

# COMPUTE!'s First Book of Apple



Challenging games, exciting educational tools, useful home applications, and sophisticated graphics and sound programs for Apple II, II+, IIe, and IIC computers.

A **COMPUTE! Books** Publication

\$12.95



**COMPUTE!'s**

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**First Book of**

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**Apple**

The following articles were originally published in *COMPUTE!* magazine, copyright 1981, Small System Services, Inc.: "Commas, Colons, and Quote Marks Too" (May); "Oscilloscope" (July); "Undeletable Lines" (October).

The following articles were originally published in *COMPUTE!* magazine, copyright 1982, Small System Services, Inc.: "IRA Planner" (July); "Chemistry Lab" (August).

The following articles were originally published in *COMPUTE!* magazine, copyright 1983, Small System Services, Inc.: "Home Energy Calculator" (January); "Custom Catalog" (March); "Letter and Number Play" (March) "Typing Teacher" (April); "Apple Fast Sort" (May); "Crosswords" (May); "One on One" (May); "The Apple Hi Res Painter" (May); "Apple Shape Generator (June); "Astrostorm" (June); "Memory Trainer" (June).

The following articles were originally published in *COMPUTE!* magazine, copyright 1983, COMPUTE! Publications, Inc.: "First Math" (August); "Weather Forecaster" (August); "Caves of Ice" (September); "Apple Sounds—from Beeps to Music, Part 1" (October); "Spiralizer" (October); "Apple Sounds—from Beeps to Music, Part 2" (November); "Calorie Cop" (December); "Utility Bill Audit" (December).

The following articles were originally published in *COMPUTE!* magazine, copyright 1984, COMPUTE! Publications, Inc.: "Quatrainment" (February); "Barrier Battle" (March); "Roader" (March); "Snertle" (May); "3-D Plotting" (May); "Apple Input and Menu Screens" (June); "Devastator" (August); "ML Tracer" (August); "Apple Editing Hints" (September); "Canyon Runner" (October); "All About the Status Register" (October/November).

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Printed in the United States of America

ISBN 0-942386-69-8

10 9 8 7 6 5 4 3 2 1

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# Foreword

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Since its introduction in the late 1970s, the Apple II computer series has become the mainstay of tens of thousands of home computer users. From games and simulations to educational, financial, and programming applications, users of the II, the II+, the Iie, and the Iic have delighted in the power of Apple computers.

Now, with *COMPUTE!'s First Book of Apple*, these adaptable computers become more versatile than ever before.

There's something here for almost every Apple user. Do you like exciting games? Try "Caves of Ice," and escape from an icy cavern before the chills set in. Or take to the highway in "Roader," a game in which you maneuver a high-performance racer down a winding, hazard-strewn highway. "Devastator" puts the Earth's fate in your hands (and a 3-D scrolling spacecape on your screen), while "Barrier Battle" brings new meaning to the phrase "Don't fence me in."

Perhaps you use your Apple in education. "Letter and Number Play" introduces preschoolers to numbers and to the alphabet. "First Math" and "Snertle" make entertaining games out of elementary math. "Chemistry Lab" adds visual excitement to simple chemistry experiments, while "Typing Teacher" and "Memory Trainer" are valuable to students of all ages.

Your Apple can handle many practical assignments too. "Weather Forecaster" turns your computer into an impressive meteorological predictor. "Home Energy Calculator" and "Utility Bill Audit" help you monitor heating and cooling costs.

There's even more. Programming aids like "Custom Catalog" and "Undeletable Lines" let you customize your programs with that professional touch. The graphics techniques illustrated by "Spiralizer" and "Oscilloscope" show you what your Apple's graphics can do. There's even a comprehensive sound editor, "Apple Sounds," that can be used to create custom sound effects or to compose and play musical tunes.

Whether you've had an Apple for years or for just a few months, you'll find that *COMPUTE!'s First Book of Apple* has plenty to offer. It's a book that helps you achieve more with your Apple than you might have thought possible.





# Chapter 1

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# Games



# Introduction

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Every Apple owner knows that the Apple is a real workhorse, but the programs in this chapter will show you its more playful side.

If arcade games are your favorite, you can play tag with hurtling asteroids in Peter Lear's "Astrostorm." Another fast-paced arcade adventure—"Roader," by Brian Foley—puts you at the wheel of a high-performance race car. Just watch out for the curves.

Then there's "Devastator," by David R. Arnold. It puts the fate of the Earth in your hands—and a 3-D scrolling spacecape on your screen.

For a change of pace, try "Caves of Ice" by Martin Bunker and Robert Tsuk. You're imprisoned inside an immense ice cavern, and there's only one way out. But where could it be? With its remarkable 3-D maze graphics, this one is sure to keep your interest from one chilling episode to the next.

After escaping from the ice cave, you can limber up your frozen muscles with Heath Lawrence's "Barrier Battle." Who would have thought that fences could be so much fun? Equally challenging is Chris York's "One on One," a game that may be the ultimate variation on *Pong*.

Your Apple can play intellectual games, too. "Quatrainment," by Sean Puckett, innocently challenges you to match a simple geometric pattern. It's hard to beat, in more ways than one. And Tim Smith's "Mind Reader" will have you wondering whether your Apple is even smarter than you thought. Load it up and run it the next time someone says that computers are nothing but dumb machines.

# Astrostorm

---

Peter Lear

Apple Translation by Karen McCollough

*Try to guide your spaceship, carrying emergency medical supplies, through a dangerous asteroid storm. But be careful. Success may depend on your ability to make split-second decisions.*

You are Captain Bosdiger of the interstellar tug *The Viccard*. While orbiting the fifth planet in the Benard system, you receive a distress call from the Solarian system. They are in desperate need of vital medical supplies, and you are the only one who can deliver them in time.

But your calculations indicate that you'll have to cross *six* different asteroid fields to reach the planet in safety. Can you do it?

## Looking at Astrostorm

There is no time limit. The game loop (lines 120–250) will execute until a crash is detected in line 230.

Asteroids scroll vertically, from the bottom to the top of the screen, but only horizontal movement of the spaceship is allowed. Direction is controlled with the left and right arrow keys. Movement is initiated by pressing the space bar; every time you change direction, your ship will stop until you press the space bar again.

There are several skill levels, and you can make the game more difficult by specifying a higher level. That will place the spaceship closer to the bottom of the screen and require a quicker reaction to avoid collisions.

Scoring is based on the level of difficulty, on how far you have traveled, and on the direction in which you are moving. More points are given on the higher levels. In addition, points are awarded for movement of the spaceship to the right and deducted for movement to the left.

## Astrostorm

```
20 FOR I = 770 TO 795: READ M: POKE I, M: NEXT I
25 DATA 172,01,03,174,01,03,169,04,32,168,252,17
   3,48,192,232,208,253,136,208,239,206,0,03,208
   ,231,96
30 GOTO 1000
```

```

100 TEXT : HOME : VTAB 1: PRINT "SCORE: ": POKE 3
    4,2
110 FOR I = 1 TO 15:SP = INT ( RND (1) * 39) + 2
    : VTAB 24: HTAB (SP): PRINT "*": NEXT I
115 FOR I = 10 TO 50 STEP 40: POKE 768,10: POKE 7
    69,I: CALL 770: NEXT I
120 POKE 0P,160: VTAB 24:SP = INT ( RND (1) * 39
    ) + 2
130 HTAB (SP): PRINT "*"
140 IF PEEK (CP) = 170 THEN GOTO 800
145 POKE CP,CC:OP = CP
146 FOR I = 1 TO 25: NEXT
149 VTAB 1: HTAB 7: CALL - 868: VTAB 1: HTAB 7: PRINT
    PT
170 M = PEEK ( - 16384): ON M < 128 GOTO 120
180 IF M - 128 = 8 THEN CC = 188:MV = - 1: GOTO
    120
190 IF M - 128 = 21 THEN CC = 190:MV = + 1: GOTO
    120
200 IF M - 128 < > 32 THEN GOTO 120
210 IF CP < > BP OR MV > 0 THEN GOTO 215
212 ON SF GOTO 120
213 CP = BP + 39:SF = SF - 1: GOTO 230
215 CP = CP + MV
220 IF CP < > BP + 39 THEN GOTO 230
222 ON SF = 6 GOTO 600
225 CP = BP:SF = SF + 1
230 IF PEEK (CP) = 170 THEN GOTO 800
240 IF NOT MV THEN PT = PT + INT ((MV * ( INT (
    DL * .2) * ((CP - BP) * SF))) / 2): GOTO 250
245 PT = PT + (MV * ( INT (DL * .3) * ((CP - BP) *
    SF)))
250 GOTO 120
600 REM WIN
610 TEXT : HOME : VTAB 2: HTAB 15: PRINT "SCORE:
    ";PT
620 VTAB 8: HTAB 13: FLASH : PRINT "CONGRATULATIO
    NS": NORMAL : VTAB 12: HTAB 14: PRINT "YOU MA
    DE IT!"
640 POKE 768,15: POKE 769,50: CALL 770: POKE 768,
    10: POKE 769,10: CALL 770: POKE 768,15: POKE
    769,50: CALL 770
650 FOR I = 1 TO 500: NEXT I
660 POKE - 16368,0: GOTO 910
800 REM CRASH
810 V = DL + 2:H = CP - BP
820 IF H < = 1 THEN VTAB V - 1: HTAB H: PRINT "
    /": VTAB V: HTAB H: PRINT "-": VTAB V + 1: HTAB
    H: PRINT " "; CHR$(92): GOTO 850

