                STA  DOSINIT+1 ; We have changed the pointer
                   ;
                   ; Here we move MEMLO...
                   ;    we arbitrarily use 256 bytes of space
                   ;
                   MOVEMEMLO
1F12 A900                LDA  #RESETTOP&LOW
1F14 8DE702              STA  MEMLO
1F17 A920                LDA  #RESETTOP/HIGH
1F19 8DE802              STA  MEMLO+1
1F1C 60                  RTS
                   ;
                   ; FROMBASIC  is just a second entry
                   ;    entry point into the initialization...
                   ;    for initializing from BASIC
                   ;
                   FROMBASIC
1F1D 68                  PLA                  ; get cnt of parms off stack
1F1E F0E0                BEQ  CHANGEDOSINIT ; good...no parms
1F20 D0FE          OOPS  BNE  OOPS            ; otherwise, tough!
```

THE ACTUAL RESET TRAP

```
1F22                     .PAGE "THE ACTUAL RESET TRAP"
                   ;
                   ; On reset, DOS normally gets
                   ; called to reinitialize itself...
                   ; we use this to our advantage by
                   ; reinit'ing both DOS and BASIC
                   ;
                   RESET
1F22 200000              JSR  0               ; second two bytes get replaced
                   ;                       by the address of real DOSINIT
1F25 A2FF                LDX  #$FF
1F27 9A                  TXS                  ; BASIC likes it this way
1F28 8611                STX  BRKFLAG         ; ensure no BREAK key pending
1F2A 2041BD              JSR  CLOSEALL        ; so everybody agrees
1F2D 2072BD              JSR  SETDZ
1F30 A592                LDA  MEOL
1F32 F003                BEQ  RST2
1F34 2099BD              JSR  FIXEOL
                   RST2
1F37 2051DA              JSR  INITBUF
                   ;
1F3A 20121F              JSR  MOVEMEMLO ; to protect this code
                   ;
                   ; NOW we fool BASIC into thinking
                   ; an error occured
                   ;
                   ;
1F3D A9FF                LDA  #255            ; (or your choice of errors)
1F3F 85B9                STA  ERRNUM
1F41 4C40B9              JMP  ERROR           ; do it
                   ;
                   ; THE FOLLOWING EQUATE IS USED TO SET
```

```
              2000 ; RESETTOP on a page boundary
              2010 ;
2000          2020 RESETTOP =  *+$FF&$FF00
              2030 ; SET UP LOAD AND GO
              2040 ;
1F44          2050       *=   $2E0
02E0 001F     2060       .WORD CHANGEDOSINIT
02E2          2070       .END
THE ACTUAL RESET TRAP

=02E7 MEMLO      =00FF LOW            =0100 HIGH      =BD72 SETDZ
=0092 MEOL       =BD99 FIXEOL         =00B9 ERRNUM    =B940 ERROR
=00BD TRAPFLAG   =DA51 INITBUF        =0011 BRKFLAG   =BD41 CLOSEALL
=000C DOSINIT     1F00 CHANGEDOSINIT   1F22 RESET      1F12 MOVEMEMLO
=2000 RESETTOP    1F1D FROMBASIC       1F20 OOPS       1F37 RST2
```

Program 2.

```
10 AUDCTL=53768:DBL=120
20 AUDF1=53760:AUDC1=53761
30 SOUND 1,10,10,15:SOUND 3,10,10,
   15
40 POKE AUDC1,0:POKE AUDC1+4,0
50 POKE AUDCTL,DBL
60 FOR J=10 TO 15:POKE AUDF1+2,J:
   POKE AUDF1+6,20-J
70 FOR I=0 TO 255:POKE AUDF1,I:POKE
   AUDF1+4,255-I:NEXT I
80 NEXT J
      ...VERY SMOOTH GLIDES...
```

Program 3.

```
10 AUDCTL=53768:DBL=120
12 OSC=1789790/2
20 AUDF1=53760:AUDC1=53761
30 SOUND 1,10,10,0
40 POKE AUDC1,0:POKE AUDC1+4,0
50 POKE AUDCTL,DBL
60 P2=2^(1/12)
70 NTE=16:REM C IN THE REAL BASS
80 FOR I=1 TO 109
90 FREQ=INT(OSC/NTE-7+0.5):F0=INT
   (FREQ/256)
92 F1=FREQ-256*F0
100 POKE AUDF1,F1:POKE AUDF1+2,F0
102 POKE AUDC1+2,175
103 PRINT "NOW PLAYING ";INT(NTE+
    0.5);" HZ"
105 FOR J=1 TO 100:NEXT J
110 NTE=NTE*P2
120 NEXT I
130 GOTO 70
  ...9 OCTAVE CHROMATIC SCALE...
```

approximately two octaves. Unfortunately, you do not get to have some channels high and others low. Example:

SOUND 0,60,10,12 : SOUND 1,45,10,12 : POKE 53768,1 : FOR I = 1 TO 500 : NEXT I

Again, investigate *De Re* for even more details on some of the more complex aspects of the sound system. (Want to hear your Atari "MOO" like a cow?)

A Final Caution

I have had a couple of people write or call me complaining that, when they tried my assembly language routines, they didn't work. Honest, they *do* work. The listings published in the magazine are the ones I actually used. Sometimes the problem simply resolves to a typo on the part of the user. But sometimes it turns out to be an address conflict.

I do most of my work with OS/A+ and BASIC A+ (naturally. But I use Atari BASIC to check out programs for these pages), and I usually use memory addresses which are convenient to me. Since I get tired of putting everything in page six, I sometimes use $1F00 or some such as an origin. You *can* use these addresses in your system with the Atari Assembler/Editor if you change MEMLO to, say, $3000 (my usual choice, and achievable with the LOMEM command of EASMD). However, it may be more convenient to use SIZE to look at where your source, etc. is and then change the origin to reflect your memory configuration.

Of course, you can always assemble into the dreaded page six or assemble directly to disk (or cassette). But, in any case, don't use an origin ("* = xxxx") which conflicts with SIZE in your system. I purposely give you source listings so that you can see how things work; take the time to type them in and it will probably prove easier in the long run. ©

A High Resolution Digital-To-Analog Converter For The PET

G. Eric Matthews and
Pamela L. Carter
Department of Physics
Wake Forest University
Winston-Salem, NC

It is relatively simple to interface a microprocessor compatible digital-to-analog converter (D/A) to the Commodore PET. For most applications, an 8 bit signal is adequate. An 8 bit D/A interface can be implemented easily via the User Port. However, in many applications a very accurate voltage is necessary, and an 8 bit signal may be inadequate. A 12 bit signal has 16 times the resolution of an 8 bit signal and therefore allows much finer control over the output voltage. Connecting a 12 bit interface to the User Port can be somewhat complicated since the computer only offers 8 data lines there. However, the PET has a Memory Expansion Port (located on the right side of the cabinet) that includes fully buffered, partially decoded address lines [Ref. 1]. Use of the expansion port offers the additional advantage of allowing multiple interfaces to be connected and used at once merely by assigning each a unique address. The interface described here utilizes the signals available at this port.

