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```
2340 DATA63,16,8,169,11,157,116,63,32,21,
     61,96,189,108,63                  :rem 53
2350 DATA56,233,10,168,185,136,63,208,36,
     169,246,157,116,63,32             :rem 50
2360 DATA21,61,189,108,63,201,81,48,21,20
     1,89,16,17,56,233                 :rem 92
2370 DATA20,168,185,136,63,208,8,169,236,
     157,116,63,32,21,61               :rem 202
2380 DATA189,108,63,56,233,9,168,169,0,21
     7,136,63,16,8,169                 :rem 122
2390 DATA247,157,116,63,32,21,61,189,108,
     63,56,233,11,168,169                :rem 2
2400 DATA0,217,136,63,16,8,169,245,157,11
     6,63,32,21,61,96                  :rem 43
2410 DATA169,0,157,84,63,168,185,89,60,15
     7,116,63,32,21,61                 :rem 108
2420 DATA254,84,63,188,84,63,192,8,48,237
     ,96,169,4,157,100                 :rem 125
2430 DATA63,169,0,157,84,63,240,22,169,8,
     157,100,63,169,4                  :rem 51
2440 DATA157,84,63,208,10,169,8,157,100,6
     3,169,0,157,84,63                 :rem 106
2450 DATA168,185,105,60,157,116,63,157,92
     ,63,32,21,61,189,108              :rem 255
2460 DATA63,24,125,116,63,168,185,136,63,
     208,13,189,116,63,24              :rem 253
2470 DATA125,92,63,157,116,63,76,6,63,254
     ,84,63,189,84,63                  :rem 76
2480 DATA221,100,63,48,206,96,169,0,157,8
     4,63,168,185,97,60                :rem 167
2490 DATA157,116,63,32,21,61,254,84,63,18
     8,84,63,192,8,48                  :rem 68
2500 DATA237,96                        :rem 24
```

Program 2: 64 Chess (Main Program)

Refer to "COMPUTE!'s Guide To Typing In Programs" before entering this listing.

```
10 POKE53280,9:POKE53281,9:POKE53272,21:P
   OKE53249,0                         :rem 143
20 PRINTCHR$(14)"{CLR}{DOWN}{WHT}"TAB(18)
   "CHESS"                            :rem 94
30 PRINTTAB(15)"{DOWN}{CYN}JOHN KRAUSE"
                                      :rem 108
40 FORI=16256TO16263:POKEI,192:NEXT
                                      :rem 109
50 FORI=16264TO16383:POKEI,7:NEXT :rem 11
60 FORI=16285TO16362:READJ:POKEI,J:NEXT
                                      :rem 191
70 FORI=54272TO54296:POKEI,0:NEXT :rem 12
80 POKE54296,15:POKE54273,34:POKE54277,10
                                      :rem 51
90 POKE53282,8:POKE53283,1         :rem 203
100 POKE2040,14:POKE53287,7:POKE53277,1:P
    OKE53271,1                        :rem 130
110 D$=" PNBRQKPNBRQK"                :rem 23
120 PRINT"{2 DOWN}{YEL}ENTER SKILL LEVEL
    {SPACE}(1-5)"                     :rem 253
130 GETA$:IFA$=""THEN130              :rem 75
140 IFVAL(A$)=0ORVAL(A$)>5THEN130:rem 154
150 POKE16201,VAL(A$)                 :rem 132
160 PRINT"{DOWN}{RVS}1{OFF} NEW GAME OR
    {RVS}2{OFF} SET UP POSITION?":rem 142
170 GETE$:IFE$=""THEN170              :rem 91
180 IFVAL(E$)=0ORVAL(E$)>2THEN170:rem 167
190 PRINT"{DOWN}COMPUTER VS. {RVS}1{OFF}
    {SPACE}YOU OR {RVS}2{OFF} ITSELF?"
                                      :rem 145
200 GETA$:IFA$=""THEN200              :rem 71
210 IFVAL(A$)=0ORVAL(A$)>2THEN200:rem 147
220 POKE16202,0:B$="2":IFA$="2"THENPOKE16
    202,16:B$="1":GOTO260             :rem 151
230 PRINT"{DOWN}YOU HAVE THE {RVS}1{OFF}
    {SPACE}WHITE OR {RVS}2{OFF} BLACK PIE
    CES?"                             :rem 27
240 GETB$:IFB$=""THEN240              :rem 81
250 IFVAL(B$)=0ORVAL(B$)>2THEN240:rem 157
260 IFPEEK(12288)<>60THENGOSUB380:rem 204
270 GOSUB490                          :rem 182
280 IFA$="1"ANDB$="1"THEN320          :rem 239
290 IFE$="2"THENGOSUB690:POKE53269,0
                                      :rem 98
300 GOTO330                           :rem 98
310 IFA$="2"THEN330                    :rem 0
320 GOSUB690:POKE53269,0:POKE16202,0
                                      :rem 66
330 SYS15486:IFPEEK(16256)<229ANDPEEK(162
    56)>150THENI=0:GOTO1070           :rem 250
340 J=PEEK(16252)+16264:R=INT(J/10-1628.5
    ):C=J-16285-10*R:GOSUB930         :rem 153
350 J=PEEK(16253)+16264:R=INT(J/10-1628.5
    ):C=J-16285-10*R:GOSUB980         :rem 160
360 IFPEEK(16256)<99ANDPEEK(16256)>27THEN
    I=1:GOTO1070                      :rem 101
370 GOTO310                           :rem 103
380 PRINT"{DOWN}{CYN}PLEASE WAIT..."
                                      :rem 21
390 POKE56334,0:POKE1,51              :rem 88
400 FORI=0TO431:POKEI+12288,PEEK(I+53248)
    :NEXT                             :rem 227
410 POKE1,55:POKE56334,1              :rem 86
420 FORI=12792TO12799:POKEI,85:NEXT
                                      :rem 123
430 FORI=0TO383:READJ:POKE12800+I,J
                                      :rem 99
440 POKE13184+I,JOR85                 :rem 192
450 POKE13568+I,JAND170               :rem 36
460 POKE13952+I,(JAND170)OR(255-JAND85):N
    EXT                               :rem 49
470 FORI=896TO922:READJ:POKEI,J:NEXT
                                      :rem 48
480 FORI=923TO958:POKEI,0:NEXT:RETURN
                                      :rem 145
490 POKE53272,29:POKE53270,216        :rem 149
500 PRINT"{CLR}{2 DOWN}"TAB(14)"{CYN}LEVE
    L"PEEK(16201)                     :rem 115
510 PRINT"{13}";:IFB$="1"THEN530      :rem 203
520 POKE53283,0:PRINT"{23}";:POKE16288,6:P
    OKE16289,5:POKE16358,250:POKE16359,25
    1                                 :rem 18
530 IFE$="1"THEN560                   :rem 12
540 FORI=0TO7:FORJ=0TO7:POKE16285+10*I+J,
    0:NEXT:NEXT                       :rem 243
550 PRINT:GOSUB1170:GOSUB1170:GOTO680
                                      :rem 62
560 PRINT"{DOWN} {RVS}HIJK{OFF}HIJK{RVS}@
    ABC{OFF}{SHIFT-SPACE}{K}{I}{T}{RVS}XY
    Z[{OFF}PQRS{U}{O}@{F}XYZ+"        :rem 57
570 PRINT" {RVS}LMNO{OFF}LMNO{RVS}DEFG
    {OFF}{@}{G}{+}{M}{RVS}£]↑←{OFF}TUVW
    {C}{X}{V}{B}{-}-↑{*}"             :rem 202
580 PRINT" *ABC{A}{E}{R}{W}*ABC{A}{E}{R}
    {W}*ABC{A}{E}{R}{W}*ABC{A}{E}{R}{W}"
                                      :rem 158
590 PRINT" DEFG{H}{J}{L}{Y}DEFG{H}{J}{L}
    {Y}DEFG{H}{J}{L}{Y}DEFG{H}{J}{L}{Y}"
                                      :rem 31
600 GOSUB1170                         :rem 223
610 C$=CHR$(34):PRINT" {RVS}PQRS !"C$"#PQ
    RS !"C$"#PQRS !"C$"#PQRS !"C$"#"
                                      :rem 229
```

```
620 PRINT" {RVS}TUVW$%&'TUVW$%&'TUVW$%&'T
    UVW$%&'"                          :rem 43
630 PRINT" {RVS}89:;XYZ+0123[A][E][R][W][H
    IJK{SHIFT-SPACE}[K][I][T]()*++[£][£
    [N][Q]"                           :rem 76
640 PRINT" {RVS}<=>?[-][-]↑[*]4567[H][J][L]
    [Y][LMNO][@][G][+][M],-./[D][Z][S][P]"
                                      :rem 238
650 IFB$="1"THENRETURN                :rem 81
660 PRINT"{HOME}{4 DOWN}"SPC(13)"[£][£
    [N][Q]{RVS}PQRS"                  :rem 161
670 PRINTSPC(13)"{13 DOWN}{RVS}[U][O][@][F]
    *ABC{DOWN}"                       :rem 245
680 RETURN                            :rem 126
690 POKE53269,1                        :rem 52
700 GETC$:IFC$=""ORFTHEN780            :rem 68
710 N=0                                :rem 83
720 IFMID$(D$,N+1,1)=C$THEN750        :rem 129
730 N=N+1:IFN<13THEN720                :rem 78
740 GOTO780                           :rem 115
750 J=16285+C+10*R:IFN>6THENN=262-N
                                      :rem 249
760 IFNTHENGOSUB990:GOTO780           :rem 221
770 GOSUB940:FORI=0TO1:FORP=0TO3:POKEK+40
    *I+P,M:NEXT:NEXT                  :rem 182
780 I=NOTPEEK(56320)                  :rem 140
790 R=R-SGN((IAND2)-(IAND1))           :rem 81
800 C=C+SGN((IAND8)-(IAND4))           :rem 50
810 IFR<0THENR=0                      :rem 212
820 IFR>7THENR=7                      :rem 229
830 IFC<0THENC=0                      :rem 184
840 IFC>7THENC=7                      :rem 201
850 POKE53248,30+32*C:POKE53249,193-16*R
                                      :rem 167
860 IF(PEEK(56320)AND16)THEN700       :rem 244
870 J=16285+C+10*R                    :rem 162
880 IFFTHEN970                         :rem 68
890 IFPEEK(J)=0ORPEEK(J)>6THEN700:rem 248
900 F=1:GOSUB930                      :rem 163
910 IF(PEEK(56320)AND16)THEN700       :rem 240
920 GOTO910                           :rem 110
930 POKE54276,0:POKE54276,17           :rem 52
940 K=1745-80*R+4*C:N=PEEK(J):POKEJ,0
                                      :rem 103
950 M=32:IF(R+C)/2-INT((R+C)/2)THENM=63
                                      :rem 197
960 RETURN                            :rem 127
970 F=0                                :rem 83
980 FORI=0TO1:FORP=0TO3:POKEK+40*I+P,M:NE
    XT:NEXT                           :rem 98
990 K=1745-80*R+4*C                   :rem 216
1000 M=0:IF(R+C)/2-INT((R+C)/2)THENM=48
                                      :rem 182
1010 IFR=0ANDN=255THENN=251            :rem 92
1020 IFR=7ANDN=1THENN=5               :rem 150
1030 IFN<7THENM=M+96                  :rem 180
1040 POKEJ,N:IFN>6THENN=256-N          :rem 21
1050 FORI=0TO1:FORJ=0TO3:POKEK+40*I+J,56+
     M+8*N+4*I+J:NEXT:NEXT            :rem 51
1060 RETURN                           :rem 167
1070 IFPEEK(16202)THENI=I+1           :rem 34
1080 I=I+VAL(B$):PRINT"{DOWN}{CYN}CHECKMA
     TE!{2 SPACES}";                  :rem 249
1090 IFI/2-INT(I/2)THENPRINT"BLACK WINS."
     :GOTO1110                        :rem 24
1100 PRINT"WHITE WINS."               :rem 131
1110 POKE54273,40:POKE54276,0:POKE54276,1
     7                                :rem 89
1120 FORI=0TO999:NEXT                 :rem 40
1130 POKE54273,20:POKE54276,0:POKE54276,1
     7                                :rem 89
1140 PRINT"PRESS JOYSTICK BUTTON."
                                      :rem 158
1150 IF(PEEK(56320)AND16)THEN1150     :rem 77
1160 RUN                              :rem 189
1170 FORI=1TO2:FORJ=1TO2              :rem 234
1180 PRINT" ????{4 SPACES}????{4 SPACES}?
     ???{4 SPACES}????{4 SPACES}":rem 139
1190 NEXT:FORJ=1TO2                   :rem 184
1200 PRINT"{5 SPACES}????{4 SPACES}????
     {4 SPACES}????{4 SPACES}????"
                                      :rem 132
1210 NEXT:NEXT:RETURN                 :rem 150
1220 DATA4,2,3,5,6,3,2,4,7,7,1,1,1,1,1,1,
     1,1,7                            :rem 193
1230 DATA7,0,0,0,0,0,0,0,0,7,7,0,0,0,0,0,
     0,0,0,7                           :rem 0
1240 DATA7,0,0,0,0,0,0,0,0,7,7,0,0,0,0,0,
     0,0,0,7                           :rem 1
1250 DATA7,255,255,255,255,255,255,255,25
     5,7                              :rem 188
1260 DATA7,252,254,253,251,250,253,254,25
     2                                :rem 69
1270 DATA0,0,0,0,0,0,0,0              :rem 152
1280 DATA0,0,0,3,15,15,3,15            :rem 65
1290 DATA0,0,0,192,240,240,192,240
                                      :rem 164
1300 DATA0,0,0,0,0,0,0,0              :rem 146
1310 DATA0,0,0,0,0,0,0,0              :rem 147
1320 DATA3,3,15,63,63,0,0,0            :rem 66
1330 DATA192,192,240,252,252,0,0,0
                                      :rem 165
1340 DATA0,0,0,0,0,0,0,0              :rem 150
1350 DATA0,0,0,0,3,3,3,3              :rem 163
1360 DATA0,192,240,255,255,63,255,255
                                       :rem 83
1370 DATA0,0,0,0,240,252,252,255      :rem 61
1380 DATA0,0,0,0,0,0,0,0              :rem 154
1390 DATA15,15,3,0,0,0,0,0             :rem 10
1400 DATA255,243,3,15,63,255,255,0
                                      :rem 178
1410 DATA255,255,255,255,255,255,255,0
                                      :rem 136
1420 DATA0,192,192,192,192,192,192,0
                                       :rem 29
1430 DATA0,0,0,0,0,0,0,0              :rem 150
1440 DATA0,60,60,255,255,255,255,255
                                       :rem 31
1450 DATA0,60,60,63,207,243,243,243
                                      :rem 225
1460 DATA0,0,0,0,0,0,0,0              :rem 153
1470 DATA0,0,0,0,15,63,48,0            :rem 69
1480 DATA63,48,63,48,255,252,0,0      :rem 90
1490 DATA252,12,252,12,255,63,0,0:rem 121
1500 DATA0,0,0,0,240,252,12,0        :rem 150
1510 DATA0,3,3,3,0,0,0,0              :rem 158
1520 DATA0,207,207,255,192,255,255,255
                                      :rem 132
1530 DATA0,243,243,255,3,255,255,255
                                       :rem 28
1540 DATA0,192,192,192,0,0,0,0       :rem 220
1550 DATA0,0,0,0,3,15,15,0             :rem 8
1560 DATA255,255,255,192,255,255,255,0
                                      :rem 142
1570 DATA255,255,255,3,255,255,255,0
                                       :rem 38
1580 DATA0,0,0,0,192,240,240,0       :rem 212
1590 DATA0,0,0,0,48,48,12,12         :rem 123
1600 DATA0,48,48,48,48,252,252,252
                                      :rem 192
1610 DATA0,48,48,48,48,252,252,252
                                      :rem 193
```

```
1620 DATA0,0,0,0,48,48,192,192    :rem 231
1630 DATA15,3,3,3,3,3,3,0         :rem 224
1640 DATA255,0,255,252,255,0,255,0
                                  :rem 178
1650 DATA255,3,255,255,255,3,255,0
                                  :rem 188
1660 DATA192,0,0,0,0,0,0,0          :rem 7
1670 DATA0,0,0,15,63,63,63,15     :rem 179
1680 DATA0,63,51,60,243,255,240,252
                                  :rem 230
1690 DATA0,240,48,243,63,255,63,255
                                  :rem 243
1700 DATA0,0,0,192,240,240,240,192
                                  :rem 160
1710 DATA15,3,3,3,3,3,3,0         :rem 223
1720 DATA255,0,255,252,255,0,255,0
                                  :rem 177
1730 DATA255,3,255,255,255,3,255,0
                                  :rem 187
1740 DATA192,0,0,0,0,0,0,0          :rem 6
1750 DATA255,255,192,192,0,192,192,0,192
                                  :rem 235
1760 DATA192,0,192,192,0,192,192,0,192
                                  :rem 128
1770 DATA192,0,192,192,0,192,255,255,192
                                  :rem 237
```

Program 3: VIC Chess (Main Program)

Refer to "COMPUTE!'s Guide To Typing In Programs" before entering this listing.

```
10 POKE36879,138:POKE36869,194    :rem 172
20 PRINT"{CLR}{WHT}"TAB(8)"{DOWN}CHESS
                                   :rem 84
30 PRINT"{DOWN}{CYN}{5 SPACES}JOHN KRAUSE
                                  :rem 188
40 FORI=16256TO16263:POKEI,192:NEXT
                                  :rem 109
50 FORI=16264TO16383:POKEI,7:NEXT :rem 11
60 FORI=16285TO16362:READJ:POKEI,J:NEXT
                                  :rem 191
70 D$=" PNBRQKPNBRQK"             :rem 236
80 PRINT"{2 DOWN}{YEL}SKILL LEVEL (1-5)?
                                  :rem 113
90 GETA$:IFA$=""THEN90            :rem 245
100 IFVAL(A$)=0ORVAL(A$)>5THEN90  :rem 107
110 POKE16201,VAL(A$)             :rem 128
120 PRINT"{DOWN}{RVS}1{OFF} NEW GAME
                                  :rem 172
130 PRINT"{RVS}2{OFF} SET UP POSITION
                                  :rem 159
140 GETE$:IFE$=""THEN140           :rem 85
150 IFVAL(E$)=0ORVAL(E$)>2THEN140:rem 161
160 PRINT"{DOWN}COMPUTER VS.       :rem 29
170 PRINT"{RVS}1{OFF} YOU          :rem 25
180 PRINT"{RVS}2{OFF} ITSELF      :rem 229
190 GETA$:IFA$=""THEN190           :rem 87
200 IFVAL(A$)=0ORVAL(A$)>2THEN190:rem 154
210 POKE16202,0:B$="2":IFA$="2"THENPOKE16
    202,16:B$="1":GOTO270         :rem 151
220 PRINT"{DOWN}YOU HAVE THE      :rem 214
230 PRINT"{RVS}1{OFF} WHITE PIECES:rem 83
240 PRINT"{RVS}2{OFF} BLACK PIECES:rem 49
250 GETB$:IFB$=""THEN250           :rem 83
260 IFVAL(B$)=0ORVAL(B$)>2THEN250:rem 159
270 IFPEEK(5120)<>28THENGOSUB390 :rem 149
280 GOSUB460                      :rem 180
290 IFA$="1"ANDB$="1"THEN330      :rem 241
300 IFE$="2"THENGOSUB660          :rem 137
310 GOTO340                       :rem 100
320 IFA$="2"THEN340                 :rem 2
330 GOSUB660:POKE16202,0          :rem 114
340 SYS15486:IFPEEK(16256)<229ANDPEEK(162
    56)>150THENI=0:GOTO1120       :rem 247
350 J=PEEK(16252)+16264:R=INT(J/10-1628.5
    ):C=J-16285-10*R:GOSUB980     :rem 159
360 J=PEEK(16253)+16264:R=INT(J/10-1628.5
    ):C=J-16285-10*R:GOSUB1030    :rem 196
370 IFPEEK(16256)<99ANDPEEK(16256)>27THEN
    I=1:GOTO1120                  :rem 98
380 GOTO320                       :rem 105
390 PRINT"{DOWN}{CYN}PLEASE WAIT...
                                  :rem 244
400 FORI=0TO431:POKE5120+I,PEEK(32768+I):
    NEXT                          :rem 170
410 FORI=0TO223:READJ:POKE6224+I,J:rem 45
420 POKE5776+I,JOR85              :rem 150
430 POKE6000+I,JAND170            :rem 225
440 POKE5552+I,(JAND170)OR(255-JAND85):NE
    XT                            :rem 252
450 RETURN                        :rem 121
460 POKE36869,205                 :rem 156
470 PRINT"{CLR}{DOWN}{CYN}{7 SPACES}LEVEL
    "PEEK(16201)"{DOWN}{WHT}      :rem 207
480 POKE36878,15:POKE646,9:IFB$="1"THEN50
    0                             :rem 128
490 POKE36878,31:POKE646,8:POKE16288,6:PO
    KE16289,5:POKE16358,250:POKE16359,251
                                  :rem 233
500 IFE$="1"THEN530                 :rem 6

510 FORK=0TO70STEP10:FORJ=0TO7:POKE16285+
    K+J,0:NEXT:NEXT               :rem 54
520 GOSUB1210:GOSUB1210:RETURN    :rem 115
530 PRINT"{3 SPACES}{RVS}Z£{OFF}Z[-]
    {RVS}VX{OFF}[+][£]{RVS} $[OFF]↑
    {SHIFT-SPACE}{RVS}RT{OFF}[I][@]"
                                  :rem 16
540 PRINT"{3 SPACES}{RVS}[]{OFF}+-{RVS}WY
    {OFF}[M]£{RVS}#%{OFF}[*][K]{RVS}SU
    {OFF}[T][G]"                  :rem 34
550 PRINT"{3 SPACES}VX{RVS}NP{OFF}VX{RVS}
    NP{OFF}VX{RVS}NP{OFF}VX{RVS}NP"
                                  :rem 153
560 PRINT"{3 SPACES}WY{RVS}OQ{OFF}WY{RVS}
    OQ{OFF}WY{RVS}OQ{OFF}WY{RVS}OQ"
                                  :rem 170
570 GOSUB1210                     :rem 224
580 PRINT"{3 SPACES}[R][H]:<[R][H]:<[R]
    [H]:<[R][H]:<"                :rem 222
590 PRINT"{3 SPACES}[W][J];=[W][J];=[W]
    [J];=[W][J];="                :rem 239
600 PRINT"{3 SPACES}FH[L][U]BD{RVS}BD
    {OFF}NP@[C]>*[V]{RVS}@"       :rem 53
610 PRINT"{3 SPACES}GI[Y][O]CE{RVS}CE
    {OFF}OQ[F][X]?A[B]{RVS}A"     :rem 70
620 POKE4173,162                  :rem 91
630 IFB$="1"THENRETURN            :rem 79
640 PRINT"{HOME}{3 DOWN}"SPC(9)"[N][D]
    {RVS}↑ "                      :rem 43
650 PRINT"{13 DOWN}"SPC(9)"{RVS}FH{OFF}JL
    {DOWN}":RETURN                :rem 240
660 GETC$:IFC$=""ORFTHEN740        :rem 69
670 N=0                            :rem 88
680 IFMID$(D$,N+1,1)=C$THEN710    :rem 130
690 N=N+1:IFN<13THEN680            :rem 88
700 GOTO740                       :rem 107
710 J=16285+C+10*R:IFN>6THENN=262-N
                                  :rem 245
720 IFNTHENGOSUB1040:GOTO740      :rem 248
730 GOSUB990:FORI=0TO1:FORP=0TO1:POKEK+22
    *P+I,M:NEXT:NEXT              :rem 181
```

```
740 POKE37154,127:I=PEEK(37152)AND128:J=(
    I=0)                              :rem 2
750 POKE37154,255:I=PEEK(37151)       :rem 206
760 R=R+((IAND8)=0)-((IAND4)=0)       :rem 152
770 C=C+((IAND16)=0)-J                :rem 149
780 IFR<0THENR=0                      :rem 218
790 IFR>7THENR=7                      :rem 235
800 IFC<0THENC=0                      :rem 181
810 IFC>7THENC=7                      :rem 198
820 I=4473-44*R+C+C                   :rem 223
830 J=PEEK(I)                         :rem 225
840 P=56:IFJ>106THENP=-P              :rem 181
850 POKEI,J+P:POKEI+22,J+P+1          :rem 148
860 POKEI+1,J+P+2:POKEI+23,J+P+3      :rem 81
870 FORP=0TO70:NEXT                   :rem 198
880 POKEI,J:POKEI+22,J+1              :rem 161
890 POKEI+1,J+2:POKEI+23,J+3          :rem 94
900 FORP=0TO30:NEXT                   :rem 188
910 IF(PEEK(37151)AND32)THEN660       :rem 244
920 J=16285+C+10*R                    :rem 158
930 IFFTHEN1020                       :rem 99
940 IFPEEK(J)=0ORPEEK(J)>6THEN660:rem 249
950 F=1:GOSUB980                      :rem 173
960 IF(PEEK(37151)AND32)THEN660       :rem 249
970 GOTO960                           :rem 120
980 POKE36876,225                     :rem 163
990 K=4473-44*R+C+C:N=PEEK(J):POKEJ,0
                                      :rem 125
1000 M=54:IF(R+C)/2-INT((R+C)/2)THENM=110
                                      :rem 21
1010 POKE36876,0:RETURN               :rem 117
1020 F=0                              :rem 118
1030 FORI=0TO1:FORP=0TO1:POKEK+22*P+I,M:N
     EXT:NEXT                         :rem 131
1040 K=4473-44*R+C+C                  :rem 12
1050 M=54:IF(R+C)/2-INT((R+C)/2)THENM=110
                                      :rem 26
1060 IFR=0ANDN=255THENN=251           :rem 97
1070 IFR=7ANDN=1THENN=5               :rem 155
1080 IFN>7THENM=M+28                  :rem 182
1090 POKEJ,N:IFN>6THENN=256-N         :rem 26
1100 FORI=0TO1:FORJ=0TO1:POKEK+22*J+I,M+4
     *N+I+I+J:NEXT:NEXT               :rem 169
1110 RETURN                           :rem 163
1120 IFPEEK(16202)THENI=I+1           :rem 30
1130 I=I+VAL(B$):PRINT"{DOWN}{CYN}CHECKMA
     TE! ";                           :rem 245
1140 IFI/2-INT(I/2)THENPRINT"BLACK WINS."
     :GOTO1160                        :rem 25
1150 PRINT"WHITE WINS."               :rem 136
1160 POKE36876,240:FORI=0TO500:NEXT
                                      :rem 79
1170 POKE36876,195:FORI=0TO500:NEXT:POKE3
     6876,0                           :rem 44
1180 PRINT"{UP}PRESS JOYSTICK BUTTON.";
                                      :rem 110
1190 IF(PEEK(37151)AND32)THEN1190     :rem 84
1200 RUN                              :rem 184
1210 FORK=1TO2:FORJ=1TO2              :rem 231
1220 PRINT"{3 SPACES}{2 SHIFT-R}{2 SHIFT-R}{2 SHIFT-R}
     {2 SHIFT-R}{2 SHIFT-R}"          :rem 150
1230 NEXT:FORJ=1TO2                   :rem 179
1240 PRINT"{3 SPACES}{2 SHIFT-R}{2 SHIFT-R}{2 SHIFT-R}
     {2 SHIFT-R}{2 SHIFT-R}"          :rem 152
1250 NEXT:NEXT:RETURN                 :rem 154
1260 DATA4,2,3,5,6,3,2,4,7            :rem 23
1270 DATA7,1,1,1,1,1,1,1,7            :rem 102
1280 DATA7,0,0,0,0,0,0,0,7            :rem 95
1290 DATA7,0,0,0,0,0,0,0,7            :rem 96
1300 DATA7,0,0,0,0,0,0,0,7            :rem 88
1310 DATA7,0,0,0,0,0,0,0,7            :rem 89
1320 DATA7,255,255,255,255,255,255,255,25
     5,7                              :rem 186
1330 DATA7,252,254,253,251,250,253,254,25
     2                                :rem 67
1340 DATA0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
                                      :rem 118
1350 DATA0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
                                      :rem 119
1360 DATA0,0,0,0,0,3,3,0,3,0,0,3,3,0,0,0
                                      :rem 135
1370 DATA0,0,0,0,192,240,240,192,240,192,
     192,240,240,0,0,0                :rem 39
1380 DATA0,48,63,63,63,15,63,63,60,60,60,
     0,3,15,15,0                      :rem 26
1390 DATA0,0,0,192,240,240,252,252,252,25
     2,252,252,252,252,252,0          :rem 100
1400 DATA0,3,15,15,15,15,15,15,15,0,3,0,3
     ,63,48,0                         :rem 107
1410 DATA0,48,204,204,204,204,252,252,252
     ,0,240,0,240,63,3,0              :rem 139
1420 DATA0,51,51,63,63,12,15,15,15,15,15,
     12,63,63,63,0                    :rem 114
1430 DATA0,204,204,252,252,48,240,240,240
     ,240,240,48,252,252,252,0        :rem 197
1440 DATA0,3,3,3,51,51,51,63,15,0,15,15,1
     5,0,15,0                         :rem 105
1450 DATA0,48,48,48,51,51,243,255,252,0,2
     52,60,252,0,252,0                :rem 71
1460 DATA0,0,3,0,12,63,63,63,63,0,15,15,1
     5,0,15,0                         :rem 107
1470 DATA0,192,240,192,204,63,255,255,255
     ,0,252,60,252,0,252,0            :rem 12
```

Program 4: Atari Chess

Refer to "COMPUTE!'s Guide To Typing In Programs" before entering this listing.

```
EC 10 POKE 106,87:GRAPHICS 0:POKE 53
      251,0
LL 20 POKE 712,148:DIM D$(13),Z$(272
      )
GI 30 D$=" PNBRQK{P}{N}{B}{R}{Q}{K}"
MF 40 OPEN #1,4,0,"K":POKE 752,1
AB 50 POKE 82,0:POSITION 17,1:? "CHE
      SS"
FG 60 POSITION 14,3:? "John Krause"
OP 70 FOR I=1 TO 269 STEP 4:READ K:F
      OR J=0 TO 3:Z$((I+J),(I+J))=CH
      R$(K+J):NEXT J:NEXT I:Z$(60,60
      )=CHR$(0)
GD 80 Z$(17,20)="{Y}{Z}  ":Z$(232,23
      2)=CHR$(128):Z$(267,268)="  "
FM 90 FOR I=1591 TO 1598:POKE I,192:
      NEXT I
CB 100 FOR I=1599 TO 1718:POKE I,7:N
       EXT I
MM 110 FOR I=1620 TO 1697:READ J:POK
       E I,J:NEXT I
GJ 120 ? "{2 DOWN}Enter skill level
       (1-5)"
DD 130 GET #1,A:IF A<49 OR A>53 THEN
        130
JJ 140 POKE 1536,A-48
AD 150 ? "{DOWN}1 New game or 2 Set
       up position?"
EC 160 GET #1,E:IF E<49 OR E>50 THEN
        160
AF 170 ? "{DOWN}Computer vs. 1 you o
       r 2 itself?"
DK 180 GET #1,A:IF A<49 OR A>50 THEN
        180
```

```
KN 190 POKE 1537,0:B=50:IF A=50 THEN
       POKE 1537,16:B=49:GOTO 220
GO 200 ? "{DOWN}You have the [1] white
       or [2] black pieces?"
DB 210 GET #1,B:IF B<49 OR B>50 THEN
       210
MF 220 IF PEEK(24304)<>96 THEN GOSUB
       340
DB 230 I=USR(24333):GOSUB 420:GOSUB
       1100
JI 240 IF A=49 AND B=49 THEN 280
FI 250 IF E=50 THEN GOSUB 660
GM 260 GOTO 290
NF 270 IF A=50 THEN 290
MF 280 POKE 53251,16*C+64:GOSUB 1100
       :GOSUB 660:POKE 1537,0
HL 290 POKE 77,0:I=USR(24333):I=USR(
       23590):IF PEEK(1591)<229 AND
       PEEK(1591)>150 THEN I=0:GOTO
       990
GJ 300 J=PEEK(1587)+1599:R=INT(J/10-
       162):C=J-1620-10*R:GOSUB 860
GH 310 J=PEEK(1588)+1599:R=INT(J/10-
       162):C=J-1620-10*R:GOSUB 910
ND 320 IF PEEK(1591)<99 AND PEEK(159
       1)>27 THEN I=1:GOTO 990
GI 330 GOTO 270
NA 340 ? "{DOWN}Please wait ..."
NC 350 FOR I=1538 TO 1545:READ J:POK
       E I,J:NEXT I
CO 360 FOR I=24320 TO 24352:READ J:P
       OKE I,J:NEXT I
GN 370 FOR I=0 TO 391:READ J:POKE 22
       528+I,J
IL 380 POKE 203,J:M=USR(1538):POKE 2
       2920+I,PEEK(204):NEXT I
CP 390 FOR I=0 TO 207:POKE 23312+I,P
       EEK(57608+I):NEXT I
PK 400 FOR I=0 TO 39:POKE 23512+I,PE
       EK(57480+I):NEXT I
EH 410 FOR I=23552 TO 24304:READ J:P
       OKE I,J:NEXT I:RETURN
GK 420 GRAPHICS 0:POKE 756,88:POKE 8
       2,4:?
MP 430 POKE 559,46:POKE 53277,3
CJ 440 POKE 53251,64:POKE 707,216
DI 450 POKE 53259,1:POKE 54279,92
MB 460 POKE 623,1
HN 470 DL=PEEK(560)+256*PEEK(561)
FD 480 POKE DL+3,68
JH 490 FOR I=DL+6 TO DL+28:POKE I,4:
       NEXT I
BD 500 POKE DL+6,2
KG 510 POKE I,65:POKE I+1,0:POKE I+2
       ,DL/256
IH 520 POKE 708,39:POKE 710,0:POKE 7
       11,15:POKE 712,37
BP 530 IF B=50 THEN POKE 710,15:POKE
        711,0:POKE 1623,6:POKE 1624,
       5:POKE 1693,250:POKE 1694,251
EH 540 POSITION 16,1:? "mfwfm":POKE
       21374,PEEK(1536)+122
OE 550 IF E=49 THEN 580
IN 560 FOR I=0 TO 70 STEP 10:FOR J=0
        TO 7:POKE 1620+I+J,0:NEXT J:
       NEXT I
OP 570 ? :GOSUB 1110:GOSUB 1110:RETU
       RN
PH 580 ? :? Z$(1,32):? Z$(33,64):? Z
       $(65,96):? Z$(97,128)
GE 590 POKE 21454,91:POKE 21455,92
NJ 600 GOSUB 1110
PP 610 ? Z$(129,160):? Z$(161,192):?
        Z$(193,224):? Z$(225,256)
CC 620 IF B=49 THEN RETURN
IC 630 POSITION 16,3:? Z$(257,264)
KO 640 POSITION 16,17:? Z$(265,272):
       CHR$(29)
MA 650 POKE 22010,219:POKE 22011,220
       :RETURN
MM 660 IF PEEK(764)=255 OR F THEN 74
       0
DG 670 N=0:GET #1,D
AA 680 IF D$(N+1,N+1)=CHR$(D) THEN 7
       10
FI 690 N=N+1:IF N<13 THEN 680
GL 700 GOTO 740
LI 710 J=1620+C+10*R:IF N>6 THEN N=2
       62-N
MO 720 IF N THEN GOSUB 920:GOTO 740
EN 730 GOSUB 870:FOR I=0 TO 1:FOR P=
       0 TO 3:POKE K+40*I+P,M:NEXT P
       :NEXT I
CB 740 J=STICK(0)
MK 750 IF (J=7 OR J=5 OR J=6) AND C<
       7 THEN C=C+1:POKE 53251,16*C+
       64
CC 760 IF (J=11 OR J=9 OR J=10) AND
       C>0 THEN C=C-1:POKE 53251,16*
       C+64
NL 770 IF (J=14 OR J=10 OR J=6) AND
       R<7 THEN I=USR(24333):R=R+1:G
       OSUB 1100
KP 780 IF (J=13 OR J=5 OR J=9) AND R
       >0 THEN I=USR(24333):R=R-1:GO
       SUB 1100
HC 790 IF STRIG(0)=1 THEN 660
FO 800 J=1620+C+10*R
DG 810 IF F THEN 900
PG 820 IF PEEK(J)=0 OR PEEK(J)>6 THE
       N 660
KH 830 F=1:GOSUB 860
GO 840 IF STRIG(0)=1 THEN 660
HC 850 GOTO 840
OG 860 SOUND 0,99,10,8
KD 870 K=21996-80*R+4*C:N=PEEK(J):PO
       KE J,0
NF 880 M=48:IF (R+C)/2-INT((R+C)/2)
       THEN M=97
II 890 SOUND 0,0,0,0:RETURN
EM 900 F=0
PE 910 FOR I=0 TO 1:FOR P=0 TO 3:POK
       E K+40*I+P,M:NEXT P:NEXT I
AL 920 K=21996-80*R+4*C
CI 930 M=120:IF (R+C)/2-INT((R+C)/2)
        THEN M=169
DH 940 IF R=0 AND N=255 THEN N=251
HB 950 IF R=7 AND N=1 THEN N=5
MI 960 POKE J,N:IF N>6 THEN N=256-N:
       M=M-128
AK 970 FOR I=0 TO 1:FOR J=0 TO 3:POK
       E K+40*I+J,M+8*N+4*I+J:NEXT J
       :NEXT I
IB 980 RETURN
NB 990 IF PEEK(1537) THEN I=I+1
EF 1000 POKE DL+25,2:POKE DL+26,2:PO
       KE DL+27,2
HP 1010 I=I+B:POSITION 4,20:? "difdl
       nbuf":POSITION 26,20
BA 1020 IF I/2-INT(I/2) THEN ? "cmbd
       lPxjot":GOTO 1040
IC 1030 ? "xijufPxjot"
```