```

## 1: Games

---

```
830 IF H > = 39 THEN VTAB V - 1: HTAB H: PRINT
    CHR$ (92);" ": VTAB V: HTAB H: PRINT "- ": VTAB
    V + 1: HTAB H: PRINT "/ ": GOTO 850
840 VTAB V - 1: HTAB H: PRINT CHR$ (92);" /": VTAB
    V: HTAB H: PRINT "- -"; VTAB V + 1: HTAB H: PRINT
    "/ "; CHR$ (92);
850 FOR I = 1 TO 200: X = PEEK ( - 16336): NEXT I

890 POKE - 16368,0
900 TEXT : HOME : VTAB 2: HTAB 15: PRINT "SCORE:
    ";PT
905 VTAB 10: HTAB 11: PRINT "YOU LOST YOUR SHIP!"

910 VTAB 21: HTAB 6: PRINT "SAME GAME ? Y)ES, N)O
    , E)ND ";: GET A$
915 IF A$ = "E" THEN END
920 IF A$ = "Y" OR A$ = CHR$ (13) THEN GOTO 113
    0
1000 TEXT : HOME
1010 VTAB 5: HTAB 15: PRINT "ASTROFIELD"
1050 VTAB 10: HTAB 1: INPUT "ENTER DIFFICULTY LEV
    EL (5-18) ";DL$
1055 IF LEN (DL$) < 1 OR LEN (DL$) > 2 THEN GOTO
    1050
1060 E = 0: FOR I = 1 TO LEN (DL$):CH$ = MID$ (D
    L$,I,1): IF ASC (CH$) < 48 OR ASC (CH$) > 5
    7 THEN E = 1
1070 NEXT I: ON E GOTO 1050
1080 DL = VAL (DL$)
1090 IF DL < 5 THEN VTAB 18: PRINT "TOO EASY": FOR
    I = 1 TO 1000: NEXT I: VTAB 18: CALL - 868: GOTO
    1050
1100 IF DL > 18 THEN VTAB 18: PRINT "TOO HARD": FOR
    I = 1 TO 1000: NEXT I: VTAB 18: CALL - 868: GOTO
    1050
1110 VTAB 15: HTAB 10: INPUT "INSTRUCTIONS (Y/N)
    ";A$: IF A$ = "Y" THEN GOTO 1200
1130 J = 0: FOR I = 1024 TO 1920 STEP 128
1140 J = J + 1
1150 IF J = DL + 2 THEN CP = I: I = 1921: GOTO 118
    0
1160 IF J + 8 = DL + 2 THEN CP = I + 40: I = 1921:
    GOTO 1180
1170 IF J + 16 = DL + 2 THEN CP = I + 80: I = 1921
```

```
1180 NEXT I
1190 BP = CP:SF = 1:CC = 190:MV = + 1:PT = 0: GOTO
100
1200 TEXT : HOME
1210 VTAB 3: HTAB 14: PRINT "INSTRUCTIONS"
1220 VTAB 6: PRINT "THE LEFT AND RIGHT ARROW KEYS
CONTROL ": PRINT "THE DIRECTION OF MOVEMENT
OF THE ROCKET.": PRINT "PRESS THE SPACE BAR
TO MOVE THE ROCKET."
1230 PRINT : PRINT : HTAB 4: PRINT "PRESS SPACE B
AR TO BEGIN THE GAME"
1240 VTAB 20: HTAB 8: PRINT "PRESS ANY KEY WHEN R
EADY": WAIT - 16384,128
1250 GOTO 1130
```

# One on One

---

Chris York

Apple Version by Patrick Parrish

*Can you defend your wall against fate, your opponent, and a bouncy but determined brick? "One on One" will let you find out. Paddles required to play.*

In "One on One," two players go head-to-head in an attempt to knock down the wall that the opponent is protecting. Player 1 tries to protect the wall at the top of the screen, while player 2 defends the wall at the bottom.

Each player's "swatter" (the horizontal line closest to the middle section of the screen) is used to intercept the ball before it hits his wall and destroys a section. When the ball hits either player's swatter, it bounces toward the opponent's wall. En route, the flight of the ball may be changed or impeded by barriers or additional sections of wall—a feature that serves to make the game faster and more exciting.

Eventually, the ball will break through. The first player to get the ball past his opponent's wall wins the game and receives an appropriate victory message.

## Two Skill Levels

One on One is played with paddles and offers two skill levels. On level 1, all ball movement is at a 45-degree angle to the swatter and walls. However, on level 2, players can alter the ball's flight angle by moving the swatter just before the ball strikes it. If this is successful (as detected in lines 18–28), then the X component of the ball's velocity is doubled and the ball moves twice as fast horizontally. Vertical ball movement remains the same. To return to normal ball motion, the ball must strike a stationary swatter.

A pleasing feature of this game is the random choice of wall colors each time a new game is played. This is accomplished by the short subroutine at line 30.

For an interesting variation, change the rules so that the object is to *break through* the wall behind you rather than defend it.



## One on One

```

10 GOSUB 2000: GOTO 50
12 IF SCRN( X,Y + DY) = 1 THEN DX = - DX: DY = -
   DY: RETURN
13 IF SCRN( X + DX,Y) = 15 THEN DX = - DX: RETURN

14 DY = - DY: RETURN
18 IF DX = - 2 THEN DX = - 1
19 IF DX = 2 THEN DX = 1
22 IF Y + DY = R1 THEN 26
23 X0 = INT ( PDL (0) / M6) + 2: IF X0 < > L0 THEN
   DX = 2 * DX
25 RETURN
26 X1 = INT ( PDL (1) / M6) + 2: IF X1 < > L1 THEN
   DX = DX * 2
28 RETURN
30 D = INT ( RND (1) * 13) + 2: IF D = DL OR D =
   13 THEN 30
40 RETURN
50 M6 = 7.73: X0 = 2: X1 = 34: R0 = 7: R1 = 32
110 GOTO 1000
112 REM PADDLE 0 SUBROUTINE
115 X0 = INT ( PDL (0) / M6) + 2: IF X0 = L0 THEN
   RETURN
120 COLOR= 0: HLIN L0,L0 + 3 AT R0
130 COLOR= 1: HLIN X0,X0 + 3 AT R0
140 L0 = X0: RETURN
145 REM PADDLE 1 SUBROUTINE
150 X1 = INT ( PDL (1) / M6) + 2: IF X1 = L1 THEN
   RETURN
155 COLOR= 0: HLIN L1,L1 + 3 AT R1
160 COLOR= 1: HLIN X1,X1 + 3 AT R1
170 L1 = X1: RETURN
250 FOR I = 1 TO 5: A = PEEK ( - 16336): NEXT I: RETURN
260 RETURN
280 POKE 768,1: POKE 769,10: CALL 770: RETURN
1000 TEXT : HOME : VTAB 11: HTAB 10: FLASH : PRINT
   "O N E   O N   O N E!": NORMAL
1010 VTAB 17: PRINT SPC( 13); "LEVEL 1 OR 2 ";: INPUT
   LV: IF LV > 2 OR LV < 1 THEN 1010
1020 HOME : GR : PRINT : PRINT : PRINT : PRINT : FOR
   Z = 1 TO 35 STEP 34: FOR Y = Z TO Z + 3
1030 GOSUB 30
1035 COLOR= D: DL = D
1040 HLIN 2,37 AT Y: NEXT Y: NEXT Z
1043 FOR Z = 8 TO 28 STEP 10: FOR Y = 19 TO 21: GOSUB
   30: COLOR= D: DL = D
1045 HLIN Z,Z + 4 AT Y: NEXT Y: NEXT Z: COLOR= 15

```

## 1: Games

---

```
1048 FOR I = 0 TO 38 STEP 38: VLIN 1,38 AT I: VLIN
1,38 AT I + 1: NEXT I: IF LV = 1 THEN 1056
1049 FOR I = 7 TO 32 STEP 25: VLIN 17,23 AT I: VLIN
17,23 AT I + 1: NEXT I
1050 FOR X = 13 TO 26 STEP 13: FOR Y = 11 TO 23 STEP
12: VLIN Y,Y + 5 AT X: VLIN Y,Y + 5 AT X + 1:
NEXT Y: NEXT X: GOTO 1059
1056 FOR I = 5 TO 35 STEP 30: VLIN 17,23 AT I: NEXT
I
1057 FOR X = 14 TO 26 STEP 12: FOR Y = 11 TO 24 STEP
13: VLIN Y,Y + 5 AT X: NEXT Y: NEXT X
1059 COLOR= 1: GOSUB 130: GOSUB 160
1060 PRINT SPC( 8 );"PRESS THE FIRE BUTTON ON": PRINT
SPC( 4 );"PADDLE 0 OR 1 TO START THE GAME"
1070 P0 = PEEK ( - 16287):P1 = PEEK ( - 16286): IF
P0 > 127 OR P1 > 127 THEN 1090
1080 GOSUB 115: GOSUB 150: GOTO 1070
1090 PRINT : PRINT : PRINT : REM CLEAR T
EXT WINDOW
1100 REM GAME ROUTINE
1110 X = INT ( RND ( 1 ) * 9 ) + 17:Y = 23:DX = 1:DY
= 1
1120 IF RND ( 1 ) < .5 THEN DX = - 1
1130 IF RND ( 1 ) < .5 THEN DY = - 1:Y = 17
1135 GOTO 1180
1140 COLOR= 0: PLOT X,Y: IF ABS ( DX ) = 2 AND ( SCRN(
X + DX / 2,Y + DY) < > 15 AND SCRN( X + DX /
2,Y + DY) < > 1) THEN PLOT X + DX / 2,Y + D
Y
1150 X = X + DX:Y = Y + DY: COLOR= 13: PLOT X,Y: IF
Y > 4 AND Y < 35 THEN FL = 0
1160 IF (L < 15 AND L > 1 AND OLDL < 15 AND OLDL >
1) OR (L < 15 AND L > 1 AND FL = 1) THEN GOSUB
250: GOTO 1180
1170 IF L < 15 AND L > 1 THEN GOSUB 250:DY = -
DY: IF Y < 5 OR Y > 34 THEN FL = 1
1180 GOSUB 115: GOSUB 150: IF Y = 0 OR Y = 39 THEN
1250
1190 OLDL = L
1200 L = SCRN( X + DX,Y + DY)
1210 IF L = 0 THEN 1140
1220 IF L = 15 THEN GOSUB 280: GOSUB 12: GOTO 12
00
1230 IF L = 1 AND LV = 1 THEN GOSUB 280:DY = -
DY
1235 IF L = 1 AND LV = 2 THEN GOSUB 280: GOSUB 1
8:DY = - DY: GOTO 1200
1240 GOTO 1140
1250 REM WINNER
```

```
1270 IF Y = 39 THEN PRINT SPC( 5); "!!!VICTORY GOES TO PLAYER 1!!!"
1280 IF Y = 0 THEN PRINT SPC( 5); "!!!VICTORY GOES TO PLAYER 2!!!"
1290 FOR I = 1 TO 1000: NEXT I
1300 PRINT : PRINT SPC( 5); "PRESS A PADDLE BUTTON TO PLAY": PRINT SPC( 5); "AGAIN, Q TO QUIT"
;
1310 POKE - 16368,0:P0 = PEEK ( - 16287):P1 = PEEK ( - 16286): IF P0 > 127 OR P1 > 127 THEN 1000
1320 IF PEEK ( - 16384) = ASC ("Q") + 128 THEN 1400
1330 GOTO 1310
1400 POKE - 16368,0: TEXT : HOME : END
2000 REM SOUND ROUTINE
2010 FOR I = 770 TO 795: READ M: POKE I,M: NEXT
2020 DATA 172,01,03,174,01,03,169,04,32,168,252,173,48,192,232,208,253,136,208,239,206,0,03,208,231,96
2030 RETURN
```