Since the computer has only an 8 bit data bus, interfacing a 12 bit D/A is more difficult than implementing an 8 bit device. This can be accomplished through double buffered data latching. A latch holds the signal until the program signals the latch to accept a new value and to pass it on to the next part of the circuit. Signalling the latch to hold or pass data is accomplished from BASIC through POKE commands. The actual interfacing technique follows.

The Hardware

The first step in the design of an analog output port is to determine the accuracy of the conversion that is to be performed. If the desired analog accuracy is ± 1%, or 1 part in 100, then a 7 bit conversion is adequate, with a resolution of better than ½% (one part in 64). ±0.1% accuracy requires 10 bits to be within the desired range. When the accuracy level has been determined, the digital-to-analog converter chip (DAC) can be chosen. The characteristics of the DAC should meet the requirements of the circuit in which it is to be used. In this interface an Analog Devices AD7541 (CMOS 12-Bit Monolithic Multiplying DAC) was chosen [Ref. 2].

The next step is to determine the addresses to be devoted to receiving the data for the latches. Checking the computer memory to find available space is necessary in order to avoid interfering with other operations of the computer. The most straightforward way of passing a 12 bit number to the DAC is by assigning one address to the upper eight bits of the DAC and assigning a second address to the lower four bits of the DAC. Therefore at least two addresses must be devoted to the interface. For simplicity, only partial decoding of the address bus (the high order eight bits) has been used. The addresses chosen are $90XX and $91XX (where an X means "don't care"). These two addresses do not conflict with the Toolkit or Wordpro. A POKE to $90XX enables a latch for the upper eight bits and a POKE to $91XX enables the corresponding latch for the lower four bits.

A schematic diagram of the circuit employed is shown in figure 1. The chip used for address decoding is the 74154 (4 Line Decoder) [Ref. 3]. This chip decodes four binary-coded inputs to one of 16 mutually exclusive outputs when each of the two strobe inputs are low. Address decoding with the PET is simplified by the availability of partially decoded address lines on the Memory Expansion Port: $\overline{\text{SEL9}}$ is low when the high order four bits of the address bus corresponds to $9. Applied to the strobe inputs of the 74154 are $\overline{\text{SEL9}}$ and A11 for the chosen address. To the four binary-coded inputs A,B,C,D are fed the Ø2 clock, A8,A9,A10 respectively. As configured, output 1 will be low if and only if the Ø2 clock is high, $\overline{\text{SEL9}}$ is low, and A8-11 are low (as during a POKE to $90XX). Output 3 will be low when the Ø2 clock is high, $\overline{\text{SEL9}}$ is low, A8 is high, and A9-11 are low as during a POKE to $91XX). These two outputs provide the enabling pulses for the latches. Note that this circuit does not decode the R/W line. Care should be taken, therefore, that no PEEKs to the above addresses be included in any program using this circuit as this would result in spurious data being passed to the DAC.

The latches used here are 7475 Quad Latches [Ref. 4] and function as temporary storage for binary information. Information at the data inputs is transferred to the outputs when the enable is high. Therefore the two independent (low) output pulses from the 74154 must be inverted before being applied to the 7475 enable pins. These two inverted pulses correspond to the enabling addressed $90XX and $91XX. The output of the latch follows the input as long as the enable is high. When the enable goes high the output is held constant no matter the state of the input until the enable goes high again. The purpose in double buffering the data latches is to pass all 12 data bits at the same instant to the DAC. If the latches were only single buffered, then the eight bit data latch (two 7475's) and the four bit data latch (one 7475) would be enabled with separate POKE commands, and an instant of time would exist when the data input to the DAC is in an intermediate state between the previous input and the present input. The data in this state is erroneous and produces a glitch in the voltage output. Double buffering avoids this glitch by passing the data to the DAC in the following way.

Address $90XX enables the first eight bit latch. This passes the eight most significant bits to the first latch. Then POKEing address $91XX enables the four bit latch simultaneously with the second eight bit latch. This enable passes the four least significant bits to the four bit latch and transfers the eight upper bits from the first latch to the second. Therefore all 12 data bits appear at the inputs of the DAC at the same time producing a smooth transition of voltage [Ref. 5].

The AD7541 consists of an R-2R ladder and 12 CMOS current switches which perform the D/A conversion. Adding a 741 operational amplifier at $I_{out\ 1}$ and connecting the output of the 741 to $R_{Feedback}$ completed this simple, but very powerful, circuit.

The Software

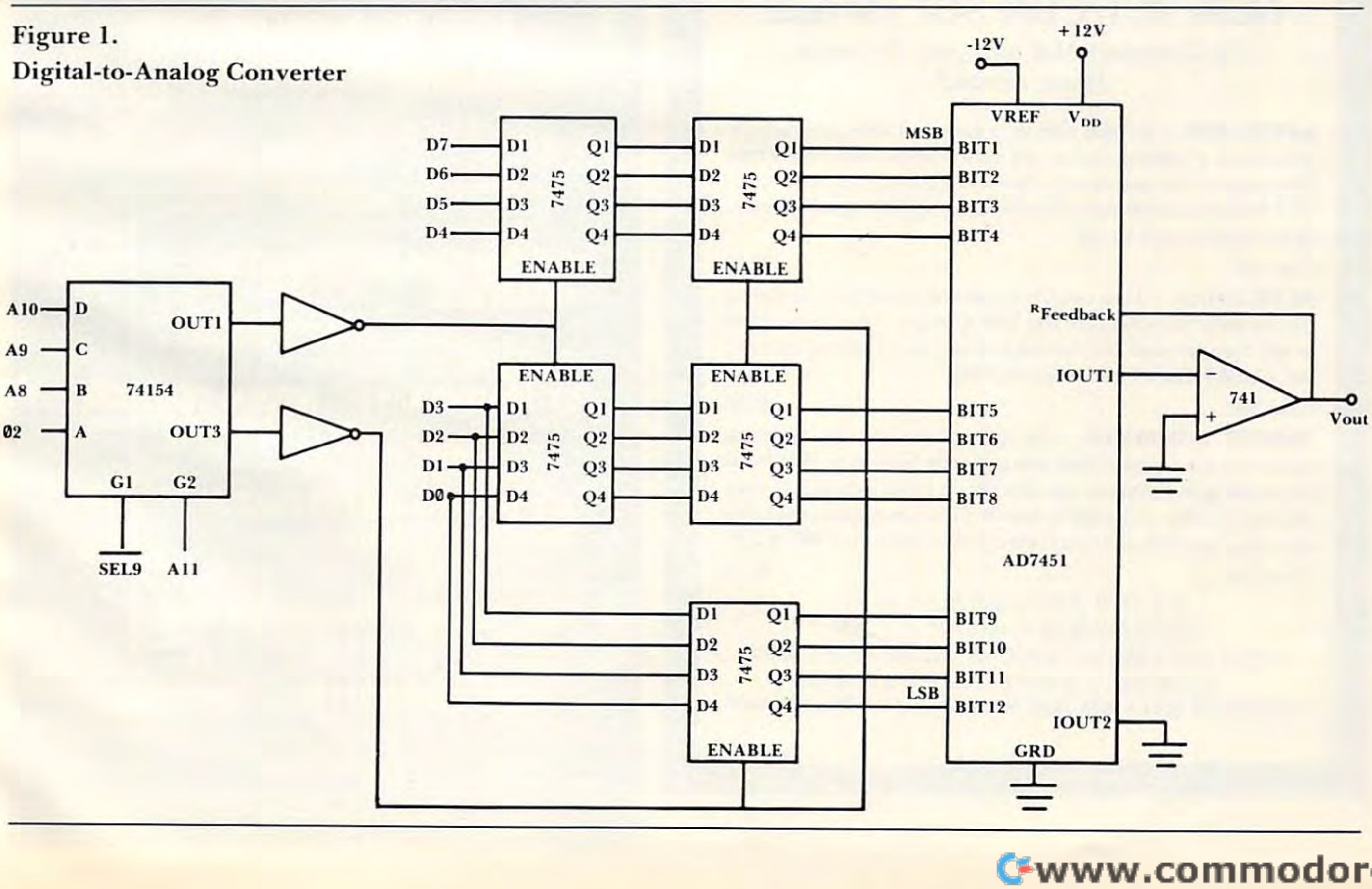
The following program allows the input of any number from 0 to 4095. The D/A outputs the corresponding voltage from 0 to 11.25 volts.