```
MM 1040 SOUND 0,50,10,12:FOR I=0 TO
        50:NEXT I
PJ 1050 SOUND 0,100,10,12:FOR I=0 TO
         50:NEXT I
JE 1060 SOUND 0,0,0,0
KP 1070 POSITION 9,22:? "qsfttPkpztu
        jdlPcvuupo"
FK 1080 IF STRIG(0) THEN 1080
LP 1090 RUN
LE 1100 POKE 24326,212-8*R:I=USR(243
        20):RETURN
OE 1110 FOR I=1 TO 2:FOR J=1 TO 2
FH 1120 ? "aaaaPPPPaaaaPPPPaaaaPPPPa
        aaaPPPP"
PM 1130 NEXT J:FOR J=1 TO 2
FJ 1140 ? "PPPPaaaaPPPPaaaaPPPPaaaaP
        PPPaaaa"
CM 1150 NEXT J:NEXT I:RETURN
GL 1160 DATA 9,40,1,64,64,48,89,56,1
        3,44,5,68,21,52,93,60
AH 1170 DATA 32,81,32,81,32,81,32,81
        ,36,85,36,85,36,85,36,85
AE 1180 DATA 209,160,209,160,209,160
        ,209,160,213,164,213,164,213
        ,164,213,164
BK 1190 DATA 184,217,176,145,200,129
        ,168,137,188,221,180,149,204
        ,133,172,141
GH 1200 DATA 72,17,153,192
MA 1210 DATA 4,2,3,5,6,3,2,4,7,7,1,1
        ,1,1,1,1,1,1,7
PP 1220 DATA 7,0,0,0,0,0,0,0,0,7,7,0
        ,0,0,0,0,0,0,0,7
AA 1230 DATA 7,0,0,0,0,0,0,0,0,7,7,0
        ,0,0,0,0,0,0,0,7
LL 1240 DATA 7,255,255,255,255,255,2
        55,255,255,7
EE 1250 DATA 7,252,254,253,251,250,2
        53,254,252
BP 1260 DATA 165,203,9,85,133,204,10
        4,96
AP 1270 DATA 160,8,185,25,95,153,0,9
        5,136,16,247,104,96
AJ 1280 DATA 160,128,169,0,153,128,9
        5,136,16,250,104,96
PK 1290 DATA 255,129,129,129,129,129
        ,129,255
JC 1300 DATA 0,0,0,0,0,0,0,0
DL 1310 DATA 0,0,0,3,15,15,3,15
JO 1320 DATA 0,0,0,192,240,240,192,2
        40
JF 1330 DATA 0,0,0,0,0,0,0,0
JG 1340 DATA 0,0,0,0,0,0,0,0
EF 1350 DATA 3,3,15,63,63,0,0,0
KI 1360 DATA 192,192,240,252,252,0,0
        ,0
JJ 1370 DATA 0,0,0,0,0,0,0,0
KG 1380 DATA 0,0,0,0,3,3,3,3
FG 1390 DATA 0,192,240,255,255,63,25
        5,255
DH 1400 DATA 0,0,0,0,240,252,252,255
JE 1410 DATA 0,0,0,0,0,0,0,0
AE 1420 DATA 15,15,3,0,0,0,0,0
LF 1430 DATA 255,243,3,15,63,255,255
        ,0
IL 1440 DATA 255,255,255,255,255,255
        .255,0
CA 1450 DATA 0,192,192,192,192,192,1
        92,0
JJ 1460 DATA 0,0,0,0,0,0,0,0
CC 1470 DATA 0,60,60,255,255,255,255
        ,255
OE 1480 DATA 0,60,60,63,207,243,243,
        243
JM 1490 DATA 0,0,0,0,0,0,0,0
DP 1500 DATA 0,0,0,0,15,63,48,0
FE 1510 DATA 63,48,63,48,255,252,0,0
HD 1520 DATA 252,12,252,12,255,63,0,
        0
JJ 1530 DATA 0,0,0,0,240,252,12,0
KB 1540 DATA 0,3,3,3,0,0,0,0
IH 1550 DATA 0,207,207,255,192,255,2
        55,255
BP 1560 DATA 0,243,243,255,3,255,255
        ,255
NP 1570 DATA 0,192,192,192,0,0,0,0
AL 1580 DATA 0,0,0,0,3,15,15,0
JB 1590 DATA 255,255,255,192,255,255
        ,255,0
CA 1600 DATA 255,255,255,3,255,255,2
        55,0
MD 1610 DATA 0,0,0,0,192,240,240,0
HF 1620 DATA 0,0,0,0,48,48,12,12
MD 1630 DATA 0,48,48,48,48,252,252,2
        52
ME 1640 DATA 0,48,48,48,48,252,252,2
        52
OK 1650 DATA 0,0,0,0,48,48,192,192
OD 1660 DATA 15,3,3,3,3,3,3,0
LF 1670 DATA 255,0,255,252,255,0,255
        ,0
LP 1680 DATA 255,3,255,255,255,3,255
        ,0
AK 1690 DATA 192,0,0,0,0,0,0,0
KN 1700 DATA 0,0,0,15,63,63,63,15
OA 1710 DATA 0,63,51,60,243,255,240,
        252
ON 1720 DATA 0,240,48,243,63,255,63,
        255
KD 1730 DATA 0,0,0,192,240,240,240,1
        92
OC 1740 DATA 15,3,3,3,3,3,3,0
LE 1750 DATA 255,0,255,252,255,0,255
        ,0
LO 1760 DATA 255,3,255,255,255,3,255
        ,0
AJ 1770 DATA 192,0,0,0,0,0,0,0
JO 1780 DATA 0,0,0,0,0,0,0,0
MF 1790 DATA 21,12,248,237,235,244,8
        ,19,10,11,1,247,246,245
BB 1800 DATA 255,9,11,247,245,9,10,1
        ,246,255,46,9,5,3,3,1,0,1
LK 1810 DATA 3,3,5,9,46,120,169,192,
        141,55,6,162,0,142,54,6
DG 1820 DATA 202,142,53,6,76,8,93,18
        9,35,6,24,125,43,6,72,168
GP 1830 DATA 185,63,6,188,35,6,153,6
        3,6,104,168,189,3,6,153,63
MM 1840 DATA 6,24,105,6,168,174,0,6,
        169,0,157,56,6,174,53,6
OK 1850 DATA 185,24,92,56,253,56,6,1
        68,169,192,157,56,6,152
EH 1860 DATA 224,0,208,34,221,55,6,4
        8,28,208,11,173,10,210,205
LL 1870 DATA 54,6,144,18,141,54,6,14
        0,55,6,173,35,6,141,51,6,173
DD 1880 DATA 43,6,141,52,6,96,221,55
        ,6,48,250,240,248,152,157
AP 1890 DATA 55,6,189,2,6,24,105,6,1
        68,185,24,92,56,253,55,6
DM 1900 DATA 221,54,6,48,59,224,1,24
        0,221,221,54,6,240,50,96
```

```
FL 1910 DATA 189,35,6,24,125,43,6,14
        1,2,6,168,185,63,6,172,1,6
LH 1920 DATA 208,6,201,1,16,192,48,8
        ,201,0,48,186,201,7,240
FB 1930 DATA 182,157,3,6,201,6,240,4
        ,201,250,208,12,169,46,157
CO 1940 DATA 55,6,104,104,104,104,76
        ,140,93,188,35,6,185,63,6
CL 1950 DATA 172,2,6,153,63,6,188,35
        ,6,169,0,153,63,6,236,0,6
JN 1960 DATA 208,3,76,55,92,232,142,
        53,6,169,20,157,35,6,169,16
MB 1970 DATA 56,237,1,6,141,1,6,254,
        35,6,188,35,6,185,63,6,201,7
HB 1980 DATA 240,86,172,1,6,240,4,20
        1,0,16,77,192,0,208,4,201,1
GH 1990 DATA 48,69,201,0,16,9,188,35
        ,6,169,0,56,249,63,6,201,1
OM 2000 DATA 208,6,32,173,93,76,133,
        93,201,2,208,6,32,104,94
OI 2010 DATA 76,133,93,201,3,208,6,3
        2,130,94,76,133,93,201,4
PD 2020 DATA 208,6,32,142,94,76,133,
        93,201,5,208,6,32,154,94
EB 2030 DATA 76,133,93,32,215,94,76,
        133,93,189,35,6,201,98,48
GM 2040 DATA 150,224,0,240,16,169,16
        ,56,237,1,6,141,1,6,202,142
IN 2050 DATA 53,6,76,55,92,173,51,6,
        24,109,52,6,141,52,6,88,104
GL 2060 DATA 96,173,1,6,208,89,189,3
        5,6,24,105,10,168,185,63,6
DB 2070 DATA 208,36,169,10,157,43,6,
        32,188,92,189,35,6,201,31
MB 2080 DATA 48,21,201,39,16,17,24,1
        05,20,168,185,63,6,208,8,169
KB 2090 DATA 20,157,43,6,32,188,92,1
        89,35,6,24,105,9,168,185,63
JE 2100 DATA 6,16,8,169,9,157,43,6,3
        2,188,92,189,35,6,24,105,11
KL 2110 DATA 168,185,63,6,16,8,169,1
        1,157,43,6,32,188,92,96,189
MK 2120 DATA 35,6,56,233,10,168,185,
        63,6,208,36,169,246,157,43,6
AC 2130 DATA 32,188,92,189,35,6,201,
        81,48,21,201,89,16,17,56
GM 2140 DATA 233,20,168,185,63,6,208
        ,8,169,236,157,43,6,32,188
EE 2150 DATA 92,189,35,6,56,233,9,16
        8,169,0,217,63,6,16,8,169
HH 2160 DATA 247,157,43,6,32,188,92,
        189,35,6,56,233,11,168,169
HF 2170 DATA 0,217,63,6,16,8,169,245
        ,157,43,6,32,188,92,96,169
FQ 2180 DATA 0,157,11,6,168,185,0,92
        ,157,43,6,32,188,92,254,11
NN 2190 DATA 6,188,11,6,192,8,48,237
        ,96,169,4,157,27,6,169,0,157
BM 2200 DATA 11,6,240,22,169,8,157,2
        7,6,169,4,157,11,6,208,10
JP 2210 DATA 169,8,157,27,6,169,0,15
        7,11,6,168,185,16,92,157,43
HA 2220 DATA 6,157,19,6,32,188,92,18
        9,35,6,24,125,43,6,168,185
DC 2230 DATA 63,6,208,13,189,43,6,24
        ,125,19,6,157,43,6,76,174
GE 2240 DATA 94,254,11,6,189,11,6,22
        1,27,6,48,206,96,169,0,157
GO 2250 DATA 11,6,168,185,8,92,157,4
        3,6,32,188,92,254,11,6,188
MP 2260 DATA 11,6,192,8,48,237,96
```

Apple Notes

The Apple version of "Chess" uses the DATA statements from Program 1. Type in Program 5 and add lines 2000 to 2500 from Program 1 (ignoring the *:rem* numbers, which are for Commodore owners using the "Automatic Proofreader"). Then substitute line 2080 with the following line and save the program before running it:

2080 DATA 11,173,35,192,205,127, 63,144,18,141,127,63,140,128,63

Use the A, S, D, and W keys to move the blinking cursor atop the piece you wish to move and press RETURN. Then move the cursor to the square on which you want to set the piece and hit RETURN again.

As in the other versions, the P, N, B, R, Q, and K keys let you add pieces to the board. To add one of the computer's pieces, hold down the CONTROL key while pressing one of these editing keys. Use the space bar to delete a piece.

When the computer announces checkmate, press any key to start a new game. You can start a new game at any time by pressing CONTROL–RESET and rerunning the program.

Program 5: Apple Chess (Main Program)

Refer to "COMPUTE!'s Guide To Typing In Programs" before entering this listing.

```
10  HIMEM: 15448
20  HOME : PRINT  TAB( 18)"CHESS"
30  PRINT : PRINT  TAB( 15)"JOHN KRAUSE
    "
40  DIM A(12),C(69)
50  FOR I = 16256 TO 16263: POKE I,192:
    NEXT I
60  FOR I = 16264 TO 16383: POKE I,7: NEXT
    I
70  FOR I = 16285 TO 16362: READ J: POKE
    I,J: NEXT I
80  FOR I = 0 TO 12: READ A(I): NEXT I
90 B(0) = 17118:B(1) = 18142:B(2) = 191
    66:B(3) = 20190:B(4) = 21214
100  FOR I = 0 TO 69: READ C(I): NEXT I
    : GOSUB 430
110  IF  PEEK (16200) <  > 96 THEN  GOSUB
    370
120  IF B$ = "2" THEN  POKE 16288,6: POKE
    16289,5: POKE 16358,250: POKE 1635
    9,251
130  IF E$ = "1" THEN 150
140  FOR R = 0 TO 7: FOR C = 0 TO 7: POKE
    16285 + 10 * R + C,0: NEXT C: NEXT
    R
150  HGR2 : FOR R = 0 TO 7: FOR C = 0 TO
    7
160 I =  PEEK (16285 + 10 * R + C)
```

```
170  GOSUB 820
180  NEXT C: NEXT R:R = 0:C = 0
190  IF A$ = "1" AND B$ = "1" THEN 230
200  IF E$ = "2" THEN  GOSUB 540
210  GOTO 240
220  IF A$ = "2" THEN 240
230  GOSUB 540: POKE 16202,0
240  CALL 15486: IF  PEEK (16256) < 229
      AND  PEEK (16256) > 150 THEN 310
250 J =  PEEK (16252) + 16264:R =  INT
     (J / 10 - 1628.5):C = J - 16285 -
     10 * R
260  CALL  - 198:K =  PEEK (J):I = 0:
     GOSUB 820:I = K
270 J =  PEEK (16253) + 16264:R =  INT
     (J / 10 - 1628.5):C = J - 16285 -
     10 * R
280  GOSUB 820
290  IF  PEEK (16256) > 99 OR  PEEK (16
     256) < 28 THEN 220
300 Z = 1
310  IF  PEEK (16202) THEN Z = Z + 1
320  FOR I = 1 TO 5: CALL  - 198: NEXT
     I
330 K = 2:Z = Z +  VAL (B$): IF Z / 2 -
      INT (Z / 2) THEN L = 15
340  GOSUB 910: GOSUB 900
350  IF  PEEK ( - 16368) < 128 THEN 350
360  TEXT : RUN
370  PRINT : PRINT : PRINT "PLEASE WAIT
      ..."
380  FOR I = 24576 TO 25275: READ J: POKE
     I,J:K = K + J: NEXT I
390  FOR I = 25276 TO 25339: POKE I,255
     : NEXT I
400  FOR I = 15449 TO 16200: READ J: POKE
     I,J:K = K + J: NEXT I
410  IF K = 134648 THEN  RETURN
420  POKE 16200,0: PRINT : PRINT "CHECK
      DATA STATEMENTS": STOP
430  PRINT : PRINT : PRINT "ENTER SKILL
      LEVEL (1-5)";
440  GET A$: IF  VAL (A$) = 0 OR  VAL (
     A$) > 5 THEN 440
450  POKE 16201, VAL (A$)
460  PRINT : PRINT : PRINT "(1) NEW GAM
     E OR (2) SET UP POSITION?";
470  GET E$: IF  VAL (E$) = 0 OR  VAL (
     E$) > 2 THEN 470
480  PRINT : PRINT : PRINT "COMPUTER VS
       (1) YOU OR (2) ITSELF?";
490  GET A$: IF  VAL (A$) = 0 OR  VAL (
     A$) > 2 THEN 490
500  POKE 16202,0:B$ = "2": IF A$ = "2"
      THEN  POKE 16202,16:B$ = "1": RETURN
510  PRINT : PRINT : PRINT "YOU HAVE TH
     E (1) WHITE OR (2) BLACK     PIECE
     S?";
520  GET B$: IF  VAL (B$) = 0 OR  VAL (
     B$) > 2 THEN 520
530  RETURN
540 F = 0
550 I =  PEEK ( - 16368)
560  IF I = 215 AND R < 7 THEN R = R +
     1: GOTO 670
570  IF I = 193 AND C > 0 THEN C = C -
     1: GOTO 670
580  IF I = 211 AND R > 0 THEN R = R -
     1: GOTO 670
590  IF I = 196 AND C < 7 THEN C = C +
     1: GOTO 670
600  IF I < 128 OR I = 141 OR F THEN 67
     0
610 J = 0
620  IF A(J) = I THEN 650
630 J = J + 1: IF J < 13 THEN 620
640  GOTO 550
650 I = J: IF I > 6 THEN I = 262 - I
660  GOSUB 820: GOTO 540
670  POKE 251,R: POKE 252,C
680 J = 16285 + 10 * R + C:K =  PEEK (J
     )
690  IF I = 141 THEN 740
700  POKE 8,7: CALL 24576
710  FOR J = 0 TO 30: NEXT J
720 I = K: GOSUB 850
730  FOR J = 0 TO 60: NEXT J: GOTO 550
740  IF F THEN 790
750  IF K = 0 OR K > 6 THEN 550
760 F = 1:R1 = R:C1 = C: CALL  - 198
770  IF  PEEK ( - 16368) = 141 THEN 770
780  GOTO 550
790 R2 = R:C2 = C:R = R1:C = C1:I = 0
800 K =  PEEK (16285 + 10 * R + C): GOSUB
     820
810 R = R2:C = C2:I = K
820  IF R = 0 AND I = 255 THEN I = 251
830  IF R = 7 AND I = 1 THEN I = 5
840  POKE 16285 + 10 * R + C,I
850  IF I > 6 THEN I = 384 - I
860  IF B$ = "1" OR I = 0 THEN 890
870  IF I > 6 THEN I = I - 256
880 I = I + 128
890  POKE 251,R: POKE 252,C: POKE 8,I: CALL
     24576: RETURN
900 K = 7:M = 3:L = 30
910  FOR J = 0 TO K: FOR I = 0 TO 4: POKE
     B(I) + M + J,C(L):L = L + 1: NEXT
     I: NEXT J: RETURN
920  DATA 4,2,3,5,6,3,2,4,7,7,1,1,1,1,1
     ,1,1,1,7
930  DATA 7,0,0,0,0,0,0,0,0,7,7,0,0,0,0
     ,0,0,0,0,7
940  DATA 7,0,0,0,0,0,0,0,0,7,7,0,0,0,0
     ,0,0,0,0,7
950  DATA 7,255,255,255,255,255,255,255
     ,255,7
960  DATA 7,252,254,253,251,250,253,254
     ,252
970  DATA 160,208,206,194,210,209,203,1
     44,142,130,146,145,139
980  DATA 19,21,19,21,115,68,42,46,42,7
     4,21,20,12,20,21
990  DATA 85,85,119,87,85,100,68,68,68,
     68,29,4,12,4,28
1000  DATA 72,40,72,8,104,1,64,64,65,0,
     43,40,56,40,43,103,17,19,17,103
1010  DATA 42,106,102,42,42,73,21,29,21
     ,21,59,9,25,9,57,35,37,37,5,35
1020  DATA 165,251,69,252,41,1,133,48
1030  DATA 32,19,96,166,8,208,1,96
1040  DATA 232,134,48,165,48,41,15,168
1050  DATA 185,170,96,133,6,185,179,96
1060  DATA 133,7,169,0,133,9,164,251
1070  DATA 185,162,96,133,254,165,252,1
     0
1080  DATA 10,24,121,154,96,133,253,32
1090  DATA 75,96,165,253,24,105,128,133
1100  DATA 253,165,254,56,233,32,133,25
     4
1110  DATA 76,75,96,32,90,96,165,254
1120  DATA 24,105,4,133,254,201,96,48
```

```
1130  DATA 242,96,169,3,133,25,164,48
1140  DATA 240,41,136,240,38,16,19,164
1150  DATA 9,177,6,230,9,73,255,164
1160  DATA 25,49,253,145,253,198,25,16
1170  DATA 238,96,164,9,177,6,230,9
1180  DATA 164,25,17,253,145,253,198,25
1190  DATA 16,240,96,164,9,177,6,230
1200  DATA 9,164,25,145,253,198,25,16
1210  DATA 242,96,84,84,44,44,44,44
1220  DATA 4,4,65,64,67,66,65,64
1230  DATA 67,66,188,252,60,124,188,252
1240  DATA 60,124,188,96,96,97,97,97
1250  DATA 97,98,98,98
1260  DATA 0,0,0,0,213,170,213,170,213,
      170,213,170,213,170,213,170
1270  DATA 213,170,213,170,213,170,213,
      170,213,170,213,170,213,170,213,17
      0
1280  DATA 213,170,213,170,213,170,213,
      170,213,170,213,170,213,170,213,17
      0
1290  DATA 213,170,213,170,213,170,213,
      170,213,170,213,170,213,170,213,17
      0
1300  DATA 0,0,0,0,42,85,42,84,42,85,42
      ,84,42,85,42,84
1310  DATA 42,85,42,84,42,85,42,84,42,8
      5,42,84,42,85,42,84
1320  DATA 42,85,42,84,42,85,42,84,42,8
      5,42,84,42,85,42,84
1330  DATA 42,85,42,84,42,85,42,84,42,8
      5,42,84,42,85,42,84
1340  DATA 0,0,0,0,0,0,0,0,0,0,0,0,0,3,
      96,0
1350  DATA 0,15,120,0,0,15,120,0,0,3,96
      ,0,0,15,120,0
1360  DATA 0,3,96,0,0,3,96,0,0,15,120,0
      ,0,63,126,0
1370  DATA 0,63,126,0,0,0,0,0,0,0,0,0,0
      ,0,0,0
1380  DATA 0,0,0,0,0,0,0,0,0,0,1,64,0,0
      ,7,64
1390  DATA 0,0,127,64,0,15,127,112,0,63
      ,126,48,0,63,127,112
1400  DATA 1,127,127,112,1,127,127,124,
      7,127,103,124,7,127,96,48
1410  DATA 7,127,120,0,7,127,126,0,7,12
      7,127,64,0,0,0,0
1420  DATA 0,0,0,0,0,0,0,0,0,60,30,0,0,
      60,30,0
1430  DATA 1,124,127,64,1,115,127,64,1,
      79,127,64,1,79,127,64
1440  DATA 0,63,126,0,0,48,6,0,0,63,126
      ,0,0,48,6,0
1450  DATA 7,127,127,112,31,124,31,124,
      24,0,0,12,0,0,0,0
1460  DATA 0,0,0,0,0,0,0,0,3,103,115,96
      ,3,103,115,96
1470  DATA 3,127,127,96,0,96,3,0,0,127,
      127,0,0,127,127,0
1480  DATA 0,127,127,0,0,127,127,0,0,12
      7,127,0,0,96,3,0
1490  DATA 3,127,127,96,15,127,127,120,
      15,127,127,120,0,0,0,0
1500  DATA 0,0,0,0,0,0,0,0,0,48,24,0,0,
      48,24,0
1510  DATA 96,48,24,12,97,124,126,12,25
      ,124,126,48,25,124,126,48
1520  DATA 31,127,127,112,6,0,1,64,7,12
      7,127,64,7,124,127,64
1530  DATA 7,127,127,64,6,0,1,64,7,127,
      127,64,0,0,0,0
1540  DATA 0,0,0,0,0,63,120,0,0,51,24,0
      ,30,60,121,112
1550  DATA 127,115,31,124,127,127,127,1
      24,127,112,31,124,31,124,127,112
1560  DATA 31,127,127,112,6,0,1,64,7,12
      7,127,64,7,124,127,64
1570  DATA 7,127,127,64,6,0,1,64,7,127,
      127,64,0,0,0,0
```

Muppet Roundup

Fred D'Ignazio, Associate Editor

This month we're going to take a look at three computer products for children, all associated with the Muppets, that lovable gang of characters invented by Jim Henson and Associates in New York.

The first product we'll examine is the Muppet Learning Keys, codeveloped by Christopher Cerf of Henson Associates, Koala Technologies (which makes the popular KoalaPad), and Sunburst Software, one of the foremost educational software publishers. The keys cost $80 and plug into the joystick socket on your Commodore 64 or Apple computer.

Muppet Learning Keys is intended for children age three and up. But it is not just for children. If someone is intimidated by computers and mystified by the computer's keyboard, then the Muppet Keys may be just the thing—at least to get started. The keys are large buttons with big, easy-to-read letters, numbers, words, and colorful pictures of the Muppets. They are easy to use regardless of the shape or size of your fingers.

The alphabet keys are arranged alphabetically, not in the mysterious QWERTY order you see on typewriter and computer keyboards. Next to these keys is a paint box to change colors on the screen. There is an Eraser to erase the picture on the screen. There is a Help key, in case you are lost and need help. There is an Oops key that lets you undo a mistake. There is even a Zap key you can punch when you are tired of playing a game and you want to go back to the main menu and select a new game.

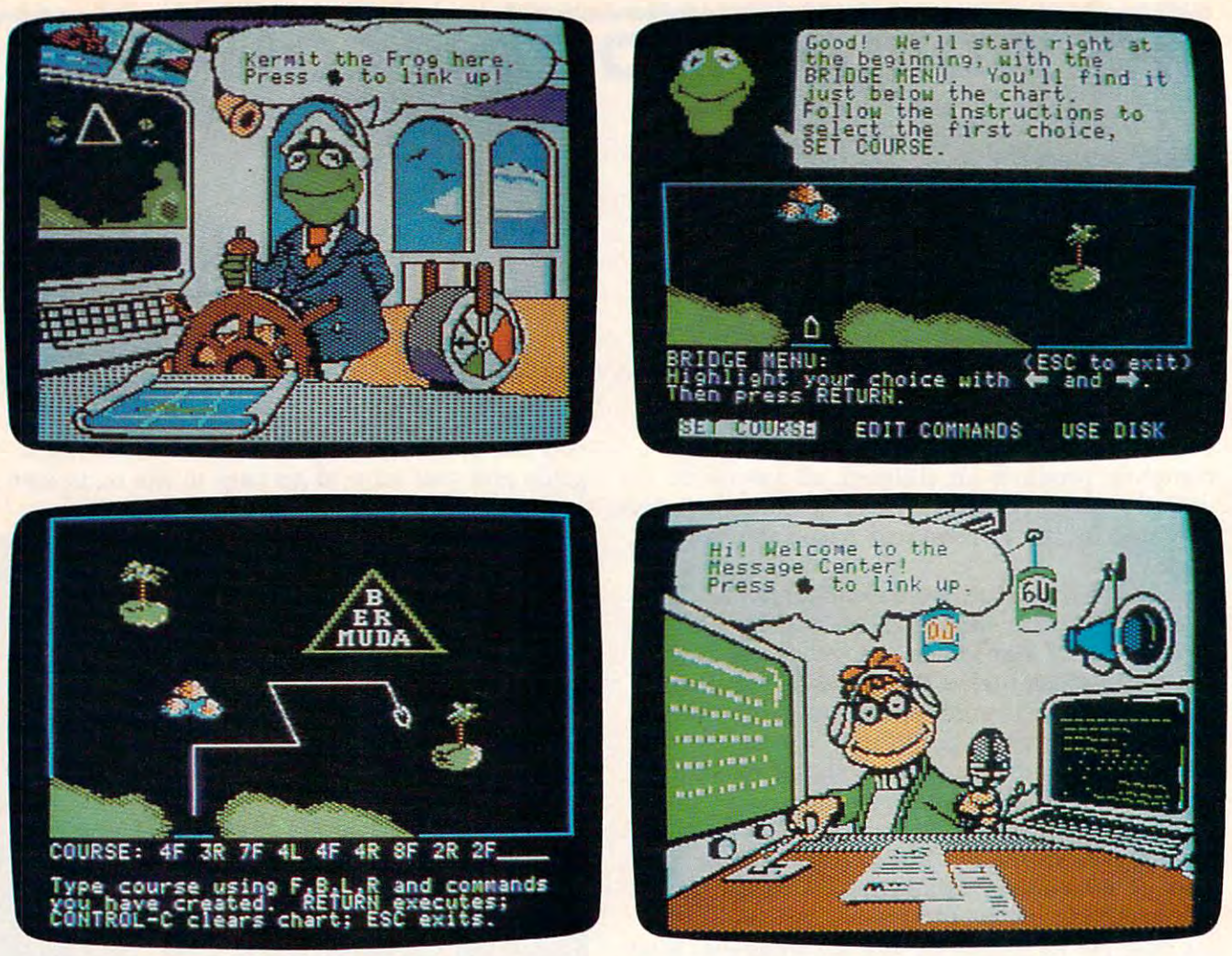
Koala Technologies' Muppet Learning Keys is an auxiliary computer keyboard especially suited for young children.

Like other touch pads on the market, Muppet Learning Keys comes with software on disk. More software is planned for additional activities. However, the important thing to remember is that this is not just a new application or software product for your computer. It is a new keyboard for the computer—especially suitable for children and beginners. Already, some of the most prestigious software publishers are designing new games and educational programs for this keyboard.

However, since it's a new product, the only thing that works with it now is the Muppet disk from Koala Technologies. This might influence you to postpone buying the product until more software becomes available. Also, you might

Fred D'Ignazio is a computer enthusiast and author of several books on computers for young people. His books include Katie and the Computer *(Creative Computing),* Chip Mitchell: The Case of the Stolen Computer Brains *(Dutton/Lodestar),* The Star Wars Question and Answer Book About Computers *(Random House), and* How To Get Intimate With Your Computer (A 10-Step Plan To Conquer Computer Anxiety) *(McGraw-Hill).*

As the father of two young children, Fred has become concerned with introducing the computer to children as a wonderful tool rather than as a forbidding electronic device. His column appears monthly in COMPUTE!.



Some sample screens from Brøderbund Software's Welcome Aboard! The Muppets Cruise to Computer Literacy, *an educational program for youngsters.*

wonder if it's worth paying $80 for an additional keyboard with pictures of Muppets, paintbrushes, compasses, and rulers. Wouldn't kids be better off using real rulers and real paintbrushes instead of imaginary ones on a computer?

This seems like a good question—until you have seen a young child or a computerphobic adult approach a computer keyboard for the first time. Usually they're frozen into inaction by the bewildering number of keys and the strange symbols. Muppet Learning Keys offers an attractive alternative to the standard keyboard. It is a beginner's keyboard—familiar, colorful, and inviting—and both children and adults warm up to it quickly.

The Muppet Institute Of Technology

The Muppet Institute of Technology (or "M.I.T.") was endowed by Simon & Schuster to offer early learning courses to children who use microcomputers. The Institute is the whimsical creation of Frank Schwartz of Simon & Schuster's Electronic Publishing Division. It doesn't charge a price for its software; it charges tuition. And in every package, children who complete the imaginary course are awarded a diploma and course credits.

The first two products come from the Institute's Reading Department and are intended for children ages four to eight. Each costs $40 and will be available for the Commodore 64 at the end of the year, and for the Apple early in 1985. In *The Great Gonzo in Word Rider,* Gonzo's favorite chicken, Camilla, has been kidnapped and carried away into the mountains. Children go on a quest with Gonzo to rescue Camilla. They have to survive several hazards on the journey. On the way, they construct vehicles that allow them to make it safely through the hazards. The vehicles are fanciful—like Gonzo's Rolling Hornblower. Yet they are also logically suited for the particular hazard the child must overcome. On the way to rescuing poor Camilla, children gain skills in reading, vocabulary, word usage, problem solving, and elementary logic.

In the second program, *Kermit's Electronic*

Finally, a Computer Keyboard Kids Can Use

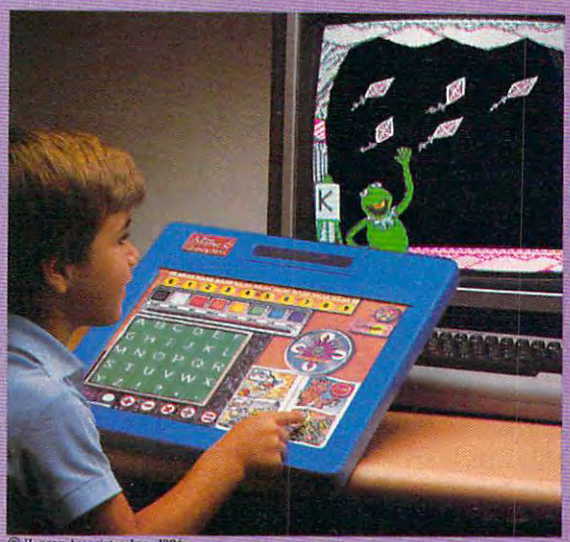
A computer can help your child learn, but the keyboard often gets in the way. It's a jumble of keys that's confusing and hard for little fingers to operate. And it's not much fun.

Introducing Muppet Learning Keys™ from Koala Technologies™

It's the first computer keyboard made especially for young children. Unlike regular computer keyboards, all the letters and numbers are in order. So a child can find A-B-C and 1-2-3 without hunting all over the keyboard. And with Muppet Learning Keys software, learning letters and numbers becomes fun.

From the Experts

Muppet Learning Keys was created by education specialists to make learning exciting for your child. It's the first computer keyboard with Kermit, Miss Piggy and the whole Muppet gang right on it, ready to introduce your children to the magic of letters, numbers and colors.



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Kid Stuff

Muppet Learning Keys has things that every child knows and loves:

- A paint box with eight touchable colors
- A blackboard with the ABC's in order
- A ruler with the numbers where they're supposed to be
- And keys the right size for small fingers

Press any key and something always happens. Press K and Kermit flies his kites. Press 6 and six kites appear. Touch a button on the paint box and leave a colorful impression.

Muppet Learning Keys–for a child's hands, a child's mind and a child's heart. Give your child Muppet Learning Keys and make computer learning child's play.

Muppet Learning Keys. The Hands-on Keyboard for Kids.

Jim Henson's Muppet Learning Keys

For the Apple® IIe and IIc, Atari,® and Commodore 64™ computers. In-Box software by Sunburst Communications. Muppet Learning Keys works with software that is designed or adapted for it.

Koala Technologies Corporation

Storymaker, children build stories using nouns, verbs, and prepositions, plus Muppets, locations of Muppets, and Muppet actions. For example, children can place Miss Piggy in a desert and make her fly, or they can set Kermit spinning under the ocean. Children learn new words as they build their stories. Then they can make the computer display their stories, like a slide show, and save the stories on disk so they can read them later.

Welcome Aboard! The Muppets Cruise To Computer Literacy

The third Muppet computer product, *Welcome Aboard! The Muppets Cruise to Computer Literacy*, comes from Henson Associates and Brøderbund Software and costs about $40. This is another product, like the Muppet Learning Keys, that is ideal both for children age five and up and for all computer beginners.

You begin your voyage with the Muppets by viewing a cross section of their ship on the computer screen. The picture of the ship is really a disguised menu. You can choose different activities by pressing the arrow keys to position a small anchor in any of the rooms, including a Message Center, Computer Room, Joke Library, Salon de Beauté, Game Room, and the Bridge.

The beauty of *Welcome Aboard!* is that on the surface you're playing make-believe games with the Muppets, while actually you are learning about important computer applications, such as using the computer as an electronic typewriter, post office, and file cabinet. You are learning how to create computer pictures, or graphics, and how to program the computer. And, most importantly, you are learning to take control of the computer and use it as a tool to accomplish meaningful goals.

In the Message Center, for example, you don't just write letters. Instead, you send messages to the crew of the Muppet boat, and then they send messages back to you. You can choose to edit the messages or save them on disk for later reference. On the Bridge, you use a Logo-like Muppet programming language called Slowgo to pilot the Muppets' ship across the treacherous sea to its goal—either Pig Island or Frog Island.

In the past, I've been a major critic of teaching children how to program in regular computer languages such as Logo or BASIC because I feel that programming has little meaning to a child, and it has little practical use in the child's world. In *Welcome Aboard!*, however, both of my criticisms have been at least partly answered. Children program the computer to help the Muppets navigate a boat (a practical task), and to help them reach their destination without sinking (a meaningful objective).

Worthwhile Products

Many of the computer products on the market for children suffer from the same maladies. Either they are trivial copies of activities children would be better off doing with paper, scissors, glue, modeling clay, and fingerpaints, or they are cheap commercial spinoffs of popular products in other media—software Smurfs, superheroes, and Barbie dolls. Or they are so insipid and uninspired that adults avoid them and children quickly get bored with them.

But the Muppet products are a pleasant surprise. They are charming, educational, and practical. They are equally attractive to children and adults. They take characters which are successful in other media—on TV and in the movies—and bring them to life on the computer "stage." They teach fundamental skills such as how to use a computer, how to read, plan, and reason logically, and they do it not by dull, rote drill, but with exciting adventures, like rescuing other creatures, piloting a ship across hazardous straits, and communicating with other creatures. These products teach computing not as a science or hobby, but as a tool to accomplish practical goals and to help other people.

However, the key ingredient in all these products is missing if you plop your child in front of the computer and walk away. The ingredient does not come packaged inside the boxes and it's not found inside any computer. The key ingredient is your attention. If you and your child use these products together, the experience will be far richer and more valuable for both of you than if you use them alone.

For More Information

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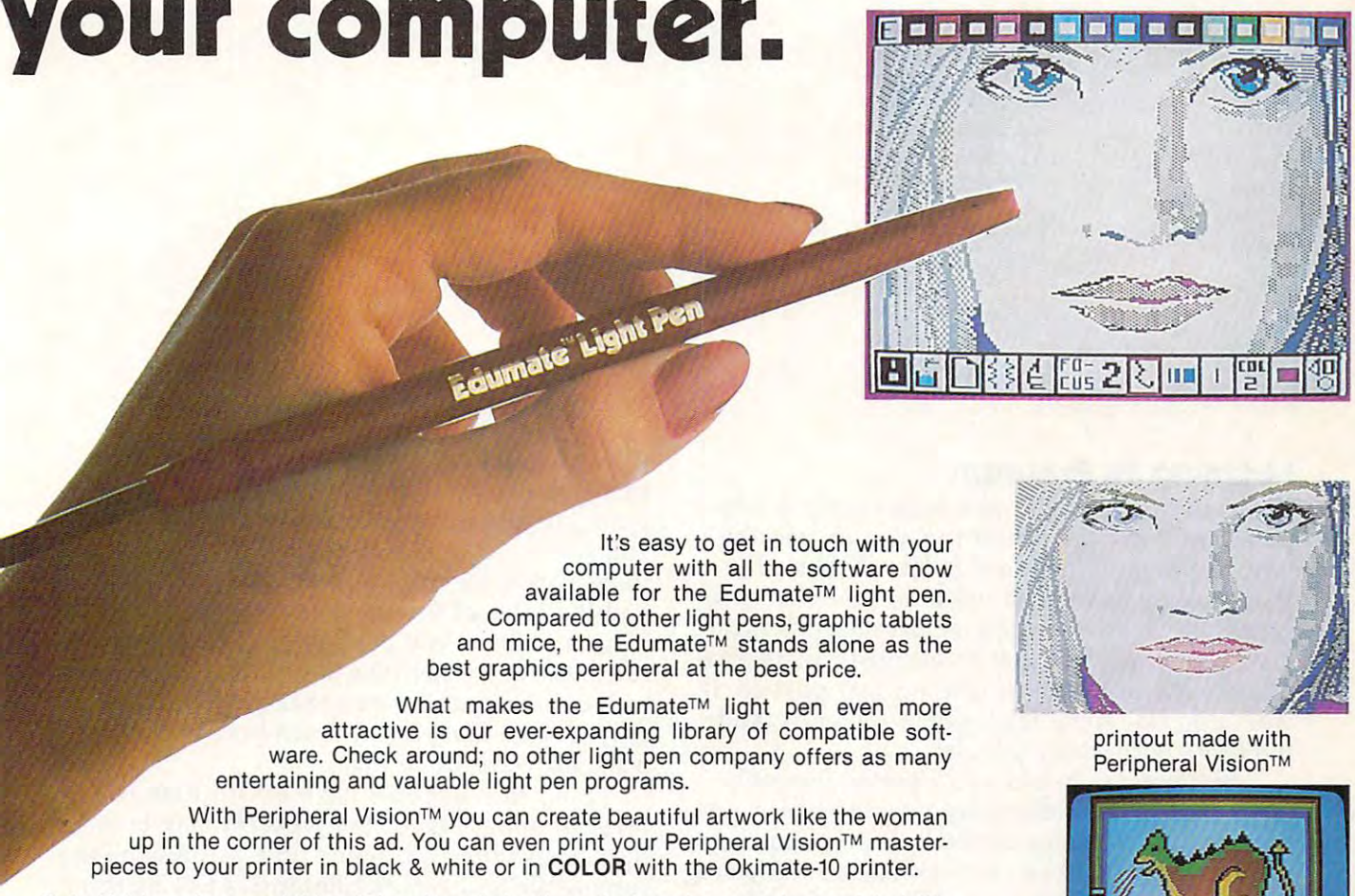
Sunburst Communications, Inc.
39 Washington Avenue
Pleasantville, NY 10570

Simon & Schuster Electronic Publishing Group
Simon & Schuster Building
1230 Avenue of the Americas
New York, NY 10020

Brøderbund Software, Inc.
17 Paul Drive
San Rafael, CA 94903

how to really get in touch with your computer.



It's easy to get in touch with your computer with all the software now available for the Edumate™ light pen. Compared to other light pens, graphic tablets and mice, the Edumate™ stands alone as the best graphics peripheral at the best price.

What makes the Edumate™ light pen even more attractive is our ever-expanding library of compatible software. Check around; no other light pen company offers as many entertaining and valuable light pen programs.

With Peripheral Vision™ you can create beautiful artwork like the woman up in the corner of this ad. You can even print your Peripheral Vision™ masterpieces to your printer in black & white or in **COLOR** with the Okimate-10 printer.

Put a light pen in your children's hands and give them the learning experience of their life with our Playground Software™ series. The Playground programs speak to your children, structing and entertaining them with a computerized voice. Using Playground, your kids will arn to draw the alphabet, spell and even read. Children never want to stop learning once they e Playground Software.™

hat's not enough, keep your eyes on your dealer's shelves for our soon to be released design ftware for draftsmen, architects, engineers...and even the weekend builder.

t in touch with your local dealer and discover the magic of the Edumate™ light pen today.

The Edumate light pen and software package offers ne most for the price." Popular Computing, Oct. '84

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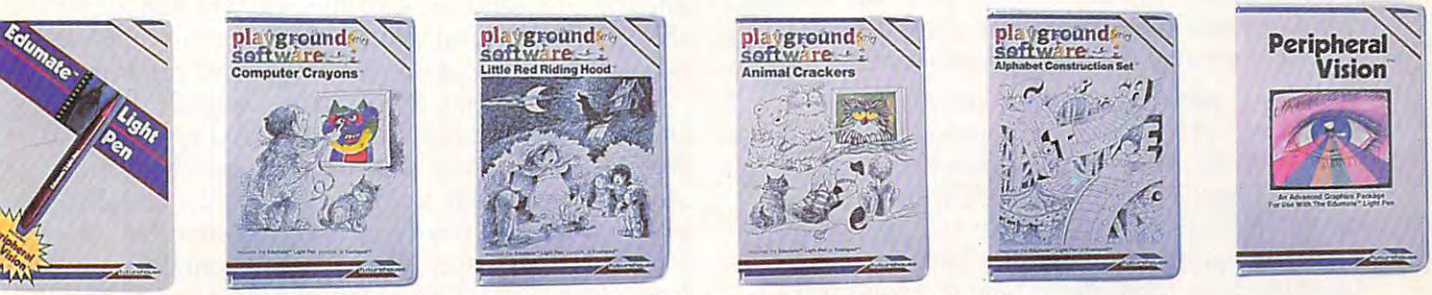

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THE BEGINNER'S PAGE

Tom R. Halfhill, Editor

Learning To Program

Too many people who first begin using a computer are overwhelmed at the idea of learning how to program. It's hard to blame them. For years people have been led to believe that programming is an obscure and extremely difficult task, something best left to scientists, mathematicians, and technicians. Like nuclear physics, it was supposed to be far beyond the reach (and interests) of ordinary people.

By now we should know better. Not only have thousands of everyday people learned how to program, but some of the best programmers have turned out to be people who are too young to vote or even drive a car. Millions of grade-school children are pecking away at computer keyboards and programming while they're still learning the traditional three R's.

So if little kids can program, what's to stop anyone else?

Some people fear they can't learn to program because they've always been bad at math. But actually, programming has little to do with higher mathematics—unless, of course, you want to write programs that employ higher mathematics. For the most part, plain old addition, subtraction, multiplication, and division are all you'll need to know. You can write a program which calculates mortgage payments even if you can't tell trigonometry from a tyrannosaur.

Other people are discouraged by the complexity of learning a computer programming language. Yet, computer languages—such as BASIC, Logo, Pascal, FORTRAN, or even machine language—are far easier to tackle than human languages. All human languages have vocabularies consisting of tens of thousands of words, plus thousands more variations of words. And the grammatical rules for putting those words together into meaningful phrases are tricky and complicated. But practically all computer languages have vocabularies of less than 100 words, often closer to 50. Only about half of those words are used in everyday programming, and the rules of syntax are more rigidly defined. What's more, if you inadvertently break the rules, the computer tells you so and even gives you a clue about the nature of your error. (If only it were that easy to learn how to conjugate irregular verbs in French!)

Still, many people have a hard time with programming. Part of the problem may be that they're spending too much time learning all the commands and syntax rules instead of figuring out how to solve the problem they're working on. This is like learning by rote the vocabulary words of a foreign language without actually linking them together into sentences to express your thoughts. It's fairly easy to learn what the GOTO command does in BASIC, for example, but figuring out when to use it may be less obvious.

That's why many programming instructors favor a different approach to learning how to program—a *problem-solving* or *algorithm-based* approach rather than a language-based approach. In other words, once you learn the basic ways of solving problems on a computer, you just apply the vocabulary and syntactical rules of whatever language you're using and write your program.

In practice, it's a *little* more difficult than that—some languages are structured quite differently than others in order to make them more suitable for certain tasks, or to reflect a certain philosophy (the nearly GOTO-less structure of Pascal, for instance). But the basic approach holds true. Once you know how to solve problems in one computer language, it's relatively easy to apply your knowledge to other lan-

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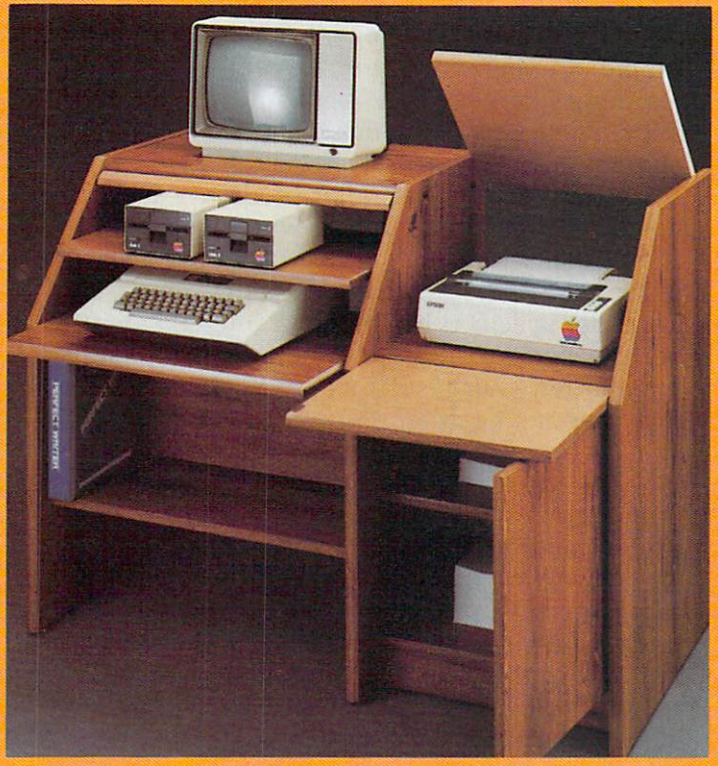

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guages. The key is to learn the basics of problem-solving on a computer.

A Computer In Your Mind

To a large degree, your skill at programming depends on how well you can learn to think like a computer yourself. This might sound strange, but there's nothing hard about it at all. At their present state of technology, computers are rather simple "thinkers." They only seem so smart sometimes because they perform their simple thinking so rapidly—much faster than we mere humans.

However, any computer program—no matter how sophisticated it appears when it's running—is essentially just a list of instructions. The computer follows the instructions one at a time, in the order specified by the programmer. If you, a human, performed these same instructions in the same order, your results would be the same as the computer's (although it would probably take you longer, of course). There's nothing theoretical about this, because that's exactly how the programmer wrote the program. The programmer started out by defining the problem, conceiving a way of solving the problem, and then giving the computer a list of step-by-step instructions so it could find the solution.

Notice that only the third step involves actually programming the computer. Although many people think it's the major step, it might actually be a minor part of the process. The first two steps often demand the most skill and creativity. In fact, major software developers these days often employ teams of "programmers." The senior members of the team concentrate on defining the problem and constructing a method of finding the solution. Then they assign the task of coding the instructions in a computer language to the junior programmers. The senior programmers, or *program designers*, may never touch a computer keyboard.

Whether a team is involved or only one programmer, the process is the same. You can't program a computer to solve a problem until you first know how to solve it yourself. Not that you have to actually arrive at the solution—that's the computer's job. Your job is to encode the *method of finding the solution* into instructions the computer can understand and carry out. And to do that, you have to comprehend how the computer will interpret each instruction you give it before going on to the next instruction. You have to learn how to think like the computer.

How Computers Think

As we said above, learning to think like a computer isn't really very hard because computers right now are pretty simple-minded thinkers. They always think logically and sequentially. On their own, they aren't capable of illogical thinking, emotion, or leaps of insight. The fact is, they're utterly predictable. Even their randomness is the product of carefully simulated disorder. Their behavior is a lot easier to figure out than that of most people, which is why some obsessive programmers withdraw from the world and spend all their time programming.

Let's try an example. Assume you're a schoolteacher who wants to calculate a student's grade based on five test scores.

The first step is to define the problem. That seems easy: You just want to figure out a letter grade based on five numeric scores. But do all the scores carry the same weight? Were some tests more important than others? And how many points will it take to earn an A instead of a B?

To keep things simple for this example, let's say all the scores carry the same weight. Therefore, you need to calculate the *mean average* of the five scores. To translate the result into a letter grade, you'll use the following scale: 95–100 points is an A, 85–94 points is a B, 75–84 points is a C, 65–74 points is a D, and 0–64 points is an F.

Now that you've defined the problem, the second step is to figure out how to find the solution. Some people, especially when first learning how to program, work this out on paper before sitting down at the computer. There's even a formal way of doing this, called *flow charting*. It's similar to diagramming a sentence in English, except the object of flow charting is to figure out how to construct the program in the first place rather than analyzing the structure of an existing program.

We won't get into formal flow charting here, but we can do the same thing by drawing up a simple outline. Here's how we might tackle our sample problem:

A. Calculate the mean average of the five test scores.
   1. Add the five scores together and remember the sum.
      a. Add the first test score to the second test score.
      b. Add the result of the previous calculation to the third score.
      c. Add the result of the previous calculation to the fourth score.
      d. Add the result of the previous calculation to the fifth score.
      e. Store the final sum for later use.
   2. Divide the sum by the number of test scores.

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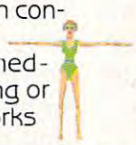

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a. Take the sum of the scores as calculated above and divide them by five.
b. Store this result, the mean average, for later use.

B. Translate the average score into a letter grade.
1. Take the average score as calculated above and compare it to the grading scale.
a. Is the score somewhere between 95 and 100? If so, then the grade is an A.
b. Is the score between 85 and 94? If so, then the grade is a B.
c. Is the score between 75 and 84? If so, then the grade is a C.
d. Is the score between 65 and 74? If so, then the grade is a D.
e. Is the score less than 65? If so, then the grade is an F.
2. Give the result of the calculations by revealing the final letter grade.

Writing The Code

Whether you realize it or not, we've actually written a program. We've compiled a list of step-by-step instructions which, if followed exactly, will yield the solution to our problem. You could take this list and solve the problem yourself, right now, with pencil and paper or a pocket calculator. The only thing that's required besides the list is some knowledge of simple addition and division, plus the actual data (the test scores). You've already done the hard part; you've concocted the recipe. Now the problem can be solved by anyone who's capable of following instructions and handling sixth-grade arithmetic, whether he's a genius or an idiot.

In this case we'll submit the problem to an idiot—the computer. You don't have to worry about the computer jumping to an illogical conclusion or arriving at a wrong answer. As long as you do your job—give the right instructions to the computer in the proper order and in a language it can understand—the computer will do exactly what you say. It's not smart enough to disobey or come up with its own solution to the problem. It can't appear to be any more intelligent than its programmer.

At this point you could encode the instructions—that is, write the actual program—in any one of dozens of computer languages. BASIC, Pascal, PILOT, Logo, FORTRAN, machine language—the results will be the same. Which one should you choose? The decision is based on a number of factors: which language is best-suited to this type of problem; which language will give the fastest results; which language is easier to use; which language is readily available for your computer; and so on.

Since virtually all personal computers have some form of BASIC built-in, we'll write the sample code in BASIC. But it's important to realize that the program could be written more or less as well in any computer language.

Now let's see how the program might look. Keep in mind that this is a generalized example; because of variations between the BASICs built into various computers, it may require modifications to run on your particular computer (see the notes following the listing). Also, we'll explain the meaning of some special symbols and terms at the end of the listing. Comments explaining sections of the program are printed in italics.

[Store the five test scores in variables.]