# Roader

---

Brian Foley

Apple Translation by Chris Poer

*Your driving skills and endurance are put to the test as you careen around curves and dodge highway obstacles in "Roader." Paddles required.*

The object of "Roader" is to control a car on a winding road while dodging obstacles. The farther you drive, the more dangerous the road becomes—but the longer you stay on the pavement, the higher your score. If you hit the side of the road or crash into an obstacle, you'll hear appropriate sounds and the run will end. Your score will appear on the screen.

When you run the program, the computer will wait for you to select a level (1-4). Level 1 is for beginners. On level 2 there are more curves and you have to take them at higher speed. Level 3 gives you slower speeds and a less curvy road, but it puts obstacles in your path. Finally, when you're ready for the big time, level 4 challenges you with a curvy road, high speeds, and obstacles too. With all of that to choose from, Roader should be challenging for everyone.

The car is steered with paddle 0.

## Roader

```
100 N$ = " REDAOR":D = 0:A = 0:B = 0
110 HOME
120 FOR I = 1 TO 7:N$(I) = MID$(N$,I,1): NEXT I

130 FOR I = 1 TO 7:A = A + .4:N = INT ( COS (A) *
    B)
140 VTAB 24 - D - I: HTAB 20 + N: PRINT N$(I)
150 NEXT I:B = B + .4:A = B: IF D = 16 THEN 170
160 D = D + 1: GOTO 130
170 VTAB 12: PRINT " WHAT SKILL LEVEL DO YOU WISH
    TO PLAY?"
180 PRINT : PRINT "1) EASY";: HTAB 26: PRINT "2)
    INTERMEDIATE"
190 PRINT "3) DIFFICULT";: HTAB 26: PRINT "4) EXP
    ERT"
200 PRINT : PRINT " USE PADDLE 0 TO CONTROL YOUR
    CAR.": PRINT
210 GET LV$:LV = VAL (LV$)
220 IF LV < 1 OR LV > 4 THEN 210
230 C = 0: IF LV = 2 OR LV = 4 THEN C = .05
```

```
240 C = C + .05: C1 = 14: C2 = 25: A = 0: SC = 8
250 N$ = " "
260 HOME
270 A = A + C + LV / 16: Y = INT ( COS ( A ) * 10)
280 POKE YLOC, 160: INVERSE
290 PRINT LEFT$ ( N$, C1 + Y ); : PRINT "^"; : HTAB C
    2 + Y: PRINT "^"; : PRINT LEFT$ ( N$, C1 - Y +
    1 );
300 N = INT ( PDL ( 0 ) / 7 ): XLOC = N + 1360
310 IF PEEK ( XLOC ) = 30 OR PEEK ( XLOC ) = 42 OR
    PEEK ( XLOC ) = 32 THEN 380
320 NORMAL : POKE XLOC, 200: YLOC = XLOC
330 IF LV = 1 OR LV = 2 THEN 350
340 G = INT ( RND ( 1 ) * 120 ): IF G = 1 THEN G = INT
    ( RND ( 1 ) * 39 ): POKE 1872 + G, 42
350 D = D + 1: IF D / 120 = INT ( D / 120 ) AND D <
    480 THEN C1 = C1 + 1: SC = SC - 1
360 IF C < .25 THEN C = C + .001
370 GOTO 270
380 FOR I = 1 TO 20
390 FOR C = 1 TO 15: W = PEEK ( - 16336 ): NEXT C
400 POKE XLOC - 128, 220: POKE XLOC - 128, 225: POKE
    XLOC - 128, 239: POKE XLOC - 128, 223
410 NEXT I: NORMAL
420 HOME : VTAB 5: HTAB 10: PRINT " YOUR SCORE IS
    "; : INVERSE : PRINT INT ( 10000 / SC ): NORMAL

430 VTAB 10: PRINT "HIT THE PADDLE BUTTON TO PLAY
    AGAIN AT": HTAB 10: PRINT "THE SAME LEVEL, O
    R:": PRINT
440 PRINT "TYPE (S) TO START OVER, (E) TO END."
450 IF PEEK ( - 16384 ) = 197 THEN POKE - 16287
    , 0: END
460 IF PEEK ( - 16384 ) = 211 THEN POKE - 16287
    , 0: GOTO 100
470 IF PEEK ( - 16287 ) > 127 THEN 230
480 GOTO 450
```

# Caves of Ice

---

Marvin Bunker and Robert Tsuk

*Here's a game that will send chills down your spine. "Caves of Ice" puts you inside a three-dimensional ice cavern and challenges you to find your way out. And you thought it was chilly in the basement.*

Ever wondered what it would be like to be trapped inside a giant ice cube? "Caves of Ice" will give you a chance to find out. Imagine yourself imprisoned somewhere inside a five-story structure made entirely of ice. Each floor has 25 rooms in a five-by-five array. Carved into the walls of each room are one or more openings; there may be exits to the north, south, east, or west, as well as trap doors leading up or down.

Unfortunately, only *one* door opens to the outside. You may find it in any of the exterior rooms—in a wall, the ceiling, or the floor.

Your goal is to escape as quickly as possible. It's getting chilly, and you left your mittens at home.

## Exploring the Caves

As you stand in the maze, you can see straight ahead, up, down, left, and right. To see behind you, you'll have to turn (by pressing the F key) and face a different direction.

Navigation is simple. Move through the maze by typing the N, S, E, W, U, and D keys to specify the direction of movement. However, if you type F to change the direction you are facing, you'll need to enter a number instead of a letter to specify the new direction. Remember that N=1, S=2, E=3, and W=4.

To escape from the caves, it helps to be methodical. One proven strategy is to travel in one direction as far as you can go. At that point, assume that you've reached an outside wall, and explore it carefully for an exit. Be careful, though. Those icy rooms look very much alike, and if you're careless you could wander around inside the caves forever.

Once you do find your way out, you'll have the option of trying the same maze again to improve your time. Alternately, you may decide to play a new random maze.

If you decide to take a break, press Q (to *Quit* that round) and you'll have the opportunity to save the current maze for

future exploration. Following the prompts, select a filename and press RETURN. The maze (and your location in it) will be saved under the name you selected. To return to that maze, answer YES at the prompt RESTART OLD MAZE and then type in the name of the maze you want to explore. Be sure to use the correct name, or you'll get an END OF DATA error.

## Cold Clues

If you find the game too challenging, you can type an asterisk (\*) to learn your location in the maze. You will be given X and Y coordinates (0-4) on the current level, as well as a value for A (0-4) that indicates which level you are on.

If you get hopelessly lost, the program will even show you the coordinates of the exit. Press the question mark (?) key (remember to press SHIFT too) to display the coordinates of the exit. It's nice to know you have that as a last resort. But remember: True adventurers frown on using the ?—unless the hot coffee is running low.

## Caves of Ice

```

1  DATA 201,84,208,15,32,177,0,32,248,230,138,72,
      32,183,0,201,44,240,3,76,201,222,32,177,0,32,
      248,230
2  FOR I = 768 TO 833: READ P: POKE I,P: NEXT I
3  DATA 104,134,3,134,1,133,0,170,160,1,132,2,173
      ,48,192,136,208,4,198
4  DATA 1,240,7,202,208,246,166,0,208,239,165,3,1
      33,1,198,2,208,241,96
5  POKE 1013,76: POKE 1014,0: POKE 1015,3
10 TEXT : HOME
90 GOSUB 2000
100 DIM FC(5,7): DIM FC$(5)
105 FC$(1) = "NORTH":FC$(2) = "SOUTH":FC$(3) = "EA
      ST":FC$(4) = "WEST"
110 FOR B = 1 TO 4: FOR I = 1 TO 6: READ FC(B,I):
      NEXT : NEXT
115 GOTO 155
120 HPLLOT 0,0 TO 279,0 TO 279,159 TO 0,159 TO 0,0
      TO 69,29 TO 209,29 TO 209,129 TO 69,129 TO 6
      9,29: HPLLOT 209,29 TO 279,0: HPLLOT 209,129 TO
      279,159: HPLLOT 69,129 TO 0,159: RETURN
125 RETURN