```
100 INPUT "V = ";V
110 U = INT(V/16):REM-UPPER 8 BITS
120 L = V-16*U:REM-LOWER 4 BITS
130 POKE 36864,U:REM-HIGH 8 BITS
              GO TO $90XX
140 POKE37120,L:REM-LOW 4 BITS
              GO TO $91XX
150 GOTO 100
```

Additional Comments

After construction of the D/A interface, it was seen that double buffering the lower four bits rather than the upper eight bits of the data for the DAC would require one less chip and also would allow the use of the interface as an eight bit D/A. For use

Figure 1.
Digital-to-Analog Converter



as an eight bit D/A, a POKE command at the beginning of the program would set the lower four bits to 0 and then a single POKE would output the data to the upper eight bits.

Some difficulty has been encountered in finding connectors compatible to the PET Memory Expansion Port. The authors prefer the Relia-Tac connectors (Amphenol 221-1660 receptacle strips with 220-502 contacts) for this purpose.

The only modification required to use this circuit with other 6502 based machines is a change of the address decoder. Partially decoded address lines are not universally available, so one may need to use an additional 74154 to decode the high order four bits of the address bus. If the addresses $90XX and $91XX are occupied in your machine, you will need to change the decoder to an unused address.

It should be emphasized that the decision to decode eight address lines was rather arbitrary. The authors chose that figure because it is the maximum that could be decoded with a single 74154.

Finally, note that if you wish to implement additional analog outputs, more address decoders are unnecessary. Outputs 5, 7, 9, etc. of the 74154 as configured correspond to addresses $92XX, $93XX, $94XX, etc.

A high resolution analog output is straightforward to implement for the PET microcomputer. The circuit is easy to construct using readily available components. Using the Memory Expansion Port rather than the User Port allows one to add other analog outputs by merely changing the address assigned to the interface. The potential uses of the interface are restricted only by the imgination of the designer. For example, the availability of two analog outputs allows high resolution plotting via an X-Y recorder.

This circuit also demonstrates the ease with which the Memory Expansion Port can be utilized for interfacing. We share with Marvin L. DeJong the hope that there are other "hardware nuts" out there interested in such circuits.

References:

1. *CBM Professional Computer User Manual, Commodore Business Machines, Inc., Santa Clara, June 1979, pp. 82-83.*
2. *Analog Devices Spec Sheet for AD7541 CMOS 12-Bit Monolithic Multiplying DAC.*
3. *Signetics Data Book, Signetics Corporation, 1974, pp. 2-144-145.*
4. *Signetics Data Book, Signetics Corporation, 1974, pp. 2-76-77.*
5. *Short, Kenneth L., Microprocessors and Programmed Logic, Prentice-Hall, Inc., Englewood Cliffs, 1981, pp. 403-312.*

©

Renumber VIC-20 BASIC Lines The Easy Way

Charles H. Gould
Computer Science Department
Florida Institute of Technology

Until we have a ROM available, such as the Toolkit, for the VIC-20, here is a simple way to renumber lines in that crowded program you are writing. Simply type in the lines given below, and: RUN 10000. Better still, put this program on a separate tape, load it whenever you start a new program development; when complete, erase these lines. The program uses only 198 bytes, so 95% of your RAM is still there.

As shown, the renumbered lines start at line 10, and increment each line number by 10. *But* it does not change GOTO or GOSUB line numbers. You must manually change these after renumbering, and before running. An easy way to keep track of the GOTO and GOSUB terminal addresses is to insert "REM line #" at the end of each such statement, renumber, correct GOTO and GOSUB references to the new line numbers, and erase the REMs.

Line 9990 simply protects your program from entering the renumber routine until you want it to. In line 10010, Y7 is the starting line number, and in line 10050, the Y7 = Y7 + 10 sets the increment. Either can be changed. Line 10020 tests to see if we have renumbered up to, but not including, line 9990. Line 10030 changes the line number. Line 10040 searches for the next line. Y6 is the normal start of BASIC text (-1). The BASIC text lines are stored in RAM memory in this way: the first and second (LO and HI) bytes are a link to the next line; the third and fourth bytes are the line number (see line 10030 below); the BASIC statement is then given using tokens; the last byte of the line is a null (ASCII 0). After the last BASIC line, two more nulls are inserted to indicate end of program.

So, until we get support utility ROMs, let's make do.

```
9990 END
10000 REM RENUMBER
10010 Y6=4096: Y7=10
10020 IFPEEK(Y6+3)=6ANDPEEK(Y6+4)=39T
    HENEND
10030 Y8=INT(Y7/256):Y9=Y7-256*Y8:POK
    EY6+3,Y9:POKEY6+4,Y8
10040 IFPEEK(Y6+5)<>0THENY6=Y6+1:GOTO
    10040
10050 Y7=Y7+10:Y6=Y6+5:GOTO10020
```

©

Part II:

Atari Microsoft BASIC

Jerry White
Levittown, NY

In the first of this three-part series, I pointed out many of the strengths and weaknesses of Atari Microsoft BASIC (AMSB). In Part 2, I will make comparisons between the three versions of BASIC available to the Atari owner. To conserve space, the abbreviation 8K will be used for the standard Atari BASIC, and A+ will be used to indicate O.S.S. BASIC A+ (Optimized Systems Software).

It somehow seems unfair to include 8K in these comparisons. The others did not have to fit into an 8K ROM cartridge. The fact that 8K is on a ROM, and that it requires far less RAM than the others, is its greatest asset. Those who have less than 32K, or do not have a disk drive, cannot consider the others at this time. For those with at least 32K and one disk drive, AMSB and A+ can provide many useful features not found in 8K.