```
10 TEST1=84 TEST2=76 TEST3=92 TEST4=88
TEST5=68
```

[Add the test scores together and store the sum in a variable.]

```
60 TESTSUM=TEST1+TEST2+TEST3+TEST4+
TEST5
```

[Find the mean average by dividing the sum by the number of test scores.]

```
70 AVERAGE=TESTSUM/5
```

[Compare the average score to the grading scale to translate it into a letter grade.]

```
80 IF AVERAGE>=95 AND AVERAGE<=100
  THEN GRADE$="A"
90 IF AVERAGE>=85 AND AVERAGE<=94 THEN
  GRADE$="B"
100 IF AVERAGE>=75 AND AVERAGE<=84
  THEN GRADE$="C"
110 IF AVERAGE>=65 AND AVERAGE<=74
  THEN GRADE$="D"
120 IF AVERAGE<65 THEN GRADE$="F"
```

[Tell the result of running the program—the student's final letter grade.]

```
130 PRINT "THE STUDENT'S GRADE IS ";GRADE$
```

Analyzing The Program

If you compare the outline we prepared with the program listing, you'll see how closely they correspond. They're both linear and logical. The hard work, indeed, was in defining the problem and designing the method of solution. The actual coding or programming was almost an anticlimax. Even if you've never programmed in BASIC, you should be able to deduce what the program is doing by consulting a BASIC programming manual. To save you some time, here's what some of the special symbols and terms mean:

A *variable* is a way of storing a number in a program. The statement TEST1=84 assigns the number 84 to the variable TEST1. In effect, the variable becomes the number. The rules for using

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variables differ on various computers; on Commodore and Apple computers, for example, only the first two letters of a variable matter, so the computer couldn't distinguish TEST1 from TEST2. (Try T1 and T2 instead.)

Variables that end with a dollar sign ($) are *string variables*. Instead of storing numbers, they store strings of characters. In this program, we used GRADE$ to store the character of the letter grade (A, B, C, D, or F). Some forms of BASIC, such as Atari BASIC, require you to define the maximum number of characters a string variable will hold before using the string variable, so you'd need to add a statement like **15 DIM GRADE$(1)**.

In BASIC, the arithmetic operators are + for addition, − for subtraction, * for multiplication, and / for division. Thus, the statement **AVERAGE=TESTSUM/5** in line 70 divides the variable TESTSUM by 5 and assigns the answer to the variable AVERAGE.

In BASIC, the symbol <= means *less than or equal to* and the symbol >= means *greater than or equal to*. Therefore, a statement like **IF AVERAGE>=75 AND AVERAGE<=84 THEN GRADE$="C"** in line 100 means, "If the average test score is between 75 and 84, then the letter grade is a C." In line 120, rather than checking to see if the average score falls between 0 and 64, the program just assigns an F if the number is anything less than 65.

Line 130 tells us the result by printing the answer on the screen. If the result is a B, the program prints THE STUDENT'S GRADE IS B.

As you can see, the program structure is pretty straightforward. Certainly more complex problems demand more complex programming. But trying to learn how to program just by memorizing all the commands in a language is like learning how to speak French just by memorizing vocabulary words. You won't become fluent until you actually begin linking the words together to express thoughts—the very purpose of a human language. And you won't become a fluent programmer until you start designing solutions to problems and expressing the solutions in programming commands—the purpose of a computer language.

Your programming manual is just a dictionary of instructions, and your computer is just a machine which can execute those instructions faster than you can. The real computer is in your brain.

Questions Beginners Ask

Q I've seen the phrase "full-screen editing" in advertisements, but I'm not sure what it means. Does it have something to do with word processing? Is this considered a valuable feature?

A Full-screen editing is indeed a valuable feature, and it's becoming standard on virtually all computers designed within the last few years. Although it applies to word processing, the term "full-screen editing" as used in advertisements usually refers to the editing features available in BASIC.

Very simply, full-screen editing means you can move a cursor anywhere on the screen with four directional cursor keys, make a change to a line of BASIC with insert and delete/backspace keys, and press the RETURN or ENTER key to register your change with the computer. This is an easy and fast way to edit BASIC programs. Computers which have full-screen editing include all Commodores, Ataris, and IBM Personal Computers.

Although computers which lack full-screen editing usually let you make changes to BASIC lines without retyping them entirely, the process is a little more tedious. Often you have to memorize special editing commands and key sequences. Sometimes, however, utility programs are available which enhance the computer's built-in editing capabilities. ©

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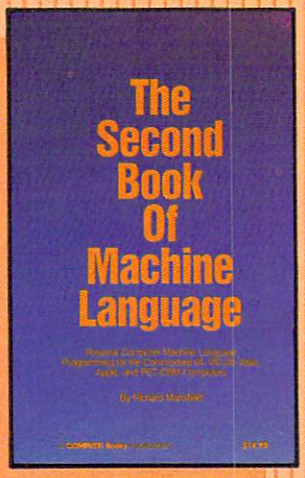

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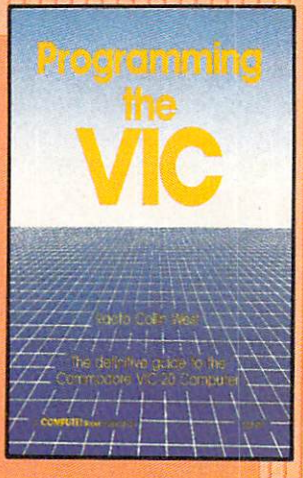

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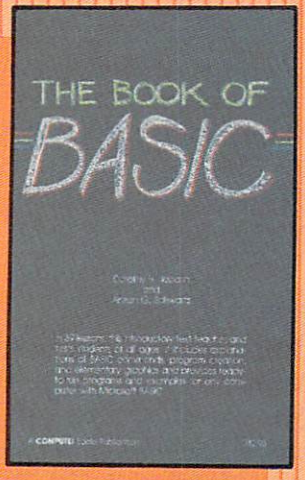

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64 Paintbox

Chris Metcalf

One of the most powerful features of the Commodore 64 is its high-resolution color graphics. But like any powerful, versatile system, it can be difficult to learn and use. This program makes it easy. Atari computers have an efficient set of graphics commands, and "64 Paintbox" now makes them available on the 64 as well. You can plot points, set colors, or draw lines with just one statement. You can even type in programs originally written for Atari graphics modes 7 and 8 on your 64.

The Commodore 64 is an undeniably powerful computer; its capabilities in high-resolution color graphics, for example, surpass those of the Atari and Apple computers. Nonetheless, it takes time to calculate the POKEs and PEEKs required to access these graphics. Also, the resulting program will likely be fairly slow. This graphics program, "64 Paintbox," takes Atari's far more powerful command set and makes it available to the Commodore 64 user.

BASIC programs written for Atari graphics modes 7 and 8 can be transferred to the Commodore 64 with 64 Paintbox. You can type in an Atari program, line by line, adding an exclamation mark (!) before each graphics command to let the 64 BASIC interpreter know that it is a special command.

Entering 64 Paintbox

To enter Program 1, 64 Paintbox, you first need to load and run the MLX program found elsewhere in this issue. MLX makes it easy to type in a machine language program like 64 Paintbox and insures you'll have a working copy the first time. Once you've run MLX, it asks for two addresses. They are:

Starting address: 49152
Ending address: 51197

Now you can begin typing in Program 1. When you're through, save it to tape or disk, using the filename *64 Paintbox* if you want to use the loader program (Program 2) to load it in.

Load 64 Paintbox by entering:

LOAD"64 PAINTBOX",8,1 (for disk)
LOAD"64 PAINTBOX",1,1 (for tape)

Then type

SYS 49152:NEW

to initialize the program and reset the pointers. To simplify loading the program, you may use Program 2. Use the Automatic Proofreader program to type in this short autoload routine. Save it on the same disk as 64 Paintbox. (If you're using tape, Program 2 should precede 64 Paintbox on the 8 is a 1.) Type LOAD"PROGRAM 2",8 (or just LOAD"PROGRAM 2" if you've got a Datassette) and RUN; the program will display the command set, load in 64 Paintbox, initialize 64 Paintbox, and execute a NEW. At that point, you can start entering Atari programs.
can start entering Atari programs.

No matter which method you use to load 64 Paintbox, the Atari graphics commands are easy to use. Each command must be preceded by an exclamation mark (and a colon, if following an IF-THEN statement). The command name can be spelled out in full, or abbreviated with a period as on the Atari. However, these abbreviations are *not* expanded when the program is listed. The various parameters follow the command name. Thus a typical syntax might be:

!PLOT 100,100

to plot a point at 100,100.

As with normal BASIC commands, spaces are ignored, whether in the command name or in the parameters.

Since the 64 Paintbox commands are not standard BASIC, the IF-THEN routine will not recognize them as being legal commands unless they're preceded by a colon. Imagine, for example, that you want to plot a point where there is no point already. Here's how:

!LOCATE 10,15,A : IF A = 0 THEN.: !COLOR 1 : !PLOT 10,15

64 Paintbox Commands

The commands themselves are as follows (abbreviations are enclosed within parentheses):

- **!GRAPHICS n (!G.)** This command is identical to the Atari GRAPHICS command, and takes only one parameter, *n*, the graphics mode. Since only graphics modes 7 and 8 are supported,

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all graphics commands between 1 and 6 are treated as if they were 0. As with the Atari, either 7 or 8 may have 16, 32, or 48 added to it. Plus 16 gives no text window; +32 does not clear the graphics screen; and +48 combines the two. Without any of these extra numbers (just !GRAPHICS 8, for instance), the graphics screen will clear, and a four-line text window will be set up at the bottom. Regardless of the additional numbers, however, the screens will always be reset to standard Atari graphics colors.

Do not try to use tape or disk with the text window enabled. For example, if you enter LOAD and hit RUN/STOP, the interrupts will be partially disabled, and you will need to reenter the graphics mode (with +32). Attempted disk access will return a ?DEVICE NOT PRESENT ERROR.

The Atari does not allow plotting to the area "under" the text window, but 64 Paintbox does, although the graphics remain concealed until you view what you have done with a !GRAPHICS n+48 where n is 7 or 8. Furthermore, when working with the graphics screen in immediate mode, 64 Paintbox does not need a text window, as the Atari itself does.

- **!PLOT x,y (!P.)** This is the PLOT command; x and y are offset from the top left corner of the screen, and have a range of 0–319 for x and 0–199 for y in graphics mode 8. In GRAPHICS 7, the ranges are 0–159 for x and 0–99 for y. The command is not set up to work in graphics mode 0. The PLOT command plots in the current color register (see the SETCOLOR and COLOR commands). PLOT also sets the starting point for the DRAWTO command.

- **!POSITION x,y (!PO.)** The POSITION command sets the starting point for the DRAWTO command without actually altering the display. The x and y values are the same as in the plot command. This command, like plot, positions the graphics screen "cursor" (not the actual text cursor), regardless of the graphics mode.

- **!DRAWTO x,y, (!DR.)** This command, DRAWTO, draws a line connecting the old starting point to the specified x,y, using the current color register, and then sets the starting point for the next DRAWTO to the specified x,y. The x,y parameters have the same range as for plot and position. This command does not affect the screen in GRAPHICS 0.

- **!SETCOLOR r,c1,c2 (!S.)** The SETCOLOR command changes the specified r register to hue (c1) and luminance (c2) in the range 0–15. The format is identical to that of the Atari. The various registers set the colors of the border, the background, the characters, and the pixels according to Table 1. Note that bit-pairs (00, 01, 10, and 11) are used to define single pixels in graphics mode 7. The number above is the graphics register r (the first parameter).

Table 1: SETCOLOR r Values

GRAPHICS 0	GRAPHICS 7	GRAPHICS 8
0 ———	01 pair pixels	———
1 Characters	10 pair pixels	Characters/pixels
2 Background	11 pair pixels	Background
3 ———	———	———
4 Border	Screen color	Border

An unfortunate problem with the way the 64 and the Atari are configured is that, in graphics mode 7, the 64's character color in the window is set by SETCOLOR register 2, not 1, and that the text window cannot be set to its own color. Instead, it takes on the color of the rest of the screen.

Another problem with register 2 in graphics mode 7 is that this register is set to the background color (or white on old 64s) whenever the screen is cleared. Thus, printing the "clearscreen" character when in graphics mode 7 (even with no window) must be avoided. All 11 pixel pairs would become background color: in other words, invisible. Furthermore, any scrolling of the text window in GRAPHICS 7 will scroll strange color data into the 11 pixel pairs. This is, however, no problem in graphics mode 8.

You may be interested to know that executing a !SETCOLOR 2,c1,c2 in GRAPHICS 7 or a !SETCOLOR 1,c1,c2 in GRAPHICS 8 causes the character color register at 646 to be set to colors

Table 2: Matching Atari Hue And Luminance To 64 Paintbox Color Codes

Hue \ Luminance	0	2	4	6	8	10	12	14
0	0	11	11	11	12	12	15	1
1	0	12	7	7	7	7	1	1
2	0	2	8	8	8	8	15	15
3	0	9	2	2	2	2	8	8
4	0	9	2	2	2	2	8	8
5	0	6	6	6	4	4	4	4
6	0	6	6	6	4	4	4	4
7	0	6	6	6	14	14	14	14
8	0	6	6	6	14	14	14	14
9	0	6	14	14	14	14	3	3
10	0	6	14	14	5	5	13	13
11	0	6	14	14	5	5	13	13
12	0	5	5	5	5	5	13	13
13	0	5	5	5	13	13	7	7
14	0	8	8	8	5	5	13	13
15	0	8	8	8	10	10	10	10

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Yes!	Sample test	Yes!
No	Practice SAT and TSWE on disk	Yes!
Yes!	Manual with test taking strategies	Yes!
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Yes!	Multiple levels	Yes!
No	Based on Successful typing procedure	Yes!
No	Timed paragraph typing test	Yes!
No	Drill on weakest characters	Yes!
No	Progress recorded	Yes!

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c1,c2. Thus, previous color codes are disregarded when a !SETCOLOR or !GRAPHICS command is executed (!GRAPHICS calls !SETCOLOR to set up default colors).

The numbers (0–15) that you can use for c1 and c2 in SETCOLOR *do* correspond to various color and luminance settings on the Atari. Take a look at Table 2 to see what values in 64 Paintbox match Atari's hue and luminance values.

• **!COLOR r (!C.)** This command specifies which color register (given above for !S.) is to be used for plotting and line drawing. In both graphics modes, 0 has the same effect: It erases pixels. In GRAPHICS 8, an odd number for *r* always sets the computer to plot pixels. Registers 1–3 are used in GRAPHICS 7, where register 1 sets bit-pair 01, 2 sets 10, and 3 sets 11 (note that this is the SETCOLOR number plus one).

• **!LOCATE x,y,v (!L.)** The LOCATE command returns (in floating-point variable v) the pixel currently at location x,y and sets the starting point for DRAWTO to the LOCATEd pixel. Thus, for GRAPHICS 8, either a zero (no pixel) or a one (pixel present) is returned. In GRAPHICS 7, a zero also indicates no pixel, while one to three correspond to bit-pairs 01, 10 and 11. Using the LOCATE command with a non-floating-point variable does nonproductive (though interesting) things, so it's best to stick to floating-point variables. That is, use no % (integer variable) or $ (string variable) symbols after a variable.

• **!FILL x,y (!F.)** This command is a more powerful version of the Atari XIO fill command. It will fill any area, regardless of the shape. It will stop at any *on* pixel, as well as at the edges of the screen. The x and y parameters determine where it will start and also set a begin-point for future DRAWTO commands. Atari users, remember to draw a line at the left of whatever you are going to fill, as this FILL needs a border to stop at. However, it's much more flexible than the XIO command.

• **!TEXT x,y, "string" (!T.)** The TEXT command allows text to be located starting at any column and row on the GRAPHICS 8 screen (it will execute on GRAPHICS 7 screens, but produces strange multicolored characters). The "string" can be characters enclosed in quotes, a string variable, or combinations of the two. An additional parameter can be passed before the "string"; a 0 or 1 in this position determines whether the computer will use upper/lowercase text or graphics and uppercase. The program is initially set up to use lower- and uppercase. No control characters will be printed, but the RVS ON and RVS OFF characters have their usual effect of putting the characters in-between in reverse video (or inverse video for Atari people). Remember that the x and y parameters must be specified for each TEXT command, although the uppercase/graphics need only be set once to be used repeatedly. The reverse video, however, turns off at the end of the string.

• **!QUIT (!Q.)** This command cuts 64 Paintbox out of the command processing loop and removes the check on error-message display. The program can be restarted with SYS 49152. Calling SYS49152 repeatedly will not, by the way, create any difficulty.

Programmer's Notes

Locations 3 and 4 hold two variables used by the interrupt that drives the text window to determine uppercase/graphics for the window and hi-res/multicolor for the graphics. To use location 3 to control the case in the window, POKE 3 with 21 for uppercase/graphics and with 23 for lowercase. (And note that *lowercase is required* for entering commands in lower/uppercase mode.) Register 4 is used by the program to determine pixel plots, LOCATE returns, and so forth, and so may be used to flip between hi-res (8) and multicolor (24). Other values generate interesting, and harmless, effects.

Memory configuration for 64 Paintbox is:

0400–07E7	Used as the text window (the bottom four lines, at least)
0800–9FFF	Unused and completely free for BASIC programs
A000–BC7F	BASIC ROM with RAM underneath
BC80–BFFF	Used for data tables and the FILL routine stacks
C000–C7FF	The 2000 bytes of actual program
C800–CBFF	Used as the color screen for all but 11 pixels in GRAPHICS 8
CC00–CFFF	Left free for use by the DOS Wedge or other utility
E000–FFFF	Operating System ROM, with the graphics screen under it

Variable storage is:

Permanent: locations 3–6, 251–254 (interrupt shadows: 3 = 53272, 4 = 53270)
Temporary: locations 27–42, 107–113, 158–159, 163–164, 167–170
Non-zero page storage: locations 670–699

Abbreviations For 64 Paintbox Commands

DRAWTO	!DR.
PLOT	!P.
POSITION	!PO.
GRAPHICS	!G.
COLOR	!C.
LOCATE	!L.
FILL	!F.
TEXT	!T.
QUIT	!Q.

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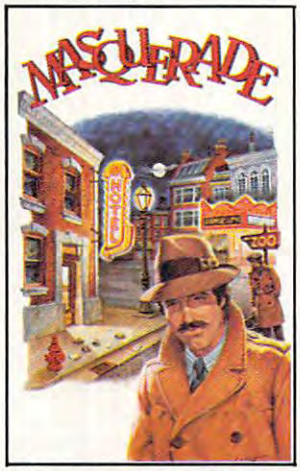

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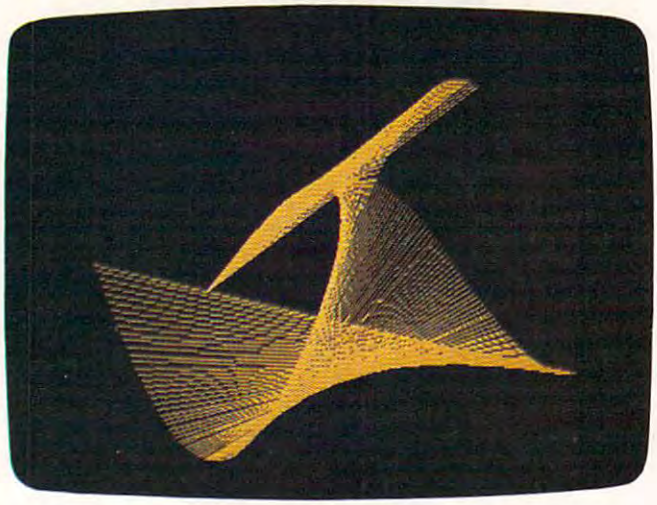
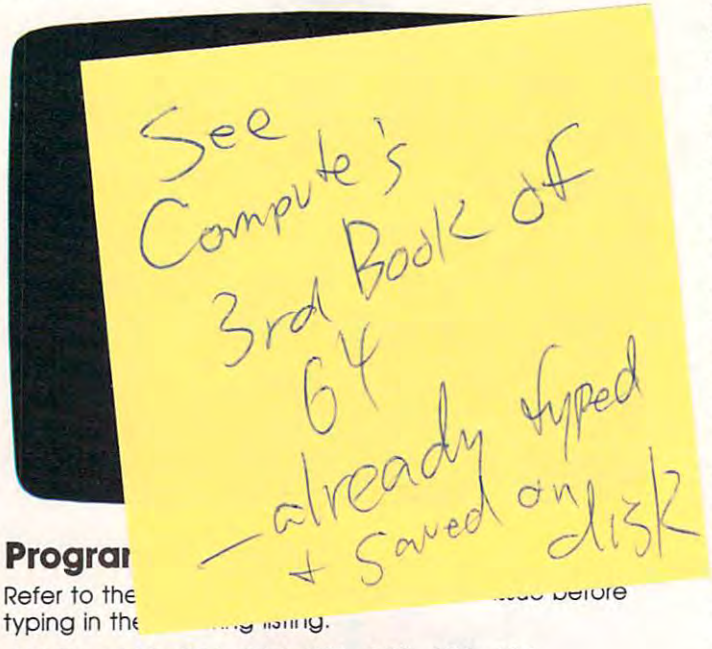


The screen graphics on this page were created with "64 Paintbox" and Program 3.

Demonstrations

Program 3 is a short program which illustrates how 64 Paintbox can be used. It draws several figures on the screen and then waits for a keypress from you to continue. To see this demonstration, make sure 64 Paintbox is in memory (if you load it manually, remember to type SYS 49152 and NEW), then load Program 3. Run it and watch the effects.



Progra

Refer to the ... before typing in the ... listing.

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49188 :234,169,001,160,007,153,248
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49242 :188,153,239,188,153,247,234
49248 :188,056,042,056,042,136,104
49254 :136,016,239,169,066,141,101
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49266 :003,169,134,141,008,003,060
49272 :169,192,141,009,003,169,035
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49284 :001,096,160,001,177,122,177
49290 :201,033,240,003,076,228,151
49296 :167,165,212,208,249,032,153
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49314 :160,000,165,158,133,122,132
49320 :165,159,133,123,232,032,244
49326 :115,000,041,127,221,242,152
49332 :192,240,245,201,046,240,064
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49416 :197,083,069,084,067,079,075
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49650 :168,032,008,196,198,158,234
49656 :016,242,096,008,014,006,118
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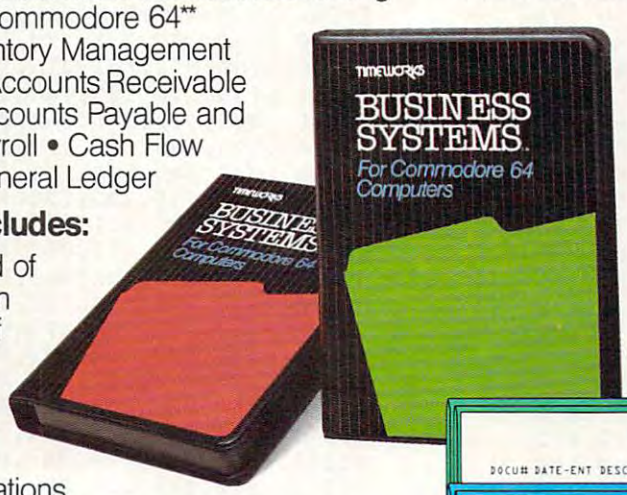

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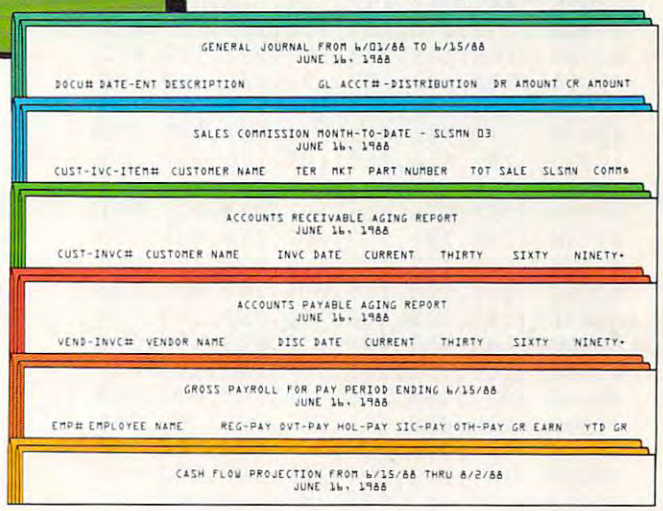

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50118 :197,032,042,197,208,248,098
50124 :224,005,176,244,138,072,039
50130 :032,035,197,138,041,015,156
50136 :010,010,133,168,032,035,092
50142 :197,138,041,015,074,170,089
50148 :240,003,074,005,168,133,083
50154 :168,074,168,185,118,196,119
50160 :176,004,074,074,074,074,204
50166 :041,015,164,168,192,003,061
50172 :208,006,224,007,208,002,139
50178 :169,001,133,168,104,170,235
50184 :224,003,240,036,160,240,143
50190 :165,168,032,024,197,208,040
50196 :028,224,000,240,023,202,225
50202 :208,005,032,082,196,240,021
50208 :031,224,001,208,005,032,021
50214 :045,196,240,032,202,202,187
50220 :202,157,032,208,096,202,173
50226 :048,012,202,048,019,240,107
50232 :025,202,032,045,196,202,246
50238 :240,237,160,015,165,168,023
50244 :010,010,010,010,133,168,153
50250 :169,204,133,170,162,200,088
50256 :208,011,162,216,169,220,042
50262 :133,170,165,168,141,134,229
50268 :002,132,006,160,000,132,012
50274 :195,134,196,177,195,037,008
50280 :006,005,168,145,195,200,055
50286 :208,245,232,228,170,208,121
50292 :238,096,011,207,199,113,212
50298 :040,143,146,040,153,170,046
50304 :102,068,102,068,102,238,040
50310 :102,238,100,227,110,227,114
50316 :110,093,085,093,085,215,053
50322 :136,093,136,170,032,042,243
50328 :197,138,041,003,032,024,075
50334 :197,208,005,041,001,133,231
50340 :254,096,133,254,201,000,078
50346 :208,002,169,001,010,010,058
50352 :010,141,170,002,096,032,115
50358 :031,194,032,234,198,032,135
50364 :170,198,072,169,055,133,217
50370 :001,032,115,000,032,139,001
50376 :176,032,133,177,104,168,222
50382 :169,000,032,145,179,165,128
50388 :098,041,127,133,098,160,101
50394 :004,185,097,000,145,071,208
50400 :136,016,248,096,032,042,026
50406 :197,032,012,197,152,240,036
50412 :008,192,002,176,076,224,146
50418 :064,176,072,142,167,002,097
50424 :140,168,002,032,035,197,054
50430 :032,012,197,152,208,057,144
50436 :224,200,176,053,142,169,200
50442 :002,096,032,024,197,240,089
50448 :006,138,010,170,152,042,022
50454 :168,096,133,170,165,004,246
50460 :041,016,008,165,170,040,212
50466 :096,169,055,133,001,032,008
50472 :253,174,169,055,133,001,057
50478 :032,158,173,032,247,183,103
50484 :169,054,133,001,166,020,083
50490 :164,021,096,162,246,154,133
50496 :162,014,224,128,176,027,027
50502 :134,163,072,169,055,133,028
50508 :001,174,021,003,224,197,184
50514 :240,010,169,032,044,017,082
50520 :208,240,003,032,096,193,092
```