```

## 1: Games

---

```
130 HPLOT 109,9 TO 169,9 TO 159,19 TO 119,19 TO 1
    09,9: HPLOT 119,19 TO 119,9: HPLOT 159,19 TO
    159,9: RETURN
135 HPLOT 119,139 TO 159,139 TO 169,149 TO 109,14
    9 TO 119,139: HPLOT 119,139 TO 119,149: HPLOT
    159,139 TO 159,149: RETURN
140 HPLOT 19,39 TO 49,49 TO 49,139: HPLOT 19,149 TO
    19,39: HPLOT 19,139 TO 49,139: HPLOT 19,49 TO
    49,49: RETURN
145 HPLOT 119,59 TO 159,59 TO 159,129 TO 119,129 TO
    119,59 TO 129,69 TO 149,69 TO 149,119 TO 129,
    119 TO 129,69: HPLOT 149,69 TO 159,59: HPLOT
    149,119 TO 159,129: HPLOT 129,119 TO 119,129:
    RETURN
150 HPLOT 229,49 TO 259,39 TO 259,149: HPLOT 229,
    139 TO 229,49: HPLOT 229,49 TO 259,49: HPLOT
    229,139 TO 259,139: RETURN
155 DIM S$(6,6)
160 INPUT "RESTART OLD MAZE ";Y$: IF LEFT$(Y$,1
    ) = "Y" THEN 1360
165 FOR A = 1 TO 5: FOR X = 1 TO 5: FOR Y = 1 TO
    5
167 & T10 * A + 10 * X + 10 * Y,10
170 IF A < > 5 AND RND (1) < .80 THEN S$(X,A) =
    S$(X,A) + "0": GOTO 180
175 S$(X,A) = S$(X,A) + "X"
180 IF MID$(S$(X,A - 1),(Y - 1) * 6 + 1,1) = "0
    " THEN S$(X,A) = S$(X,A) + "0": GOTO 190
185 S$(X,A) = S$(X,A) + "X"
190 IF Y - 2 < 0 THEN 200
195 IF MID$(S$(X,A),(Y - 2) * 6 + 4,1) = "0" THEN
    S$(X,A) = S$(X,A) + "0": GOTO 205
200 S$(X,A) = S$(X,A) + "X"
205 IF Y < > 5 AND RND (1) < .8 THEN S$(X,A) =
    S$(X,A) + "0": GOTO 215
210 S$(X,A) = S$(X,A) + "X"
215 IF X < > 5 AND RND (1) < .8 THEN S$(X,A) =
    S$(X,A) + "0": GOTO 225
220 S$(X,A) = S$(X,A) + "X"
225 IF MID$(S$(X - 1,A),(Y - 1) * 6 + 5,1) = "0
    " THEN S$(X,A) = S$(X,A) + "0": GOTO 235
230 S$(X,A) = S$(X,A) + "X"
235 NEXT : NEXT : NEXT
240 X = INT ( RND (1) * 3) + 2:Y = INT ( RND (1)
    * 3) + 2:A = INT ( RND (1) * 3) + 2
245 RD = INT ( RND (1) * 6) + 1: ON RD GOTO 250,2
    55,260,265,270,275
250 A = 5:P1$ = LEFT$(S$(X,A),(Y - 1) * 6):L = 2
    9 - LEN (P1$):P2$ = RIGHT$(S$(X,A),L):S$(X
    ,A) = P1$ + "0" + P2$: GOTO 280
```



```

255 A = 1:P1$ = LEFT$ (S$(X,A), (Y - 1) * 6 + 1):L
    = 29 - LEN (P1$):P2$ = RIGHT$ (S$(X,A),L):
    S$(X,A) = P1$ + "O" + P2$: GOTO 280
260 Y = 5:P1$ = LEFT$ (S$(X,A), (Y - 1) * 6 + 3):L
    = 29 - LEN (P1$):P2$ = RIGHT$ (S$(X,A),L):
    S$(X,A) = P1$ + "O" + P2$: GOTO 280
265 Y = 1:P1$ = LEFT$ (S$(X,A), (Y - 1) * 6 + 2):L
    = 29 - LEN (P1$):P2$ = RIGHT$ (S$(X,A),L):
    S$(X,A) = P1$ + "O" + P2$: GOTO 280
270 X = 5:P1$ = LEFT$ (S$(X,A), (Y - 1) * 6 + 4):L
    = 29 - LEN (P1$):P2$ = RIGHT$ (S$(X,A),L):
    S$(X,A) = P1$ + "O" + P2$: GOTO 280
275 X = 1:P1$ = LEFT$ (S$(X,A), (Y - 1) * 6 + 5):L
    = 29 - LEN (P1$):P2$ = RIGHT$ (S$(X,A),L):
    S$(X,A) = P1$ + "O" + P2$: GOTO 280
280 SX = X:SY = Y:SA = A
290 VTAB 23: PRINT "HIT ANY KEY TO START"
300 IF PEEK ( - 16384) < 127 THEN 300
310 POKE - 16368,00
1000 X = INT ( RND (1) * 5) + 1:Y = INT ( RND (1)
    ) * 5) + 1:A = INT ( RND (1) * 5) + 1:FC = 1
    : GOTO 1220
1010 HOME = VTAB 22: HTAB 18: PRINT FC$(FC):A$ =
    "":D = 0: IF LS = 1 THEN PRINT X,Y,A
1020 VTAB 22: PRINT "TIME :";T: FOR TIME = 1 TO 8
    0
1025 IF PEEK ( - 16384) > 127 THEN 1030
1027 NEXT :T = T + 1: VTAB 22: PRINT "TIME :";T: GOTO
    1020
1030 GET A$
1035 IF A$ = "*" THEN LS = 1
1040 IF A$ = "Q" THEN 1300
1050 IF A$ = "U" THEN D = 1
1060 IF A$ = "D" THEN D = 2
1070 IF A$ = "N" THEN D = 3
1080 IF A$ = "S" THEN D = 4
1090 IF A$ = "E" THEN D = 5
1100 IF A$ = "?" THEN 1290
1110 IF A$ = "W" THEN D = 6
1120 IF A$ = "F" THEN GOTO 1280
1130 IF D = 0 THEN 1010
1135 T = T + 1
1140 IF MID$ (S$(X,A), (Y - 1) * 6 + D,1) < > "O
    " THEN PRINT CHR$ (7): GOTO 1010
1150 ON D GOTO 1160,1170,1180,1190,1200,1210
1160 A = A + 1: GOTO 1220
1170 A = A - 1: GOTO 1220
1180 Y = Y - 1: GOTO 1220
1190 Y = Y + 1: GOTO 1220

```

## 1: Games

---

```
1200 X = X + 1: GOTO 1220
1210 X = X - 1: GOTO 1220
1220 IF X > 5 OR X < 1 OR Y > 5 OR Y < 1 OR A > 5
    OR A < 1 THEN PRINT "YOU WIN": & T100,100: &
    T100,50: & T100,50: & T75,66: & T100,66: & T7
    5,66: & T60,255: GOTO 3000
1230 HGR : HCOLOR= 3: HPL0T 0,0: CALL 62454: HCOLOR=
    0: GOSUB 120
1240 FOR I = 1 TO 6: IF MID$(S$(X,A),(Y - 1) *
    6 + I,1) = "X" THEN NEXT : GOTO 1010
1250 R = FC(FC,I) + 1
1260 HCOLOR= 0: ON R GOSUB 125,130,135,140,145,15
    0
1270 NEXT : GOTO 1010
1280 INPUT "WHAT FACING 1-N 2-S 3-E 4-W":FC: IF F
    C < 1 OR FC > 4 THEN 1280
1285 GOTO 1220
1290 INVERSE : HTAB 18: PRINT SX;" ";SY;" ";SA:
    NORMAL : GOTO 1220
1300 PRINT "DO YOU WANT TO SAVE THIS MAZE": INPUT
    Y$: IF LEFT$(Y$,1) < > "Y" THEN GOTO 3000

1310 INPUT "WHAT DO YOU WANT TO CALL IT ";N$
1320 D$ = CHR$(4)
1330 PRINT D$;"OPEN OLD MAZE/";N$: PRINT D$;"WRIT
    E OLD MAZE/";N$
1340 FOR A1 = 1 TO 5: FOR X1 = 1 TO 5: PRINT S$(X
    1,A1): NEXT : NEXT : PRINT X: PRINT Y: PRINT
    A: PRINT T: PRINT FC
1350 PRINT D$;"CLOSE OLD MAZE/";N$: GOTO 3000
1360 INPUT "WHAT IS ITS NAME ";N$
1370 D$ = CHR$(4)
1380 PRINT D$;"OPEN OLD MAZE/";N$: PRINT D$;"READ
    OLD MAZE/";N$
1390 FOR A1 = 1 TO 5: FOR X1 = 1 TO 5: INPUT S$(X
    1,A1): NEXT : NEXT : INPUT X: INPUT Y: INPUT
    A: INPUT T: INPUT FC
1400 PRINT D$;"CLOSE OLD MAZE/";N$: GOTO 1220
2000 VTAB 10: HTAB 14: INVERSE : PRINT "CAVES OF
    ICE": NORMAL : VTAB 22: INPUT "DO YOU WANT IN
    STRUCTIONS ";Y$: IF LEFT$(Y$,1) < > "Y" THEN
    RETURN
2010 HOME : PRINT "THE OBJECT OF MAZE IS TO FIND
    YOUR WAY": PRINT : PRINT "OUT OF A 5X5X5 CUBI
    C MAZE. IN ONE OF THE": PRINT "ROOMS THERE IS
    AN EXIT OUT OF THE MAZE."
```

```

2020 PRINT : PRINT "YOU MUST TRY TO FIND IT IN AS
      FEW TURNS " : PRINT "AS POSSIBLE. THE COMMAND
      S ARE : "
2030 PRINT : HTAB 6: INVERSE : PRINT "U";: NORMAL
      : PRINT "-UP";: HTAB 17: INVERSE : PRINT "S";
      : NORMAL : PRINT "-SOUTH"
2040 PRINT : HTAB 6: INVERSE : PRINT "D";: NORMAL
      : PRINT "-DOWN";: HTAB 17: INVERSE : PRINT "E
      ";: NORMAL : PRINT "-EAST"
2050 PRINT : HTAB 6: INVERSE : PRINT "N";: NORMAL
      : PRINT "-NORTH";: HTAB 17: INVERSE : PRINT "
      W";: NORMAL : PRINT "-WEST"
2060 PRINT : HTAB 6: INVERSE : PRINT "Q";: NORMAL
      : PRINT "-QUIT";: HTAB 17: INVERSE : PRINT "F
      ";: NORMAL : PRINT "-CHANGE FACING"
2070 VTAB 23: PRINT "HIT ";: INVERSE : PRINT "SPA
      CE";: NORMAL : PRINT " FOR MORE"
2080 IF PEEK ( - 16384) < 127 THEN 2080
2090 POKE - 16368,0: HOME : INVERSE : PRINT "F";
      : NORMAL : PRINT " WILL COME BACK WITH A QUES
      TION AS TO": PRINT : PRINT "WHICH FACING YOU
      WISH.HIT ONLY ONE KEY": PRINT : PRINT "AND ";
      : INVERSE : PRINT "RETURN": NORMAL
2100 PRINT : PRINT "PLEASE WAIT WHILE IT SETS UP
      THE MAZE": PRINT : PRINT : RETURN
3000 TEXT : HOME : VTAB 5: HTAB 12: PRINT "CONGRA
      TULATIONS !"
3010 PRINT : PRINT TAB( 7)"YOU HAVE FINISHED THE
      MAZE IN ": PRINT TAB( 7)T;" SECONDS"
3030 INPUT "DO YOU WANT TO PLAY AGAIN ? ";Y$
3040 IF LEFT$(Y$,1) = "Y" THEN RUN
9999 NORMAL
10000 DATA 1,2,4,0,5,3,1,2,0,4,3,5,1,2,3,5,4,
      0,1,2,5,3,0,4

```

# Barrier Battle

---

Heath Lawrence

Apple Translation by Chris Poer

*Barriers, barriers everywhere—but wait! Is that a hole? Its four levels will leave you breathless, if you don't get all boxed in. Requires paddles.*

The object of “Barrier Battle” is to build barriers to cut off your opponent so that he runs out of room and collides with a wall. You create barriers by guiding a barrier builder with your paddle. Be careful, though. You'll lose the game if you hit one of the screen boundaries or one of the player-built barriers.