Sources at Atari tell me that a 16K AMSB ROM is in the planning stages, but will not be available until at least the end of this year.

One of the major arguments I've noticed when different versions of BASIC are compared, is the way strings are handled. Most Microsoft users cannot imagine how one could possibly live without string arrays. 8K and A+ users have the "unlimited length string." They have learned that this can certainly be an advantage, and that one long string can be manipulated to simulate string arrays.

For those who require more than a two dimensional array, AMSB is the only choice.

It would appear that compatibility would be the most important factor in choosing between AMSB and A+. While AMSB is not 100% compatible with other versions of Microsoft BASIC, converting from other versions of Microsoft to AMSB is not all that difficult. All the necessary information is provided in the rather large AMSB manual. It would certainly be easier to convert from one Microsoft BASIC to another, than to convert from Microsoft to Atari 8K or to A+.

On the other hand, A+ is compatible with 8K, and is a logical upgrade for current 8K users.

What is BASIC A+? A+ is a version of BASIC which is available for the Atari as well as other microcomputers. It is available from Optimized Systems Software and sells for $80.00. While A+ requires more RAM than Atari 8K, it uses about 3K less than AMSB. Overall, A+ is the fastest of the three.

A+ has all the features of 8K, many of those found in AMSB, and a few unique to itself. Among its unique commands are DIR which is used to list a disk directory on the screen. LVAR lists all variables currently in use to any device. DPEEK and DPOKE may be used to access or change double byte locations. HSTICK and VSTICK provide a simple method for reading horizontal and vertical joystick positions. BGET and BPUT are used to GET and PUT blocks of data very quickly. Using only these two commands, an entire screen may be placed into a string. Similarly, RGET and RPUT are used to input and output fixed length records.

A+ is the friendliest of all when it comes to using Player Missile Graphics (PMG). Briefly, the PMG command is used to turn off, or enable single, or double line resolution P/M Graphics. PMCLR is used to clear or erase players and/or missiles. PMCOLOR, PMWIDTH, PMADR, and PMMOVE statements are self-explanatory. The MISSILE command provides an easy way for a parent player to "shoot" a missile. The BUMP command is used to detect collisions.

A+ is still being improved. The folks at O.S.S. tell me that RENUM command will be available by the time this article is printed. A+ is efficiently written, well documented, and moderately priced.

AMSB has the most accurate math package and its own unique features. Some, such as multidimensional, alphanumeric arrays, have already been discussed. AMSB also has integer, single, and double precision numeric variables and constants, and hexadecimal constants.

AMSB has the most commands from which to choose. Three of its unique commands I found particularly interesting and useful were TIME$, VERIFY, and COMMON.

TIME is set and reset by setting TIME= JIFFIES. A jiffy is 1/60 of a second. Once TIME has been set, the current time in the format of HOURS:MINUTES:SECONDS is automatically stored as TIME$. A demonstration program using TIME$ as well as other AMSB features will be the subject of the third and final part of this series.

VERIFY is used to match the program in memory with a program on cassette or diskette. If the two programs are not identical, a TYPE MISMATCH ERROR will let you know.

COMMON provides the ability to make variables in two programs the same in value as well as in name. Chaining programs takes on an entirely new dimension when the COMMON command is available. ©

An EPROM is an Erasable Programmable Read Only Memory. It is similar to the ROM chips inside the computer that hold BASIC, except that it can *be erased, usually by exposing it to ultraviolet light for a period of time. It is useful if you have a program, such as Micromon (***COMPUTE!***, January, 1982, #20, pg. 160) which you use quite often. Instead of having to load it into the computer each time, it could be saved onto an EPROM, pushed into one of the empty sockets in your machine, and then used by a SYS to its starting location. This is sometimes called* firmware, *falling, as it does, between soft- and hardware.*

Review:

The "Branding Iron" EPROM Programmer For PET/CBM

David A. Hook
Barrie, Canada

The Branding Iron is a versatile EPROM burner for Pet 2001, CBM 4000 and 8000 series computers. The software provided functions with Original ROM, Upgrade ROM, or ROM 4.0 (both 40-column and 80-column).

Software and hardware allow programming of the three PET-compatible EPROMs: Intel 2716 or TI 2516 (both 2K) and TI 2532 (4K). The single, 5-volt, version is the correct type for the PET.

You may: program an EPROM, verify the contents of the EPROM just programmed, or copy an EPROM's contents into the PET's memory.

The Branding Iron consists of a 5"x 5"x 1" module and two connectors. One attaches to the User Port and the other to the 2nd Cassette Port. Ribbon cables are connected to the main unit. A 250 mA transformer provides the power and is to be plugged into a nearby AC socket.

The main module is attractively housed: no bare circuit board. Rubber feet should prevent scratches to your table. The 24-pin socket is not a "zero insertion-force" type. However, it has been gentle to the fragile IC-leads so far. There is a read/program switch and a status light to show programming activity.

The two cables are approximately 24 inches long. Both connectors are marked to show the "up" side. Neither included polarizing keys to prevent upside-down insertion. This 10-cent cost should not have been omitted. (The etched markings on my User Port connector were not painted).

Installation

Four typewritten pages of instructions are included. They indicate the location of the proper cassette port for each model PET/CBM. Most large keyboard, 40-column, machines make this connection inside the case. If your machine was upgraded from a built-in cassette, this port will be external.

I chose to plug in the transformer at a different wall socket than the PET.

Operation

The first program on the cassette provides several screens of instructions. The proper syntax and function for each command is shown.

You are then offered a choice of four programs, or a return to the start of the instructions. Then hit 'RETURN' and the tape will seek and load the chosen program. If you are working from disk, add ',8' to the 'LOAD' command on the screen.

The proper 'SYS' command has also been printed on the screen. Move the cursor here and hit 'RETURN'. The software has now been linked to the normal machine language monitor. Four extra commands are now available: T,P,V and C.

The documentation also gives the memory addresses used by each program. This is helpful – you won't accidentally use these yourself.

'T' Command: selects the type of EPROM. Defaults to a 2716 or 16K bit ('.T 16'). Enter '.T 32' for a 2532. No need to re-enter for each EPROM, unless you're switching types.

'P' Command: programs the EPROM from PET memory, given a start/end address in hexadecimal. Follow the manual directions for the 7-step procedure.

An address counter increments on the screen during programming. Any errors or defective memory locations are displayed on the PET's screen. Two minutes later it's done.

It isn't necessary to program the entire contents of the EPROM at any one session! This feature is quite significant. It is shown in the demo program, but not emphasized. Because of this, it is important to program from PET memory carefully.

If you want to store into the first byte of the EPROM, be sure to have this byte at a "round" hex address in the PET. (e.g. $2000, $3000, $4000, etc.).

Correspondingly, to program the fifth 256-byte "page" of the EPROM, you might enter: '.P 2400 24FF'. I have programmed as few as 21 bytes in a session.

'V' Command: compares the EPROM's contents with a given range of PET memory. It's done in an instant. Any discrepancies are reported, giving: memory address, PET memory contents, and EPROM contents at that address.