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```
50526 :104,166,163,076,139,227,201
50532 :173,025,208,141,025,208,112
50538 :169,027,141,017,208,169,069
50544 :199,141,000,221,169,023,097
50550 :141,024,208,169,008,141,041
50556 :022,208,162,000,173,018,195
50562 :208,048,022,162,218,169,189
50568 :196,141,000,221,169,059,154
50574 :141,017,208,169,040,141,090
50580 :024,208,169,008,141,022,208
50586 :208,142,018,208,173,013,148
50592 :220,041,001,240,003,076,229
50598 :049,234,056,032,240,255,008
50604 :224,021,176,006,162,021,014
50610 :024,032,240,255,165,003,129
50616 :141,117,197,165,004,141,181
50622 :151,197,104,168,104,170,060
50628 :104,064,072,041,127,201,037
50634 :032,144,004,104,076,202,252
50640 :241,104,032,202,241,008,012
50646 :133,170,134,158,132,159,076
50652 :056,032,240,255,224,021,024
50658 :176,006,162,021,024,032,135
50664 :240,255,166,158,164,159,094
50670 :165,170,040,096,032,031,004
50676 :194,032,234,198,169,000,047
50682 :141,174,002,169,000,141,109
50688 :176,002,141,175,002,165,149
50694 :252,208,004,165,251,240,102
50700 :033,165,251,056,237,177,163
50706 :002,133,251,165,252,233,030
50712 :000,133,252,032,170,198,041
50718 :240,229,165,251,024,109,024
50724 :177,002,133,251,165,252,248
50730 :105,000,133,252,230,253,247
50736 :032,170,198,208,011,173,072
50742 :176,002,208,011,032,212,183
50748 :198,169,001,044,169,000,129
50754 :141,176,002,198,253,198,010
50760 :253,032,170,198,208,011,176
50766 :173,175,002,208,011,032,167
50772 :212,198,169,001,044,169,109
50778 :000,141,175,002,230,253,123
50784 :032,061,194,165,251,024,055
50790 :109,177,002,133,251,165,171
50796 :252,105,000,133,252,165,247
50802 :197,201,063,240,048,165,004
50808 :252,240,006,165,251,201,211
50814 :064,176,005,032,170,198,003
50820 :240,168,172,174,002,240,104
50826 :028,136,185,000,189,133,041
50832 :253,185,000,190,133,252,133
50838 :185,000,191,133,251,140,026
50844 :174,002,165,253,201,200,127
50850 :176,226,076,253,197,076,142
50856 :034,194,032,066,194,134,054
50862 :170,189,224,188,073,255,249
50868 :162,053,120,134,001,049,187
50874 :195,230,001,088,072,165,169
50880 :170,041,007,170,104,236,152
50886 :178,002,176,007,074,232,099
50892 :236,178,002,144,249,201,190
50898 :000,096,172,174,002,165,051
50904 :251,153,000,191,165,252,204
50910 :153,000,190,165,253,153,112
50916 :000,189,238,174,002,096,159
50922 :162,001,160,007,032,024,108
50928 :197,240,002,232,136,142,165
50934 :177,002,140,178,002,096,073
50940 :032,042,197,208,015,224,202
50946 :040,176,011,134,163,032,046
50952 :035,197,208,004,224,025,189
50958 :144,005,162,014,076,066,225
50964 :197,169,000,133,196,165,112
50970 :163,010,010,010,038,196,197
50976 :024,125,128,188,133,195,057
50982 :165,196,125,160,188,133,237
50988 :196,169,055,133,001,032,118
50994 :115,000,032,158,173,165,181
51000 :013,048,025,032,247,183,092
51006 :165,020,041,001,008,173,214
51012 :160,199,040,208,003,041,207
51018 :247,044,009,008,141,160,171
51024 :199,076,049,199,165,098,098
51030 :208,015,032,133,177,160,043
51036 :002,177,071,153,097,000,080
51042 :136,016,248,048,011,165,210
51048 :023,133,022,165,023,056,014
51054 :233,003,133,023,165,097,252
51060 :240,089,169,000,141,180,167
51066 :002,173,160,199,041,251,180
51072 :141,160,199,169,000,133,162
51078 :159,172,180,002,177,098,154
51084 :032,208,199,144,052,010,017
51090 :038,159,010,038,159,010,048
51096 :038,159,133,158,165,159,196
51102 :024,105,216,133,159,160,187
51108 :007,162,055,169,051,120,216
51114 :133,001,177,158,145,195,211
51120 :136,016,249,134,001,088,032
51126 :165,195,024,105,008,133,044
51132 :195,144,006,230,196,165,100
51138 :196,240,010,238,180,002,036
51144 :173,180,002,197,097,208,033
51150 :180,096,170,201,018,208,055
51156 :008,173,160,199,009,004,253
51162 :141,160,199,201,146,208,249
51168 :008,173,160,199,041,251,032
51174 :141,160,199,138,041,127,012
51180 :201,032,144,010,138,201,194
51186 :128,041,191,144,002,233,213
51192 :064,056,096,013,013,013,247
```

Refer to "COMPUTE!'s Guide To Typing In Programs" before typing in the following listings.

Program 2: 64 Loader

```
100 IFA=1THENSYS49152:NEW          :rem 38
110 PRINT"{CLR}{3 DOWN}":PRINTTAB(14)"
    {RVS}64 PAINTBOX"              :rem 162
130 PRINT"{DOWN} !GRAPHICS SELECTS GRAPHI
    C MODE (0,7,8)"                :rem 102
140 PRINT" !COLOR SELECTS COLOR REGISTER"
                                   :rem 253
150 PRINT" !SETCOLOR SETS THE REGISTER'S
    {SPACE}COLOR"                  :rem 113
160 PRINT" !POSITION PLACES THE GRAPHICS
    {SPACE}CURSOR"                 :rem 198
170 PRINT" !PLOT PLOTS THE POINT SET BY C
    OLOR"                          :rem 204
180 PRINT" !DRAWTO DRAWS TO THE SPECIFIED
     POINT"                        :rem 119
190 PRINT" !LOCATE PUTS THE POINT IN THE
    {SPACE}VARIABLE"               :rem 185
195 PRINT" !TEXT PUTS TEXT ON THE SCREEN"
                                   :rem 165
200 PRINT" !QUIT DISABLES PAINTBOX COMMAN
    DS"                            :rem 197
210 PRINT"{DOWN}ALL COMMANDS CAN BE ABBRE
    VIATED WITH":PRINT" A PERIOD (.)"
                                   :rem 220
220 PRINT"{DOWN}LOADING ML INTO LOCATIONS
     49152-51200 .."               :rem 121
230 A=1:LOAD"PAINTBOX",8,1          :rem 8
```

Program 3: 64 Paintbox Demonstrations

```
100 :                                   :rem 203
110 REM DEMOS FOR 64 PAINTBOX           :rem 164
130 :                                   :rem 206
140 GOSUB700                            :rem 172
150 DATA "{WHT}SIMPLE FIGURE NUMBER 1"
                                        :rem 127
160 DATA "HIT ANY KEY AFTER THIS DESIGN,
    {SPACE}AND ALL"                     :rem 231
170 DATA "FOLLOWING DESIGNS, ARE COMPLETE
    "                                   :rem 17
180 DATA "TO GO ON TO THE NEXT ONE.",
                                        :rem 204
190 FORI=0TO270STEP5:!PL.I,100+SIN(I/50)*
    100:!DR.319-I,100+COS(I/25)*50:NEXT
                                        :rem 68
200 GETA$:IFA$=""THEN200                :rem 71
210 GOSUB700                            :rem 170
220 DATA "THIS FIGURE IS DRAWN IN HIRES T
    HEN"                                :rem 69
230 DATA "REDISPLAYED IN MULTICOLOR FOR A
    N"                                  :rem 64
240 DATA "INTERESTING EFFECT",          :rem 25
250 FORI=0TO309STEP2:!PL.I,100+SIN(I/50)*
    100:!DR.I+10,100+SIN(I/50)*50:NEXT
                                        :rem 6
260 GOSUB640:GOSUB700                   :rem 3
270 DATA "HIRES/MULTICOLOR FIGURE NUMBER
    {SPACE}2",                          :rem 148
280 FORI=0TO309STEP2:!PL.I,100+COS(I/50)*
    100:!DR.I+10,100+SIN(I/50)*50:NEXT
                                        :rem 4
290 GOSUB640:GOSUB700                   :rem 6
300 DATA "SIMPLE FIGURE NUMBER 2",
                                        :rem 164
310 FORI=0TO319STEP2:!PL.I,100+SIN(I/50)*
    100:!DR.319-I,100+COS(I/50)*50:NEXT
                                        :rem 61
330 GETA$:IFA$=""THEN330                :rem 79
340 GOSUB700                            :rem 174
350 DATA "SIMPLE FIGURE NUMBER 3",
                                        :rem 170
390 FORI=0TO310STEP5:!PL.I,100+SIN(I/50)*
    100:!DR.319-I,100+SIN(I/50)*50:NEXT
                                        :rem 68
420 GETA$:IFA$=""THEN420                :rem 79
430 GOSUB 700                           :rem 174
440 DATA "THE NEXT IMAGE IS A CIRCLE",
                                        :rem 52
460 FORI=0TO2*↑-↑/100STEP↑/100:!PL.160,10
    0:!DR.160+COS(I)*100,100-SIN(I)*80
                                        :rem 176
470 NEXT:C=0:I=2                        :rem 182
480 !SE.1,C,I:I=I+1:IFI=16THENI=2:C=C+1:I
    FC=16THENC=0                        :rem 130
490 GETA$:IFA$=""THEN480                :rem 92
500 DATA "THIS IS A MULTICOLOR IMAGE"
                                        :rem 117
510 DATA "CREATED WITH LINE AND FILL ROUT
    INES",                              :rem 239
520 !GR.7+16:!CO.1:N=32:FORI=0TO2*↑STEP↑/
    N                                   :rem 75
530 !CO.1:!PL.80,50:!DR.80+COS(I)*40,50-S
    IN(I)*32:NEXT                       :rem 209
540 N=16:!CO.2:FORI=0TO2*↑STEP↑/N:X=80+CO
    S(I)*50:Y=50-SIN(I)*40              :rem 73
550 !PL.X,Y:!DR.80+COS(I+↑/N)*50,50-SIN(I
    +↑/N)*40:NEXT                       :rem 185
560 !CO.3:!PL.0,0:!DR.159,0:!DR.159,99:!D
    R.0,99:!DR.0,0                      :rem 110
590 GETA$:IFA$=""THEN590                :rem 95
620 !GR.7:!GR.0:END                     :rem 26
630 :                                   :rem 211
640 GETA$:IFA$=""THEN640                :rem 87
650 !GR.7+32+16:!SE.0,2,8:!SE.1,5,8:!SE.2
    ,0,14                               :rem 70
660 GETA$:IFA$=""THEN660                :rem 91
670 GOTO750                             :rem 114
690 :                                   :rem 217
700 PRINT"{CLR}{DOWN}":!GR.0:K=0        :rem 80
710 READN$:IFN$=""THEN730               :rem 171
720 PRINTTAB(20-LEN(N$)/2)N$"{DOWN}":K=K+
    1:GOTO710                           :rem 27
730 PRINTTAB(17)"{6 @}":PRINTTAB(17)"
    {RVS} WAIT {UP}"                    :rem 70
740 FORI=1TO350*K:GETA$:IFA$=""THENNEXT
                                        :rem 133
750 !GR.8+16:!SE.2,0,0:!SE.1,RND(1)*15,10
    :!CO.1:RETURN                       :rem 192
```

VIC Music Maker

Frank Colosimo

Here is a program that can help you more easily create sound effects or generate songs. The BASIC program generates its own DATA statements as notes are played, allows realtime playing of notes, and lets you adjust the tempo.

"VIC Music Maker" is an easy to use, multifunctional music program for VIC-20s of all memory sizes. Immediately after running, a menu is displayed which gives you a choice of four options. You can:

1. Develop sound effects or play simple music using the keyboard.
2. Play back music or sound effects previously added to the program.
3. Generate DATA statements "recording" the music as you play it on the keys.
4. Produce a tape file composed of DATA statements and a sound-generating subroutine which can easily be added to other programs.

After typing the program, check for errors, save a copy on tape or disk, and run it. A menu will direct you to select one of the four choices by pressing keys 1 through 4.

Playing And Recording

Press 1 to play music on the keyboard. You can try the tune at the end of this article or experiment to get sound effects. Pressing the S key returns you to the main menu.

Press 3 to "record" what you play in DATA statements. The program will ask you for a starting DATA line number. By default, the number 1000 is printed on the screen, and simply pressing RETURN produces DATA lines starting with this number. Avoid numbers that are used in the program lines.

While you're playing notes, DATA statements will be created on the screen. You can play up to 95 notes before the screen fills and the program ends. Pressing the S key (or reaching the maximum number of notes) causes the program to print one final DATA statement with a value of 99. This is the signal used by the playback loop to indicate end of data.

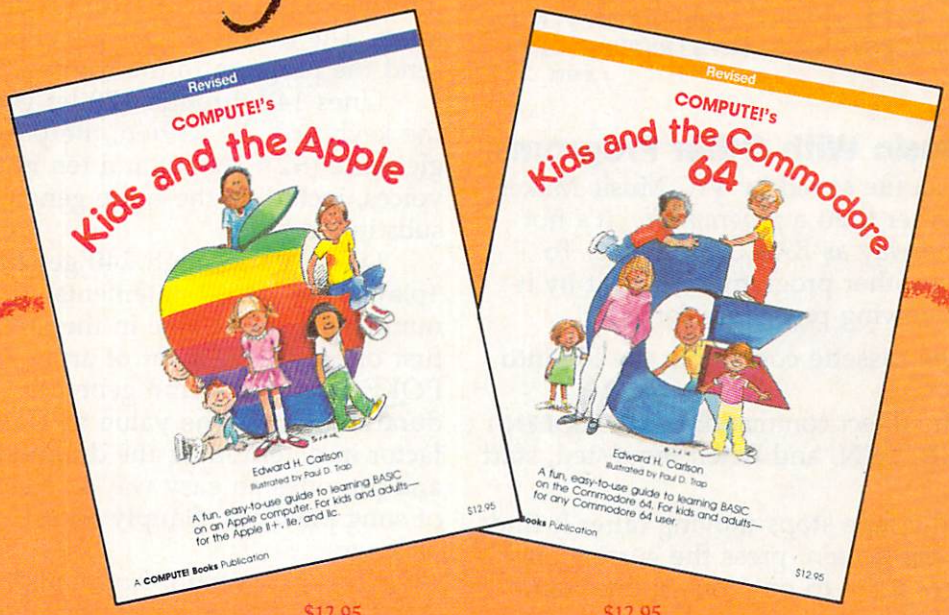
With your DATA lines on the screen, you can move the cursor up to each DATA line number and press RETURN. This will enter the lines into your program. If you hit a bad note or two, you can do a little editing on the numbers before entering them. Of course, if you do not want to keep a recording of your playing, you can simply rerun the program.

Automatic Music

Selecting option 2 from the menu plays back the music you recorded in the DATA statements. VIC Music Maker plays back notes until it encounters the number 99, signaling that the tune is done. The RESTORE command in line 220 allows only a single tune to be played. By removing it, you can have a number of tunes stored in DATA statements, and they'll be played one by one as you press key 2.

The fourth menu option lets you save a copy of your efforts on tape or disk and later merge it with another program. VIC Music Maker asks you to prepare a cassette or disk and input a filename. Then it requests the number of the last line to be saved. All lines between 800 and this line will be stored. Lines 800–940 contain the playback subroutine, so you'll have both the musical DATA statements and the routine to merge with your other program.

For Kids and grownups too!



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Note: VIC Music Maker, as listed, is designed for saving the music data on tape. To modify the program for disk, substitute the following lines for the lines in the listing:

```
610 PRINT"{CLR}POSITION DISK IN DRIVE":IN
    PUT"ENTER FILE NAME{7 RIGHT}";A$
                                    :rem 228
660 PRINT"{DOWN}{GRN}OPEN1,8,1,";CHR$(34)
    ;A$;CHR$(34);":CMD1:LIST800-";A
                                    :rem 233
680 PRINT"{BLU}{4 DOWN}WHEN DISK STOPS, M
    OVE CRSR TO{2 SPACES}{GRN}PRINT#{BLU}
     AND{3 SPACES}PRESS {RVS}RETURN{OFF}"
                                    :rem 217
```

Merging Music With Other Programs

The tape or disk file saved by VIC Music Maker is a *data file* rather than a *program file*. It's not stored the same way as BASIC programs. To merge it with another program, or load it by itself, use the following procedure for tape:

1. Place the cassette containing the file into the tape drive.
2. Enter the direct command: **POKE19,1:OPEN 1**
3. Press RETURN, and when requested, start the tape.
4. When the tape stops moving (after it finds the file), clear the screen, press the cursor-down key *exactly three times* to put you on line four, and enter the following line:

PRINT"{HOME}":POKE198,1:POKE631,13:POKE153,1

5. Press RETURN. When the tape comes to a final stop, enter **CLOSE 1** and press RETURN.

The sound routine and DATA lines are now added to your own program already in memory. A few cautions are in order, however. First, the merge technique will wipe out any lines in your program if they have the same numbers as the incoming lines. Second, if DATA statements are used in your other program, you will probably have to remove the RESTORE from line 220 and check for proper order of the READ and DATA statements.

To merge data files from disk, first type in Program 2, "VIC Disk Merger." Save a copy before running it, because the BASIC loader portion automatically erases itself from memory when you type RUN. When you have a copy saved, type RUN and follow this procedure:

1. Load the program to which you want to add the music DATA statements.
2. Enter **SYS 828,"*filename*"** (where *filename* is the name of the music data file).
3. You'll see the data lines being entered on the screen. Ignore any error messages you might see.

That's it. The sound routine and DATA statements are now part of your program already in memory. Observe the same precautions noted for tape merges above.

How It Works

VIC Music Maker was written in response to trial-and-error efforts at generating songs and sound effects. I was fascinated with the idea of the computer writing its own program lines.

Lines 20 through 40 initialize A(0)–A(9), which are the frequency values that are POKEd into the sound generator to produce musical tones. The next few lines generate the menu and send the program to the routine that is selected.

Lines 140 through 170 let you play notes on the keyboard. As written, the program uses a single voice (S2=36876) and ten notes. The other voices, including the noise generator, could be substituted here.

Lines 200 through 240 generate what "plays" the DATA statements. There are two numbers for each note in the DATA lines. The first one is the element of array A that will be POKEd into the sound generator. The second is a duration figure. The value of T also is used as a factor in determining the duration of each note and provides an easy way to change the tempo of song playback. Simply adjust its value higher or lower.

The next section, from line 310 to 520, creates DATA statements on the screen as you play the notes. The duration of each note is obtained with the VIC's built-in timing variable, TI. The complex string expression in line 420 trims off all extra blanks that the VIC tries to print so the maximum number of notes can be squeezed into the DATA lines.

Lines 600–700 produce a tape file (or disk file, if you've substituted the lines above).

VIC Music Maker was written using fairly straightforward BASIC programming principles. This makes it a good program to study for those just starting to learn programming.

If you don't want to type in the program, send a cassette, a self-addressed, stamped envelope, and $3 to:

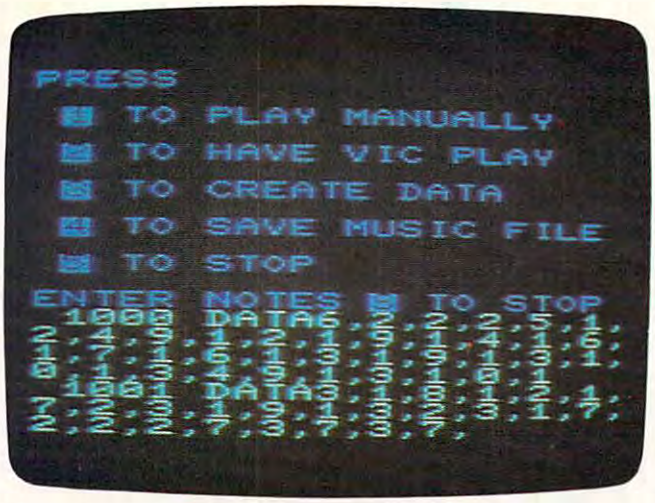
F. Colosimo
112 Shoreway Drive
Rochester, NY 14612

Sample Tune

Play the notes below using menu selection 1 or 3:

"A Bicycle Built For Two"

```
0 8 7 6
4 5 6 4 6 3
7 0 8 6
4 5 6 7 8 7
8 9 8 7 0 8 7 6
7 8 6 4 6 4 3
3 6 8 7 3 6 8 7
8 9 0 8 6 7 3 6
```



After selecting option 3, you can play the VIC keyboard like an organ as the computer converts the notes into numbers. The encoded music can then be saved for later playback or added to your own programs.

Refer to "COMPUTE!'s Guide To Typing In Programs" before entering these listings.

Program 1: VIC Music Maker

```
10 REM MUSIC MAKER                          :rem 54
15 PRINT"{CLR}"                             :rem 202
20 S2=36876:POKES2+2,15                     :rem 15
30 N$="215,159,163,175,183,191,195,201,20
   7,209"                                   :rem 237
40 FORM=0TO9:A(M)=VAL(MID$(N$,4*M+1,3)):N
   EXT                                      :rem 55
50 PRINT"{CLR}PRESS{DOWN}":PRINT"{RVS}1
   {OFF} TO PLAY MANUALLY{DOWN}"            :rem 148
60 PRINT"{RVS}2{OFF} TO HAVE VIC PLAY
   {DOWN}"                                  :rem 253
70 PRINT"{RVS}3{OFF} TO CREATE DATA{DOWN}
   "                                        :rem 145
80 PRINT"{RVS}4{OFF} TO SAVE MUSIC FILE
   {DOWN}"                                  :rem 149
85 PRINT"{RVS}5{OFF} TO STOP{DOWN}"
                                            :rem 17
90 GETS:ONSGOTO120,200,310,600,110
                                            :rem 144
100 GOTO90                                  :rem 51
110 END                                     :rem 105
120 PRINT"{CLR}"SPC(89)"PLAY NOTES ON
    {RVS}1{OFF} - {RVS}0{OFF}"              :rem 21
130 PRINTSPC(5)"{DOWN}*{RVS} S{OFF} TO ST
    OP *"                                   :rem 22
140 GETA$:IFA$=""THEN140                    :rem 77
150 IFA$="S"THENPOKES2,0:GOTO50             :rem 117
160 POKES2,0:FORA=1TO20:NEXT                :rem 245
170 N=VAL(A$):POKES2,A(N):GOTO140           :rem 190
200 REM PLAY SECTION                        :rem 193
210 T=16:REM TEMPO VAL                      :rem 17
220 READN:IFN=99THENPRINT"YOUR CHOICE":RE
    STORE:GOTO90                            :rem 248
230 POKES2,A(N):READD:FORM=1TO(10*D*T):NE
    XT                                      :rem 133
240 POKES2,0:FORA=1TO20:NEXT:GOTO220
                                            :rem 251
300 REM COMPOSE SECT                        :rem 188
310 INPUT"DATA LINE# 1000{6 LEFT}";L
                                            :rem 195
320 PRINT"{UP}ENTER NOTES {RVS}S{OFF} TO
    {SPACE}STOP":X=L                        :rem 249
330 GETA$:IFA$=""THEN330                    :rem 79
340 PRINT"{GRN}";L;"DATA";:C=0              :rem 203
350 C=C+1:IFC=20THENPRINT"{LEFT} ":L=L+1
                                            :rem 106
360 IFL=X+5THENGOTO500                      :rem 102
370 IFC=20THEN340                           :rem 209
380 IFA$="S"THENPRINT"{LEFT} ":GOTO500
                                            :rem 8
390 POKES2,0:FORZ=1TO20:NEXT:TI$="000000"
    :POKES2,A(VAL(A$))                      :rem 244
400 PRINTA$+",";                            :rem 92
410 GETA$:IFA$=""THEN410                    :rem 77
415 IFMID$(TI$,5,1)<>"0"THENPRINT"9,";:GO
    TO350                                   :rem 144
420 PRINTRIGHT$(STR$(INT(TI/12)+1),1)+","
    ;:GOTO350                               :rem 137
500 REM END/COMPOSE                         :rem 149
510 POKES2,0                                :rem 166
520 PRINTL+1;"DATA 99{UP}{BLU}":END
                                            :rem 152
600 REM SAVE MUSIC FILE                     :rem 74
610 PRINT"{CLR}POSITION TAPE IN DRIVE":IN
    PUT"ENTER FILE NAME{7 RIGHT}";A$
                                            :rem 227
620 PRINT"ENTER LAST DATA LINE{2 SPACES}T
    O BE SAVED":INPUTA                      :rem 5
640 PRINT"{CLR}{DOWN}{BLU}MOVE CRSR TO
    {GRN}OPEN{BLU} AND{2 SPACES}PRESS
    {RVS}RETURN{OFF}"                       :rem 149
660 PRINT"{DOWN}{GRN}OPEN1,1,1,";CHR$(34)
    ;A$;CHR$(34);":CMD1:LIST800-";A
                                            :rem 226
680 PRINT"{BLU}{4 DOWN}WHEN TAPE STOPS, M
    OVE CRSR TO{2 SPACES}{GRN}PRINT#{BLU}
     AND{3 SPACES}PRESS {RVS}RETURN{OFF}"
                                            :rem 216
700 PRINT"{DOWN}{GRN}PRINT#1:CLOSE1{BLU}"
    :END                                    :rem 137
800 REM PLAYBACK SUB.                       :rem 219
805 S2=36876:POKES2+2,15:T=20               :rem 119
810 N$="215,159,163,175,183,191,195,201,2
    07,209"                                 :rem 35
820 FORM=0TO9:A(M)=VAL(MID$(N$,4*M+1,3)):
    NEXT                                    :rem 109
900 READN:IFN=99THENPOKES2,0:RESTORE:RETU
    RN                                      :rem 128
920 POKES2,A(N):READD:FORM=1TOD*T*10:NEXT
                                            :rem 58
940 POKES2,0:FORM=1TO10:NEXT:GOTO900
                                            :rem 18
999 REM THREE BLIND MICE                    :rem 142
1000 DATA8,3,7,2,6,5,8,3,7,1,7,1,6,4,0,2,
     9,3,8,5,0,3,9,2,9,1,8,4,3,1,6,2,6,1,
     5,1,4,1                                :rem 248
1001 DATA5,1,6,2,3,1,3,2,3,1,6,2,6,1,5,1,
     4,1,5,1,6,2,3,1,3,2,3,1,6,2,6,1,5,1,
     4,1,5,1                                :rem 200
1002 DATA6,2,3,1,3,2,9,1,8,4,7,4,6,9
                                            :rem 250
1003 DATA 99                                :rem 80
```

Program 2: VIC Disk Merger

By Charles Brannon, Program Editor

```
100 PRINTCHR$(14)"{CLR}{RVS}VIC DATA MERG
    ER LOADER"                              :rem 179
110 PRINT"{2 DOWN}NOW READING DATA..."
                                            :rem 23
```

```
120 FORI=828TO939:READA:POKEI,A:CK=CK+A:N
    EXT                              :rem 24
130 IF CK<>13998 THEN PRINT"{UP}ERROR IN
    {SPACE}DATA LINES.":END          :rem 63
140 PRINT "{UP}VIC DATA MERGER NOW":PRINT
    "IN MEMORY."                     :rem 82
150 PRINT"{DOWN}TO MERGE AN ASCII":PRINT"
    SEQUENTIAL FILE, ENTER"          :rem 211
160 PRINT"SYS 828,";CHR$(34);CHR$(34);CHR
    $(20)"{RVS}FILENAME{OFF}";CHR$(34)
                                     :rem 41
170 PRINT"{DOWN}{RVS}FILENAME{OFF} IS THE
     NAME":PRINT"OF THE ASCII FILE."
                                     :rem 181
180 NEW                              :rem 131
828 DATA 032,253,206,032,158,205  :rem 41
834 DATA 032,130,215,166,034,164  :rem 37
840 DATA 035,032,189,255,169,032  :rem 50
846 DATA 162,008,160,008,032,186  :rem 44
852 DATA 255,032,192,255,169,099  :rem 64
858 DATA 141,036,003,169,003,141  :rem 38
864 DATA 037,003,096,008,138,072  :rem 49
870 DATA 152,072,169,008,032,180  :rem 44
876 DATA 255,169,104,032,150,255  :rem 51
882 DATA 032,165,255,141,172,003  :rem 40
888 DATA 032,171,255,165,144,240  :rem 51
894 DATA 026,169,032,032,195,255  :rem 56
900 DATA 032,138,255,169,008,032  :rem 41
906 DATA.177,255,169,232,032,147  :rem 56
912 DATA 255,032,174,255,169,013  :rem 47
918 DATA 141,172,003,173,172,003  :rem 35
924 DATA 201,013,240,003,032,210  :rem 13
930 DATA 255,104,168,104,170,040  :rem 35
936 DATA 173,172,003,096        :rem 167 ©
```

Enchanter

Marc Berman

Requirements: Apple Macintosh; Apple II-family computer with at least 32K RAM and a disk drive; Commodore 64 with a disk drive; or an Atari with at least 48K RAM and a disk drive. The version reviewed was for the Macintosh; other versions are identical.

The adventure game wizards at Infocom have just unleashed a new challenge—*Enchanter*, which the package blurb claims "is in the *Zork* tradition." That's quite a tradition to live up to, because as practically all adventure-game addicts know, Infocom's best-selling *Zork* trilogy set new standards for adventure game sophistication. Yet *Enchanter* upholds those high standards. And it even includes some of the characters from *Zork*.

Enchanter is strictly a text adventure—no pictures. Again, this is an Infocom tradition. Infocom maintains that personal computer graphics are not yet advanced enough to match the picture in your mind's eye. If you enjoy reading novels as much as watching TV, you'll probably agree.

Enchanter should be especially welcomed by Macintosh users. Until now, they haven't had many games to choose from, except for *Transylvania*, *Millionaire*, and the simple puzzle game that comes with the Mac.

A Well-Woven Tale

This is a remarkably well-planned game which encourages you to make logical or instinctive decisions. There's nothing strikingly original about it, but you'll appreciate its high level of challenge and meticulously maintained continuity.

The premise is that Krill, an evil sorcerer, has control of the land. The Circle of Enchanters sends you, a novice enchanter, to stop him. You might ask, "Why don't they go themselves?" Well, they claim Krill might recognize one of them—a likely story. Anyhow, along the way, you must find scrolls which reveal the magic you will need to seek out and vanquish Krill. Some of the scrolls are hidden along the roads around Krill's castle and some are in the rambling castle itself. Other spells are revealed by friendly animals, and at least one spell requires another spell to unlock it.

Keeping a map as you find your way through this complex game is absolutely essential. The bigger the paper, the better. Your starting point is at the western extreme, so you might want to start your map at the left edge of the paper.

You begin at a fork in a road. Explore both forks before you approach the castle. There are supplies you will need along each trail. Be practical. One of the strengths of this game is its tether to reality. The sun comes up and goes down at regular intervals. You get hungry, thirsty, and sleepy in cycles. And characters you meet respond in predictable ways. For example, an adventurer you meet in Krill's castle is suspicious of you, even if you offer him lunch. With so much evil lurking, it makes sense to be suspicious.

Likewise, a dog may show interest in you only when you have something it wants. On the other hand, you may learn something valuable with an off-the-wall command. For instance, by commanding, "Take all," you will find out what is portable in a room. But be careful—don't do something you wouldn't do in real life, such as extinguishing your lantern to learn the spell you need to light it again.

Mastering Magic Spells

Using the spells can be a chore. You must initially write the spells in your spell book. Then, each time you need to use one, you must memorize it. You may find that by the time you're finished memorizing, the creature you wanted to cast the spell on has wandered away.

But the spells are the key to *Enchanter*. At the outset you're given four: Gnusto, Frontz, Blorb, and Nitfol. Gnusto writes magic in your spell book. Frontz illuminates. Blorb protects your belongings. And Nitfol lets you talk to the animals. These four spells won't get you very far. Some of the first spells you'll find when you explore are a spell to open locked objects, a spell to repair damaged items, and a one-time-only spell that dispels evil magic.

Among the things that go bump in the night are a turtle, a dog, an adventurer, and some mean hairy guys who want to plunge a knife into you. There are other friendly and threatening creatures, but these are some that can move from room to room. You can summon certain creatures, like Belboz, your mentor, but he won't always be pleased to see you. Fortunately, there aren't so many moving creatures that you can't always find safe havens to sleep or otherwise regroup.

You can become stalemated, but entering "Wait" may change the situation. You can also return to rooms you already visited and find them altered. Or you can go to sleep—are those dreams you're having, or are they clues? Even an inexperienced player can discover or create new possibilities, though they may lead to his demise.

Exceptional Documentation

No expense was spared on the documentation, which is complete and flashy. For instance, the map-making advice is prepared by The Guild of Cartographers and the advice on entering commands comes from The Guild of Scriveners. You'll have to review the instructions carefully at least once before you'll get the hang of playing. It takes a while to remember all the idiosyncrasies of *Enchanter*, such as rules for talking to animals. Animals answer only "Who" and "Where" questions. For instance, you might say, "Frog, where is a scroll?" But don't ask "Frog, where are scrolls?" because *Enchanter* doesn't know the word *are*.

Most adventure gamers enjoy a good joke now and then, or at least a worthy attempt. Some of the old Adventure International games and other Infocom games are pretty witty. *Enchanter* has intelligent gameplay, but some of the humor lacks, well, subtlety. One character's name is Lord Dimwit Flathead. If you enter too many off-the-wall commands, the game will comment that you must be under a silliness spell.

The narrative won't win any literary awards, either. The package copy was obviously very carefully written, but the text in the program is sometimes vague. For instance: "A more incongruous place than this would be difficult to believe"; or "a door surpassing anything you could have imagined." I don't want to nitpick, but considering the overall excellence of this game, the writing ought to be better.

At least you don't have to worry about the kids getting funny ideas from *Enchanter*. There's very little violence in this game, for all its drama. As an enchanter, you have no use for knives or other weapons. Outwitting your opponents is more effective than killing them.

An Advanced Adventure

Enchanter is a huge program. The Macintosh version of the

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game takes up 122K on the disk. By comparison, the *MacWrite* word processor takes up only 55K. The system folder on the Macintosh *Enchanter* disk accounts for another 139K, leaving roughly 140K for storage. Saving a game in progress requires 13K, so some quick division tells you there is disk space for ten games.

Crashing the system is possible with the Macintosh, I discovered, when I accidentally hit the option key. The message SYSTEM ERROR appeared and the only recourse was to restart the disk, losing the game.

Enchanter is an excellent game for adventure freaks. However, you wouldn't want to use it to introduce your Aunt Fanny to computers—it's pretty advanced, even for seasoned adventurers.

With its large vocabulary, you won't tire too quickly of *Enchanter*. Even when you stop playing, you'll find yourself thinking about possible solutions for hours afterward. The challenge will preoccupy you for a long time.

Enchanter
Infocom, Inc.
55 Wheeler Street
Cambridge, MA 02138
$49.95 ©

Logo For The 64

Andrew Keith

The Logo language has been causing quite a stir in the home/educational market lately. Originally available only for the Texas Instruments microcomputers, there are now implementations of Logo available for every major brand of home computer on the market.

Expensive Propositions

Buying Logo, like buying a computer, can be an expensive proposition for home users:

Typically, the language retails for between $100 and $200. The Commodore 64, however, has the virtue of being inexpensive as home computers go; it is also remarkably versatile. Given this, it is not surprising that the Commodore 64 *Logo* package is both affordable and powerful.

Designed for Commodore by Terrapin, the 64 version of Logo makes good use of the hires graphics, sprites, color and sound capabilities for which the 64 is known. It also includes a thorough manual/tutorial and a utilities/demo disk. The price: about $50–$80, although it can be picked up on sale for as low as $35 at some retail outlets.

Logo includes both the turtle graphics system and a sophisticated language that is stimulating and challenging for adults as well as kids. Logo is a user-friendly cousin to languages like LISP, which are used in research on artificial intelligence. Because of this, it operates using a system called "list-processing," which organizes its programs as lists of procedures. Each procedure is itself a list of procedures; so a Logo program follows a "tree" structure, all the way down to the smallest roots, which are the built-in commands that come with the language. If this description seems a bit abstract, consider this standard example, one of the first Logo graphics programs most people learn to write:

```
TO SQUARE       ; Name of the procedure
 FORWARD 50     ; Moves the screen turtle
                  forward 50 "turtle steps"
 RIGHT 90       ; Turtle turns 90 degrees
                  right—
 FORWARD 50     ; Across the top...
 RIGHT 90       ; Another turn—
 FORWARD 50     ; Down the other side...
 RIGHT 90       ; Turn again—
 FORWARD 50     ; Bottom of the square
 RIGHT 90       ; Turn turtle back to
                  original heading
END
```

Taking Shortcuts

Does all that seem repetitive? Too much typing? Logo lets you abbreviate and take shortcuts, doing the whole thing more elegantly:

```
TO SQUARE
 REPEAT 4 [FD 50 RT 90]
END
```

Commands like FORWARD, BACK, RIGHT, and LEFT are called Logo "primitives." The user puts them together into procedures such as SQUARE. The interesting thing is that, for all practical purposes, Logo treats primitives like FORWARD and procedures like SQUARE as though they were identical. This lets the user "teach" the computer new commands. These commands can then be used over and over again in different programs.

Seymour Papert, the man who headed the original Logo project, had worked with the late Jean Piaget, the renowned Swiss psychologist who studied how people—particularly children—learn to teach themselves. Logo reflects Piaget's philosophy, and that is why Papert and many others consider it an ideal educational tool, if used properly. In a Logo environment, children develop an instinct for geometry and mathematical relationships by "teaching" the turtle to walk around the screen, drawing figures of startling complexity.

Thinking About Thinking

Having defined SQUARE, we can now use it as part of another procedure called HOUSE, which can in turn be part of a larger procedure called CITY. That is all, in essence, a Logo program is: a list of procedures. By breaking down the problem of drawing a city into the procedures of drawing a house, a square, a window, or a roof, children learn to structure their thinking. Bugs in the program are solved by "playing turtle"—that is, physically retracing the turtle's directions. In the process, says Papert, they become epistemologists: They learn to think about thinking.

The manual that comes with 64 *Logo* also reflects this philosophy of learning. It introduces the user to the language by allowing him or her to choose the features that are of initial interest, and starting there.

The tutorial chapters are nondirective, taking you through the steps needed to become acquainted with techniques for building programs. Having grounded you in the basics, it then simply suggests experiments, rather than telling you what to do. Three Logo "mascots" help you pace yourself: An elephant means "this is important: remember this"; a rabbit means "here is a valuable shortcut or a programming trick"; a snail means " go slowly in this section." The tutorial is excellent in most respects, but young children will find it rough going—the print is small, and it is really targeted for adult users who want thorough documentation on the language.

Graphics & Assembler

The utilities/demo disk contains several useful programs and procedures. Some are used in conjunction with the manual to demonstrate how to manipulate sprites (64 *Logo* has a total of seven) or play music. Others are graphics demos or simple games that show how list processing works. Utilities include sprite files with ready-made shapes of animals, vehicles, and assorted figures; a sprite editor for redefining your own shapes; and even a machine language assembler written in Logo for creating your own user-callable machine language routines.

The demo disk is a nice idea, but some of the demo programs are a bit disappointing; they are more fragments of programs than actual programs. Undoubtedly, that is all that was intended—program examples that the user can elaborate on—but you can't help responding to some of the demos with "That's it?" One exception is a Logo version of the famous game "Animal" in which the user thinks of an animal and the computer asks a series of questions to "guess" the name of the animal, in the process creating a tree-like classification structure which can then be viewed using the "Animal Inspector" program. This classic demonstration of simplified artificial intelligence makes particularly good use of Logo's list-processing abilities, as well as showing the user how the language stores its information.

A Sound Solution

Logo's system for handling the sound capabilities of the 64 is fairly simple, and the demo disk provides ready-made procedures like PLAY to make it even simpler. Basically, you decide what values your notes should have and what duration they should be; Logo does the rest. The manual doesn't point out how to control all three voices or how to set the volume. A serious programmer could write routines to handle these features, using the .DEPOSIT command (Logo's equivalent of the BASIC command POKE). The routines provided on the disk are satisfactory for most types of music and sound effects needed.

In addition to its turtle graphics and extras like sprites and sound, Logo is a natural for handling words and sentences. It contains all sorts of primitives for manipulating phrases. For example, typing in:

```
PRINT SENTENCE [JOHN LIKES]
 ITEM 3[ MARY SUE[TO SKI]]
```

Will print out:

```
JOHN LIKES TO SKI
```

The primitive SENTENCE will put together two elements that follow it into a single sentence, and ITEM 3 will pick out the third item in a list. Note that the bracketed phrase "to ski" is treated as one element of the list. Logo also has primitives for determining if a particular piece of input matches one or more elements in a given list. These text-manipulation features are the true core of Logo, and make it well-suited for educational uses.

Friendly Bugs

Commodore *Logo*'s error messages are friendly. If you attempt to use a procedure and haven't defined it, *Logo* will tell you that it doesn't know a procedure by that name. It also tells you exactly where the error was found. In the event of a major error that hangs up the system, *Logo* stops itself in many cases and cheerfully informs you: CONGRATULATIONS! YOU FOUND A BUG! It then gives you the option of continuing where you left off or erasing the faulty procedure and starting completely from scratch. However, the one time this happened to me the restart option didn't work quite right, resulting in input problems. I ended up turning off the computer and rebooting the language disk.

All in all, this is a solid version of Logo for a reasonable price. It contains features lacking in some of the other versions of Logo—sprites, sound, the ability to save drawings from the screen, and touch-sensitive turtles (any of the sprites can be used as turtles) that can sense contact with the background or other turtles. On top of this, it costs less than any other implementation of Logo currently on the market. For both first-time users, exploring their first programming language, and seasoned hackers—children and adults alike—Commodore 64 *Logo* is an excellent package.

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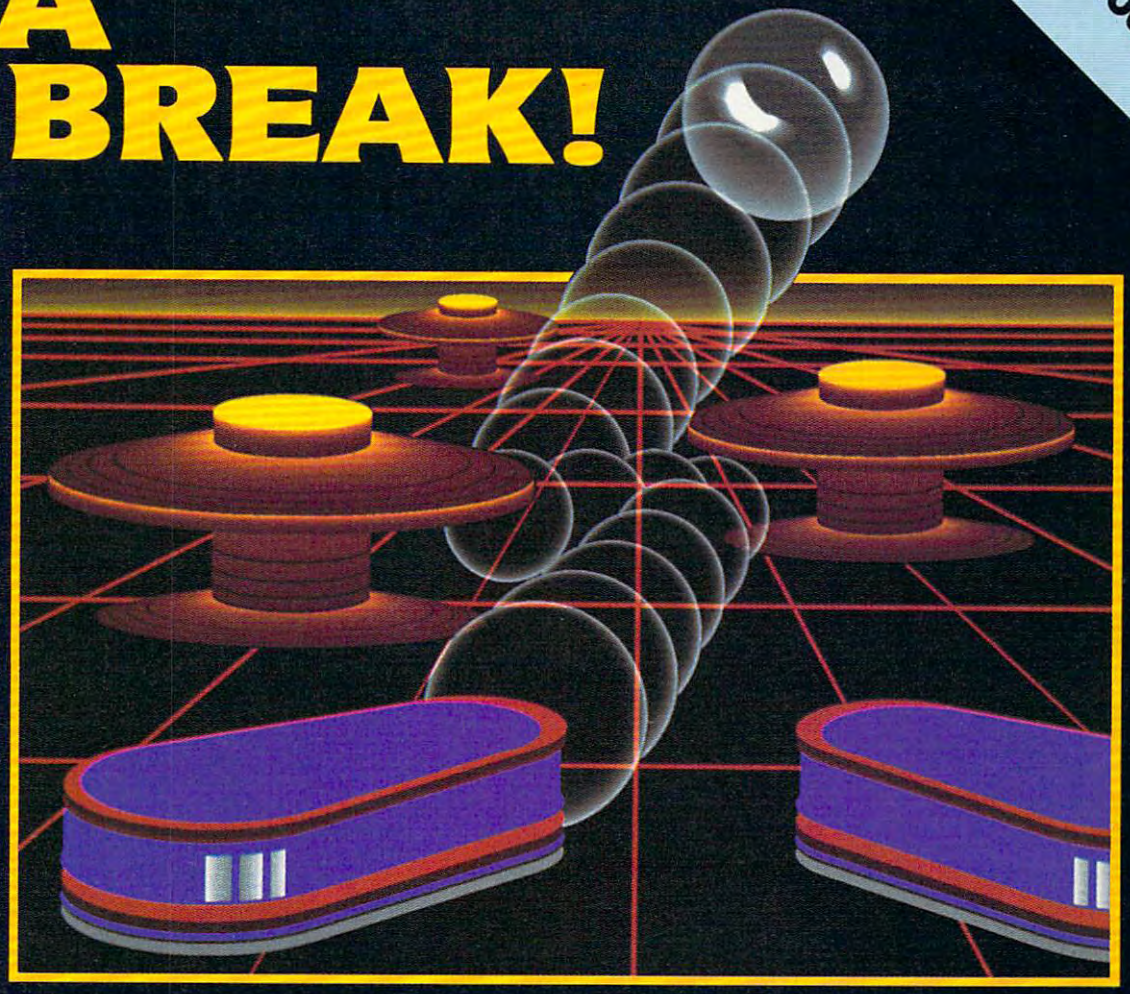

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Microsoft Flight Simulator For PC & PCjr

David Florance, Programming Assistant

Requirements: IBM PC with at least 64K RAM, one disk drive, and color/graphics adapter (optional Microsoft Mouse requires 128K RAM); or PCjr with at least 128K RAM and one disk drive. Joystick optional.

Commercial flight simulators were developed for one very good reason: Airplanes cost a great deal of money. When a student learning to fly makes a mistake, it's better for the mistake to happen in a flight simulator safe on the ground than to lose an entire aircraft (not to mention the trainee pilot).

Several software companies have recently adapted flight simulators to personal computers. You can't expect to use these programs to qualify for a pilot's license, but they're both fun and educational.

Microsoft Flight Simulator, by Bruce A. Artwick of SubLogic, is one of the best. For most of the last year it's been a top-selling program for the IBM PC and compatibles. The latest version sports two major improvements: It runs on both the PC and PCjr, and it generates a color display on direct-drive RGB monitors. Earlier versions depended upon artifacting (false high-resolution colors) to create color displays. This was fine if you plugged your PC into a composite color monitor or TV set. But everything appeared in black and white on RGB monitors because they're capable of resolving adjacent hi-res pixels without the artifacting effect. The new version of the program generates true colors on both types of displays.

Before you try *Microsoft Flight Simulator*, however, be forewarned—if you don't know much about flying, this program may overwhelm you. It's not a simple simulation. It's a challenging program even for experienced pilots. Your first step should be to read the 149-page manual, packed with diagrams, maps, runway layouts for dozens of airports, an appendix describing your plane's performance specs, an airport directory, a glossary of aviation terms, and an index. The manual explains how to fly the aircraft with either the keyboard or a joystick, plus a great many more details.

This view from the pilot's window shows a landing approach to Los Angeles International Airport.

Changing The Weather

Before you take off, read the section that explains how an aircraft operates. Once you know a bit about flying, you'll be better prepared to enjoy (and understand) *Microsoft Flight Simulator*. Even if you've done some flying, you'll benefit by reading the manual.

Next, if you're using a PCjr, you should become familiar with the keyboard overlay. If you have a PC, you'll have to work without an overlay, so carefully study the section on aircraft controls. It explains the various instruments you'll be working with. These instruments

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An alternate simulation, World War I Ace, puts you in the cockpit of a 1917 warplane. Notice the more primitive instrumentation.

should be constantly monitored during flight because they indicate your airspeed, attitude, altitude, heading, and throttle at a glance.

With any program requiring sharp hand-eye coordination, practice makes perfect. But it's especially critical with *Microsoft Flight Simulator*. When using the keyboard controls, keep the manual in a strategic location for easy reference. As you improve your flying skills, you'll learn how to use navigational aids such as the VOR, the ADF, the NAV 1, NAV 2, and COM radios. You can use the 3-D display window to look around you from nine different perspectives. Finally, there is the radar view, which is indispensable when taxiing on the runways.

With the program's Editor feature, you can redefine current flight parameters. The User Mode Library gives you ten preset modes plus options to save and load player-defined modes. You can use the Editor to set cloud layers, wind factors, seasons, and even the time of day. Say, for instance, you want to work on landing skills. You would call the Editor, set the flight parameters for a landing approach, save it in the Library, and reenter the flight mode.

Until you gain a working knowledge of the instruments, you'll have trouble making successful flights. You won't fly far if you haven't practiced banks and yaws, or use of the elevators. You'll sometimes crash, but don't be discouraged when it happens.

Four Regions And A War

Microsoft Flight Simulator lets you choose to fly from Chicago, New York, Los Angeles, or Seattle. Numerous airports are available for landings, and—as in real life—not all are identically equipped. Larger airports have more sophisticated equipment. There are hours of exploration within each region.

Flying from one region to another is possible, too, but it may take four or five hours. Slewing, or exponential travel, is an alternative to realtime flying. It allows you to rapidly travel great distances in little time.

In addition to the four regions available for civilian flight, there's also a fifth simulation—World War I Ace, a game which places you in Europe in 1917.

Controls Are Sensitive

Microsoft Flight Simulator is interesting, challenging, graphically superb, diverse, rewarding, and just plain fun. And the documentation is great. In terms of realism, it sets the standards.

There are two slight drawbacks. The instruments in *Microsoft Flight Simulator* are more delicate than on real aircraft. There are legitimate arguments that this is the way a flight simulator should respond; it trains you to develop even more skill than flying a real plane would require. But others would prefer to see more realistic controls which respond exactly like the real thing.

The other weakness is an obvious one that applies to all personal computer flight simulators: the absence of rudder pedals and similar controls. Controlling the aircraft with keys or a joystick may befuddle pilots who are used to real controls.

Still, these shortcomings are easily outweighed by the sheer delight this program brings.

Microsoft Flight Simulator
Microsoft, Inc.
10700 Northrup Way
Box 97200
Belleview, WA 98009
$49.95 ©

DataPlus-PC

Darryl G. Linkow

Requirements: IBM PC or XT with at least 128K RAM, DOS 2.0/2.1, and either two double-sided floppy disk drives or a single double-sided drive and a hard disk.

DataPlus-PC converts your computer into an electronic filing system and report generator

which can perform the sophisticated data base functions found in programs that are considerably more expensive. Yet unlike some of these higher-priced programs, *DataPlus-PC* is extremely easy to use, even for novices. It is completely menu-driven and prompts you at every option.

Beginners can start entering data immediately by using the predefined record fields (name, address, etc.). Of course, you can also design your own custom forms. With the Report Generator included in *DataPlus-PC*, you can perform extensive mathematical functions. *DataPlus-PC* also contains a built-in Mailing Label and List Generator (MLG) that can print up to eight labels across. It's a fast, easy way to print labels or other lists. Another powerful feature is the memo window. It lets you enter a paragraph of text so you can link additional information and comments to individual records that are on file.

DataPlus-PC also is capable of reading files created with *Lotus 1-2-3, Multiplan, VisiCalc, TIM,* and other popular forecasting and data base programs. This capability saves you the costly and time-consuming task of retyping existing files to assemble new data bases with *DataPlus-PC*. In addition, *DataPlus-PC* can create files which can be merged with the text files produced by most popular word processing programs (including *WordPlus-PC*, a companion program from Professional Software).

Single-Key Commands

DataPlus-PC comes on a double-sided floppy disk with an instruction manual in an attractive (IBM-style) three-ring binder and slipcover. The manual itself is well-organized and written for both the novice and advanced user. There's an excellent 170-page tutorial section and a reference section of about the same length. Index tabs make it fast and easy to find helpful information. In the back is a complete index, plus an appendix with information on DOS, error messages, printer troubleshooting, a glossary of computer terms, and a section on saving crashed data files.

The program disk contains sample data files to illustrate everything covered in the tutorial. Since *DataPlus-PC* is completely menu-driven, you should be able to use the program even if you skip the tutorial. Most commands are entered by selecting a single number or letter from the main menu. This menu offers such functions as the report generator, mailing label generator, word processor file merge, the utilities menu, and the global function menu. With a single keypress you can select such options as enter records, update records, delete records, quick search, super scan, memo window, change data files, sort records, and display unformatted records.

The utilities menu lets you create new files, print field titles, add new data fields, change field titles, view report formats, erase report formats, duplicate report formats, rename data files, erase data files, create modified files, back up data files to another disk, convert ASCII files to *DataPlus-PC* files, and view disk directories.

The global menu contains many functions usually found only in word processors: global search and replace, global record delete, global mathematical update, global deletion or insertion of fields, merge two fields or two *DataPlus-PC* files, swap two fields, duplicate data from one field to another, convert data format, and convert data file to all uppercase letters. Again, you can select any of these functions by pressing a single key from the proper menu screen.

Fast Searching

DataPlus-PC's super scan function gives you the ability to quickly locate and display necessary information from any record. In seconds, using floppy disks, I retrieved records just by specifying a string of letters or numbers. Once the record appears on the screen, you can use the super scan menu to edit the record, delete the record, print a hard copy, or perform several other functions.

The printing features in *DataPlus-PC* are extremely flexible, too. Using the report generator, you can specify any number of fields to be printed in unique reports. You can design report formats and save them on disk. In addition, *DataPlus-PC* always asks if you want data and reports sent to the screen or the printer. You don't have to make a hard copy if you simply want to read a report on the screen.

Overall, *DataPlus-PC* offers professional versatility and a great number of advanced features. But perhaps the best feature is its price—relatively low compared to some competitors with similar capabilities.

DataPlus-PC
Professional Software, Inc.
51 Fremont Street
Needham, MA 02194
$250

David D. Thornburg, Associate Editor

Of Cats, Kids And Computers

I read an interesting article about cats. It was about an experiment in which newborn kittens were raised in special environments. One group of kittens was raised from birth in a room containing only vertical stripes on its walls, and the second group was raised in a room with only horizontal stripes on its walls.

As these kittens matured, they were released into the normal world of chairs, tables, and people, to see how they would react. The researchers in this study made some interesting observations. The cats that were raised among only vertical stripes fared well in the world of chairs and tables, without ever bumping into the legs by accident. But these cats never once jumped onto a chair or table top. As for the cats raised in the other room, their behavior was quite different. While they would frequently jump on table tops and chairs, they seemed to be forever bumping into furniture legs—almost as if they didn't see them.

Were these effects reversible? As I recall, it was discovered that the effects of these special rooms would wear off only if the kittens were removed from the rooms after a few weeks. If they were kept in these environments for a longer period, the sensory environment of their youth would forever influence their view of the world.

Kids, of course, are not cats, and yet parents share an almost instinctive need to provide their children with all the stimulation they can handle. From crib toys to peekaboo, our babies have their waking hours filled with the wide range of stimuli that might forever shape their own views of the world.

But, just as some of our parentally provided stimulation is intentional, some of it is not. A child who is raised from birth in front of a television set is likely to have a different world view than one who was engaged in more active pursuits. We have all heard of the toddler whose first song was "You Deserve a Break Today."

Childhood Discovery Tools

Fortunately, our babies don't rely on us as their sole source of stimulation for long. What parent hasn't noticed that the baby has been "too quiet," only to find that the little pumpkin is busily exploring the rich texture of strained apricots as they are pressed into the white living room rug a mere two hours before guests arrive for a formal dinner?

While most parents are not likely to view this incident with detached amusement and recognition of the strong desire of our children to make discoveries on their own, we do acknowledge the importance of discovery to our children and provide them with discovery tools of our choosing—blocks, dolls, trucks, and perhaps computers.

The notion that a computer can be a discovery tool for the very young is not particularly new. What is new is the growing realization that if computers are to be used by the very young, they must be used in ways that are completely different from the ways they are used by older children and adults.

I am often presented with opportunities to review commercial educational software for the preschooler. While this software has a certain appeal for the adults who purchase it, much of it is totally inappropriate for its targeted user. The reason for this is easy to detect: Our commercial marketplace has presented us with a problem. In order for a customer to find appropriate software in the store, a buyer has to be sufficiently impressed to purchase it. Amazingly few buyers for retail chains have Ph.D.'s in early childhood education, and the criteria that a buyer may use in selecting titles for inventory are likely to be different from those that are of importance to the cognitive development of a three-year-old child. As a consequence, I have seen otherwise charming alphabet-learning programs that paint words from right to left across the screen, thus causing the child's eyes to track in the wrong direction for reading. I have seen prereading software that includes (in small type) messages such as PRESS RETURN WHEN DONE.

In fact, good software is hard to write, and good software for preschoolers is *very* hard to write. Consequently, there is very little of it.

Designing Software For Tots

To see the nature of the problem, consider three aspects of a child's use of the computer. In order to interact with the computer effectively, three

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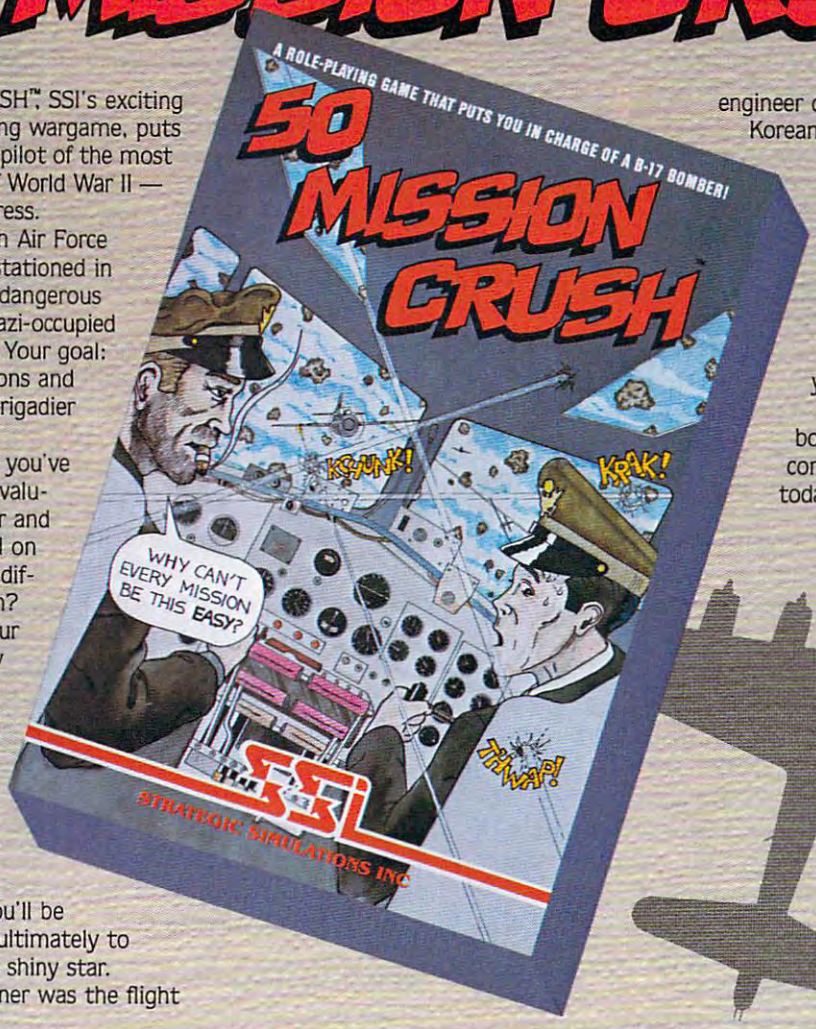

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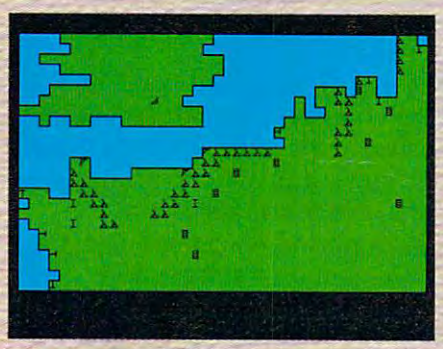

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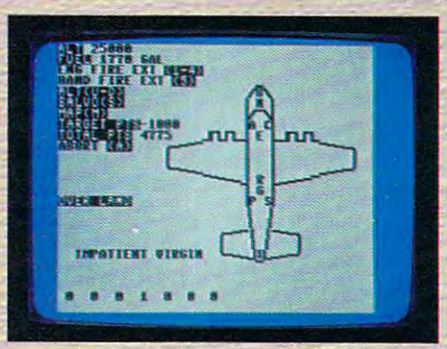

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things need to be at the child's level: the input skills, the subject matter and style, and the information displayed on the screen. Some otherwise wonderful software has fallen short because of a failure in one of these areas.

Many of the shortcomings in early childhood software can be overcome by careful design of the program in the first place. While too many experts can ruin an otherwise good product, it is important that software be examined by someone on the staff who has worked extensively with children in the target age-range, and who knows their skills and limitations. It is also important that the software be tested (and modified and tested again) with a group of children to see what problems they uncover. In fact, most of the problems I have seen could have been trapped and corrected at the storyboard stage before a single line of program was written.

Of course, such testing is expensive, and it causes product development cycles to be much longer than they would be otherwise. When these factors are considered in the light that a good children's package may be harder to program than a new spreadsheet, it is a miracle that there are any good programs available at all.

In fact, there is much that any programmer can do to make sure that programs for young children are appropriate. On the content side, give careful consideration to the dominant learning mode of the child. If the audience consists of children who are engaged in making their own discoveries by physical experimentation, the interactiveness of the program should reflect this learning mode. If the program is to be used by early readers, be certain that the screen is free of clutter and the words are formed from characters that are easy to read. Just because a child can read a ¼-inch-high letter in a book does not mean that you should use letters of this size when working with a computer display screen. You will want to use letters that are much larger and that are created with a very easy-to-read set of characters.

Keeping It Simple

Animation has its place, but words should not move across the screen while they are being read. Reading is a hard enough task as it is, and making the words move only makes it worse. You can test this on yourself by having words move across the screen in a language you barely understand. You will most likely find that the words are a lot easier to read when they are standing still.

If your software is to be used by a child who has no reading skills, and this software is to be used by an unattended child for purposes other than *developing* these skills, the screen should contain no words at all—ever.

Color and sound can be entertaining, but must be used carefully. If the object is to create a passive viewing experience as a reward, this may be fine. If these features are used as a bridge between other activities in the program, they may distract the child enough to cause the thought train to be broken.

While content and display present their own special problems, the real challenge comes from input. Devices like the joystick and KoalaPad represent two alternatives to the normal keyboard, but they may be inappropriate for some applications, especially when letters and numbers are to be entered.

As for the typewriter keyboard, we have two choices: We can either change the order of our alphabet for all time into QWERTYUIOP[]ASDFGHJKL;ZXCVBNM,.? or we can take advantage of special keyboards such as the Muppet Learning Keys from Koala Technologies. Muppet Learning Keys is a keyboard designed for children from the age of three upward. Its principal features are an alphabetic arrangement of keys, an uncluttered layout with one character per keytop, and functional clustering of keyboard characters. All the numbers are clustered into one grouping, colors are clustered into a paint box, and the alphabet is clustered in a writing tablet.

Since we teach our children the alphabet in alphabetical order, it makes sense for them to be able to use a computer keyboard that has the keys in this order as well.

Graduating To QWERTY

Of course, there is the question of when a child should make the move up to the normal keyboard layout.

To me, the essence of keyboard comfort is achieved by starting children off with something that they expect—alphabetic keys. This makes using the computer more transparent to the user, and gives the child a closer connection to the software, instead of requiring continued focus on the mechanics of the computer's operation.

Once a child has reached an age where he or she is ready to learn to type, the child's first exposure to the normal keyboard should be through a typing tutor program.

At what age should the transition take place? It depends on the child of course, but you should look at the skills needed to master the keyboard (and mastery does not include typing with two fingers). Is it a skill for three-year-olds? I think not. In fact, it might be appropriate for some preteens, but not all of them.

In fact, it isn't even appropriate for all adults! ©

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TELECOMPUTING TODAY

Arlan R. Levitan

COMPUTE! *welcomes a new monthly column this issue: Arlan R. Levitan's "Telecomputing Today." It's a general column for everyone who has an interest in telecommunications with personal computers—no matter which computer you own.*

Levitan has wide experience in this field. He was introduced to computing in 1966 when his high school was among the first in the nation to participate in a pilot computer-instruction project. Today he's a staff analyst in technical support for the data processing division of a major telephone company. His work has appeared in such magazines as Softside *and* Creative Computing.

He has edited a major user group newsletter and is the author of The Consumer's Guide to Atari Computers. *He is an assistant sysop (system operator) for the CompuServe Information Service and subscribes to The Source and Delphi as well. He also was the system designer of AMIS, a major bulletin board program for Atari systems. Levitan owns and uses Atari, IBM, and Apple personal computers and has experience on all types of computers.*

1984, eight years into the microcomputer revolution. It's hard to ignore recent trends which indicate that the explosive growth rate enjoyed by this industry is leveling off. As you read this, retailers of mass-market computers are yearning nostalgically for the frantic buying of the past two years.

This is not to say that the home computer market is ready to lie down and die. Millions of computer enthusiasts are active with their systems, and the market is, by ordinary standards, still quite vigorous.

The revolution has yielded to evolution. By current reckoning, almost half of the families who purchased computers during the boom years of 1982 and 1983 are letting their systems gather dust in dark closets or relegating them to use as expensive paperweights.

Large numbers of people hung up their computing shoes after just a few months of experimentation with their new toys. They discovered to their genuine dismay that word processors do not write letters by themselves, spreadsheets do not make entries in checkbooks, and that maintaining data bases of recipes isn't such a hot idea after all.

It certainly wasn't the public's fault. Everyone from a well-meaning but starry-eyed press to the refrigerator salesmen who found themselves selling disk drives instead of ice-cube makers firmly believed that personal computers could do almost anything in the hands of almost anyone. No one wanted to think about the possibility that the classical business applications of microcomputers would not translate well into the home.

Is Computing Antisocial?

The slowdown began late in 1983. Several companies tried to boost their holiday season sales with "big fear" campaigns, losing points with educators and sociologists by implying that refusing to buy your children a home computer would doom them to failure in the competitive atmosphere of higher academics.

The campaign for 1984 has been "personal productivity." Home computer owners want to use their machines without learning how to program and without spending hours trying to figure out how a canned application works. Yet the most popular type of home software is still games, the best of which offer intuitive rules and interaction with other human players as well as the computer.

Interaction is an important point. To some extent, the classical applications of microcomputer technology all tend to isolate the user in a one-on-one relationship—with the computer, a machine. But a computer's reactions to user input are usually well-defined and limited.

Things don't have to be this way. The more personal interaction that can be brought into "personal" computing, the more engaging and rewarding it can be.

Reach Out And Touch

There is a segment of computing that brings people into contact with one another, rather than encouraging isolation. According to a recent Public Broadcasting System market survey, that segment boasts a user satisfaction rate of more than 90

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percent (compared to an average of about 50 percent for home computer owners as a whole).

That segment is comprised of home computer owners who use their systems to hook up with other computer systems and their users via telephone lines. The general application is referred to as telecommunications or *telecomputing*, and unlike the rest of the home computer market, it's still growing at an accelerated clip.

Do you find this hard to believe? Consider that the most popular features on the commercial information services such as CompuServe and The Source are those which center on people-to-people contacts.

On CompuServe it's the CB simulation, a freewheeling computerized version of Citizens Band radio. Except with this CB, you're not limited to a range of ten miles or so. Your buddies on the channel may be as far-flung as Fairbanks, Miami, and Bangor. The intellectual content, the wit, of these electronic conversations may never rival Plato's discourses, but it is fascinating to watch and participate in.

On The Source it's POST, a national bulletin board that can put you in touch with the lady in Butte, Montana, who's willing to sell the used letter-quality printer you've always wanted, and the stamp collector in Fargo who's willing to pay top dollar for those Millard Fillmore commemoratives you've been trying to unload locally for over a year.

On Delphi it's the ORACLE, where networked bands of self-styled experts on any subject under the sun are more than willing to voice their opinion on any question posed to them.

You Are What You Say

Why are people attracted to personal keyboard conversations with folks they've never met before? Because this mode of communication is the great equalizer. No one knows or really cares whether you're a yuppie, preppie, hacker, punk, or blue-suiter. You're judged by your words and general attitude.

Telecomputing offers a commonality of experience that can be shared by almost every computer owner. The telecomputing experience crosses all boundaries of computer brands, operating systems, and programming languages.

Common telecomputing applications offer convincing evidence of the power of the medium. How many stock market buffs spend countless hours typing issue histories into spreadsheets and other stock analysis programs? The same information can be transferred directly from an on-line information service to a formatted file on a personal computer in a matter of minutes.

How many students wait and wait for an hour of time at a college computer terminal? A personal computer in a dorm room can access the same system. How many times have you flown within the past year? The Official Airlines Guide (OAG), accessible via computer, can pinpoint the lowest fare available in a matter of seconds.

A vast number of free public bulletin boards accessible by computer offer information ranging from Aerospace to Zoology. Free user-written programs for almost any type of computer may be transferred with ease from one remote system to another.

Undeveloped Potential

Telecomputing is not without its failures. For all the publicity about electronic editions of popular national newspapers, it turned out that not too many people cared to pay five to ten dollars for the information found in 25 cents' worth of newsprint. Electronic banking's development has been tediously slow, and the U.S. Postal Service is about to give up on its electronic mail service, ECOM (they never could get the hang of handling lowercase letters).

Still, there's plenty available now, and the cost of a ticket to telecomputing is extremely low—especially for those who already own a computer.

Modems, the devices that make it possible for computers to link up to other computers over ordinary phone lines, are available for under a hundred dollars and are extremely reliable. Most can be used with almost any computer, so they can be shared by more than one system if you're a two-computer family.

Terminal programs—which turn a computer into a telecomputing device—are commonly available in the form of public-domain software at little or no cost. Terminal programs also are published from time to time in computer magazines such as COMPUTE! and COMPUTE!'s GAZETTE.

So start saving your money for a modem, and if you've been neglecting it, dust off that computer. In the months that follow, this column will take you on a tour of a huge communications network that many people don't even know exists. Before we're done, tenderfoots will become well-seasoned hands, and old telecomputing prospectors will learn of some rich new lodes of information to mine.

BCNU
Arlan R. Levitan

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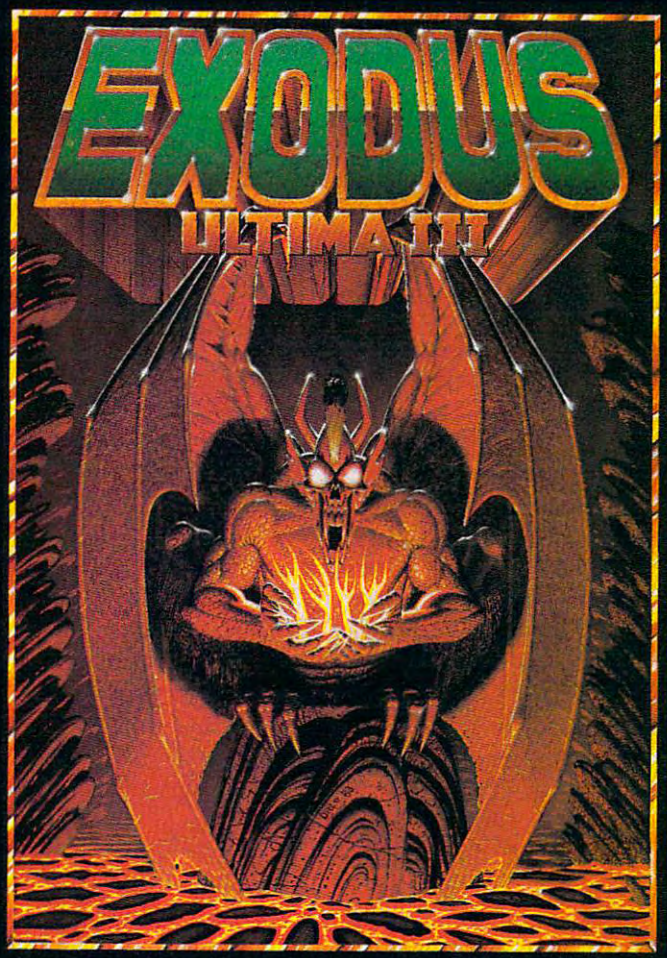

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MACHINE LANGUAGE

Jim Butterfield, Associate Editor

A Simple Sort

I recently received a request from Marshall Stewart in Louisiana for a numeric array sort. Such a sort isn't too useful for real data, but can illustrate a number of machine language coding techniques.

It should be noted that a sort, in order to be practical, should be able to find its way through multifield records and should handle strings, floating point, and fixed point numbers. The program presented here, "Tiny Sort," is written for the Commodore 64 and sorts a single floating point array into ascending order. This might be useful for certain types of statistical analysis, but is otherwise of limited practical use.

The sorting method (or *algorithm*) is called an "insertion sort." In other words, each number is inserted into the collection of sorted numbers obtained so far. As an example; suppose we have so far sorted the five numbers: 3, 8, 22, 35, and 84. Now the next number comes along; it has a value of 18. The insertion sort will "move up" the values 22, 35, and 84, pop the 18 into the blank space to get the sequence of six: 3, 8, 18, 22, 35, and 84. This algorithm is easy to follow, but like most simple sorting procedures it takes a long time to sort large arrays. Most simple sort algorithms are called "N squared"; this means that if you have an array twice as big as before, it will take four times as much time to do the job. With large collections of data, the programmer must seek out more sophisticated algorithms.

So Tiny Sort is limited in application, and it uses a decent but not superfast algorithm. It is useful for study purposes, however. We do a number of interesting jobs, such as digging into the workings of an array and comparing floating point numbers.

Tracking The Program

When Tiny Sort is called, it assumes that only one array is in the machine—or at least it looks only at the first array. It assumes that the array is one-dimensional, that the type is floating point, and that the zero element is part of the data to be sorted. We could choose to check all this, but let's forge ahead.

How do we find the array? Well, there's a pointer which indicates the start of the first array, and that's the one we want. It's called the Start-of-Arrays pointer (ARYTAB), and in the Commodore 64 it's found at addresses $2F and $30. (Consult your memory maps to find similar pointers in other 6502 machines.) By looking at this pointer, we can tell where to find the first array.

The array comes in two parts: information about the array, and the array data itself. Most of the information we'll pass by: the array name, its size in bytes, and the number of dimensions. We'll assume it's the right array and that it's singly dimensioned. One piece of information we will extract: the number of elements in the array. That will tell us how many items we have to sort. If there are 15 elements, we'll need to do 14 inserts. The first element is already "sorted." The number of elements is held in two bytes, which are to be found five locations from the start of the array. So we dig out the array size minus one and place it into our storage location we call SIZE, at hex address 033D and 033E:

```
        LDY   #5          ;get array size
        LDA   (SOA),Y     ;from pointer
        TAX               ;size hi byte
        INY               ;try for lo byte
        LDA   (SOA),Y     ;here it is
        TAY               ;check zero
        BNE   DECK        ;minus one
        DEX
DECK    DEY
        STY   SIZE        ;store size
        STX   SIZE+1
```

Now let's go for the array data. For a single dimension array, we must skip ahead 7 locations to get past the overhead information. The start of the data will be logged in START, and we'll also place it into pointer NEXT. START will stay where it is, but NEXT will move along as we add

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data to our sorted list.