Your barrier builder automatically leaves a solid trail as you move it around the screen. However, by pressing the trigger, you can create up to five holes in your barrier. Strategically placed, those holes can spell the difference between victory and defeat—particularly when escape routes become scarce. A legend at the top of the screen shows how many holes each player has left. At the end of each round, the winner is identified (particularly helpful in the case of close calls). The game is over when you or your opponent wins four rounds.

At the beginning of the game, it's a good idea to secure yourself a large part of the playfield. In the long run, it's usually the player with the most real estate who is victorious. But if you should find yourself out of room, try pressing the trigger and moving back and forth. This will only delay the inevitable, but it may stall long enough for the other player to smash into a barrier.

## About the Program

The barriers are drawn on the low-resolution graphics screen. Paddles were chosen to control each player's movement, and direction is based on the change of the values in functions PDL(0) and PDL(1). A positive change (of a preset magnitude) will move you to the right. A negative change will turn you to the left. If you find that the paddles are too sensitive (or not sensitive enough), increase or decrease the number in lines 340 and 400.

## Barrier Battle

```
10 TEXT : HOME :PI = 3.1415927 / 180
20 A = 0:B = 0
30 GOSUB 660
40 REM INITIALIZATION
50 FIR = 0:SEC = 0
60 XLOC = 20:YLOC = 26:ALOC = 20:BLAC = 25:AVAR =
  0:BVAR = - 1
70 T1 = 0:T2 = 180:XVAR = 0:YVAR = 1
80 S = 0:T = 0
90 REM PADDLE SETTING
100 PRINT : PRINT "NOW SET YOUR PADDLE ON THE CEN
  TER VALUE OF 125": PRINT : PRINT : PRINT
130 GOSUB 1000
140 PRINT " HIT A PADDLE BUTTON TO CONTINUE"
150 IF PEEK ( - 16287) < 128 AND PEEK ( - 16286
  ) < 128 THEN 150
160 N1 = PDL (1):N2 = PDL (0)
170 HOME
180 REM SET SCREEN
190 GR : HOME : POKE - 16302,0: CALL - 1998
200 COLOR= 1: HLIN 0,39 AT 4: HLIN 0,39 AT 47: VLIN
  47,4 AT 0: VLIN 47,4 AT 39
210 COLOR= 13: FOR I = 1 TO 10 STEP 2: PLOT I,2: NEXT
220 COLOR= 4: FOR I = 20 TO 29 STEP 2: PLOT I,2: NEXT
230 COLOR= 13: PLOT ALOC,BLOC: COLOR= 4: PLOT XLO
  C,YLOC
240 FOR I = 1 TO 300: NEXT
250 GOTO 330
260 REM MOVE PLAYERS
270 COLOR= 13
280 IF S < 5 AND PEEK ( - 16286) > 127 THEN COLOR=
  0:S = S + 1: PLOT S * 2 - 1,2
290 PLOT ALOC,BLOC
300 COLOR= 4
310 IF T < 5 AND PEEK ( - 16287) > 127 THEN T =
  T + 1: COLOR= 0: PLOT 18 + (T * 2),2
320 PLOT XLOC,YLOC
330 O1 = N1:N1 = PDL (0):O2 = N2:N2 = PDL (1)
340 IF ABS (O1 - N1) < 8 THEN 390
350 S1 = SGN (O1 - N1)
360 IF S1 = 1 THEN T1 = T1 + 90: GOTO 380
370 T1 = T1 - 90
380 XVAR = INT ( SIN (T1 * PI) + .1):YVAR = INT
  ( COS (T1 * PI) + .1)
390 XLOC = XLOC + XVAR:YLOC = YLOC + YVAR
400 IF ABS (O2 - N2) < 8 THEN 450
```

## 1: Games

---

```
410 S2 = SGN (O2 - N2)
420 IF S2 = 1 THEN T2 = T2 + 90: GOTO 440
430 T2 = T2 - 90
440 AVAR = INT ( SIN (T2 * PI) + .1):BVAR = INT
    ( COS (T2 * PI) + .1)
450 ALOC = ALOC + AVAR:BLOC = BLOC + BVAR
460 PNT = SCRNI( XLOC,YLOC):POT = SCRNI( ALOC,BLOC
    )
470 IF PNT = 0 AND POT = 0 THEN FOR I = 1 TO LEV
    : GOTO 270
480 IF PNT = 4 OR PNT = 1 OR PNT = 13 THEN FIR =
    1
490 IF POT = 4 OR POT = 13 OR POT = 1 THEN SEC =
    1
500 FOR I = 1 TO 1000: NEXT
510 REM DETERMINING WINNER
520 GOSUB 790: TEXT : HOME
530 IF FIR = 1 AND SEC = 1 THEN PRINT "IT WAS A
    TIE": GOTO 560
540 IF FIR = 1 THEN B = B + 1: PRINT B$;" WON THI
    S ROUND": GOTO 560
550 A = A + 1: PRINT A$;" WON THIS ROUND"
560 PRINT "THE SCORE IS ": PRINT B$;" VICTORIES FO
    R ";B$
570 PRINT A$;" VICTORIES FOR ";A$
580 IF B = 4 THEN C$ = B$: GOTO 630
590 IF A = 4 THEN C$ = A$: GOTO 630
600 PRINT "HIT YOUR PADDLE BUTTON TO CONTINUE"
610 IF PEEK ( - 16287) > 127 OR PEEK ( - 16286)
    > 127 THEN 40: GOTO 620
620 GOTO 610
630 PRINT : PRINT : PRINT C$;" IS THE WINNER"
640 END
650 IF PEEK ( - 16287) > 127 OR PEEK ( - 16286)
    > 127 THEN 40: GOTO 650
660 INVERSE : HTAB 15: PRINT "BARRIER BATTLE"
670 NORMAL : PRINT : PRINT : PRINT "THE OBJECT OF
    THE GAME IS TO FORCE YOUR OPPONENT INTO A WA
    LL."
680 PRINT : PRINT "YOU CANNOT RUN INTO YOUR OWN W
    ALL OR THE";: PRINT "BOUNDARY."
690 PRINT : PRINT "YOU CAN MAKE FIVE HOLES IN THE
    WALL PER ROUND BY PRESSING THE BUTTON ON YOU
    R": PRINT "PADDLE.": PRINT : PRINT "THE NUMBE
    R OF HOLES YOU HAVE LEFT IS": PRINT "SHOWN AT
    THE TOP OF THE SCREEN."
700 PRINT : PRINT "THE FIRST ONE TO WIN FOUR ROUN
    DS WINS": PRINT "THE GAME."
```

```
710 PRINT : PRINT "WHAT SPEED DO YOU WANT (1-4) ?  
    <4 IS THE";: PRINT "FASTEST>": INPUT LEV  
720 LEV = (4 / LEV - 1) * 40  
730 PRINT "WHO IS PLAYER ONE": INPUT B$  
735 B$ = LEFT$ (B$,8)  
740 PRINT "WHO IS PLAYER TWO": INPUT A$  
745 A$ = LEFT$ (A$,8)  
750 HOME  
760 PRINT : PRINT B$;" IS ON TOP AND USES PADDLE  
    1": PRINT A$;" IS UNDERNEATH AND USES PADDLE  
    0"  
765 PRINT "GET READY!!!!!!": FOR D = 1 TO 2000: NEXT  
    D  
770 RETURN  
780 REM NOISE  
790 FOR I = 1 TO 40  
800 F = PEEK ( - 16336)  
810 NEXT  
820 RETURN  
1000 VTAB 22: PRINT B$;" IS AT": VTAB 22: HTAB 15  
    : PRINT "          ": VTAB 22: HTAB 15: PRINT  
    , PDL (1)  
1010 VTAB 23: PRINT A$;" IS AT": VTAB 23: HTAB 15  
    : PRINT "          ": VTAB 23: HTAB 15: PRINT ,  
    PDL (0)  
1020 IF PDL (1) < 122 OR PDL (1) > 128 OR PDL  
    (0) < 122 OR PDL (0) > 128 THEN 1000  
1030 RETURN
```

# Devastator

---

David R. Arnold

Apple Version by Todd Koumarian

*You and your comrades approach the hostile Devastator—a powerful mothership ready to destroy Earth. Out of nowhere, guardian ships attack. You have 30 seconds to destroy all of them or the Earth will be lost. Requires a joystick (for one player) or paddles (for two players).*

“Devastator” is an action game where you must save Earth from aliens.

You and your comrades are in one-person spaceships skimming the surface of a huge alien craft known as *Devastator*. You’re being attacked by alien ships, and you have 30 seconds to destroy the attackers before *Devastator* annihilates Earth.