'C' Command: the EPROM contents are transferred to the user-designated range of PET memory. This too is almost instantaneous.

You may then examine or edit, using the normal PET monitor commands.

I've programmed both 2K and 4K EPROM's with this device. All features have worked flawlessly.

It's very versatile: all PET/CBM hardware, software for all PET ROMs and all compatible EPROMs. All this for a reasonable price.

With all the utilities now available for the PET, EPROMs to expand user-memory are a valuable enhancement. The PET's character-generator is another candidate for an EPROM.

Producer: K-Z Systems, Rt. 2, Box 473
Manchester, MO 63011
Availability: AB Computers, 115 E. Stump Road
Montgomeryville, PA 18936
Cost: $79, plus shipping

©

A look at the first VIC three-in-one program package from The Code Works, creators of the "magnetic magazines," CURSOR for PET and IRIDIS for Atari.

Review: VIXEL #1

Eric Giguere
Peace River, Canada

VIXEL #1, for VIC, is the first in a series of software packages published by The Code Works, following in the tradition of CURSOR for the PET and IRIDIS for the Atari. For $12.95 you receive three excellent programs that can keep you tied to your VIC for hours. Also included in the package is an informative booklet which gives you the instructions and explanations of the programs. Here is a brief summary:

FIRE!

The first program is called FIRE!. It is a game in which you pilot a helicopter and try to douse a skyscraper fire with the water in your tanks. Sounds easy, eh? Well, there is more to it than that. You only have three minutes to extinguish the fire or the people you are trying to save will die. Also, you may only hold 1000 gallons of water in your tanks at once and, when you run out, you have to waste precious time refilling the tanks, as the fire mercilessly continues to spread. It isn't easy to put out the fire, but it can be done. My record for putting it out was eight seconds, and, although I admit it was really a fluke, I challenge anyone to beat that!

The game itself is very creative. It uses no custom characters to form the helicopter or fire. Instead it uses the VIC's graphic symbols (with some creativity). It also uses a short machine language program to make the fires flicker, but, apart from that, there is nothing special about the program itself that any knowledgeable programmer couldn't figure out.

DRAW

One of my friends has an Apple, and the thing I admire most about it is its HI-RES graphics, where you can draw a line from any point on the screen to any other. Apparently, this feature will be incorporated in the Commodore *[a new VIC add-on, expected soon]*.

DRAW has partially solved that problem. This program allows you to draw in HI-RES within a 13x14 character-wide box in the middle of the screen. Using function keys and the standard VIXEL control keys (described in the instruction book), you can draw, erase, or move the cursor around at your pleasure. And, when you're finished drawing, you have the option of SAVEing the whole thing for later viewing.

Basically, what the program does is create custom characters "on the fly" using a machine language program. It creates a character which looks like part of your drawing. It is a good idea, exploited to the utmost, and I find it very useful as a way to get children interested in the VIC.

RACE

You control a race car and are trying to earn as many points as possible before the computer's car crashes into you. You pick up points by passing over dots on the track and, after having passed fifty dots, the computer's car starts laying down diamonds after it, with each diamond being worth five points. If you happen to collide with the computer's car, do not fear. You have two other cars in reserve (when these are used up the game ends), though you start over with a new screenful of dots.

RACE is divided into two programs: the first, called RACE.CHSET (for RACE CHaracter SET), creates the special characters used by the game and then automatically loads the second program, the game itself. RACE is very enjoyable; a good finale to VIXEL#1.

The Cover

I neglected to mention that, at the start of the tape, there is actually a fourth program called COVER. This program uses the custom characters to create a likeness of the VIXEL mascot and move him across the screen, chalking out the words "VIXEL #1," tapping his feet and blinking his eyes all at the same time.

It shows the VIC owner how he can use the VIC's ability to create custom characters for his own special purposes. After this demonstration, the user is prompted to press the SPACE bar, after which the program lists the programs available on that particular tape. All the user has to do now is LOAD the program of his or her choice.

In my view, VIXEL #1 is a good investment for the VIC-20 owner. I feel that the programs need only one major improvement: that The Code Works change the selection of keys used to control the programs. Perhaps they use the I,J,K, and M keys instead of the present W,A,D, and X. I always manage to hit the SHIFT LOCK key instead of the A key, and this is rather frustrating as it prevents the other keys from being read. It can cause problems when you are playing RACE.

Apart from this minor problem (probably due to the fact that these programs are mainly made for use with a joystick) VIXEL #1 scores an A+ with me, and I can hardly wait for the release of VIXEL #2.

VIXEL #1, The Code Works, Box 550, Goleta, CA, 93116. $12.95. For VIC-20 with tape drive. ©

CAPUTE!:

Corrections And Amplifications

1. "VIC: Alternate Screens," *Home and Educational Computing!*, Fall, 1981, pg. 14: change line 500 POKE 648,S:POKE 36866,T

2. "Discovering Atari's 'Hidden Graphics'," **COMPUTE!**, December, 1981, #19, pg. 98: in the first program, change line 50 SE. X,RC,6 and, in the second program, change line 110 IF X=219 THEN Z=97:X=0:Y=4:G.30 and line 120 IF Z=123 THEN Z=225: X=0:Y=6:G.30

3. "SuperFont," **COMPUTE!**, January, 1982, #20, pg. 110: Mr. Brannon has made the following improvements to his program. Change line 1110 FOR I=0 TO 7: A=INT(PEEK(CHSET+C*8+I)/2) and change line 1320 Z=0: FOR I=0 TO 2: FOR J=0 TO 1+(I>0): A=PEEK(CHSET+C*8+Z): Z=Z+1

4. "MICROMON," **COMPUTE!**, January, 1982, #20, pg. 160: the author sent in one additional change (to those listed in the article which adapt the program to the 8032's screen). Change $XD18 from $08 to $10. Our thanks also to John Stout for mentioning this correction. In addition, several readers have mentioned problems in attempting to relocate the main program up to $6000. The transfer memory function must be used first to move the program to $6000. Both New Locator functions attempt to resolve all internal JMP's and JSR's which are not (after Transfer) correct any more. Nevertheless, the moved code should be disassembled to find any remaining out-of-range references.

5. "Named GOSUB With Variable Passing," **COMPUTE!**, February, 1982, #21, pg. 69: two lines should be changed. Change 270 K=INT(10*RND(1)): L=INT(10*RND(1)) and also change line 6000 DATA 169,10,133,104,169,0,141,0,10,32,75,214,169,76,141,245,1688.

6. "Timekeeping," **COMPUTE!**, February, 1982, #21, pg. 173: On page 173, replace B1 with B$ and, in the program below, replace the *60 in line 120 with *3600. On page 174, replace the 902 in line 775 with 920. ©

New Products

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Educational Activities, Inc. announces the availability of their new diagnostic, prescriptive, tutorial reading program, DIASCRIPTIVE READING. It is designed to aid the reading teacher, eliminate paper work, and provide individualized instruction for each student.