```
        CLC             ;go for start
        LDA   SOA       ;of array
        ADC   #7        ;plus 7
        STA   START     ;gives start
        STA   NEXT      ;of numbers
        LDA   SOA+1
        ADC   #0
        STA   START+1
        STA   NEXT+1
```

Now we accept a value into the sorted list, and move pointer NEW along five locations. Each floating value occupies five locations.

```
* SORT NEW ITEM INTO EXISTING ARRAY
BIGLP   CLC             ;on to next
        LDA   NEXT      ;array item
        ADC   #5        ;five bytes up
        STA   NEXT
        LDA   NEXT+1
        ADC   #0
        STA   NEXT+1
```

All five bytes of the new item of data, which pointer NEW has selected, are transferred to a work area WORK. That makes comparisons simpler, but performs another task. As we search the list, we'll move the existing items up to make room. The new value's old location will be written over as we do this move.

```
        LDY   #4        ;move item to
MVLP    LDA   (NEXT),Y  ;work area
        STA   WORK,Y    ;for testing
        DEY
        BPL   MVLP
```

Now the stage is set. We'll call subroutine SCAN to find the proper insertion point, move the existing values over, and put the new value in place.

```
        JSR   SCAN      ;insert it
```

Most of the work has been done. We may count the number of insertions—by counting down SIZE—and if there are more numbers, loop back to BIGLP.

```
        LDY   SIZE      ;now count down
        BNE   INK
        DEC   SIZE+1    ;hi and low
INK     DEC   SIZE
        BNE   BIGLP     ;more? go back
        LDA   SIZE+1
        BNE   BIGLP
        RTS
```

Subroutine SCAN's task is to move down through the data until the correct spot is found to insert the new item. We use pointer CHECK to do the scan; first, we must set it up.

```
*MOVE EVERYTHING UP AND INSERT ITEM
SCAN    LDA   NEXT      ;start at top
        STA   CHECK
        LDA   NEXT+1
        STA   CHECK+1
```

Now we move the pointer CHECK down to look at the next item. We do this, of course, by subtracting five from pointer CHECK.

```
*DOWN TO NEXT ITEM
SLOOP   SEC
        LDA   CHECK     ;go five bytes
        SBC   #5        ;lower
        STA   CHECK
        LDA   CHECK+1
        SBC   #0
        STA   CHECK+1
```

CHECK may have gone too far. We must compare it with pointer START; if it's gone below, we must insert the new item at the bottom. We do the comparison by subtraction. Usually, before we subtract, we give an SEC command; in this case, it's not necessary since we have just completed a previous legal subtraction.

```
*TEST IF BOTTOM OF DATA
        LDA   CHECK     ;subtract
        SBC   START     ;pointer from
        LDA   CHECK+1   ;bottom pointer
        SBC   START+1
        BCC   SWRAP     ;if low, wrap up
```

Now that it has been established that CHECK is in a legitimate range, we may perform the comparison. Subroutine COMPAR will do this for us. If the new value compares the right way (low), we go to SWRAP to insert it.

```
* COMPARE NEW ITEM WITH CURRENT ENTRY
        JSR   COMPAR    ;compare it
        BCS   SWRAP     ;yup, insert it
```

If we haven't rambled away to SWRAP, it means we haven't yet found the right spot to insert the new item. We move over the item in the list that we have just checked; when we finally find the right spot, everything will be moved over neatly. To move up this five-byte item, we use the stack. When we're finished, back to SLOOP to check the next point on the list.

```
* NOT YET; MOVE ENTRY UP
        LDY   #4        ;take out entry
SPUSH   LDA   (CHECK),Y ;and push to
        PHA             ;stack
        DEY
        BPL   SPUSH
        LDY   #5        ;pull entry back
SPULL   PLA             ;and insert five
        STA   (CHECK),Y ;bytes higher
        INY
        CPY   #10
        BCC   SPULL
        BCS   SLOOP     ;now get next
```

When we get to SWRAP, we can put the item into its proper place. Pointer CHECK has gone too far; rather than back it up, we use a higher index value.

```
* FOUND THE SPOT; PUT NEW ITEM IN PLACE
SWRAP   LDY   #5
SWLOOP  LDA   WORK-5,Y
        STA   (CHECK),Y
        INY
        CPY   #10
        BNE   SWLOOP
        RTS
```

The COMPAR subroutine compares signed floating point numbers. Floating point numbers as stored in arrays consist of one byte giving the exponent and four bytes giving the mantissa. But there's more: The high bit in the mantissa is the sign of the number. Providing we check the signs first, everything works out neatly: compare the exponents, then the bytes of the mantissa. But first, the signs; if they match we can continue

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with the main comparison.

```
* COMPARE CURRENT ENTRY TO NEW ITEM IN WORK
COMPAR   LDY   #1          ;floating signs
         LDA   WORK,Y
         EOR   (CHECK),Y   ;do they match?
         BMI   SGDIF       ;no, special
```

An EOR (Exclusive OR) is an excellent way to check if the high bits match. If they are different, the EOR'd result will have a high bit on, and the N flag will be set. Thus, BMI will branch on unequal signs.

If we didn't branch, the signs are the same. We still need to note the sign, since negative numbers will sort "backward" compared to positive numbers.

```
         LDA   WORK,Y      ;yes, log
         STA   SIGN        ;.. the sign
```

Now for the comparison. Quite straightforward coding.

```
* COMPARE UNSIGNED VALUE
         LDY   #0          ;compare bytes
CLOOP    LDA   WORK,Y      ;from left
         CMP   (CHECK),Y   ;to right
         BNE   CEXIT       ;quit not equal
         INY
         CPY   #5
         BCC   CLOOP
```

At this time, the C flag (carry) will tell us how the comparison went. But if the numbers are negative, we must invert the comparison result. By switching the carry flag into the high bit of the accumulator, using EOR again, and sliding the high bit back into the carry, we can do the job neatly.

```
* INSERT SIGN DATA
CEXIT    ROR               ;carry to hi-bit
         EOR   SIGN        ;flip if negative
         ASL               ;back to carry
         RTS
```

If the signs are different, we don't need to do the main comparison. The negative value is smaller, of course.

```
* DIFFERING SIGNS - SPECIAL CHECK
SGDIF    LDA   (CHECK),Y   ;get sign
         ASL               ;switch to carry
         RTS
```

That's the whole program. Note that the subroutines are called only once. In principle, we could have written the program into a single mainstream. The subroutines tend to break up the logic into neat modules, however.

Note that the comparison subroutine COMPAR always returns the result of the comparison in the Carry flag. That's where it belongs: Carry is the natural flag for signaling less-than or greater-equal-than. We might have used the N flag instead of the C flag to signal the result; this would have saved us two bytes (two ASL instructions), but it seems less comfortable than the traditional Carry.

BASIC Demonstration

The program can be typed in as a BASIC module on the Commodore 64. Since the machine language portion will end up at address $C000 (decimal 49152), be sure you don't have any special software up there.

```
10 FORI=49152TO49344                    :rem 126
20 READ A:CK=CK+A                       :rem 190
30 POKE I,A:NEXT                        :rem 193
40 IFCK<>24165THENPRINT"TYPING ERROR IN D
   ATA STATEMENTS"                       :rem 27
49152 DATA 160,5,177,47,170,200,177
                                        :rem 198
49159 DATA 47,168,208,1,202,136,140
                                        :rem 198
49166 DATA 61,3,142,62,3,24,165         :rem 250
49173 DATA 47,105,7,141,63,3,133        :rem 43
49180 DATA 251,165,48,105,0,141,64
                                        :rem 142
49187 DATA 3,133,252,24,165,251,105
                                        :rem 194
49194 DATA 5,133,251,165,252,105,0
                                        :rem 140
49201 DATA 133,252,160,4,177,251,153
                                        :rem 237
49208 DATA 67,3,136,16,248,32,83        :rem 56
49215 DATA 192,172,61,3,208,3,206       :rem 92
49222 DATA 62,3,206,61,3,208,217        :rem 38
49229 DATA 173,62,3,208,212,96,165
                                        :rem 156
49236 DATA 251,133,253,165,252,133,254
                                        :rem 90
49243 DATA 56,165,253,233,5,133,253
                                        :rem 199
49250 DATA 165,254,233,0,133,254,165
                                        :rem 243
49257 DATA 253,237,63,3,165,254,237
                                        :rem 210
49264 DATA 64,3,144,25,32,154,192       :rem 99
49271 DATA 176,20,160,4,177,253,72
                                        :rem 150
49278 DATA 136,16,250,160,5,104,145
                                        :rem 195
49285 DATA 253,200,192,10,144,248,176
                                        :rem 44
49292 DATA 206,160,5,185,62,3,145       :rem 99
49299 DATA 253,200,192,10,208,246,96
                                         :rem 1
49306 DATA 160,1,185,67,3,81,253        :rem 49
49313 DATA 48,26,185,67,3,141,72        :rem 55
49320 DATA 3,160,0,185,67,3,209         :rem 247
49327 DATA 253,208,5,200,192,5,144
                                        :rem 144
49334 DATA 244,106,77,72,3,10,96        :rem 52
49341 DATA 177,253,10,96                :rem 172
```

Once the machine language is in place, we can demonstrate the program with a random number generator. After the first program run, the machine language program remains in place and RUN 900 allows another try.

```
899 REM RANDOM NUMBER GENERATOR         :rem 191
900 INPUT"NUMBER IF ITEMS";X            :rem 218
910 J=RND(0):X=X-1:DIMA(X)               :rem 9
920 FORJ=0TOX                           :rem 52
930 A(J)=RND(1)*50-20                   :rem 57
940 NEXTJ                               :rem 38
950 FORJ=0TOX:PRINTA(J);:NEXTJ:PRINT
                                        :rem 159
960 PRINT:PRINT                         :rem 243
970 SYS12*4096                          :rem 255
980 FORJ=0TOX:PRINTA(J);:NEXT:PRINT
                                        :rem 88
```

Applesoft Searcher

Ilan Reuben

Here's a short but very handy (and fast) programming utility written entirely in machine language. With it, you can instantly locate key statements and phrases in your programs. It works on any Apple with at least 48K RAM and a disk drive.

Many BASIC programs are constructed and debugged by adding new sections and routines to existing sections and routines. As a result, these programs can become excessively long and complex. Debugging becomes a real mess when you have to sift through 2000 lines of BASIC to find a certain routine or statement.

"Applesoft Searcher" is a machine language utility which will scan any BASIC program for all the references to a phrase you specify, and tell you where each reference is—all in the blink of an eye. The machine language program itself is just over a page (256 bytes) in length, and resides at memory location 36864 ($9000 in hexadecimal). If you know little or nothing about machine language, don't worry; you can use Applesoft Searcher as long as you can type in a BASIC program and follow a few simple directions.

Using The Searcher

First, let's get Applesoft Searcher up and running. If you feel more comfortable with BASIC and would like to load the utility as a BASIC program, type in Program 1, the BASIC loader. It's a good idea to save it just in case. Now run it. This puts the machine language portion of the utility into memory, and it remains there even after you erase the BASIC loader. Next, save the machine language portion on disk by typing:

```
BSAVE SEARCHER, A$9000, L$109
```

If you'd rather enter Searcher into the computer directly, you can use the monitor listing (Program 2) and save it as shown above. In the future, to load Searcher from disk, type:

```
BLOAD SEARCHER
```

Once you have it in memory, you must set the & vector to the start of the program. This lets you run Searcher every time you type &. From BASIC, type:

```
POKE 1014,0: POKE 1015,144
```

or from the monitor type:

```
3F6:0 90
```

Searcher should now be ready to use. Here is a sample BASIC program to show how it works.

```
10  PRINT "THIS IS A TEST"
20  FOR A = 1 TO 10
30  PRINT A + 10
40  NEXT A
```

Suppose you want to find all the references to the variable A in the program. You would type:

```
& A
```

and the computer would respond with:

```
FOUND AT LINE 10
FOUND AT LINE 20
FOUND AT LINE 30
FOUND AT LINE 40
```

To find all the lines in which the number 10 appears, type:

```
& 10
```

Searcher will hunt through the program and report:

```
FOUND AT LINE 20
FOUND AT LINE 30
```

Notice that line 10 was not included even though there is a 10 in its line number. This is because Searcher ignores line numbers.

Selective Searching

To specify a range of lines for Searcher to look through, type # after the & along with the starting and ending line numbers and the phrase to search for:

```
$ #20,30,PRINT
```

This would search lines 20 through 30 for a PRINT statement.

One more thing about Searcher: It must be used only in direct mode, not in deferred mode (that is, you cannot call it from a BASIC program). If you try, the message ?NOT DEFERRED COMMAND ERROR will be displayed.

If you'd like to have Applesoft Searcher ready to use every time you boot your system, type in the BASIC setup routine (Program 3) and use it as a hello program when initializing disks. Just make sure that you've got the machine language for Searcher saved on that disk.

Program 1: Applesoft Searcher (BASIC Loader)

```
10  FOR X = 36864 TO 37129
20  READ Y:CK = CK + Y
30  POKE X,Y
40  NEXT X
50  IF CK <  > 36799 THEN  PRINT "CHECK
      DATA STATEMENTS FOR TYPING ERRORS
    "
100 DATA 165,185,201,2,240,11,169,15,3
    2,204
110 DATA 144,32,25,237,76,60,212,32,18
    3,0
120 DATA 201,35,208,40,32,177,0,32,103
    ,221
130 DATA 32,82,231,165,80,133,8,165,81
    ,133
140 DATA 9,32,190,222,32,103,221,32,82
    ,231
150 DATA 165,80,133,10,165,81,133,11,3
    2,190
160 DATA 222,76,75,144,160,0,132,8,132
    ,9
170 DATA 136,132,10,132,11,160,255,198
    ,184,32
180 DATA 177,0,201,34,208,8,165,193,73
    ,233
190 DATA 133,193,169,34,200,153,10,145
    ,201,0
200 DATA 208,233,132,6,169,239,133,193
    ,165,8
210 DATA 133,80,165,9,133,81,32,26,214
    ,169
220 DATA 3,133,7,230,7,164,7,162,0,177

230 DATA 155,240,27,221,10,145,208,241
    ,200,232
240 DATA 228,6,208,241,169,0,32,204,14
    4,160
250 DATA 2,177,155,170,200,177,155,32,
    36,237
260 DATA 160,0,177,155,72,200,177,155,
    133,156
270 DATA 104,133,155,177,155,240,10,16
    0,3,177
280 DATA 155,197,11,240,8,144,188,169,
    141,32
290 DATA 240,253,96,136,177,155,197,10
    ,240,175
300 DATA 144,173,176,239,170,169,141,3
    2,240,253
310 DATA 189,222,144,240,6,32,240,253,
    232,208
320 DATA 245,96,198,207,213,206,196,16
    0,193,212
330 DATA 160,204,201,206,197,160,0,135
    ,191,206
340 DATA 207,212,160,196,197,198,197,2
    10,210,197
350 DATA 196,160,195,207,205,205,193,2
    06,196,160
360 DATA 197,210,210,207,210,0
```

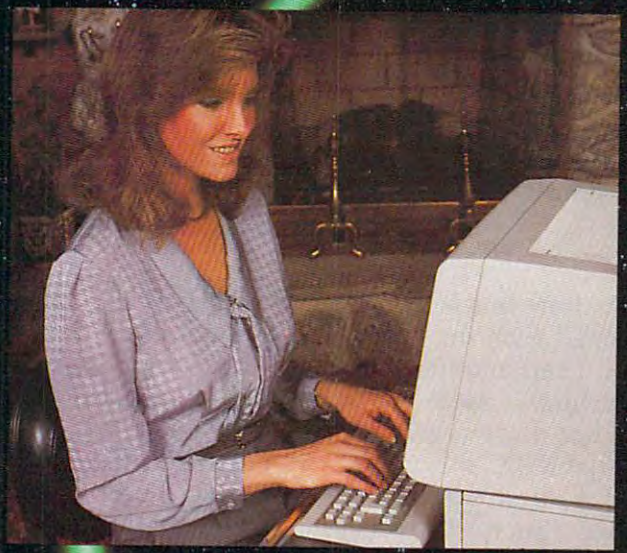
Program 2: Applesoft Searcher (Monitor Listing)

```
9000- A5 B9 C9 02 F0 0B A9 0F
9008- 20 CC 90 20 19 ED 4C 3C
9010- D4 20 B7 00 C9 23 D0 28
9018- 20 B1 00 20 67 DD 20 52
9020- E7 A5 50 85 08 A5 51 85
9028- 09 20 BE DE 20 67 DD 20
9030- 52 E7 A5 50 85 0A A5 51
9038- 85 0B 20 BE DE 4C 4B 90
9040- A0 00 84 08 84 09 88 84
9048- 0A 84 0B A0 FF C6 B8 20
9050- B1 00 C9 22 D0 08 A5 C1
9058- 49 E9 85 C1 A9 22 C8 99
9060- 0A 91 C9 00 D0 E9 84 06
9068- A9 EF 85 C1 A5 08 85 50
9070- A5 09 85 51 20 1A D6 A9
9078- 03 85 07 E6 07 A4 07 A2
9080- 00 B1 9B F0 1B DD 0A 91
9088- D0 F1 C8 E8 E4 06 D0 F1
9090- A9 00 20 CC 90 A0 02 B1
9098- 9B AA C8 B1 9B 20 24 ED
90A0- A0 00 B1 9B 48 C8 B1 9B
90A8- 85 9C 68 85 9B B1 9B F0
90B0- 0A A0 03 B1 9B C5 0B F0
90B8- 08 90 BC A9 8D 20 F0 FD
90C0- 60 88 B1 9B C5 0A F0 AF
90C8- 90 AD B0 EF AA A9 8D 20
90D0- F0 FD BD DE 90 F0 06 20
90D8- F0 FD E8 D0 F5 60 C6 CF
90E0- D5 CE C4 A0 C1 D4 A0 CC
90E8- C9 CE C5 A0 00 87 BF CE
90F0- CF D4 A0 C4 C5 C6 C5 D2
90F8- D2 C5 C4 A0 C3 CF CD CD
9100- C1 CE C4 A0 C5 D2 D2 CF
9108- D2 00
```

Program 3: Applesoft Searcher (Hello Program)

```
10 D$ =  CHR$ (4): REM CTRL-D
20  PRINT D$"BLOAD SEARCHER"
30  POKE 1014,0: POKE 1015,144
40  REM ^ SET & VECTOR ^
50  PRINT "'SEARCHER' ENABLED"
```

LOVE AT FIRST BYTE



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Donald B. Trivette

Christmas Shopping For An IBM

Here's a one-line BASIC program that's sure to put panic in the hearts of holiday shoppers:

```
10 M=VAL(MID$(DATE$,1,2)):D=VAL(MID$(DATE
   $,4,2)):IF M=11 THEN D=55-D:PRINT D
   ELSE D=25-D:PRINT D
```

Can you figure out what it does? While you're working on that, let's talk Christmas shopping. For those friends or relatives on your Christmas list with an IBM Personal Computer, finding just the right gift may be easier than you think.

Computer programs make great holiday gifts. Well, some computer programs make good gifts. Others don't. The selection of a word processing, financial, or spreadsheet program is very much a matter of personal choice and taste. Don't give *DisplayWrite* or *VisiCalc* to someone unless it is on his or her Christmas list. For a surprise gift, stick with less expensive, one-of-a-kind software.

Subtle Intelligence-Gathering

Before we get to some specific ideas, you should do a little research. (Especially if you don't know much about computers and someone clipped this article as a hint. Otherwise you may skip this section.)

First, find out exactly which computer the intended recipient of your gift actually owns. Is it an IBM PC, PCjr, PC-XT, or Portable PC? It will be embarrassing if you buy a PCjr cartridge program for someone who owns a PC, for instance, because the PC has no cartridge slots. Perhaps you can work this query into dinner-table conversation: "Mother's coming a week early for the holidays . . . could you move the computer out of the spare bedroom? What kind is it, anyway?" If the answer is the name of a fruit, you are consulting the wrong column; otherwise, press for more information. "She's bringing her cats . . . by the way, how much memory does it have?"

Armed with the model and amount of memory, you need another fact: "Can that thing draw color pictures?" Here you're trying to find out if the PC has a color/graphics board. (The PCjr and Portable PC include this as a standard feature.) If it doesn't have a color/graphics board, it's called a monochrome system, and certain programs won't work on it.

Finally, it's important to know if the computer has a disk drive—almost all PCs do—but you won't have to ask about that. Snoop around the machine for evidence. If you find paper envelopes about 5-1/2 × 4-1/2 inches that say *disk* or *diskette* on them, you can be sure the machine has a disk drive. (Either that, or the person is hinting heavily that he *wants* a disk drive.)

By now, you've gathered the four basic (very basic) facts you need to know to purchase a program for an IBM computer: the model of the computer, the amount of memory it has, whether it is equipped for color graphics, and if it has a disk drive. For example, let's say your relative or friend has an IBM PCjr with 128K of memory (memory always comes in K's, for *kilobytes*)—and you've found the telltale envelopes that mean a disk drive. With this information you can visit a local dealer and make your selection. Your gift still may not make the person jump for joy, but at least the computer won't choke on it.

Software Suggestions

If you're stuck for an idea, I can pass on a few hints. While the following summaries aren't full-blown reviews and don't necessarily represent endorsements by COMPUTE!, they are based on my experience with the products.

ProKey is a program that works along with other software. It allows you to redefine the keys on the keyboard to have whatever meaning you'd like. For example, instead of typing four

lines of difficult-to-remember commands to start a program, you can have *ProKey* enter those lines every time you hold down the Alt key and press the A key. *ProKey* is one of those programs you don't appreciate until you've used it—then you don't want to be without it. (*ProKey 3.0* from RoseSoft; for the PC, PCjr, PC-XT; requires 64K memory, disk drive, color or monochrome; $130.)

The *Norton Utilities* is a collection of programs that allow you to examine, modify, and manipulate disk files. Unless you are interested in the complexities of disk storage, this package will sit on the shelf collecting dust—until you do the unthinkable and accidentally erase an important file. Then the UnErase program can bring it back, saving you hours or days of work. You don't need the *Norton Utilities* until something goes wrong, then you'll be awfully glad you have them. (*Norton Utilities* by Peter Norton; for the PC, PCjr, PC-XT; requires 64K memory, disk drive, color or monochrome; $80.)

Disk Drive Analyzer is an inexpensive program that tests the disk drive hardware for alignment, speed, clamping, and read/write performance, and then reports problems and potential problems. It's a program that a computer owner might not buy for himself, but which he would surely love to have. (*Disk Drive Analyzer* by Verbatim Products; for the PC, PC-XT; requires 64K memory, disk drive, color or monochrome; $40.)

Just For Fun

The programs mentioned so far could qualify as tax deductions for someone in business, and therefore might not be ideal presents. But one does not compute for practicality alone. Computer games make wonderful gifts and certainly would not be deductible. Here are three family games for consideration.

Microsoft Flight Simulator has been at the top of software best-seller lists for a long time—and with good reason. It's a realistic program that puts you in the cockpit of a Cessna 182. Even if you fear flying, you'll enjoy this program. (*Microsoft Flight Simulator* by Microsoft; for the PC, PC-XT with 64K memory, disk drive, and color/graphics; PCjr with 128K memory and disk drive; $49.95. Be sure to get the latest version which works on all types of monitors.)

Ultima II is an adventure game. You roam around the Ultima universe seeking to find and conquer the evil Enchantress. Along the way you must fend off all manner of strange characters, including Orcs, thieves, wizards, and even sea monsters. Since the adventure can easily last weeks, *Ultima* lets you save a game in progress and pick it up later. (*Ultima II* by Sierra On-Line; for the PC, PC-XT with 64K memory, disk drive, and color/graphics; PCjr with 128K and disk drive; $60.)

Championship Boxing puts you in the ring with the boxer of your choice—Duran? Leonard? Hearns?—to slug out your aggressions. Sixty of the greatest boxers are included. If you're too tired to step into the ring, you can match any two fighters and whisper strategy from the corner. A great game for a sports fan. (*Championship Boxing* by Sierra On-Line; for the PC, PC-XT with 64K memory, disk drive, and color/graphics; PCjr with 128K and disk drive; $35.)

Hardware And Accessories

Software isn't your only choice for a computer gift. Consider hardware and accessories.

Computer users can never have too many blank disks. Disks generally cost $20 to $35 for a box of ten. There are dozens of brands, but there's not a great deal of difference. Any brand labeled DS/DD (double-sided, double-density) and "soft-sectored" will work in any of the IBM PC-family computers. A related gift is a smoked-plastic storage box that holds 50 disks (about $35).

Books always make good gifts. *The Naked Computer* by Rochester and Gantz (William Morrow & Co., $15.95) is a 335-page almanac of computer facts and trivia. *Sing a Song of Software* by Soltzberg (William Kaufmann, Inc., $9.95) is a light-hearted book of computer graphics and verse:

> *Who wrote this code so long ago?*
> *I feel as if I know her, though*
> *We've never met nor shared a word*
> *Of pleasure at this program's flow.*

(Only modesty, good taste, and a picky editor prevent me from recommending my own book: *A BASIC Primer for the IBM PC*, Scott, Foresman & Co., $18.95.)

Of course, an excellent gift is an IBM PC or PCjr. If you're planning to give a computer—and retailers say quite a few of you are—then please include at least one computer program. There's nothing worse on Christmas morning than receiving a shiny new computer without a program to run on it. That's like getting a camera without film or a GI Joe Walkie Talkie without a battery.

A word about retail prices. Almost all computer programs can be purchased at a substantial discount from mail-order firms, though you may prefer the personalized service and assistance that a local dealer can provide. With the Christmas mail crunch, you may not have time to take advantage of these lower prices, unless you ask for express shipping. The BASIC program at the beginning of this article will tell you exactly how many days you *do* have. ©

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(more power than Apple II at 1/3 the price)

$188.00*

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80 COLUMN BOARD $99.00
Now you program 80 COLUMNS on the screen at one time! Converts your Commodore 64 to 80 COLUMNS when you plug in the 80 COLUMN EXPANSION BOARD!! PLUS 4 slot expander! Can use with most existing software.

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This EXECUTIVE WORD PROCESSOR is the finest available for the COMMODORE 64 computer! The ULTIMATE FOR PROFESSIONAL Word Processing DISPLAYS 40 or 80 COLUMNS IN COLOR or Black and White! Simple to operate, powerful text editing with 250 WORD DICTIONARY, complete cursor and insert/delete key controls line and paragraph insertion, automatic deletion, centering, margin settings and output to all printers! Includes a powerful mail merge.

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Accounting Pack	$49.00	$39.00	$29.00
Practicalc	$59.95	$44.95	$36.95
Programmers Reference Guide	$20.95	$16.95	$12.50
Programmers Helper (Disk)	$59.95	$39.95	$29.95
80 Column Screen (Disk)	$59.95	$39.95	$29.95
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Easy to use. Just plug into your Commodore 64 computer and you're ready to transmit and receive messages. Easier to use than dialing your telephone just push one key on your computer! Includes exclusive easy to use program for up and down loading to printer and disk drives. List $129.00 **SALE $79.00.**

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For Com-64 or VIC-20 computers. Just plug it in and your can program words and sentences, adjust volume and pitch, make talking adventure games, sound action games and customized talkies!! FOR ONLY $19.95 you can add TEXT TO SPEECH, just type a word and hear your computer talk—ADD SOUND TO "ZORK", SCOTT ADAMS AND AARDVARK ADVENTURE GAMES!! (Disk or tape).

COM-64 POWER FOR VIC-20 $69.00
Just plug in our 32K RAM MEMORY EXPANDER and you get as much usable programming power as the Commodore-64 computer!! Master control switches on cover. Gold Edge connectors, five year warranty (FREE $29.95 CARTRIDGE GAME).

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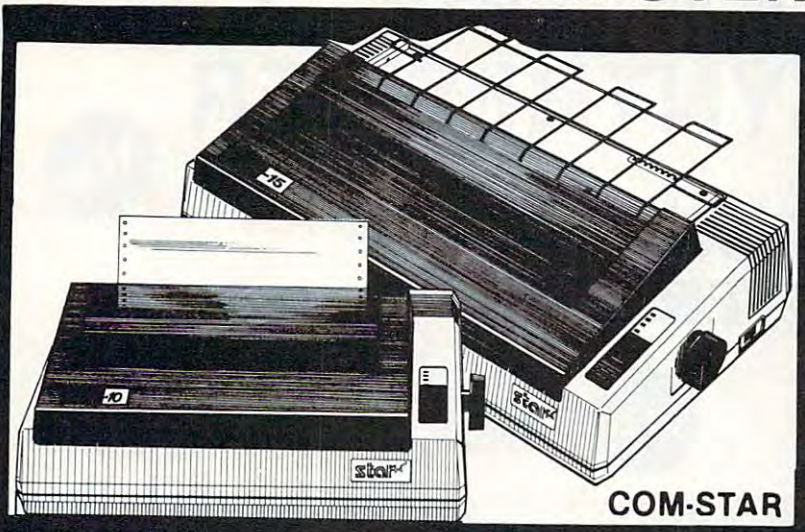

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Commodore 64

(Modem)

Sale

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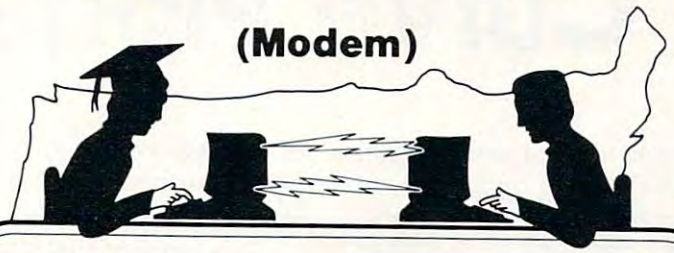

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Conic Curve Plotter

Lam-hing Wong

The Commodore 64 is a versatile and powerful computer, but its built-in BASIC has no commands for drawing high-resolution graphics. Here's a program that makes it easier to draw in hi-res by providing commands for a variety of geometric figures.

"Conic Curve Plotter" lets you create lines, angles, arcs, circles, ellipses, parabolas, and hyperbolas on the Commodore 64's high-resolution graphics screen at the touch of a key. It also lets you draw with the joystick and save your pictures on tape or disk.

The 64's hi-res screen normally has 320 horizontal pixels (screen dots) by 200 vertical pixels. In early versions of this program, lines looked like they were at off-angles and circles looked squashed. After taking some measurements with a ruler, I discovered that the length of 9 pixels vertically is equal to the width of 11 pixels horizontally. No wonder things looked skewed.

To remedy this problem, here are three types of screens. Screen 1 is the normal high-res screen with 320 pixels horizontally and 200 vertically. The dimensions of Screen 2 are 320 horizontal and 244 vertical (multiplying the normal vertical length by 11/9). If you want your drawings to appear undistorted, choose Screen 2. Screen 3 allows you to define your own dimensions. For example, you can stretch the drawing horizontally by setting the dimensions to 320 horizontal and 488 vertical.

The screen boundaries are checked for in all drawing modes except the joystick mode. When drawing lines, parabolas, or hyperbolas, the drawing can be stopped manually; otherwise, it stops when it reaches a border. When drawing

Figure 1: Demo-Screen 1

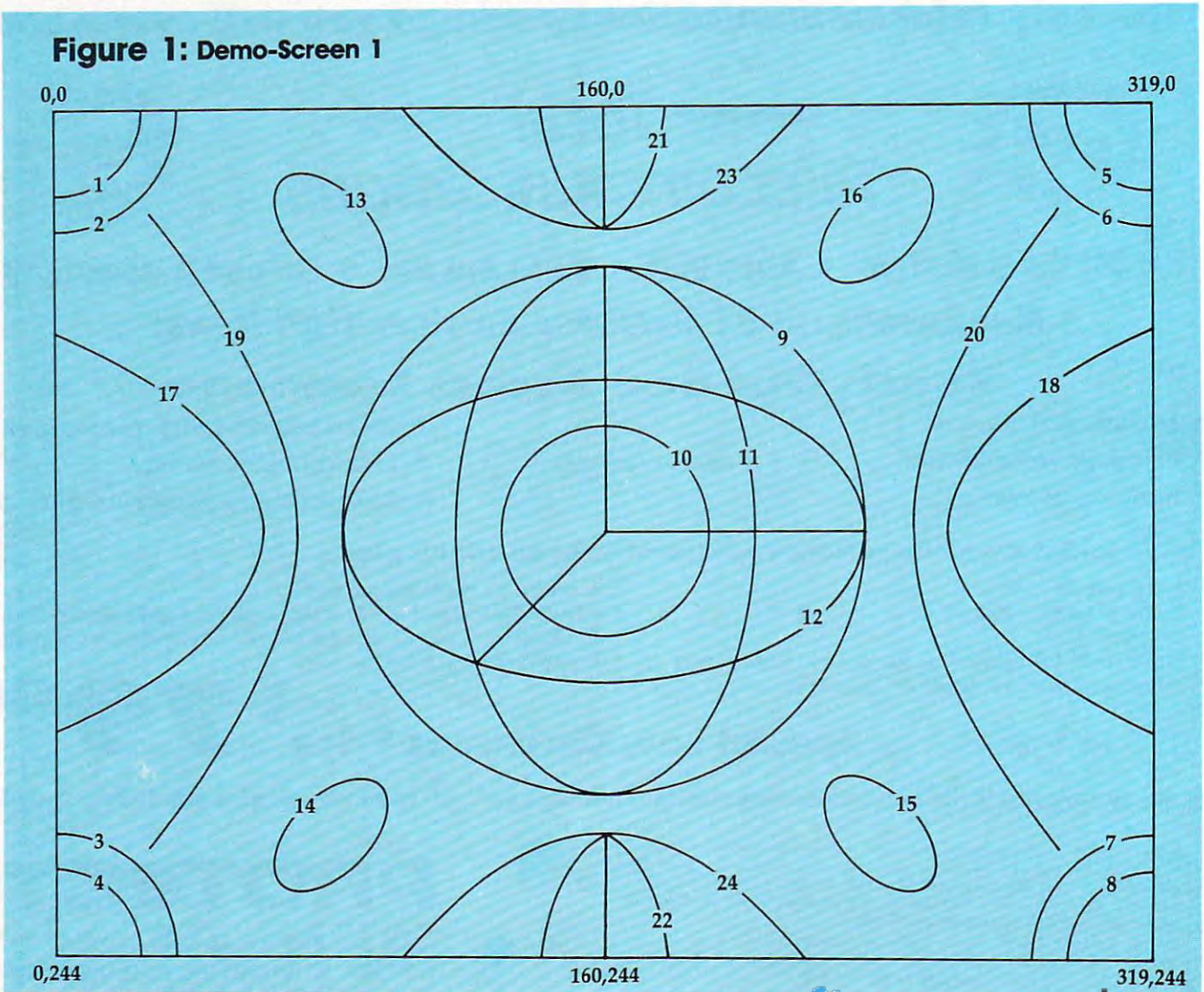

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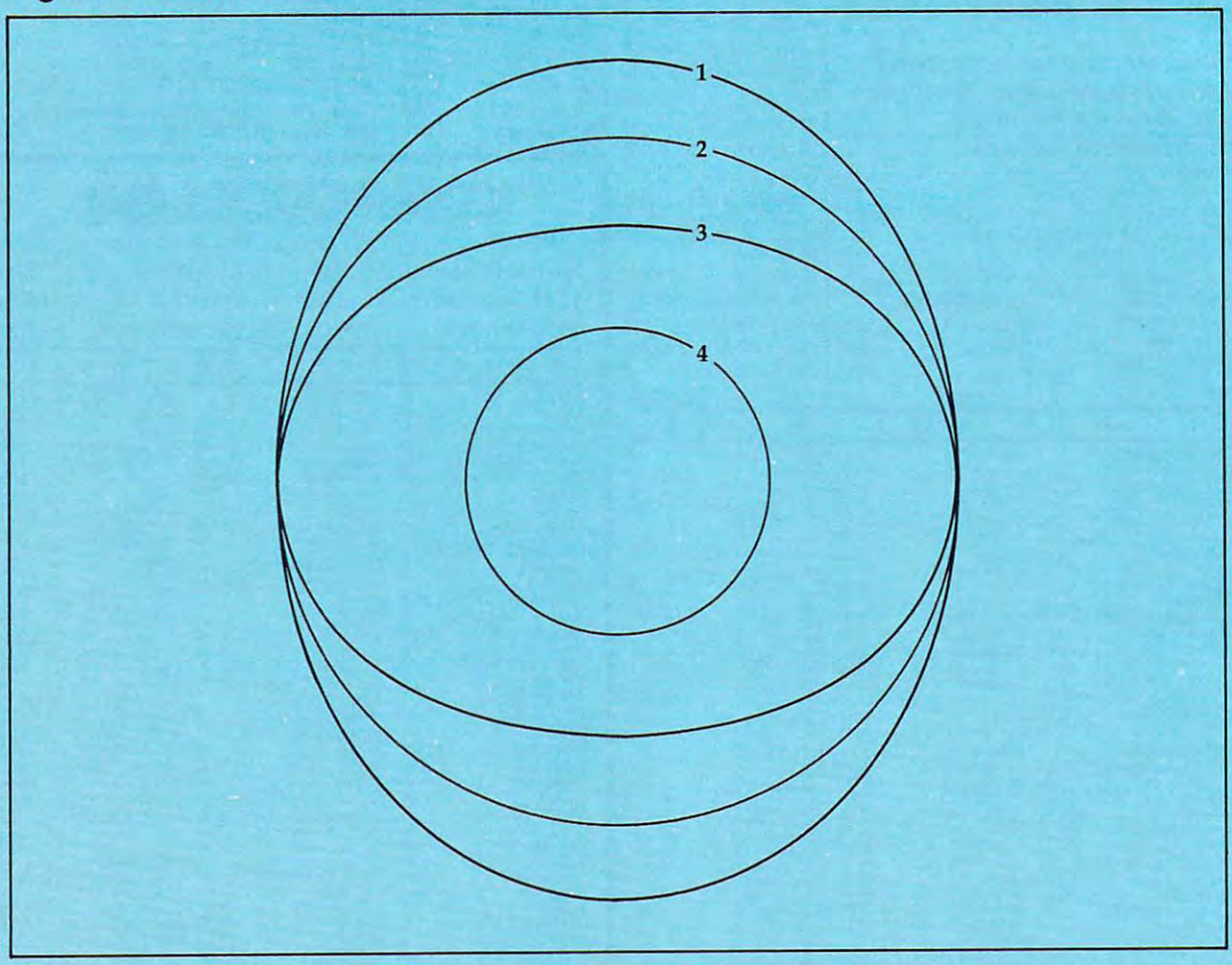
Figure 2: Demo-Screen 2



circles, arcs, or ellipses, you cannot stop the drawing manually. You can speed up the drawing by bypassing the boundary check routine. To do this, change these lines to REM statements: 638, 852, 975, and 4500. But be careful that the drawing does not go beyond the top border of the screen. If it does, the program might crash.

Originally, the program was written entirely in BASIC. It took 27 seconds to erase the high-resolution screen (POKEing locations 8192–16191 with 0), three seconds to set the bitmap background color to cyan (POKEing locations 1024–2023 with 3), and 25 minutes to save or load the screen on tape (using PRINT# and GET#). These time-consuming routines were replaced with machine language, and now clearing the screen and setting the background color are instantaneous. Using Kernal routines to save and load the screen on tape takes about four minutes.

Setting Things Up

At the beginning of the program, you are asked to select a type of screen. After you make your selection, the screen will clear and the high-res cursor (a small dot) will appear in the center. You are now ready to draw your picture using any of the one-key commands.

Several commands require that you enter additional information such as a screen position or angle. Screen position is specified by entering the X and Y coordinates. X is measured horizontally from the left of the screen. Y is measured vertically from the top of the screen. The top-left corner of the screen is position (0,0). Since the program does not check the coordinates of the points that you enter, be sure to confine them to the screen dimensions you have chosen. Angles are specified in degrees measured counterclockwise from the horizontal.

One-Letter Commands

Pressing A draws a line at a specified angle. You will be prompted for the starting point and the angle. The cursor will keep moving until it reaches the border or until you stop it by pressing any key.

Pressing O draws a line between two points. You will be prompted for the starting and ending points. The cursor can be stopped by pressing the f1 key. Pressing the f3 key switches the

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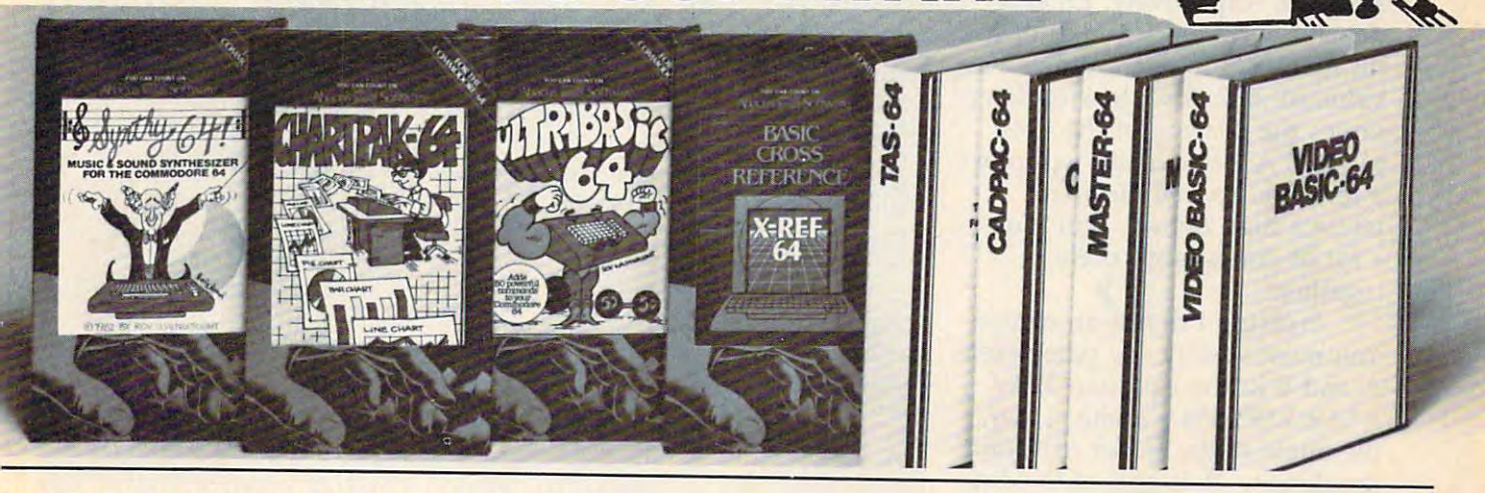

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draw/erase modes and reverses the direction of the cursor.

C draws a circle or arc. You must specify the radius, center, starting angle, ending angle, and density. To draw a circle, the starting and ending angles are 0 and 360, respectively. Enter a density between .1 and 1, or just hit RETURN to use the default value of .667. The density determines the spacing of the dots plotted. A low density will plot a few dots spaced far apart, while a high density will plot a lot of dots spaced close together.

Pressing I draws an ellipse. You must specify the parameters A and B in the equation X*X/A*A+Y*Y/B*B=1, the center, the angle of the major axis, and the density. A is half of the major (long) axis and B is half of the minor (short) axis. If A and B are equal, a circle will be drawn with A and B equal to the radius.

P draws a parabola. You will be prompted for the parameter A in the equation X=A*Y*Y, the vertex, the angle of the axis of symmetry, and the density. You can stop the drawing manually by pressing any key.

H draws a hyperbola. You must specify the parameters A and B in the equation X*X/A*A−Y*Y/B*B=1, the center, the angle of the transverse axis, and the density. Again, you can stop the drawing by pressing a key.

Q queries the location of the cursor, type of screen, and screen dimensions.

T changes the type of screen. This command is executed automatically at the beginning of the program. The previous drawings will not be affected.

M moves the cursor to a specified point. The CLR/HOME key moves the cursor to the top-left corner. Pressing SHIFT–CLR/HOME clears the screen and moves the cursor to the top-left corner.

S saves the screen to tape or disk. L allows you to reload a previously saved screen.

The / key ends the program. To restart the program, type GOTO 15. The previous drawings will not be lost.

Table 1: Demo-Screen 1

This table lists the data entered when drawing the curves on Demo-Screen 1. The screen dimensions are 320 × 244 (type 2).

Type Of Curve	Curve No.	Center Or Vertex	Parameters		Angles Init.	Angles Final	Density Of Points
arc	1	(0,0)	R=25		270	360	0.2
arc	2	(0,0)	R=35		270	360	0.2
arc	3	(0,244)	R=35		0	90	0.8
arc	4	(0,244)	R=25		0	90	0.8
arc	5	(319,0)	R=25		180	270	0.4
arc	6	(319,0)	R=35		180	270	0.4
arc	7	(319,244)	R=35		90	180	0.6
arc	8	(319,244)	R=25		90	180	0.6
circle	9	(160,123)	R=75		0	360	1.0
circle	10	(160,123)	R=30		0	360	0.1
			A:	B:	betw. major axis & horizontal:		
ellipse	11	(160,123)	75	40	90		0.667
ellipse	12	(160,123)	75	40	0		0.667
ellipse	13	(80,35)	20	13	135		0.2
ellipse	14	(80,210)	20	13	45		0.667
ellipse	15	(239,210)	20	13	135		0.4
ellipse	16	(239,35)	20	13	45		0.3
hyperbola	17,18	(160,123)	100	75	0		
hyperbola	19,20	(160,123)	85	73	0		
parabola	21	(160,40)	A=0.1		90		
parabola	22	(160,206)	A=0.1		270		
parabola	23	(160,40)	A=0.01		90		
parabola	24	(160,206)	A=0.01		270		

I used the O command to draw three lines that form the Cartesian coordinates. The starting and ending points are:

From (125,168) to (160,123)
From (160,123) to (160,48)
From (160,123) to (235,123)

You can use either the O command or the A command to draw the border lines and the axes of symmetry for the parabolas easily.

The program is divided into two parts. Program 1 POKEs the machine language routines into memory, and Program 2 is the main program. After you have the programs typed in and saved, you can activate "Conic Curve Plotter" by loading and running Program 1, then loading and running Program 2.

Programs 1 and 2 are designed for loading from and saving to tape. If you are using disk instead, make the modifications shown in Programs 3 and 4. Program 3 shows which lines must be changed in Program 1, and Program 4 gives the modifications for Program 2.

Sample Runs

To give you a better idea of how to use the program, Table 1 contains the information used to draw the curves shown in Figure 1. Figure 2 illustrates the effect of using different screen dimensions. Four circles were drawn using the C

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Table 2: Demo-Screen 2

On this screen, four shapes were drawn using the C command. Between drawings, the T command was used to redefine the screen dimensions.

Curve No.	Center	Radius	Density Of Points	Screen Dimensions
1	(160,100)	R=90	0.2	320 × 200
2	(160,123)	R=90	0.4	320 × 244
3	(160,160)	R=90	0.667	320 × 320
4	(320,244)	R=90	0.667	640 × 488

command. Between drawings, the T command was used to change the screen dimensions. The parameters used for each curve are given in Table 2.

The following is a line-by-line explanation of Program 2.

Lines	Explanation
14	Call machine language routine to clear high-res screen.
17	Turn on text mode.
18-19	Read joystick directional values.
20-30	Define screen dimensions.
35	Call machine language routine to turn on bitmap mode and set background color to cyan.
40-42	Define functions that calculate BY,BI given X,Y.
90-190	Joystick routine.
300-350	Check-boundary routine.
400-410	Take away the erased bit and POKE the byte with the remaining bits. Called whenever something needs to be erased.
600-640	Command A routine.
638	Call boundary-check routine.
800-860	Parabola routine.
900-990	Hyperbola routine.
960-972	Calculate and plot points on four branches.
1000-1190	Command O routine.
1100-1110	Determine horizontal and vertical increments: DX & DY.
1170-1176	Check to see if one component (x or y) has reached the end point.
1180	If S$ is f1, stop.
1182	If S$ is f3, reverse everything.
1200-1230	Command M routine.
1300-1400	Obtain data to draw circle, arc, or ellipse.
1405-1492	Calculate points of circle, arc, or ellipse. Notice that the FOR-NEXT loop is incremented by radians (DR), and that DR is a variable depending on a parameter specified by the user and on the radius.
1520-1550	Draw or erase an ellipse's foci.
3000-3080	Call machine language routines to save the high-res screen.
3100-3110	Call machine language routines to load the high-res screen.
3220-3250	Command Q routine—display cursor and screen dimension information.
4000-4570	This routine calculates points to be plotted or erased (takes rotating into account).
4450-4460	Calculates point positions after the axes were rotated.
4500	Call boundary-check routine.

If you don't want to type in the program, just send me $3, a blank cassette, and a self-addressed, stamped mailer. I will send you the program and two demo-screens along with full documentation.

Lam-hing Wong
5234 Gordon Avenue
El Cerrito, CA 94530

Program 1:
Conic Curve Plotter, Part 1

Refer to "COMPUTE!'s Guide To Typing In Programs" before entering these listings.