## How It Works

Devastator is written in Applesoft, with several machine language (ML) subroutines. A single player can aim with the joystick. Alternately, two players can use paddles and work together. When two are playing, one controls movement from left to right while the other controls movement up and down.

When playing Devastator, there is no need to hold down the fire button. Merely placing the crosshairs on the moving alien interceptor will insure its destruction. However, if you take too long to aim, your foe will destroy the earth.

The crosshairs and alien interceptors are drawn using shape tables. The Applesoft SCALE and ROT commands are used to create the approach (and explosion) of the interceptors. The shape table is POKEd in at line 8020 and sits at \$300.

Earth and its subsequent destruction are handled by short ML routines. The world drawing routine resides at \$9100 and is CALLED once every loop through the main program or whenever the image is garbled. The routine stores the bit image in screen memory from a data table at \$1980–\$1A6F. The world drawing routine ORs the image with what is on the screen and then stores it so that it does not erase what is already there.



The destruction of Earth at the end of the game is handled by an ML routine at \$1A70. It stores random garbage in a randomly selected line and byte in screen memory; the routine momentarily confines the garbage to the area around Earth and then expands it to the edges of the screen. The effect is that of a rapidly expanding explosion.

The ML random number generator used at \$1AFF is a common one that generates random nybbles and masks them together for random byte values. A short lookup table is used by both the world drawing and world exploding routines to find the addresses of the first 40 lines on the screen. The table lies between \$1930 and \$197F; its use has been well documented.

When you're typing in Devastator, it's important that the data be typed in correctly. If the data for the shape tables or the world image has errors, the images will look malformed. If there are errors in the data for the ML routines, the computer will most likely crash or write all over your program. If you have a printer, use it to check the data. Finally, remember to save your program before you run it.

## Devastator

```

5 TEXT : HOME : VTAB 10: HTAB 15: PRINT "PLEASE W
  AIT"
10 GOSUB 8000
15 HGR : POKE - 16302,0:EX = 140:EY = 90:Q = 1:D
  L = 10
20 SCALE= 1: ROT= 0
25 CALL 6400
30 HCOLOR= 7: HPLOT 0,100 TO 91,100 TO 91,130 TO
  189,130 TO 189,100 TO 279,100
35 HPLOT 91,100 TO 0,191: HPLOT 189,100 TO 279,19
  1
40 HPLOT 91,130 TO 30,191: HPLOT 189,130 TO 249,1
  91
45 GOTO 3999
50 I = I + 1: IF I > 3 THEN I = 1
55 ON I GOTO 100,200,300
100 HCOLOR= 7: GOSUB 1000: HCOLOR= 4: GOSUB 3000:
  RETURN
200 HCOLOR= 7: GOSUB 2000: HCOLOR= 4: GOSUB 1000:
  RETURN
300 HCOLOR= 7: GOSUB 3000: HCOLOR= 4: GOSUB 2000:
  RETURN

```

## 1: Games

---

```
1000 H PLOT 0,105 TO 84,105: H PLOT 86,107 TO 86,13
2: H PLOT 88,134 TO 190,134: H PLOT 192,132 TO
192,106: H PLOT 195,105 TO 279,105
1010 RETURN
2000 H PLOT 0,125 TO 63,125: H PLOT 65,127 TO 65,15
3: H PLOT 69,155 TO 210,155: H PLOT 212,152 TO
212,127: H PLOT 216,125 TO 279,125
2010 RETURN
3000 H PLOT 0,155 TO 33,155: H PLOT 35,157 TO 35,18
3: H PLOT 38,185 TO 241,185: H PLOT 243,182 TO
243,157: H PLOT 245,155 TO 279,155
3010 RETURN
3999 X = 140:Y = 90
4000 HCOLOR= 0: SCALE= 1: DRAW 1 AT X,Y:PX = X:PY
= Y
4010 X = PDL (0)
4020 Y = PDL (1): IF Y > 124 THEN Y = 124
4030 IF Y < 6 THEN Y = 6
4040 IF X > 95 AND X < 165 THEN 4060
4050 IF Y > 94 THEN HCOLOR= 7:X = PX:Y = PY: DRAW
1 AT PX,PY: GOSUB 50
4060 HCOLOR= 7: DRAW 1 AT X,Y
4070 GOSUB 50
4090 IF ABS (EY - Y) > 9 THEN 4120
4100 IF T = 3 AND EX - X > 3 AND EX - X < 13 AND
ABS (EY - Y) < 6 THEN 5000
4110 IF T = 4 AND EX - X > - 9 AND EX - X < 13 THEN
5000
4120 IF F = 0 THEN 4140
4130 HCOLOR= 0: SCALE= SC: DRAW SS AT EX,EY
4140 W = INT ( RND (1) * 2) + 1: IF W = 2 THEN W =
- 1
4150 EX = EX + W * INT ( RND (1) * 30):EY = EY +
W * INT ( RND (1) * 20)
4160 IF EX < 0 THEN EX = 0
4170 IF EX > 260 THEN EX = 260
4180 IF EY < 8 THEN EY = 8
4190 IF EY > 121 THEN EY = 121
4200 IF EX > 95 AND EX < 165 THEN 4220
4210 IF EY > 90 THEN EY = 90
4220 DI = DI + Q * INT ( RND (1) * 20): IF DI > 1
00 THEN DI = 100: IF INT ( RND (1) * 2) = 0 THEN
Q = - 1
4230 IF DI < 0 THEN DI = 0: IF INT ( RND (1) * 2
) = 0 THEN Q = 1
4240 IF DI < 30 THEN SC = 1:SS = 2
4250 IF DI > 30 AND DI < 70 THEN SC = 2:SS = 2
4260 IF DI > 71 THEN SC = 1:SS = 3
4270 HCOLOR= 7: SCALE= SC: DRAW SS AT EX,EY
4280 T = SS + 3
```

```

4290 F = 1
4300 TI = TI + 1
4310 IF TI > DL THEN 10000
4320 CALL 6400
4330 GOTO 4000
5000 HCOLOR= 0: DRAW 1 AT X,Y
5010 HCOLOR= 7: FOR I = SC TO SC + 15: SCALE= I: DRAW
SS AT EX,EY: POKE 6952,15 + I: POKE 6953,3: CALL
6954: NEXT
5020 HCOLOR= 0: FOR I = SC TO SC + 15: SCALE= I: DRAW
SS AT EX,EY: POKE 6952,30 + I: POKE 6953,3: CALL
6954: NEXT
5030 SR = SR + 10 * (101 - DI)
5040 CALL 6400
5050 DI = 0
5060 EX = INT ( RND (1) * 60) + 95:EY = INT ( RND
(1) * 80): HCOLOR= 7
5070 FOR I = 20 TO 1 STEP - 1: ROT= 1.05 * I - 1
: SCALE= I: DRAW 2 AT EX,EY: POKE 6952,I + 40
: POKE 6953,3: CALL 6954: NEXT
5080 HCOLOR= 0: FOR I = 20 TO 1 STEP - 1: ROT= 1
.05 * I - 1: SCALE= I: DRAW 2 AT EX,EY: POKE
6952,20 + I: POKE 6953,3: CALL 6954: NEXT
5090 DD = DD + 1
5100 IF (DD / 4) = INT (DD / 4) THEN DL = DL - 2

5110 IF DL < 2 THEN DL = 2
5120 TI = 0
5130 GOTO 20
8000 I = 768
8010 POKE 232,0: POKE 233,3
8020 READ A: IF A = - 1 THEN 9030
8030 POKE I,A:I = I + 1: GOTO 8020
9000 DATA 3,0,8,0,31,0,43,0,45,45,45,45,45,64,3
6,164,146,82,41,45,45,45,45,221,219,219,219,2
10,54,54,0
9010 DATA 36,37,45,45,46,54,54,55,63,63,60,36,0
,36,36,45,36,45,45,36,45,45,45,54,45,45,54,45
,54,54,54,63
9020 DATA 54,63,63,54,63,63,63,36,63,63,36,63,3
6,36,0,-1
9030 AD = 6448
9040 FOR I = 0 TO 1: FOR J = 0 TO 1: FOR K = 0 TO
7: POKE AD + (I * 16 + J * 8) + K,32 + (4 * K
) + I: NEXT : NEXT : NEXT
9050 FOR K = 0 TO 7: POKE AD + (I * 16) + K,32 +
(4 * K) + I: NEXT
9060 FOR Q = 0 TO 4: FOR J = 0 TO 7: IF (Q / 2) =
INT (Q / 2) THEN W = 0: GOTO 9080
9070 W = 1