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DIASCRIPTIVE READING is contained on 7 diskettes for TRS-80, Apple, and PET or on 15 cassettes for TRS-80 or PET. The price for either format is $245.00.

Educational Activities, Inc.
Microcomputer Department
P.O. Box 392
Freeport, NY 11520

* * * * * * *

The company has also announced the immediate availability of two new sound filmstrip programs developed to meet the need for computer literacy and computer career awareness in schools.

Computer Programming – BASIC for Elementary Grades is designed to instruct elementary age children in computer programming in the BASIC language. All the conceptual presentations have been pretested successfully on a broad range of youngsters. Piloted in a special computer programming course held for elementary students, the principles and applications of the major BASIC commands and statements proved to be well within the capabilities of the average middle-to-upper elementary age child.

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Computer Programming – BASIC for Elementary Grades consists of 5 full-color filmstrips, 5 audio cassettes, and a teacher's handbook. The price is $97.00. *Careers in Computers* consists of 4 full color filmstrips, 4 audio cassettes, and a teacher's guide. The price is $79.00.

For further information call, toll free, 800-645-3739 (outside New York State) or 516-223-4666 (inside New York State) or direct your inquiry to:

Educational Activities, Inc.
P.O. Box 392
Freeport, NY 11520

Understanding Your VIC From TIS

Los Alamos, NM – Total Information Services, Inc. (TIS), a publisher of books and software for Commodore and Ohio Scientific computers, announces a book for the new Commodore VIC-20. *Understanding Your VIC Volumn 1: Basic Programming* is a 148 page, 8½" by 11" softcovered book that uses a step-by-step approach to help the beginner quickly and easily learn about the VIC. The book is full of exercises and examples. Many exercises show the expected results so that the reader has immediate feedback on errors. To start the beginning programmer off on the right foot, a chapter on program design describes the use of psuedo code and data dictionaries to refine programming problems. There are chapters on the VIC color and sound features that use these program design techniques to build demonstration programs. This easy-to-use, learn-by-doing book is available from Commodore dealers or directly from TIS, Box 921, Los Alamos, NM 87544. Retail price is $11.95 plus $2.00 for first class shipping and handling. The color and sound demonstration programs are both available on a single cassette for $7.95 plus $1.00 for shipping.

VisiSchedule Program Extends Product Line From VisiCorp

VisiCorp (formerly Personal Software Inc.) announced the VisiSchedule program. The new program increases to nine the number of interrelated personal computer software products in the VisiSeries™ family.

The VisiSchedule program allows the user to create an on-screen schedule of projects and tasks. The displayed schedule

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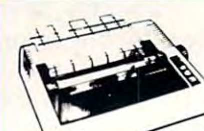

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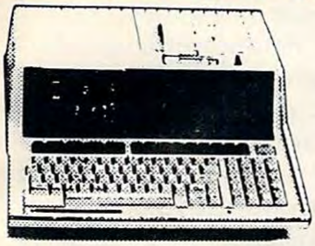

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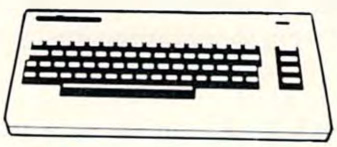

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responds immediately to "What if?" schedule detail changes and shows the effect of the change on all subsequent events. The Visi-Schedule program immediately updates its information on-screen when a change occurs; and it incorporates all pertinent data including costs, manpower, resource leveling and scheduling constraints.

The timechart and other reports produced by the Visi-Schedule program provide valuable information to any business involved in planning projects and managing resources. Managers, executives, engineers and manufacturing personnel can profitably use VisiSchedule to track any project in which deadlines and a schedule of events are important.

The program has been designed for ease of use. With its "moving cursor menu," the user need only point with the cursor to each command. The user is then guided through each step, developing the project as it is being entered; no preplanning is necessary.

Like other members of the VisiSeries product family, the VisiSchedule program may send data to the VisiCalc, VisiTrend/Plot or VisiFile programs.

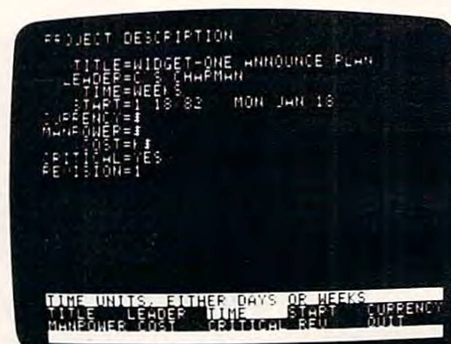
A calendar representation of start and stop dates, slack time, holidays, and deadlines for up to 160 different tasks may be displayed and automatically printed out. Many different computer-generated reports in an almost unlimited combination of information may be produced. Such information includes critical path, project milestones, cost estimates, manpower levels, slack time, number of successors, durations, earliest start dates, late finish, deadlines and prerequisites of all or some of the project tasks. The interactive time chart and reports allow a user to investigate the tradeoffs among manpower, dollars and time.

The VisiSchedule program requires an Apple II or II Plus computer with a minimum of 48K memory and two disk drives. A printer is strongly recommended. A 48K computer can handle up to a 50-task project; adding the Apple Language System or Microsoft RAMcard increases this capacity to a 160-task project.

Price and Availability: Suggested US price of VisiSchedule is $300. It has been available since mid-February.

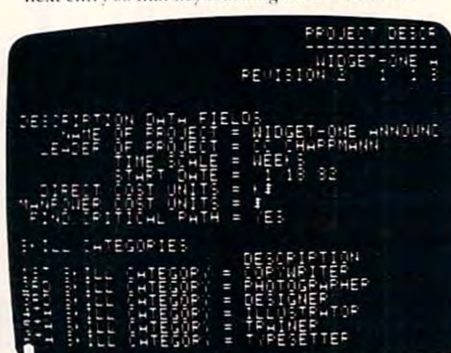
VisiCorp
2895 Zanker Rd.
San Jose, CA 95134
408-946-9000

The VisiSchedule™ program automatically loads details from the previous use of the program. The user can re-load a project schedule already set up, or create one from scratch. Current date, person preparing report, current status of last project worked on can be checked.



The Modify Menu allows the user to create or change the overall description of the project. Such items as title of project, leader, currency, cost levels and revision number can all be changed. Modify is where the user sets up manpower, skills, costs, holidays and the work week. The moving cursor anticipates the next entry so that keyboarding time is reduced.

This displays the work schedule itself. The user may scroll in all four directions to view the entire project. Simple menu commands add, delete or rearrange jobs. As each job is entered, it is displayed on screen. Once jobs are entered, manpower peaks may be auto leveled, costs and manpower levels are displayed or the project schedule adjusted in many ways.



The VisiSchedule program prints a wide range of useful reports, including summary of the entire project, critical path, project milestones, manpower and cost estimates, job descriptions, tabular reports and sorted reports. The reports stay current because you can complete jobs, slip the project or make any changes to show what is really happening.