```
10 FORI=49360TO49461:READJ:POKEI,J:NEXT
                                    :rem 192
20 FORI=49485TO49623:READJ:POKEI,J:NEXT
                                    :rem 201
30 DATA173,0,192,133,0,173,2,192,133,2,17
   3,3,192,133,3,96,165,3,141       :rem 253
40 DATA3,192,165,2,141,2,192,165,0,141,0,
   192,96,0,165,3,141,3,192,165     :rem 96
50 DATA2,141,2,192,165,0,32,224,192,169,3
   2,133,3,169,0,133,2,133          :rem 101
60 DATA0,164,0,162,0,145,2,230,2,232,224,
   255,208,247,145,2,230,3,169      :rem 37
70 DATA63,197,3,208,227,169,0,162,0,145,2
   ,230,2,232,224,63,208,247,145 :rem 160
80 DATA2,141,63,63,76,208,192       :rem 199
90 DATA32,224,192,169,59,141,17,208,169,2
   8,141,24                         :rem 172
100 DATA208,169,4,133,3,169,0,133,2,133,0
    ,162,0,164,0,169,3,145,2,230    :rem 79
110 DATA2,232,224,255,208,247,145,2,230,3
    ,169,7,197,3,208,225,169,3      :rem 17
120 DATA162,0,145,2,230,2,232,224,231,208
    ,247,145,2,141,231,7,76,208,192
                                    :rem 239
130 DATA0,0,0,0,32,224,192,160,255,162,1,
    169,1,32,186,255,169,0          :rem 49
140 DATA32,189,255,169,0,133,2,169,32,133
    ,3,162,64,160,63                :rem 37
150 DATA169,2,32,216,255,76,208,192,0,0,0
    ,0,0                            :rem 191
160 DATA169,1,162,1,160,255,32,186,255,16
    9,0,32,189,255                  :rem 206
170 DATA169,0,162,0,160,32,32,213,255,96
                                    :rem 217
```

Program 2:
Conic Curve Plotter, Part 2

```
14 SYS 49405                        :rem 106
15 POKE46,71:CLR:BASE=8192          :rem 20
16 X=160:Y=100:N=1:MODE$="DRAW":CP=53272:
   BM=53265:BO=PEEK(53265)AND223    :rem 33
17 POKECP,21:POKEBM,BO:PRINT"{CLR}"
                                    :rem 12
18 DIMX(11):DIMY(11):FORK=0TO10:READX(K),
   Y(K):NEXT                        :rem 47
19 DATA 0,0,0,-1,0,1,0,0,-1,0,-1,-1,-1,1,
   0,0,1,0,1,-1,1,1                 :rem 90
20 PRINTSPC(12)"{RVS}TYPE OF SCREEN:":PRI
   NT                               :rem 119
21 PRINT"1 - 'ORIGINAL SCALE' (320,200)":
   PRINT"2 - 'REVISED SCALE' (320,244)
                                    :rem 253
22 PRINT"3 - 'USER-DEFINED SCALE':rem 132
```

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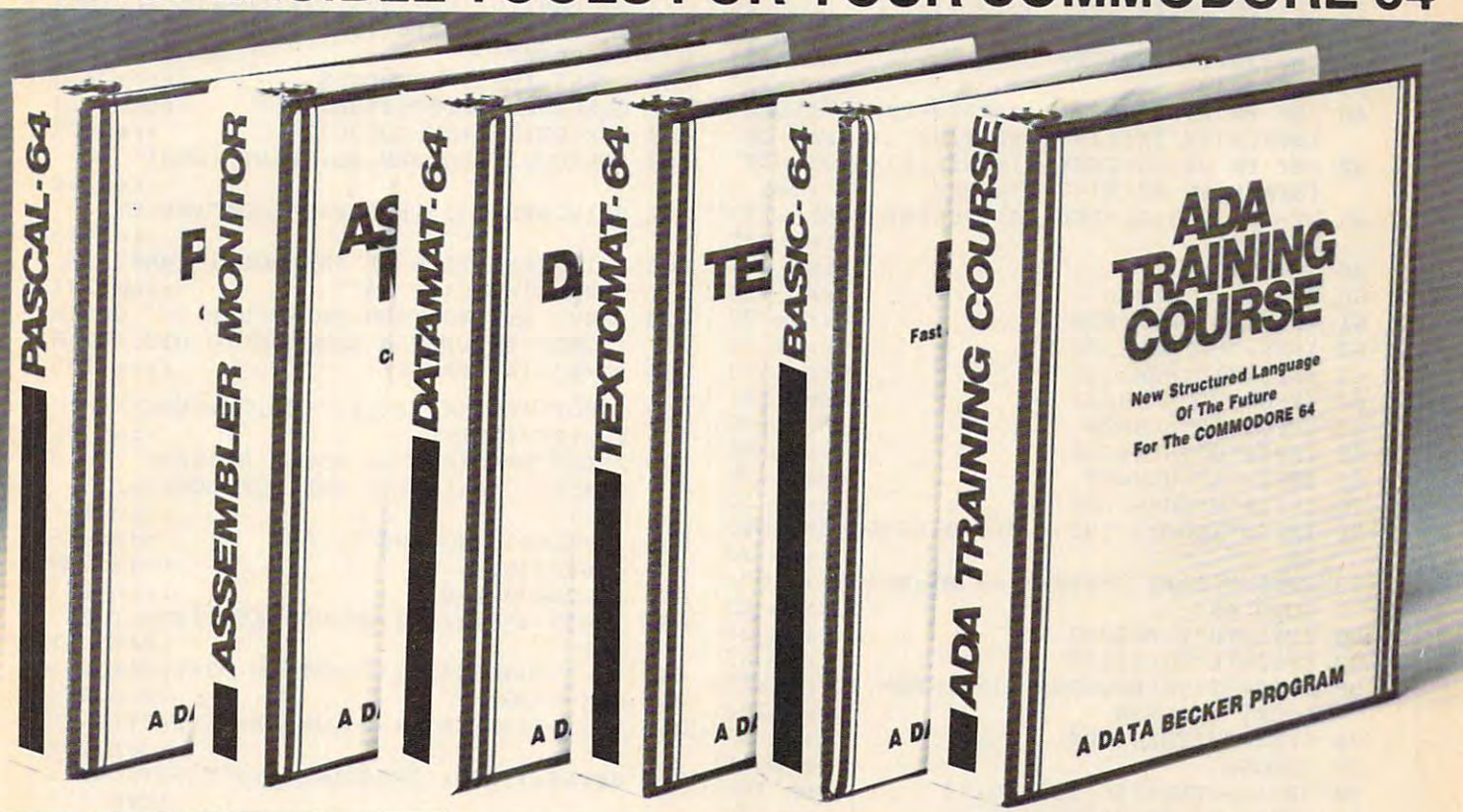

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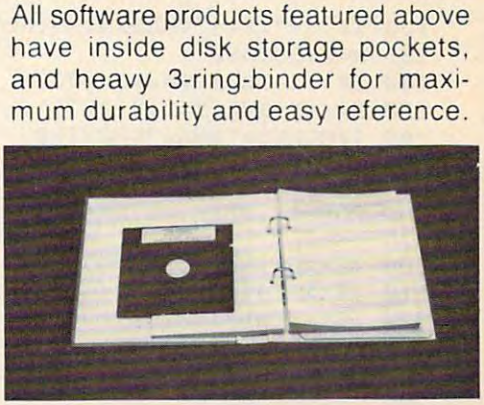

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```
24 PRINT:INPUTSCR:IFSCR=1THENXP=1:YP=1:GO
   TO30                                  :rem 48
26 IFSCR=2THENXP=1:YP=9/11:GOTO30        :rem 83
27 IFSCR=3THENPRINT:INPUT"DIMENSIONS (X,Y
   ):";XM,YM:IFXM=0ORYM=0THEN27          :rem 84
28 XP=320/XM:YP=200/YM:GOTO35            :rem 26
29 GOTO24                                :rem 10
30 XM=320:YM=INT(200/YP)                 :rem 157
35 SYS 49485                             :rem 117
40 DEF FN FY(Y)=INT(Y/8)*320+(YAND7):DEF
   {SPACE}FN FX(X)=8*INT(X/8)            :rem 101
42 DEF FN B1(O)=FNFY(Y)+FNFX(X)+8192:DEF
   {SPACE}FN B2(X)=7-(7ANDX)             :rem 9
45 BY=FNB1(0):BI=FNB2(X):POKEBY,PEEK(BY)O
   R(2↑BI)                               :rem 202
50 GET F$                                :rem 175
60 IFF$="J"THEN90                        :rem 194
61 IFF$="O"THEN1000                      :rem 32
62 IFF$="C"THEN1300                      :rem 24
63 IFF$="I"THEN1320                      :rem 33
64 IFF$="P"THEN800                       :rem 251
65 IFF$="H"THEN900                       :rem 245
66 IFF$="Q"THEN3200                      :rem 43
68 IFF$="A"THEN600                       :rem 238
70 IFF$="M"THEN1200                      :rem 32
76 IFF$="{HOME}"THENX=0:Y=0:GOSUB400:GOTO
   45                                    :rem 24
78 IFF$="{CLR}"THENSYS 49405:X=160:Y=100:
   GOTO 45                               :rem 83
80 IFF$="S"THEN3000                      :rem 39
82 IFF$="L"THEN3100                      :rem 35
86 IFF$="T"THENPOKECP,21:POKEBM,BO:PRINT"
   {CLR}":GOTO20                         :rem 228
88 IFF$="/"THEN5000                      :rem 13
89 GOTO50                                :rem 15
90 J2=15-(PEEK(56320)AND15)              :rem 181
95 GETC$:IF C$=""THEN140                 :rem 42
100 IFC$="D"THENMODE$="DRAW":GOTO140
                                         :rem 123
110 IFC$="E"THENMODE$="ERASE":GOTO140
                                         :rem 191
130 IFC$="{F1}"THENN=1-N:GOTO140         :rem 254
135 N=1:GOTO50                           :rem 45
140 IF J2 OR N THENJV=J2                 :rem 23
150 X=X+X(JV):Y=Y+Y(JV)                  :rem 149
160 IFMODE$="DRAW"THEN180                :rem 230
165 GOSUB400                             :rem 176
180 BY=FNB1(0):BI=FNB2(X)                :rem 172
190 POKEBY,PEEK(BY)OR(2↑BI):GOTO90
                                         :rem 138
300 IFX<0THENX=0:GOTO340                 :rem 228
310 IFX>319THENX=319:GOTO340             :rem 193
320 IFY<0THENY=0:GOTO340                 :rem 232
330 IFY>199THENY=199:GOTO340             :rem 209
335 O=0:GOTO350                          :rem 98
340 O=1                                  :rem 84
350 RETURN                               :rem 120
400 RB=PEEK(BY)-(2↑BI):IFRB<0THENRB=0
                                         :rem 8
410 POKEBY,RB:RETURN                     :rem 57
600 POKECP,21:POKEBM,BO:PRINT"{CLR}"
                                         :rem 58
602 PRINTSPC(8)"{RVS}LINE AT AN ANGLE":PR
    INT                                  :rem 100
606 X$="":Y$="":INPUT"STARTING POINT: (X,
    Y)";X$,Y$:IFX$=""ANDY$=""THEN620
                                         :rem 251
610 IFX=VAL(X$)ANDY=VAL(Y$)THEN615:rem 80
612 GOSUB400                             :rem 173
615 X=INT(VAL(X$)*XP):Y=INT(VAL(Y$)*YP)
                                         :rem 127
620 PRINT:INPUT"ANGLE: ";ANG:ANG=ANG*↑/18
    0                                    :rem 249
625 GOSUB3360                            :rem 233
630 DX=COS(ANG):DY=-SIN(ANG)*YP/XP
                                         :rem 122
632 BY=FNB1(0):BI=FNB2(X):IFD=1THENPOKEBY
    ,PEEK(BY)OR(2↑BI):GOTO635            :rem 125
633 GOSUB400                             :rem 176
635 GETS$:IFS$<>""THEN50                 :rem 135
638 GOSUB300:IFOUT=1THEN50               :rem 119
640 X=X+DX:Y=Y+DY:GOTO632                :rem 77
800 POKECP,21:POKEBM,BO:PRINT"{CLR}"
                                         :rem 60
802 PRINTSPC(13)"{RVS}PARABOLA":PRINT
                                         :rem 33
805 PRINT"EQUATION OF PARABOLA: X=A*Y↑2;
    {SPACE}SPECIFY 'A'"                  :rem 171
810 INPUT A:IFA=0THEN PRINT"USE 'O' OR 'A
    ' CMDS TO DRAW A LINE":GOTO 810:rem 8
818 SG=SGN(A):PRINT                      :rem 185
820 INPUT"VERTEX: (X,Y)";CX,CY:CX=CX*XP:C
    Y=CY*YP:PRINT                        :rem 26
830 PRINT"SPECIFY THE ANGLE BETWEEN THE S
    YMMETRIC AXIS AND THE HORIZONTAL:"
                                         :rem 156
835 INPUTANG:ANG=ANG*↑/180               :rem 26
838 GOSUB3360                            :rem 239
840 GOSUB400:X=0                         :rem 175
845 Y=SQR(ABS(X/A)):GOSUB 4450:IFO=1THENO
    1=1                                  :rem 151
848 Y=-Y:GOSUB4450:IFO=1THEN O2=1:rem 235
850 X=X+1*SG/XP                          :rem 129
852 IFO1+O2=2THENO1=0:O2=0:X=CX:Y=CY:GOTO
     45                                  :rem 191
855 GETS$:IFS$<>""THENX=CX:Y=CY:GOTO 45
                                         :rem 158
860 GOTO845                              :rem 120
900 POKECP,21:POKEBM,BO:PRINT"{CLR}"
                                         :rem 61
902 PRINTSPC(12)"{RVS}HYPERBOLA":PRINT
                                         :rem 133
905 PRINT"EQUATION OF HYPERBOLA: 'X↑2/A↑2
    -Y↑2/B↑2=1'; SPECIFY 'A','B' (A,B)"
                                         :rem 158
910 INPUTA,B:IFA=0ORB=0THENPRINT"A,B<>0":
    GOTO 910                             :rem 6
920 PRINT:PRINT"ANGLE BETWEEN THE TRANSVE
    RSE AXIS AND THE HORIZONTAL:":rem 191
930 INPUTANG:ANG=ANG*↑/180               :rem 22
940 PRINT:INPUT"COORDINATE OF CENTER (X,Y
    ) ";CX,CY:CX=CX*XP:CY=CY*YP          :rem 67
945 GOSUB3360:BY=FNB1(0):BI=FNB2(X):GOSUB
    400                                  :rem 137
948 X=SQR(A↑2+B↑2):Y=0:GOSUB4450:X=-X:GOS
    UB 4450                              :rem 177
950 X=A                                  :rem 116
960 Y=SQR((X↑2/A↑2-1)*B↑2):GOSUB4450:IFO=
    1THENO1=1                            :rem 57
962 Y=-Y:GOSUB4450:IFO=1THENO2=1 :rem 232
970 X=-X:GOSUB 4450:IFO=1THENO3=1:rem 230
972 Y=-Y:GOSUB4450:IFO=1THENO4=1 :rem 235
975 IFO1+O2+O3+O4=4THENO1=0:O2=0:O3=0:O4=
    0:X=CX:Y=CY:GOTO45                   :rem 117
980 GET S$:IFS$<>""THENX=CX:Y=CY:GOTO45
                                         :rem 157
990 X=-X:X=X+1/XP:GOTO960                :rem 40
1000 POKECP,21:POKEBM,BO:PRINT"{CLR}"
                                         :rem 101
1005 PRINTSPC(8)"{RVS}LINE BETWEEN TWO PO
     INTS":PRINT                         :rem 232
```

```
1010 X$="":Y$="":INPUT"STARTING POINT (X,
     Y) ";X$,Y$:PRINT                  :rem 80
1012 IFX$=""ANDY$=""THENX1=X:Y1=Y:GOTO102
     5                                 :rem 3
1015 IFX=VAL(X$)ANDY=VAL(Y$)THEN1020
                                       :rem 167
1016 GOSUB400                          :rem 220
1020 X1=INT(VAL(X$)*XP):Y1=INT(VAL(Y$)*YP
     ):X=X1:Y=Y1                       :rem 186
1025 INPUT"ENDING POINT (X,Y): ";X2,Y2:X2
     =INT(X2*XP):Y2=INT(Y2*YP)         :rem 244
1100 IFX2-X1=0THENDX=0:DY=SGN(Y2-Y1)*1:GO
     TO1120                            :rem 87
1106 SLP=(Y2-Y)/(X2-X):SY=SGN(Y2-Y):SX=SG
     N(X2-X)                           :rem 188
1108 IFABS(SLP)>1THENDY=SY*1:DX=SX*1/ABS(
     SLP):GOTO1120                     :rem 131
1110 DX=SX*1:DY=SY*ABS(SLP)            :rem 162
1120 GOSUB3360                         :rem 16
1130 BY=FNB1(0):BI=FNB2(X):IFD=1THENPOKEB
     Y,PEEK(BY)OR(2↑BI):GOTO1170       :rem 210
1140 GOSUB400                          :rem 218
1170 IFINT(X)<>X2THEN1174              :rem 236
1172 IFINT(Y)=Y2THEN45                 :rem 79
1173 Y=Y+DY:GOTO1180                   :rem 192
1174 IFINT(Y)<>Y2THEN1177              :rem 245
1175 IFINT(X)=X2THEN45                 :rem 80
1176 X=X+DX:GOTO1180                  :rem 192
1177 X=X+DX:Y=Y+DY                     :rem 117
1180 GETS$:IFS$="{F1}"THEN50           :rem 251
1182 IFS$="{F3}"THENDX=-DX:DY=-DY:X2=X1:Y
     2=Y1:D=1-D                        :rem 251
1190 GOTO1130                          :rem 201
1200 POKECP,21:POKE BM,BO:PRINT"{CLR}"
                                       :rem 103
1210 INPUT"CURSOR MOVES TO (X,Y): ";X2,Y2
     :X2=X2*XP:Y2=Y2*YP:SYS 49485:rem 139
1220 GOSUB400                          :rem 217
1230 X=X2:Y=Y2:GOTO45                  :rem 28
1300 POKECP,21:POKEBM,BO:PRINT"{CLR}"
                                       :rem 104
1302 PRINTSPC(9)"{RVS}CIRCLE OR (ARC)":PR
     INT                               :rem 90
1304 PRINT"EQUATION OF CIRCLE: X↑2+Y↑2=R↑
     2. SPECIFY RADIUS(R):"            :rem 129
1305 INPUT R:PRINT                     :rem 114
1307 P=1:INPUT"COORDINATE OF CENTER: (X,Y
     ) ";CX,CY:CX=CX*XP:CY=CY*YP:PRINT
                                       :rem 163
1309 PRINT"INITIAL AND FINAL POLAR ANGLES
      OF MAPPING IN DEG.(INIT,FINAL)"
                                       :rem 110
1310 A1$="":A2$="":INPUTA1$,A2$:IFA1$=""A
     NDA2$=""THENA1=0:A2=2*↑:GOTO1360
                                       :rem 172
1315 A1=VAL(A1$):A2=VAL(A2$):IFA1>360ORA2
     >360THEN1310                      :rem 233
1316 IFA2<A1THENA2=A2+360              :rem 145
1318 A1=A1*↑/180:A2=A2*↑/180:GOTO1360
                                       :rem 106
1320 POKECP,21:POKEBM,BO:PRINT"{CLR}"
                                       :rem 106
1325 A1=0:A2=2*↑:PRINTSPC(14)"{RVS}ELLIPS
     E":PRINT                          :rem 125
1330 PRINT"EQUATION OF ELLIPSE: X↑2/A↑2+Y
     ↑2/B↑2=1; SPECIFY A,B (A,B):"
                                       :rem 125
1335 INPUTA,B:PRINT                    :rem 210
1336 IFA<BTHENPRINT"MINOR CANNOT BE GREAT
     ER THAN MAJOR":GOTO 1335          :rem 215
1338 IFA=0THENPRINT"CAN NOT HAVE 0 AS YOU
     R MAJOR AXIS.":PRINT:GOTO 1335
                                       :rem 232
1339 P=B/A:R=A                         :rem 25
1340 PRINT "ANGLE BETWEEN MAJOR AXIS AND
     {SPACE}HORIZONTAL ":INPUT ANG:ANG=AN
     G*↑/180                           :rem 73
1341 PRINT:INPUT"COORDINATE OF CENTER: (X
     ,Y)";CX,CY:CX=CX*XP:CY=CY*YP:PRINT
                                       :rem 112
1345 PRINT"WANT TO PLOT FOCI? (Y/N)"
                                       :rem 65
1350 GETD$:IFD$<>"Y"ANDD$<>"N"THEN1350
                                       :rem 152
1360 PRINT:PRINT"POINT DENSITY: (BETWEEN
     {SPACE}0.1 AND 1.0) - DEFAULT IS 0.6
     67."                              :rem 143
1370 V$="":INPUT V$                    :rem 10
1380 IFV$=""THENV=1.5:GOTO1400         :rem 228
1390 V=VAL(V$):IFV<.1ORV>1THENPRINT"OUT O
     F RANGE":GOTO1370                 :rem 102
1395 V=1/V                             :rem 27
1400 GOSUB3360                         :rem 17
1405 GOSUB400                          :rem 222
1430 DR=V/R                            :rem 114
1440 FORAG=A1TOA2STEPDR                :rem 207
1445 X1=X:X=R*COS(AG):DI=SGN(X-X1):GOTO14
     50                                :rem 125
1450 Y=SQR(R↑2-X↑2)*(P)*DI             :rem 32
1480 GOSUB4000                         :rem 17
1492 NEXT                              :rem 15
1500 IFF$="C"THEN1600                  :rem 121
1520 X=SQR(A↑2-B↑2):Y=0                :rem 116
1530 IF D=0ORD$="Y"THENGOSUB4450:X=-X:GOS
     UB4450                            :rem 67
1540 GOTO 1600                         :rem 202
1600 X=CX:Y=CY:GOTO45                  :rem 63
3000 POKECP,21:POKEBM,BO:PRINT"{CLR}"
                                       :rem 103
3005 SYS49558                          :rem 214
3008 SYS49485                          :rem 216
3080 GOTO50                            :rem 105
3100 POKECP,21:POKEBM,BO:PRINT"{CLR}"
                                       :rem 104
3105 SYS49600                          :rem 203
3106 SYS49485                          :rem 215
3110 GOTO50                            :rem 99
3200 POKECP,21:POKEBM,BO:PRINT"{CLR}"
                                       :rem 105
3210 PRINTSPC(3)"{RVS}YOU ARE USING SCREE
     N"SCR;:PRINT"{OFF}("XM","YM")":PRINT
                                       :rem 5
3220 PRINT"CURSOR POSITION: X="X/XP:PRINT
     SPC(17)"Y="Y/YP                   :rem 90
3230 PRINT:PRINT"HIT ANY KEY TO GET BACK
     {SPACE}TO BIT MAP MODE"           :rem 47
3240 GETD$:IFD$=""THEN3240             :rem 187
3250 SYS 49485:GOTO50                  :rem 175
3360 PRINT:PRINT"DRAW OR ERASE (D/E)";
                                       :rem 231
3370 GET DIR$:IFDIR$="D"THENMODE$="DRAW":
     D=1:SYS 49485:GOTO3390            :rem 221
3380 IFDIR$="E"THENMODE$="ERASE":D=0:SYS
     {SPACE}49485:GOTO3390             :rem 3
3385 GOTO3370                          :rem 217
3390 RETURN                            :rem 175
4000 IFF$="C"THENOX=X:X=X*XP+CX:Y=Y*YP+CY
     :GOTO4500                         :rem 170
4450 XA=(X*COS(ANG)+Y*SIN(ANG))*XP:rem 19
4460 YA=(-X*SIN(ANG)+Y*COS(ANG))*YP
                                       :rem 67
4470 OX=X:OY=Y:X=XA+CX:Y=YA+CY         :rem 226
```