```

## 1: Games

---

```
9080 POKE AD + (I * 15) + 10 + J + (8 * Q),128 *
W
9090 NEXT : NEXT
9299 FOR I = 6400 TO 6447: READ A: POKE I,A: NEXT
: GOTO 9399
9300 DATA 32,74,255,169,0,168,170,133,0,164,0,
185,48,25,133,4,185,88,25,133,3,160,17,189
9310 DATA 128,25,17,3,145,3,232,200,192,23,20
8,243,230,0,165,0,201,40,208,221,32,63,255,96

9399 FOR I = 6528 TO 6974: READ A: POKE I,A: NEXT
: RETURN
9400 DATA 0,0,124,15,0,0,0,64,15,124,0,0,0,112,1
,96,3,0,0,60,14,0,15,0,0,14,31,56,28,0,0,7,59
,124,56,0,64,3,119,111,112,0,64,1,6,96,96,0,9
6,1,6,96,96,1,112,0,7,96,64,3
9410 DATA 56,0,3,48,0,7,24,0,3,48,0,6,24,0,3,24,
0,6,28,0,7,24,0,14,12,0,6,24,0,12,14,0,6,48,0
,28,6,0,102,55,0,24,6,0,110,60,0,24,6,0,124,1
24,0,24,6,0,56,64,1,24
9420 DATA 6,0,112,0,3,24,6,0,96,1,0,24,6,0,64,1,
0,24,6,0,96,7,0,24,14,0,112,12,0,28,12,0,48,1
2,0,12,28,0,24,24,0,14,24,0,24,24,0,6,24,0,24
,28,0,6,56,0,56,12,0,7
9430 DATA 112,0,48,14,64,3,96,1,112,6,96,1,64,
1,96,7,96,0,64,3,96,3,112,0,0,7,96,3,56,0,0,1
4,96,3,28,0,0,60,96,1,15,0,0,112,1,96,3,0,0,6
4,15,124,0,0,0,0,124,15,0,0
9500 DATA 32,74,255,169,0,133,1,133,5,162,5,181
,78,149,6,202,208,249,169,0,133,4,32,180,26,2
30,4,165,4,201,127,208,245,230,1,165,1,201,3,
208,233,169,0,133,4
9510 DATA 32,219,26,230,4,165,4,201,127,208,245
,230,5,165,5,201,5,208,233,32,63,255,96,32,25
5,26,41,63,201,39,16,247,170,189,48,25,133,3,
189,88,25,133,2,32,255
9520 DATA 26,41,7,201,7,240,247,24,105,17,168,3
2,255,26,145,2,96,32,255,26,41,63,201,39,16,2
47,170,189,48,25,133,3,189,88,25,133,2,32,255
,26,41,63,201,39,16
9530 DATA 247,168,32,255,26,145,2,96,32,14,27,1
33,12,32,14,27,10,10,10,10,5,12,96,56,165,7,1
01,10,101,11,133,6,162,4,181,6,149,7,202,16,2
49,165,6,41,15,141,48,192,96
9600 DATA 0,0,173,48,192,136,208,5,206,41,27,240
,9,202,208,245,174,40,27,76,42,27,96
```

```
10000 HCOLOR= 7: SCALE= 1: FOR I = 127 TO 20 STEP
      - 5: ROT= I: DRAW 2 AT 135,I: HCOLOR= 0: ROT=
      I + 5: DRAW 2 AT 135,I + 5: HCOLOR= 7: NEXT
10010 FOR I = 1 TO 7 STEP 2: H PLOT 135 + I,0 TO 1
      35 + I,130: H PLOT 135 - I,0 TO 135 - I,130: NEXT

10020 CALL 6768: HOME : V TAB 21: H TAB 7: PRINT "Y
      OU MADE "SR" POINTS BEFORE": V TAB 22: H TAB 9:
      PRINT "PLANETARY DESTRUCTION"
10030 V TAB 23: PRINT "PRESS BUTTON (0) FOR ANOTHE
      R CHANCE TO";
10040 V TAB 24: H TAB 15: PRINT "SAVE EARTH";
10050 POKE - 16301,0
10060 IF PEEK ( - 16287) > 127 THEN 10060
10070 IF PEEK ( - 16287) < 128 THEN 10070
10080 CLEAR : GOTO 15
```

# Quatrainment

---

Sean Puckett

Apple Translation by Chris Poer

*Fast thinking and careful logic are required to win "Quatrainment," a game in which you race the clock and plan your moves to match a master pattern. A joystick is required.*

The object of "Quatrainment" is to match a pattern generated by the program, using the fewest moves possible and finishing in the shortest amount of time. As the game begins, your game board is drawn at the left of the screen, and the master pattern is displayed at the right. A timer and move counter are also displayed.

A cursor appears in one of the squares on the game board. To change your pattern, use the joystick to move the cursor onto the square you want. Part of your pattern will toggle from on to off, or from off to on, depending on whether you are in the middle, in a corner, or at an edge of the board. The different ways the pattern can change are shown in examples displayed on the screen.

When you match the pattern, your weighted score will be displayed, based on elapsed time and the number of moves you made. The lower your score, the better.

## Quatrainment

```
5 TEXT : HOME : FLASH : VTAB 7: HTAB 17: PRINT "Q
  UATRAINMENT"
10 INVERSE : VTAB 12: HTAB 12: PRINT "PRESS ANY K
  EY TO BEGIN": VTAB 7: HTAB 19: GET XX$: NORMAL
20 GOSUB 1000
30 GOSUB 1100
35 GOSUB 1300
50 P1 = INT ( PDL (0) / 64):P2 = INT ( PDL (1) /
  64):X = P1 * 4 + 2:Y = P2 * 6 + 3
60 COLOR= 1: HLIN P1 * 4 + 1,P1 * 4 + 3 AT P2 * 6
  + 1: HLIN P1 * 4 + 1,P1 * 4 + 3 AT P2 * 6 +
  5
70 COLOR= 0: HLIN P1 * 4 + 1,P1 * 4 + 3 AT P2 * 6
  + 1: HLIN P1 * 4 + 1,P1 * 4 + 3 AT P2 * 6 +
  5
```

```

80 IF ( PEEK ( - 16286 ) > 127 OR PEEK ( - 16287 )
    > 127 ) THEN GOSUB 1200 : GOSUB 2100 : MOV = MO
    V + 1 : VTAB 22 : HTAB 17 : PRINT MOV
90 TC = TC + 1 : IF TC > 10 THEN TIME = TIME + 1 : TC
    = 0 : VTAB 23 : HTAB 17 : PRINT TIME
100 GOTO 50
1000 GR : COLOR= 6 : HLIN 0,16 AT 0 : HLIN 24,39 AT
    0 : HLIN 0,16 AT 6 : HLIN 24,39 AT 6 : HLIN 0,16
    AT 12 : HLIN 24,39 AT 12
1010 HLIN 0,16 AT 18 : HLIN 24,39 AT 18 : HLIN 0,16
    AT 24 : HLIN 24,39 AT 24
1020 VLIN 0,24 AT 0 : VLIN 0,24 AT 23 : VLIN 0,24 AT
    4 : VLIN 0,24 AT 27 : VLIN 0,24 AT 8 : VLIN 0,24
    AT 31
1030 VLIN 0,24 AT 12 : VLIN 0,24 AT 35 : VLIN 0,24 AT
    16 : VLIN 0,24 AT 39
1040 RETURN
1100 FOR R = 0 TO 3 : FOR RR = 0 TO 3 : B(R,RR) = INT
    ( RND (1) * 1 + .5) : NEXT : NEXT
1110 COLOR= 12 : FOR RR = 0 TO 3 : FOR R = 0 TO 3 : IF
    B(R,RR) = 1 THEN PLOT RR * 4 + 2, R * 6 + 3
1120 NEXT : NEXT
1130 FOR I = 1 TO 10 : FOR C = 0 TO 3 : FOR R = 0 TO
    3 : READ Z1 : E(I,C,R) = Z1 : NEXT : NEXT : NEXT
1140 S = INT ( RND (1) * 10 + 1) : FOR C = 0 TO 3 :
    FOR R = 0 TO 3 : D(C,R) = E(S,C,R) : NEXT : NEXT
1150 COLOR= 9 : FOR RR = 0 TO 3 : FOR R = 0 TO 3 : IF
    D(R,RR) = 1 THEN PLOT RR * 4 + 25, R * 6 + 3
1160 NEXT : NEXT
1170 FOR A = 1 TO 9 : FOR I = 1 TO 6
1180 READ Z1, Z2 : X1(A, I) = Z1 : Y1(A, I) = Z2
1190 NEXT : NEXT : RETURN
1200 IF (P1 = 1 OR P1 = 2) AND (P2 = 1 OR P2 = 2)
    THEN A = 1 : GOSUB 2000 : RETURN
1210 IF (P1 = 1 OR P1 = 2) AND P2 = 0 THEN A = 2 :
    GOSUB 2000 : RETURN
1220 IF (P1 = 1 OR P1 = 2) AND P2 = 3 THEN A = 3 :
    GOSUB 2000 : RETURN
1230 IF (P2 = 1 OR P2 = 2) AND P1 = 0 THEN A = 4 :
    GOSUB 2000 : RETURN
1240 IF (P2 = 1 OR P2 = 2) AND P1 = 3 THEN A = 5 :
    GOSUB 2000 : RETURN
1250 IF P1 = 0 AND P2 = 0 THEN A = 6 : GOSUB 2000 :
    RETURN
1260 IF P1 = 3 AND P2 = 0 THEN A = 7 : GOSUB 2000 :
    RETURN

```

## 1: Games

---

```
1270 IF P1 = 3 AND P2 = 3 THEN A = 8: GOSUB 2000:
    RETURN
1280 A = 9: GOSUB 2000: RETURN
1300 COLOR= 2: VLIN 26,31 AT 4: PLOT 5,27: PLOT 6
    ,28: PLOT 7,27: VLIN 31,26 AT 8
1310 VLIN 33,39 AT 6: HLIN 4,8 AT 36
1320 VLIN 26,31 AT 18: HLIN 18,20 AT 26: HLIN 18,
    20 AT 31
1330 VLIN 33,38 AT 18: VLIN 35,38 AT 19: VLIN 37,
    38 AT 20
1340 VLIN 26,31 AT 31: HLIN 31,34 AT 26: HLIN 31,
    34 AT 29: HLIN 31,34 AT 32
1350 VLIN 37,39 AT 30: VLIN 37,39 AT 31: HLIN 32,
    33 AT 36: HLIN 32,33 AT 35: HLIN 32,33 AT 34:
    VLIN 37,39 AT 34: VLIN 37,39 AT 35
1355 PRINT : PRINT
1360 VTAB 23: PRINT "MOVES": PRINT ,MOV: PRINT "
    TIME": PRINT ,TIME: RETURN
2000 FOR I = 1 TO 6
2005 IF X1(A,I) = 1 THEN 2030
2010 IF SCRN( X + X1(A,I),Y + Y1(A,I)) > 0 THEN
    COLOR= 0: PLOT X + X1(A,I),Y + Y1(A,I):B((Y -
    3 + Y1(A,I)) / 6, (X - 2 + X1(A,I)) / 4) = 0: GOTO
    2030
2020 COLOR= 12: PLOT X + X1(A,I),Y + Y1(A,I):B(((
    Y - 3 + Y1(A,I)) / 6),((X - 2 + X1(A,I)) / 4)
    ) = 1
2030 NEXT : RETURN
2100 FOR R = 0 TO 3: FOR RR = 0 TO 3: IF B(R,RR) <
    > D(R,RR) THEN RETURN
2110 NEXT : NEXT
2120 SC = INT (TIME / 10) * INT (MOV / 5)
2130 TEXT : HOME : VTAB 10: FLASH : HTAB 16: PRINT
    "YOU HAVE WON": VTAB 13: HTAB 11: PRINT "YOUR
    SCORE IS ";SC;" POINTS"
2140 NORMAL : END
20000 DATA 1,1,1,1,1,0,0,1,1,0,0,1,1,1,1,1
20010 DATA 0,0,0,0,0,1,1,0,0,1,1,0,0,0,0,0
20020 DATA 0,1,1,0,1,0,0,1,1,0,0,1,0,1,1,0
20030 DATA 1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1
20040 DATA 1,0,0,1,0,1,1,0,0,1,1,0,1,0,0,1
20050 DATA 1,1,1,1,0,0,0,0,0,0,0,0,1,1,1,1
20060 DATA 0,0,0,1,0,0,0,1,0,0,0,1,0,0,0,1
20070 DATA 1,0,0,1,0,0,0,0,0,0,0,0,1,0,0,1
20080 DATA 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0
20090 DATA 0,0,0,0,1,0,0,1,1,0,0,1,0,0,0,0
```



```
20110 DATA 0,0,-4,0,4,0,0,-6,0,6,1,1
20120 DATA 4,0,-4,0,0,6,1,1,1,1,1,1
20130 DATA 4,0,-4,0,0,-6,1,1,1,1,1,1
20140 DATA 4,0,0,-6,0,6,1,1,1,1,1,1
20150 DATA -4,0,0,-6,0,6,1,1,1,1,1,1
20160 DATA 0,0,0,6,0,12,4,0,4,6,8,0
20170 DATA 0,0,0,6,0,12,-4,0,-4,6,-8,0
20180 DATA 0,0,0,-6,0,-12,-4,0,-4,-6,-8,0
20190 DATA 0,0,0,-6,0,-12,4,-6,4,0,8,0
```