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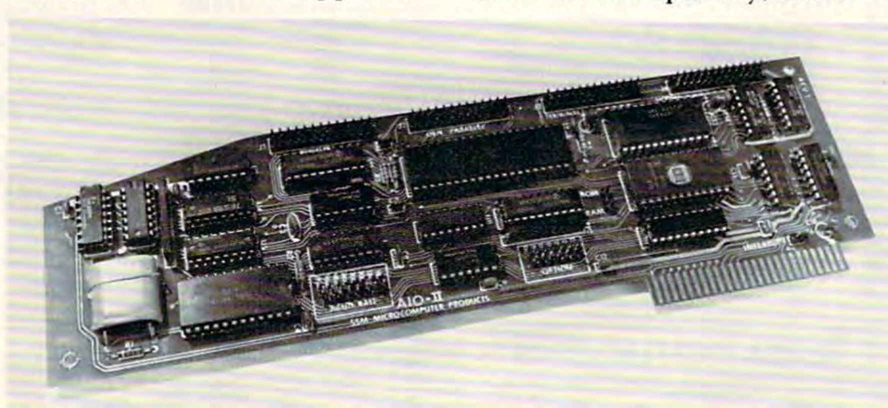
SSM Microcomputer Products Inc., a manufacturer of board level products for the Apple II,



has introduced an enhanced version of its AIO serial/parallel interface board.

The new version, designated the AIO-II, delivers significantly improved performance, and combines several new features. This highly flexible, full function serial/parallel interface eliminates the need for any other I/O boards by combining two boards into one compact unit.

Among the enhancements are the AIO-II's ability to perform four independent interface functions, including serial modem, serial terminal/printer, parallel Centronics-compatible printer, and a general purpose parallel port.

The AIO-II permits simultaneous output to both one serial and one parallel device using the standard Apple control code protocols. Additionally, the AIO-II's advanced design techniques eliminate the need for "phantom" slot assignments, special set-up requirements, or hardware modifications.

The novice user can easily install the AIO-II with jumper options, while more experienced users may override the jumper set-up with control codes identical to Apple parallel card connections. All operations are transparent, requiring no additional user-written software.

The AIO-II's on-board firmware provides all necessary drivers, including terminal communications capability, and it will operate in any Apple II expansion slot (except slot 0). Optional drivers are available which will support Apple Pascal and Microsoft Softcard™.

The AIO-II package includes manual, jumpers and wiring information to support a wide variety of printers, including Epson, Anadex, Centronics, IDS, Okadata, NEC, Diablo, Qume, and more.

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Reference Guide For Computer Publications

Micro... Publications in Review is a monthly publication, a quick reference, of titles of articles in the 70+ Micro-Mini Computer and Technology Publications. It has a magazine format and is intended to keep the reader abreast of this explosive industry through (1) reprints of the Table of Contents and (2) a subject index consisting of 26 major disciplines with each having from 6 to 40 classifications. Approximately 70 publications are covered with over 800 articles per issue.

Where possible, a fourth breakdown by computer and a fifth by language and/or operating system is classified. These later breakdowns will only appear in special issues.

Any title can be classified in one or two classifications and the breakdown is manually coded for computer indexing, since in most cases the title does not offer the necessary information for any keyword search.

Vogeler Publishing Inc.,
455 Crossen Ave.
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312-228-0951

PET Terminal Emulator

The PET Terminal Emulator is a combination of hardware and software which converts a Commodore computer with 4.0 ROMs into a sophisticated terminal emulator. This system gives you:

– A serial interface board for PET to serial conversion

– A machine language program on a PROM to handle communication

– Communication speeds between 150 and 4800 baud

– Choice of three different major manufacturer terminal configurations

– Uses almost none of the PET's RAM (only 512 bytes)

– Permits PET BASIC program residing in RAM during terminal operation

– Automatically relocates itself to operate in conjunction with other machine language programs

– Adds terminal function keys and special characters to character set

– Ability to redefine keys on the keyboard for greater flexibility

This system is optimized to give the highest possible speed when the PET is operating as a terminal and to permit taking advantage of the many programs which are designed to use the screen characteristics of terminals in their operation.

The board, called the Serial Connection, takes the signal from the Commodore computer and translates it to a serial signal that can be used with any standard RS 232C modem or acoustical coupler. It has the capacity to send and receive at speeds between 150 and 4800 baud.

The machine language program which is stored on a programmable read only memory (PROM) handles the communication between the PET and another computer. Since there are an increasing number of programs that take advantage of the screen handling features of terminals for data entry and printing on the screen this program permits the user to choose to emulate either the ADDS Regent 100, the Lear Sigler ADM 31, or the Televideo 950. These are three very popular terminals, and users should find it advantageous to use one of the three in almost all situations.

Since the machine language program is stored on PROM it uses very little of the Commodore computer's RAM. In addition, once the machine language program is initialized it is protected from PET BASIC programs that may be loaded into the PET. PET BASIC will not write over it, and it does not interfere with the operation of PET BASIC programs if it is initialized before the PET BASIC programs are loaded into the computer.

The documentation for the PET Terminal Emulator is very thorough; more than thirty pages. And there is a table of contents and an index. The manual is written for ordinary users. Each step in installation and use is carefully and explicitly described.

The PET Terminal Emulator sells for $175. It can be ordered from:

Amplify, Inc.
2325 McBride
Iowa City, IO 52240

BASIC Programmer's Notebook

BASIC Programmer's Notebook, a

110-page textbook by Earl R. Savage, presents an array of techniques and subroutines by which both novice and experienced programmers can write programs easier and better. Rewritten from notes collected over the years, the Notebook offers shortcuts to replace lengthy techniques, statements sequences to make programs more professional in appearance, and techniques for increasing their effectiveness and efficiency. Instructions and explanations given make it possible to do many things with the computer which may not have occurred to the

user. No complete programs are given, only many subroutines and program fragments that allow the user's imagination and sense of purpose to develop programs tailored to specific needs. The advanced programmer will find an array of ideas that have been worked out to save time.

Although the program statements are written in the Radio Shack Level II BASIC, they can be used in various types of computers either exactly as written or with only minimal changes to adapt them to most other BASIC dialects.

Each topic and each subroutine is stated clearly and explained in detail; how and why it works, when and how to use it. Flowcharts clarify the logic further when needed.

The book is divided into four major parts. Part 1 contains a variety of suggestions for improving the quality, size, and speed of one's programs. Part 2, the largest section, contains 50 Notes and many variations of them. Each Note is comprised of a listing of the statements as they would appear in a program, an analysis of the statements, suggested uses of the subroutine or technique, and variations of the listing with a flowchart if appropriate. Part 3 gives detailed information in utility programs which can be a real asset in program writing and guides the user in the wise selection of those aids. Part 4 presents hardware aids to increase the efficiency of the entire computer operation including, for example, various ways to shorten saving and loading time, memory expansion, and others.

BASIC Programmer's Notebook, Earl R. Savage, 110p., 8½" x 11", plastic bound, soft cover, Book No. 21841, $14.95 plus $1.00 shipping and handling.