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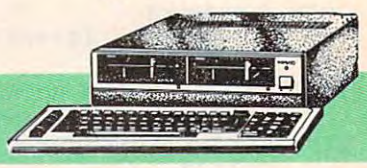

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```
4500 GOSUB300:IFO=1THENGOTO4570  :rem 154
4505 BY=FNB1(0):BI=FNB2(X)       :rem 225
4510 IFD=1THENPOKEBY,PEEK(BY)OR(2↑BI):GOT
     O4570                       :rem 145
4550 GOSUB400                    :rem 226
4570 X=OX:Y=OY:RETURN            :rem 158
5000 POKECP,21:POKEBM,BO:PRINT"{CLR}"
                                 :rem 105
5010 PRINT"TYPE 'GOTO 15' TO RE-ENTER THE
      PROGRAM":END               :rem 181
```

Program 3:
Changes For Disk In Program 1

```
20 FORI=49485TO49633:READJ:POKEI,J:NEXT
                                 :rem 202
130 DATA0,0,0,0,160,255,162,8,169,1,32,18
    6,255,169,2,162,61           :rem 117
140 DATA160,193,32,189,255,169,0,133,251,
    169,32,133,252,162,64,160,63 :rem 125
150 DATA169,251,32,216,255,96,0,0,0,0,0,0
    ,169,1,162,8,160,1,32,186    :rem 195
160 DATA255,169,2,162,61,160,193,32,189,2
    55,169,0,162,255,160,255,32,213
                                 :rem 21
170 DATA255,169,64,170,169,63,168,96
                                 :rem 59
```

Program 4:
Changes For Disk In Program 2

```
3000 POKECP,21:POKEBM,BO:PRINT"{CLR}"
                                 :rem 103
3005 INPUT"SCREEN NUMBER (0-99)";SN
                                 :rem 33
3010 L=INT(SN/10):R=SN-L*10:POKE49469,L+4
     8:POKE49470,R+48            :rem 54
3020 IFL=0THENPOKE49469,32       :rem 12
3030 SYS49558                    :rem 212
3040 SYS49485                    :rem 212
3080 GOTO50                      :rem 105
3100 POKECP,21:POKEBM,BO:PRINT"{CLR}"
                                 :rem 104
3105 INPUT"SCREEN NUMBER (0-99)";SN
                                 :rem 34
3110 L=INT(SN/10):R=SN-L*10:POKE49469,L+4
     8:POKE49470,R+48            :rem 55
3120 IFL=0THENPOKE49469,32       :rem 13
3130 SYS49600                    :rem 201
3140 SYS49485                    :rem 213
3150 GOTO50                      :rem 103
5005 POKE46,31                   :rem 243 ©
```

The Basics Of Commodore 64 Hi-Res Graphics

David Martin

Creating an interesting high-resolution screen on the Commodore 64 can be a chore. These short programs will make it easier to design detailed screens for your games or business applications. Program 1 is in BASIC so it can be easily modified and understood. Program 2 demonstrates some of the potential of the VIC-II chip.

High-resolution screens use a technique called bitmapping. That's just a different way of setting up a display screen. In bitmap mode, the VIC-II chip displays an 8K section of memory on your screen instead of the normal 1K for a text screen. The reason for this is that in bitmap mode you need eight bytes for each character space on the screen. It's like having 1000 redefinable characters on the screen at one time.

A standard text screen is 25 by 40 characters wide. If you could fill that standard text screen with a thousand redefinable characters, you would have a screen that could be easily bitmapped. The bitmap mode enables you to turn on individual pixels on the screen and create intricate graphs and game backgrounds.

In bitmap mode the screen is divided into 320 horizontal pixels by 200 vertical pixels, each of which can be turned on and off individually. The formulas in line 10 of Program 1 do all the calculation that is necessary to turn on the pixel that you prefer. The reason that formulas are necessary is that the pixel locations are not continuous (right to left and top to bottom). Instead, they are located eight bits across and eight bytes down, then back up to the top byte of the next character space.

For example, say that you wanted to turn on a complete row of pixels to form a horizontal line. You would first have to turn on the first eight bits by POKEing a 255 into the first memory location of the high-resolution screen area, then skip the next seven bytes and POKE 255 into the eighth byte, and follow this pattern 40 times to create the line. In any case, the formulas in line 10 will figure out which pixel you want to turn on.

Erasing Program Lines

To use bitmapped graphics, you will have to know not only how to set pixels, but also how to set up an 8000-byte section of memory for the bitmap and a 1K section of memory for the background color screen. This involves working with the VIC-II chip. In Program 1 the text screen is used as the background color screen, and the section of memory starting at location 8192 for the bitmap. Lines 3 and 4 in Program 1 take care of this. The bitmap could have been moved to another section of memory, but that would have involved several extra steps, such as telling the VIC-II chip to look at the second 16K bank of memory. For short programs this is not necessary. Program 1 makes itself shorter using a technique called the "Electric Eraser," which appeared in the August 1982 issue of COMPUTE!. You will find the routine that does this in line 96 of the program. After the data for two short machine language routines has been placed into memory, the Electric Eraser erases everything after line 94 (so remember to save the program before running it).

The first of the machine language routines in Program 1 is used for erasing the 8K bitmapped screen. The second routine sets the background color of the hi-res screen to whatever color you specify by filling the background color screen with the value for the desired color. Both programs are very similar; they are just general

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transfer routines that could be used for other purposes. If these routines had not been included, you would have had to wait about 40 seconds while the entire hi-res screen cleared. In machine language, the clearing is almost instantaneous.

Refer to "COMPUTE!'s Guide To Typing In Programs" before entering these listings.

Program 1: Hi-Res Screen Sketching

```
0 POKE56,32:POKE52,32:CLR:REM PROTECT SCR
  EEN FROM BASIC                    :rem 108
1 POKE53280,1:PRINT"{CLR}{WHT}":GOTO100
                                    :rem 102
2 GOSUB26:BASE=2*4096:REM START ADDRESS O
  F HIRES SCREEN                    :rem 93
3 POKE53272,PEEK(53272)OR8:REM BIT MAP AT
   8192                             :rem 39
4 POKE53265,PEEK(53265)OR32:REM BIT MAP O
  N                                 :rem 141
5 SYS49152:REM CLR HIRES SCREEN     :rem 115
6 SYS49173:REM SET SCREEN COLOR (BITS THA
  T ARE OFF)                        :rem 237
7 X=160:Y=100:REM X & Y START POSITIONS
                                    :rem 15
8 GOSUB13:REM READ JOYSTICK         :rem 198
9 REM UPDATE SCREEN                 :rem 160
10 CH=INT(X/8):RO=INT(Y/8):LN=YAND7:BY=BA
   SE+RO*320+8*CH+LN:BI=7-(XAND7)   :rem 90
11 POKEBY,PEEK(BY)OR(2↑BI):GOTO8    :rem 33
12 REM READ JOYSTICK                :rem 211
13 JV=PEEK(56320):FR=JVAND16        :rem 160
15 X=X+((JVAND4)=0)-((JVAND8)=0)    :rem 27
16 Y=Y+((JVAND1)=0)-((JVAND2)=0)    :rem 21
19 IFFR=0THEN5                      :rem 98
20 IFX>319THENX=319                 :rem 133
21 IFY>199THENY=199                 :rem 148
22 IFX<0THENX=0                     :rem 171
23 IFY<0THENY=0                     :rem 174
24 GETA$:IFA$<>"Q"THENRETURN        :rem 247
25 POKE56,160:POKE52,160:POKE53272,21:POK
   E53265,27:PRINT"{CLR}":END       :rem 4
26 PRINT"{CLR}"TAB(18)"{DOWN}MENU{DOWN}
   {4 LEFT}{4 Y}"                   :rem 72
27 PRINT "{DOWN}"TAB(16)"Q{2 SPACES}-QUIT
   "                                :rem 223
28 PRINT"{DOWN}"TAB(9)"FIRE BUTTON- CLR S
   CREEN"                           :rem 193
29 PRINT"{DOWN}"TAB(10)"JOYSTICK MOVES LI
   NE."                             :rem 106
30 PRINT"{3 DOWN}{7 RIGHT}ENTER BORDER CO
   LOR (0 TO 15).":PRINTSPC(18);    :rem 71
31 INPUTBC:POKE53280,BCAND15        :rem 206
32 PRINT"{3 DOWN}{7 RIGHT}ENTER SCREEN CO
   LOR (0 TO 15).":PRINTSPC(18);    :rem 75
33 INPUTSC:POKE49174,SCAND15:RETURN
                                    :rem 19
94 END:REM ELECTRIC ERASER          :rem 111
95 A=PEEK(61)+256*PEEK(62)+3:POKE786,INT(
   A/256):POKE785,A-256*PEEK(786)   :rem 3
96 POKEA-2,0:POKEA-1,0:POKE45,PEEK(785):P
   OKE46,PEEK(786):CLR:GOTO95       :rem 44
100 FORI=0TO42:READJ:POKE49152+I,J:NEXTI:
    GOTO2                           :rem 150
101 DATA169,0,162,32,160,0,132,33,134,34,
    145,33,200,208,251,232,224,64,208,244
                                    :rem 17
102 DATA96,169,1,162,4,160,0,132,33,134,3
    4,145,33,200,208,251,232,224,8,208,24
    4                               :rem 75
103 DATA96,0                        :rem 121
```

Program 2: Multicolor Hi-Res Screen

```
1 PRINT"{CLR}"                      :rem 149
2 BASE=10*4096:REM START OF HIRES SCREEN
                                    :rem 100
3 POKE 53272,PEEK(53272)OR10:REM PUT BIT
  {SPACE}MAP AT 40960               :rem 120
4 POKE53265,PEEK(53265)OR32:REM ENTER BIT
   MAP MODE                         :rem 147
5 POKE 53270,PEEK(53270)OR16:REM MULTI-CO
  LOR ON                            :rem 2
6 POKE 56576,5:REM SELECT VIDEO BANK
                                    :rem 68
7 FORI=BASETOBASE+7999:POKEI,0:NEXTI:REM
  {SPACE}CLEAR GRAPHIC SCREEN       :rem 157
8 END                               :rem 15©
```

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Atari's "Hidden" Character Modes

Sheldon Leemon

Atari's graphics modes are much more flexible than many programmers realize. The Atari keeps a list of numbers to tell itself which graphics mode to display, and you can change these numbers to suit yourself. Try these example programs to see how to create realistic lowercase letters and colorful high-resolution graphics.

The GTIA chip (or CTIA in early Atari models) is the heart of your computer's graphics system, but it can't do the job on its own. Another chip, called ANTIC, feeds instructions to the GTIA. The ANTIC chip is like a video microprocessor. It has its own set of instructions, like a mini-language, to let you program a variety of screen displays. For example, you can mix any two graphics modes on the same screen or even several modes simultaneously.

This set of instructions for the ANTIC chip is called the *display list*. It's basically a video program. Each instruction controls one vertical portion of the screen, from one to eight scan lines.. The display list is set up for you by the operating system in graphics modes 1 through 12, but much more flexibility is possible.

By altering the existing display list with a series of POKEs, you can combine any graphics modes onscreen at the same time. The key step involves changing the display instruction, which is a number from 2 to 15. The display instruction number tells the computer which graphics mode to display on that part of the screen.

However, the display instruction number used by ANTIC does not directly correspond to the number of the graphics mode. For example, to display a line of GRAPHICS 0, you wouldn't POKE a 0 for the display instruction; you'd POKE a 2. Likewise, POKEing a 6 orders up one line of GRAPHICS 1; POKEing a 7 makes one line of GRAPHICS 2, etc. Notice how the display instruction numbers 3, 4, and 5 were skipped? These instructions let you access graphics modes that are not available any other way in Atari BASIC. What kind of modes do these numbers produce?

These special modes are not documented in the usual Atari manuals. Instead, you must turn to the *Atari Hardware Manual*. This manual, along with the *Operating System User's Manual*, has been available from Atari and can be found at some computer dealers. It's fairly technical, but it does outline some hardware features not explained in the reference material supplied with the computer.

Creating True Descenders

Two short programs following this article help explain the nature of the "hidden" modes. Program 1 demonstrates the first of these modes, designated by Atari as *Instruction Register (IR) Mode 3*. Notice line 10: The IR number 3 is POKEd into bytes 19–26 of the display list, producing a screen which is half graphics mode 0 and half IR mode 3. Next, the whole character set is printed in both modes (line 30). Finally, the program prints a few adjacent characters in both modes for the purposes of comparison (lines 40–45).

When this program is run, the IR mode 3 characters at the bottom of the screen appear no different from the GRAPHICS 0 characters at the top. On more careful examination, however, some differences can be detected. First, there is more room between the rows of characters in IR mode 3. The four diagonal graphics characters in the middle of the screen form a diamond shape in GRAPHICS 0, but in IR 3 there is a gap between the top and bottom triangles and in the taller cursor. The second difference occurs only in the last 32 characters of the IR 3 character set. These characters appear to be shifted, so that the top of the character has been cut off and moved below the bottom of the character, invalidating the top row, but simulating a ninth row for these characters.

According to the *Atari Hardware Manual*, there is a simple reason for these differences. By creating a longer block for these characters, and having some appear at the top of the block and some at the bottom, one can create a custom character set with true descenders for lowercase

letters like *y* and *p* (a *descender* is the tail which protrudes below the line on letters such as *y*, *p*, and *q*).

To explain exactly how this mode accommodates these changes, however, we must first review the method by which the computer determines the shape of a character. The data for character shapes is stored in ROM (Read Only Memory), starting at memory location 57344. Each character is represented by eight bytes of data. Since each of these bytes is composed of eight binary digits (or bits), we can picture this data in the form of an 8 × 8 grid.

Figure 1 shows how the data for the upper- and lowercase letter L is translated into the character seen on the screen. In this drawing, each horizontal row represents one byte (the numeric value is given on the left). Each vertical column represents a bit place. A darkened square represents a 1, or "on-bit," in the corresponding bit location (the bit values, which equal the successive powers of 2 from 2^0 [a value of 1] to 2^7 [a value of 128] are shown at the top of each column). For example, no squares are darkened in the top row of Figure 1a; therefore, the first byte has a value of 0. In the second through sixth rows, where bits 5 and 6 are darkened, the byte value is 96 (32+64); in the seventh row, where bits 1, 2, 3, 4, 5, and 6 are darkened, the byte value is 126 (2+4+8+16+32+64). Finally, in the eighth row, no bits are darkened and the byte value is again 0.

In IR mode 3, however, these same characters are set up in a 10 × 8 grid. Two blank scan lines are inserted below each of the first 96 characters—see Figure 2a. The last 32 characters, which include the lowercase alphabet, receive special handling. When one of these characters is set up in the grid, the first two bytes are shifted down to the bottom two lines—see Figure 2b. This shift of the last 32 characters means that they use the bottom eight lines of the grid, while the other characters use the top eight lines, thus permitting the two bottom lines to be used for descenders.

Multicolor Characters

This leaves us with IR modes 4 and 5 to explore. These are demonstrated by Program 2. Lines 10–20 set up half the screen in IR 4 and half in IR 5. Line 30 prints the full character set in each mode. Line 40 changes the background color for better visibility. The rest of the program lets you use the console buttons to change the color and luminance values of each color register. The SELECT button determines the register, START changes the color of that register, and OPTION the brightness.

These two modes are four-color character modes. The only difference between them is that IR 5 characters are twice as high as those of IR 4. The new Atari 600XL and 800XL computers support these multicolor character modes as GRAPHICS 12 and 13, but the older Atari BASIC on cartridge lacks these modes. The only way to access them on an Atari 400, 800, or 1200XL is to modify the display list with the POKEs used here. Even if you have a 600XL or 800XL, you should stick to this POKE method if you want your programs to run on all Atari models.

Easy Hi-Res Graphics

The purpose of these colorful characters may not be obvious. When I first saw them while

Figure 1: GRAPHICS 0 Characters

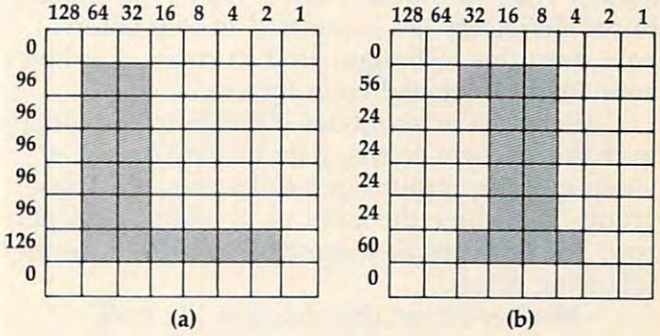


Figure 2: IR Mode 3 Characters

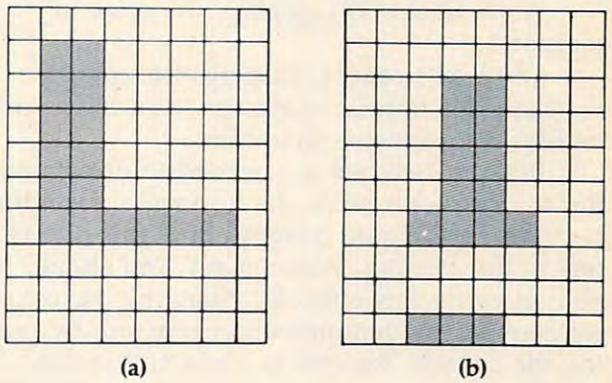
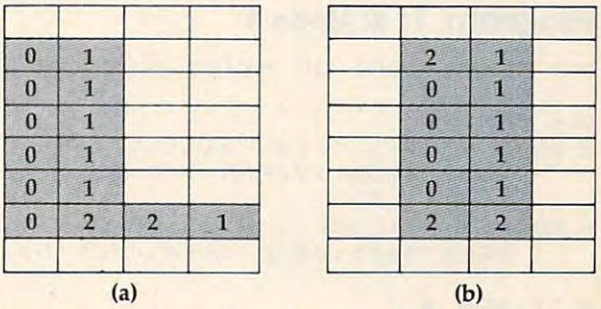


Figure 3: Multicolor Characters



The numbers in the darkened squares indicate the color register used.

experimenting a couple of years ago, I thought that a three-dimensional effect might be achieved with shading. Then it occurred to me that character modes are useful for displaying not only letters, but also graphics characters. Each of these characters can be used in combination with others to form a bigger picture. This is an easy method for producing high-resolution graphics. Each time you need the drawing, just print a string of characters.

Although Atari provides some graphics characters with the standard character set, you are perfectly free to design your own custom graphics characters. In GRAPHICS 0, these characters are all the same color, and you can achieve the same resolution with custom GRAPHICS 0 characters as you can in GRAPHICS 8 (the normal hi-res 320 × 192 graphics mode). With IR modes 4 and 5, however, these hi-res characters can be created in four colors. I have seen this technique used to create dazzling animation of detailed color figures.

These character modes differ from the others in that each byte of character display data is divided into four groups of two bytes each. These groups determine the color of the four pixels per row. The four possible combinations produce the following colors:

- Neither bit set (00) displays the background color (register 4).
- Right bit set (01) displays the color in register 0.
- Left bit set (10) displays the color in register 1.
- Both bits set (11) displays the color in register 2 for normal characters, and the color in register 3 for inverse characters.

Because two bits are needed to determine the color of each pixel, the horizontal resolution is cut in half. Figure 3 shows how this affects letters in the existing character set. You should be able to verify this effect by changing the color registers in the demonstration program by pressing the console buttons as explained above.

Refer to "COMPUTE!'s Guide To Typing In Programs" before entering these listings.

Program 1: IR Mode 3

```
IH 5 REM ** SET UP MIXED-MODE SCRE
     EN
GO 6 REM **
EI 10 ? CHR$(125):X=PEEK(560)+PEEK
     (561)*256+19:FOR I=0 TO 7:PO
     KE X+I,3
JC 20 NEXT I:POKE X+8,65:POKE X+9,
     PEEK(560):POKE X+10,PEEK(561
     )
HB 21 REM *
OB 25 REM * SET UP COMPARISON CHAR
     ACTERS
HG 26 REM *
NO 30 GOSUB 60:POSITION 2,17:GOSUB
      60
IO 40 POSITION 10,12:? CHR$(6);CHR
     $(7)
LA 41 POSITION 10,13:? CHR$(7);CHR
     $(6);"L1";CHR$(160)
DE 45 POSITION 10,14:? CHR$(6);CHR
     $(7);"{5 SPACES}";CHR$(160);
     "L1"
PG 46 POSITION 10,15:? CHR$(7);CHR
     $(6):POSITION 15,10:? " "
AK 50 POKE 752,1:POSITION 2,9:? CH
     R$(28)
HE 51 REM *
AN 55 GOTO 55
HJ 56 REM *
GB 60 FOR I=0 TO 127:? CHR$(27);CH
     R$(I);:NEXT I:RETURN
```

Program 2: IR Modes 4 & 5

```
LA 5 REM ** SET UP MIXED MODE DISP
     LAY
GO 6 REM **
CI 10 ? CHR$(125):X=PEEK(560)+PEEK
     (561)*256+3:POKE X,69
HK 15 FOR I=3 TO 8:POKE X+I,5:NEXT
      I:FOR I=9 TO 16:POKE X+I,4:
     NEXT I
GK 20 POKE X+19,65:POKE X+20,PEEK(
     560):POKE X+21,PEEK(561):POK
     E 752,1:? "{UP}"
HB 21 REM *
MO 25 REM * PRINT CHARACTER SETS
HG 26 REM *
GN 30 GOSUB 60:? :? :GOSUB 60:POSI
     TION 0,0:? CHR$(156):POSITIO
     N 1,13
HC 31 REM *
HL 35 REM * CHANGE BACKGROUND COLO
     R
HH 36 REM *
KE 40 FOR DELAY=1 TO 1500:NEXT DEL
     AY:? CHR$(253):SETCOLOR 4,0,
     14
HD 41 REM *
CH 45 REM * COLOR REGISTER CHANGE
     ROUTINE
HI 46 REM *
EE 50 R=0:S=5:GOSUB 70
DC 52 S=PEEK(53279):IF S=5 THEN R=
     R+1-5*(R=4):GOSUB 70
AF 54 IF S=6 THEN C=C+1-16*(C=15):
     SETCOLOR R,C,L:GOSUB 75
BL 56 IF S=3 THEN L=L+2-16*(L=14):
     SETCOLOR R,C,L:GOSUB 80
PL 58 FOR DELAY=1 TO 50:NEXT DELAY
     :GOTO 52
EI 60 FOR I=1 TO 154:? CHR$(27);CH
     R$(I);:NEXT I
NE 65 FOR I=156 TO 255:? CHR$(27);
     CHR$(I);:NEXT I:RETURN
GN 70 M=PEEK(708+R):C=INT(M/16):L=
     M-16*C
LC 71 POSITION 2,15:? "REGISTER ";
     R:GOSUB 75:GOSUB 80:RETURN
CM 75 POSITION 15,15:? "COLOR ";C;
     "  ":RETURN
MP 80 POSITION 25,15:? "LUM. ";L;"
       ":RETURN
```

IBM Personalized Form Letters

Donald B. Trivette

If you've ever needed to mail copies of the same letter to a number of people—for holiday greetings, notices of club meetings, or whatever—you'll appreciate this labor-saving program. It automatically retrieves addresses and salutations from disk and them atop your form letter. The program re- res an IBM PC or PCjr with BASICA or Car- dge BASIC, a disk drive, and a printer. A word processor that saves standard ASCII files is recommended.

'Tis the season to be jolly. 'Tis also the season to send out holiday cards and letters. You remember Christmas letters, those mimeographed missives that let your archfriends know how well you're doing—or how well you want them to *think* you're doing. Perhaps you've not participated in this holiday ritual because it's just too much trouble to duplicate and address 50 letters—and besides, mimeographed letters are so impersonal.

Now, with the assistance of your IBM PC or PCjr, you too can practice creative writing. The BASIC program following this article automatically merges an address list with a letter to produce a *personalized* form letter. It's guaranteed to speed up your holiday correspondence and leave your recipients wondering whether they were form-lettered or not.

Of course, "IBM Personalized Form Letters" isn't limited to holiday greetings. You might use this program to contact everyone in the neighborhood about the proposed zoning change to put a nuclear waste dump adjacent to the playground, or to keep the members of the garden club or user group informed about the next meeting. If you occasionally need to send the same letter to many people, and don't want to invest in a commercial form-letter program, then read on.

Standard ASCII Files

IBM Personalized Form Letters is only 76 lines long (53 if you leave out the comments at the beginning). It uses the input from two files, files that you must create using a word processor, a text editor, or the DOS utility program EDLIN. However the files are created, they must be standard ASCII text. (Sorry, *WordStar* fans.)

One file contains an exact image of the letter. This means that if you're using a word processor to create the letter, you must *not* count on it to format the lines, insert spaces, and adjust the right margin. Instead, *you* must decide how many characters to put on each line of the letter; you must format it manually. If your word processor automatically wraps words from one line to another, as most do, you'll need to defeat that feature. For example, text with 50 characters on a line is about right for standard margins, so when a line of text reaches column 50, press the Enter key and start the next line. In other words, type the letter just as you would on an old-fashioned typewriter.

Personalized Form Letters is a dumb program. It won't understand the special codes that switch on boldface printing, underlining, centering, or any of the fancy things your word processor can do. It just reads a line from a file and prints it.

But it's not completely stupid, either. It does know enough to print one letter for each address in the address file. How do you signal the computer where to put the address? Insert <<>> at the proper location in the letter and the program will replace it with a four-line address, a blank line, the salutation, and another blank line. For example:

```
700 Maple Avenue
Anywhere, NC 27900
December 10, 1984

<<>>
Hi. We've had a wonderful year . . . . Made so
much money
that we don't know how we'll ever spend it . . . .
```

By inserting a few blank lines ahead of your own address, you can position the letter so the recipient's address appears through a window

envelope when the paper is folded. The program automatically reprints the first letter until you get it properly aligned. (Maybe you can find red window envelopes for the holidays.)

The Address List

The second ASCII file required by the program contains the address list. Again, you may use a word processor to build and maintain the file. Remember to press the Enter key after each line in the address. Personalized Form Letters is designed to use a four-line address and a one-line salutation. The salutation—*Dear Bob & Ann,*—adds a personal touch. Insert a blank line between each address/salutation group. That's to make it easier for you to separate one address from another when editing the address file. Here's an example of how two addresses would look:

Mr. and Mrs. Bob Adams
123 Main Street
Westover, NH 93939

Dear Bob and Ann,

Dr. and Mrs. Robert Brown
Apartment 203
7000 Southfork Avenue
Snake Bluff, CO 94959
Dear Bob & Carol & Ted & Alice,

Notice that the Adams' address is only three lines long, so a blank line is entered as the fourth line of their address.

Personalized Form Letters is designed to print on continuous-forms paper. Who wants to feed in 50 sheets one at a time? You do? Then insert two lines in the program:

```
374 PRINT "Insert paper and press any key."
375 B$=INKEY$:IF B$="" THEN 375
```

and it will pause after printing each letter.

Type the BASIC program exactly as it's shown (we recommend using the "IBM Automatic Proofreader" to avoid typos). Save it. Then create your letter and address files as described above. Next, return to BASIC and run the program with those files as input. One important point: You must use Advanced BASIC (BASICA) or PCjr Cartridge BASIC when running this program (ordinary BASIC will result in a syntax error in line 560).

Happy holidays.

IBM Personalized Form Letters

Refer to "COMPUTE!'s Guide To Typing In Programs" before entering this listing.

```
IL 10 REM IBM Personalized Form Letter
      s
GB 20 REM
DI 30 REM A program to print form lett
      ers using
QL 40 REM addresses from an address fi
      le with
BE 50 REM the following format:
NF 60 REM Address line 1
PL 70 REM Address line 2
AB 80 REM Address line 3
BH 90 REM Address line 4
HC 100 REM Salutation
FG 110 REM (blank line to separate one
JI 120 REM address from another)
QK 130 REM
LO 140 REM The letter file is an ASCII
       file
MD 150 REM containing the form letter.
AA 160 REM
IN 170 REM Use <<>> to indicate where
       the
HI 180 REM address/salutation is to ap
       pear in the
FC 190 REM letter. The program automat
       ically
GM 200 REM inserts a blank line before
        and after
MC 210 REM the salutation.
QJ 220 REM
CA 230 REM --------------
MH 240 KEY OFF:CLS
FJ 250 ON ERROR GOTO 730
JM 260 PRINT
FL 270 PRINT"IBM Personalized Form Let
       ters"
JB 280 PRINT
MD 290 LINE INPUT "Enter address filen
       ame: ";ADD$
IM 300 LINE INPUT "Enter letter filena
       me : ";LETR$
DL 310 LINE INPUT "Enter left margin v
       alue: ";N$
GI 320 N=VAL(N$)
ME 330 I=0
II 340 CLOSE #2:OPEN ADD$ FOR INPUT AS
        #2
JM 350 CLOSE #1:OPEN LETR$ FOR INPUT A
       S #1
DH 360 IF I<2 THEN GOSUB 580
PF 370 LPRINT CHR$(12)  'skip to top o
       f page
MK 380 IF EOF(1) THEN GOTO 350
QP 390 LINE INPUT #1, A$
CM 400 IF A$="<<>>" THEN GOSUB 440  'p
       rint address
ML 410 LPRINT SPC(N)A$
HP 420 GOTO 380
FB 430 REM ---GOSUB to print address--
       -
BL 440 I=I+1            'count of letters
OE 450 FOR J=1 TO 4   '4-line address
HG 460 IF EOF(2) THEN PRINT:PRINT I-1;
       " Letters printed.":END
FI 470 LINE INPUT #2,A$
AG 480 LPRINT SPC(N)A$  'print on prin
       ter
EK 490 PRINT A$         'print on scre
       en
NF 500 NEXT J
MH 510 LPRINT:PRINT
MK 520 LINE INPUT #2,A$  'salutation
MA 530 LPRINT SPC(N)A$
NN 540 LPRINT:PRINT
```

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```
KI 550 LINE INPUT #2, A$ 'throw away b
       lank line
AH 560 RETURN 380
KO 570 REM ---GOSUB to line up letter-
       --
EN 580 IF I<>0 THEN GOTO 630
MN 590 PRINT "Switch on printer and pr
       ess any key to continue."
IF 600 PRINT
MJ 610 B$=INKEY$:IF B$="" THEN GOTO 61
       0
ME 620 RETURN
LI 630 LPRINT CHR$(12)
GH 640 PRINT STRING$(48,"*")
PC 650 PRINT "*  Is the letter properl
       y aligned (Y/N/Esc) ?  *"
GI 660 PRINT STRING$(48,"*"):PRINT:PRI
       NT:LOCATE ,,0
BN 670 B$=INKEY$:IF B$="" THEN 670
GO 680 IF B$=CHR$(27) THEN END
KL 690 IF B$="Y" OR B$="y" THEN RETURN
OF 700 IF B$="N" OR B$="n" THEN PRINT
       "Make adjustments...":RETURN 31
       0
KG 710 BEEP:GOTO 670
HP 720 REM ---ERRORS---
FP 730 IF ERR=53 AND ERL=340 THEN PRIN
       T "Address file not found.":END
PB 740 IF ERR=53 AND ERL=350 THEN PRIN
       T "Letter file not found.":END
ON 750 ON ERROR GOTO 0
MN 760 END
```

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INSIGHT: Atari

Bill Wilkinson

As I promised, this month will be spent answering more letters. Some of the topics I will discuss here have been requested many times; others are unique queries that provide an insight into the workings of your Atari. I think they are all interesting questions.

Before starting on the questions, though, I have a bit of news that can't wait: Microbits (Albany, Oregon) is currently developing both a *parallel* floppy disk drive and a hard disk system for the 800XL. Preliminary speed measurements indicate that we may be able to read/write over 40,000 bytes per second to and from the disk. Imagine being able to load any of your favorite games from disk in half a second or so. Presumably, you would use the parallel floppy to back up the hard disk. Since even a five-megabyte disk (small by today's standards) takes 25 double-density floppies to back up, anything Microbits does to enhance the speed or density of the floppy will be appreciated.

Microbits has not announced any delivery dates yet (in fact, they haven't even finished development, so they can't deliver anything), but I think you should ask your local dealer to get all the information he can as soon as he can. Just think of the possibilities for graphics applications (do you realize that you could load five or six graphics mode 15 pictures per second this way? Or how about windows?).

Phase Errors

Michael Richardson, of Plattsburgh, New York, used the machine language graphics routines printed in this column in 1982 as the basis for a set of his own routines. He ran up against an unexpected error with the Atari *Assembler Editor* cartridge. Although he did not provide a complete listing, I will present what I believe is a correct excerpt here:

```
10          *= $600 ; (or any other good location)
20 DRIVE  = FNAME+1 ; see below
30 ;
40          LDA DRIVE ; looks reasonable, doesn't it?
             ...
             ...
99 FNAME .BYTE "D1 :ANYNAME.*"
```

Now that tiny segment of code certainly *looks* innocuous, doesn't it? But when you try to assemble it, it gives you an ERROR 13, a "phase" error. Why?

Before answering the question, let's consider what would happen if we replaced line 40 with:

```
40          LDA FNAME
```

Do you know what will happen? Can you guess? Believe it or not, you will *not* get a phase error from the *Assembler Editor* cartridge.

Let's take this step by step. Remember that good old ASMED (if you will pardon my inventing an acronym for *ASseMbler EDitor*) is a two-pass assembler. On the first pass, ASMED tries to assemble LDA FNAME and discovers that FNAME has not been defined yet. "That's okay," says ASMED to itself, "I'll just assume that FNAME will be defined later as a non-zero page location. I'll reserve three bytes for this LDA instruction." Well, lo and not-too-surprisingly behold, FNAME is indeed defined later, and it is indeed not a zero page location. Thus, on the second pass through the source code, ASMED generates a three-byte LDA instruction (both in the listing and in the object code). Pass 1 and pass 2 have agreed on how much code to generate. *Voilà*, no phase errors.

What happens, though, when ASMED tries to assemble our original line 40, LDA DRIVE? Well, ASMED is smart (just how smart we will see in a moment), but it's not exactly all-powerful. When it encountered the line DRIVE = FNAME+1, it said to itself, "Aha! FNAME is

undefined. But since it is used in an expression, I must give it a value for now. Hmm. Why not give it a value of zero?"

Why not? Because then FNAME+1 is evaluated by ASMED as 0+1, and DRIVE is given a value of 1. ASMED is *not* smart enough to realize that DRIVE should be considered undefined along with FNAME.

The consequence? During pass 1 of the assembly, ASMED sees LDA DRIVE as being equivalent to LDA $0001, a zero page reference which thus requires only two bytes of memory. But—you saw this coming, didn't you—by the time ASMED gets to LDA DRIVE on pass 2, FNAME has been defined and so DRIVE gets a value of other than one (presumably $06xx in our little example). "Okay," says ASMED, "I'll generate three bytes for the LDA." Oops! Phase error!

Before discussing the fix for this problem, I would like to point out that many (if not all) of the other assemblers available for the Atari would also produce a phase error here. More interestingly, some (many? I haven't had a chance to try them all) would probably produce a phase error even on our other example, where we coded LDA FNAME. If so, it is because they treat undefined labels as having a value of zero, and thus reserve space for only a two-byte instruction on pass 1. The situation gets even stickier with forward referenced and/or undefined macro parameters, as implemented in the various macro assemblers available.

Anyway, what is the fix? Well, my favorite rule is simple: *Never* use a label until *after* you have defined it. I can't think of any occasion where this rule will get you in trouble. I can think of lots of ways that ignoring it can cause strange programming problems. My suggestion for the code in question would be to simply rearrange it, thus:

```
10          *= $600 ; (or any other good location)
20 FNAME .BYTE "D1 :ANYNAME.*"
30 DRIVE = FNAME+1 ; guaranteed to be defined
   now
40 ;
            ...
            ...
99          LDA DRIVE ; always three bytes now!
            ...
```

Give Me Room

Matthew Ratcliff, of St. Louis, Missouri, sent me a very complete listing of a program he calls "GTIA TEXTWRITER" along with some fairly thorny problems. Without repeating the actual questions, I think I can safely say they should all be lumped into the category of assembling relatively large programs on an Atari computer. Since many people (including Ratcliff) are still using ASMED, let's begin with a look at how ASMED uses memory.

Much has been written (here and elsewhere) about how Atari BASIC allocates memory, but I can't remember ever seeing a good description of how ASMED slices up your hard-earned RAM. Shall we rectify that?

First, because ASMED was written primarily by one of the members of the Atari BASIC team (Kathleen O'Brien, and in less than three months), it is not surprising that ASMED shares many of BASIC's allocation techniques. In fact, those of you familiar with BASIC's use of the memory pointers at $80 through $92 would be right at home if you looked at ASMED's source code. There are, however, some major differences.

Just as BASIC has to juggle the several parts of your program (variable name table, the tokenized program, arrays, etc.), so must ASMED find places for its needed components. While you are using just the editor, this task is simple: No tokenizing takes place, no variable name or variable valuable tables are built—just straightforward expands, contracts, and inserts of your source code lines.

When you assemble, though, ASMED must find a place to put your symbol table (all the labels used in your program and what their values are, etc.). For its own convenience, ASMED simply places the symbol table in memory directly following your source code. Object code is easier: ASMED puts your object code where you tell it to. If you are assembling directly to memory, ASMED puts it in memory exactly where your *= directives tell it to.

I spot some potential trouble with that last part, don't you? But let's look at what ASMED can tell us about its usage of memory: Probably the most overlooked tool in the ASMED user's reach is the SIZE command. This is roughly the equivalent of BASIC's PRINT FRE(0). When you use SIZE, you are presented with three hexadecimal numbers. The first is the lowest non-zero page RAM being used by ASMED. The second is the current top-of-the-program source code in memory. (Even if you have no program in memory, ASMED has some fixed overhead, so this number never equals the first one.) The third hex number gives you the top of the memory which ASMED will use. Not surprisingly, the first and third numbers are derived from the Atari OS locations LOMEM (at $02E7) and HIMEM (at $02E5).

Let's take a hypothetical situation (which might really occur if you used a 16K machine with a cassette recorder) where you type SIZE and ASMED responds with:

```
0700 321C 3C1F
```