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More Atari Memory

Mosaic Electronics has announced the 16K/32K RAM board. Designated Part #H216, the Mosaic 16/32K RAM, adds 16K to an Atari computer system. After the Atari user has exhausted the potential of 16K, upgrade to 32K is very easy using the $60 upgrade kit #H212. Atari 400 owners can use their existing 16K RAM to upgrade to 32K for $120 total. The Mosaic 16/32K RAM is of particular interest to owners of the Atari 400 with 16K, the Atari 800 with 16K, and the Atari 800 with 32K.

For more information write to:

Tanya Hickman, Customer Service
Mosaic Electronics
P.O. Box 748
Oregon City, Oregon 97045

Software Packages For The Atari From Roklan

Twelve new software packages have been developed by Roklan Corporation of Rosemont, Illinois. Three categories of programs are available: pro-

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gramming utilities, business applications and games.

Among the utilities designed for programmers are a Copy/ Verify – Format/Certify program and an Absolute Disk Editor. A Telecommunications package allows computers to "talk" to each other and transfer data efficiently. In addition, a 6502 simulator program has been developed for Apple computer systems.

Among the business applications packages are FinPac, a financial calculations package containing programs for all financial calculations, and Real Estate, a real estate investors aide which will also be useful to brokers and appriasers.

Game programs to be introduced include several microcomputer versions of popular arcade games. Among them are Deluxe Invaders, Midway's Gorf, and Wizard of Wor.

Roklan Corporation
10600 Higgins Road
Rosemont, IL 60018

Symtec Light Pen For The Atari And VIC Home Computer

Symtec announces a light pen for the Atari 400/800 and the VIC-20 home computers. This model is identical to the Symtec pens used by the American Heart Assoc., the Army, Bell and display systems. The pen is easily programmable and can activate any software command the Atari or VIC can handle. Programming instructions are included for the technical owners and user programs will be announced. The barrel is stainless steel and has a touch-ring that sends a signal to the computer with the touch of a user's finger or by tapping a metal clip. The pen sees where it is being pointed at with an accuracy of + or − 1 pixel. The pen sells for $150.00. For more information contact:

Software Etc.
20828 Vermander
Mt. Clemens, MI 48043
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Software For Elementary Students

Orange Cherry Media, a division of Multi Dimensional Communications, Inc., announces its line of microcomputer software for the educational and consumer marketplace.

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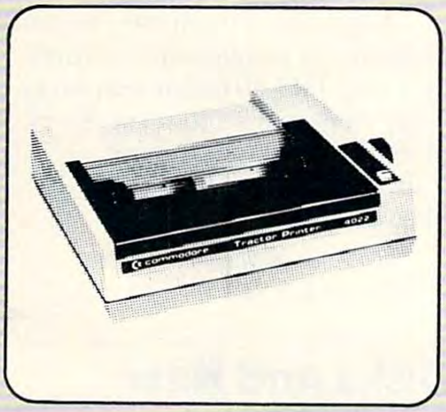

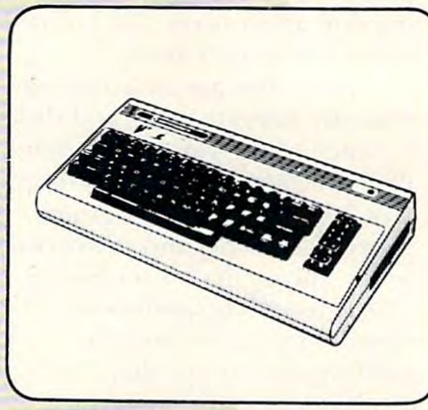

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been marketed which will include software in the areas of language arts, reading, communication skills, science, and mathematics. The programs have been specifically programmed for all popular models of Commodore PET, Radio Shack (TRS-80), and Apple microcomputers.

Similar to Orange Cherry's audio visual lines, the microcomputer software has been designed for the elementary market, grades K-8.

According to Carol Vazzana, Vice President of Marketing at Orange Cherry Media, "Our software relates directly to curriculum objectives and takes youngsters on adventures that enliven lessons in subject areas."

Programs are available on separate cassette tapes and disks for each of the various models of PET, TRS-80 and Apple computers. Many of these programs provide students and instructors with a choice of subject matter. The learner's responses are recorded to determine the reading and comprehension levels of the subject matter.

Orange Cherry Media
7 Delano Drive
Bedford Hills, NY 10507
(914)666-8434

Programs For The Classroom

Two microcomputer programs to aid classroom instruction were released in the second 1981-82 issue of CourseWare Magazine. The instructional package includes program documentation, teacher and student guides.

Decimal Estimation presents a student with a multiplication problem such as:

42.31 x .1602 = .677780620

The user moves the decimal by pressing the R key to move right or the L key to move left. The student places the decimal point to his/her satisfaction. RETURN is pressed to register the response and the computer accepts or rejects the response. A running timer is displayed and, after each success, average time per problem.

Alphabetize gives the student experience in ranking lists of between three and eight words. The teacher supplies a vocabulary. The computer selects at random the chosen number of words which appear on the screen. The student interchanges pairs of words until the list is correctly alphabetized. A score is kept which represents elapsed time to complete the task.

Versions of the instructional package are published for Apple, PET and TRS-80 microcomputers. They were mailed to subscribers in the US, Canada, Europe, Taiwan and Japan. CourseWare Magazine is located at:

4919 North Millbrook #222
Fresno, CA 93726

Disks And New Educational Programs From Teacher's Pet Software

All Teacher's Pet Software programs are now available on two disks with menus and automatic program loading from the menus. One disk contains all math and logic programs, the other all language and management programs. When a student finishes the programs, a single keypress will either restart the program or reload the menu. These programs will run on any 40 column BASIC 3.0 or 4.0 PET using a 2040, 4040, or 2031 disk drive.

Teacher's Pet Software has just released 4 new decimal and fraction math programs designed for students in grades 4 through 8. In all programs, up to 4 students can take turns working individual problems, and be scored separately.

Decimal Multiplication provides 5 levels of multiplication problems from single digit to 5 digit multiplicands with up to 4 digits after the decimal place. The program follows the paper and pencil procedure, making it a very effective tutorial. This is the only program a teacher needs to reinforce the common multiplication algorithm, and to teach the multiplication of decimal and whole numbers.

Comparing Fractions provides practice in comparing fractions, providing pictures of the fractions and a thorough, interactive tutorial teaching students a simple and fool-proof method for comparing two fractions.

Comparing Fractions II extends the practice of Comparing Fractions to more difficult fractions to let students test their mastery, and provides the same tutorial for review. Both programs have "help" and the directions available at any time in the program.

Recognizing Fractions provides the opportunity for practice in naming fractions given a picture, in drawing the picture (on the screen) given the fraction, or in a random mix of the two. The teacher can select the mode, or let the student choose.

Teacher's Pet Software has available over two dozen other programs in math, language, logic, and management suitable for elementary and junior high school students. Many of the programs are being used for remediation in high schools. These programs were written by Glenn Fisher, an elementary school teacher, computer consultant, and author of articles on computer use and programming techniques. A free brochure describing all programs is avail-