# Mind Reader

---

Tim Smith

*It's relatively easy for you to look into your computer's memory—but can it read your mind too? This program may make you think so.*

This game presents you with a bit of computerized ESP. Pick any odd number between 1 and 63, following the onscreen prompts. The computer will then show you five different arrays of numbers, asking you a question about each. After all five have been shown, it will guess your number—and the answer will always be correct.

But how could the computer possibly know? It's easy, once you understand the secret. All you have to do is add the number in the upper-left corner of each set for which the answer is "yes." The total will be the number that was initially chosen.

## Mind Reader

```
10 TEXT : HOME : PRINT TAB( 13)"The Mind Reader!"
   "
20 PRINT : PRINT TAB( 19)"By Tim Smith": GOSUB 1
   000
23 SPEED= 190
25 HOME : PRINT "In this game, I will show you 6
   sets of numbers. You must answer the question
   s below them."
26 PRINT : PRINT : PRINT : PRINT : PRINT : HTAB (
   8): PRINT "Press any key to continue."
27 GET SM$
29 HOME : FLASH : PRINT "IMPORTANT:": NORMAL
30 PRINT : PRINT : PRINT "Press RETURN after ever
   y answer unless directed otherwise."
31 PRINT : PRINT : PRINT : HTAB (8): PRINT "Press
   any key to continue.": GET SP$
35 HOME : PRINT : PRINT : PRINT : PRINT : PRINT TAB(
   9)"1 3 5 7 9 11 13 15": PRINT : PRINT TAB(
   9)"17 19 21 23 25 27 29 31"
40 PRINT : PRINT TAB( 9)"33 35 37 39 41 43 45 47
   ": PRINT : PRINT TAB( 9)"49 51 53 55 57 59 6
   1 63"
45 PRINT : PRINT : PRINT : PRINT : PRINT "Pick a
   number, and remember it! Press anykey when you
   have chosen.": GET SP$
53 LET Z = 1
```

```
55 HOME : PRINT : PRINT : PRINT : PRINT : PRINT TAB(
    9)"2 3 6 7 10 11 14 15": PRINT : PRINT TAB(
    9)"18 19 22 23 26 27 30 31"
60 PRINT : PRINT TAB( 9)"34 35 38 39 42 43 46 47
    ": PRINT : PRINT TAB( 9)"50 51 54 55 58 59 6
    2 63"
65 PRINT : PRINT : PRINT : PRINT : PRINT "Is the
    number you picked in this set?"
70 INPUT A$: IF A$ = "Y" THEN GOSUB 1100
72 IF A$ = "YES" THEN GOSUB 1100
73 IF A$ = "Y " THEN GOSUB 1100
75 HOME : PRINT : PRINT : PRINT : PRINT : PRINT TAB(
    9)"4 5 6 7 12 13 14 15": PRINT : PRINT TAB(
    9)"20 21 22 23 28 29 30 31"
80 PRINT : PRINT TAB( 9)"36 37 38 39 44 45 46 47
    ": PRINT : PRINT TAB( 9)"52 53 54 55 60 61 6
    2 63"
85 PRINT : PRINT : PRINT : PRINT : PRINT "Is the
    number you picked in this set? Look careful
    ly!"
90 INPUT B$: IF B$ = "Y" THEN GOSUB 1200
91 IF B$ = "YES" THEN GOSUB 1200
93 HOME
95 PRINT : PRINT : PRINT : PRINT : PRINT TAB( 9)
    "8 9 10 11 12 13 14 15": PRINT : PRINT TAB(
    9)"24 25 26 27 28 29 30 31"
100 PRINT : PRINT TAB( 9)"40 41 42 43 44 45 46 4
    7": PRINT : PRINT TAB( 9)"56 57 58 59 60 61
    62 63"
105 PRINT : PRINT : PRINT : PRINT : PRINT "Is the
    number you picked in this set?"
110 INPUT C$: IF C$ = "Y" THEN GOSUB 1300
113 IF C$ = "YES" THEN GOSUB 1300
115 HOME : PRINT : PRINT : PRINT : PRINT : PRINT
    TAB( 9)"16 17 18 19 20 21 22 23": PRINT : PRINT
    TAB( 9)"24 25 26 27 28 29 30 31"
120 PRINT : PRINT TAB( 9)"48 49 50 51 52 53 54 5
    5": PRINT : PRINT TAB( 9)"56 57 58 59 60 61
    62 63"
125 PRINT : PRINT : PRINT : PRINT : PRINT "Is the
    number you picked in this set?"
130 INPUT D$: IF D$ = "Y" THEN GOSUB 1400
133 IF D$ = "YES" THEN GOSUB 1400
135 HOME : PRINT : PRINT : PRINT : PRINT : PRINT
    TAB( 9)"32 33 34 35 36 37 38 39": PRINT : PRINT
    TAB( 9)"40 41 42 43 44 45 46 47"
140 PRINT : PRINT TAB( 9)"48 49 50 51 52 53 54 5
    5": PRINT : PRINT TAB( 9)"56 57 58 59 60 61
    62 63"
```

## 1: Games

---

```
145 PRINT : PRINT : PRINT : PRINT : PRINT "Is the
    number you picked in this set?"
150 INPUT E$: IF E$ = "Y" THEN GOSUB 1500
153 IF E$ = "YES" THEN GOSUB 1500
154 GOSUB 1700: PRINT ""
155 GOSUB 1700: PRINT "Let me guess. your number
    was....."Z
156 GOSUB 1000: PRINT : PRINT : PRINT "
    Was I right?": INPUT R$
157 IF R$ = "N" THEN GOSUB 2000
158 IF R$ = "NO" THEN GOSUB 2000
164 HOME : PRINT TAB( 15)"TRY ANOTHER?(Y/N)": INPUT
    J$
165 IF J$ = "Y" THEN 29
167 IF J$ = "YES" THEN 29
170 HOME : PRINT : PRINT : PRINT : PRINT TAB( 19
    )">BYE<": GOSUB 1000
175 HOME : SPEED= 255: END
1000 FOR S = 1 TO 4000: NEXT S: RETURN
1100 LET Z = Z + 2: RETURN
1200 LET Z = Z + 4: RETURN
1300 LET Z = Z + 8: RETURN
1400 LET Z = Z + 16: RETURN
1500 LET Z = Z + 32: RETURN
1700 FOR Y = 1 TO 1000: NEXT Y: RETURN
2000 PRINT ""
2050 HOME : PRINT : PRINT : PRINT : HTAB (19): PRINT
    "OOPS!!"
2100 GOSUB 1000
2200 RETURN
```

# Canyon Runner

---

Vic Neale

Apple Version by Kevin Martin

*In "Canyon Runner" you are a pilot on a mission through a very perilous canyon. You must survive this test. The only way to do so is by maneuvering your tiny plane through the endlessly scrolling canyon.*

The object of "Canyon Runner" is to navigate through a twisting canyon while trying to shoot down an opponent. But beware, your opponent will also be shooting at you.

The program is written in two parts and requires game paddles and a disk drive. Program 1 is all machine language and must be entered with the built-in monitor (see your Apple manual if you are unsure of how this is done). After Program 1 is entered, BSAVE it with the filename CANYON.ML using a starting address of \$6000 and length of \$923. Once you have saved Program 1, enter the loader program (Program 2) and save it. To play the game, load and run Program 2, which will load in and check the machine language from Program 1, then start the game.

When the program is run, you will be presented with a screen containing many options. Each player can choose his own level of difficulty. Player 1 increases or decreases his difficulty level by pressing X or Z, respectively, while player 2 uses the left and right arrow keys to accomplish this. If you wish to play alone, press S for the solo option.

There are two types of shots. If you press A at the start of the game, you will be playing with altitude bombs which explode at the altitude at which they are fired.

The second type of bomb, the detonation bomb (chosen at the start of the game by pressing D), will change its altitude as you change the altitude of your plane, so you can continue to adjust your altitude to the altitude of your opponent after the shot is fired.

The overall width of the canyon can be adjusted by pressing the numbers from 1 to 3. The higher the number picked, the narrower the canyon.

Once the options have been chosen, you can start the game by pressing both paddle buttons simultaneously. The planes are moved from left to right using the paddle. Altitude

is changed using the keyboard. Player 1 can increase or decrease his altitude with the A and Z keys. Player 2 can make his plane climb using the semicolon and descend using the period. An altitude reading for each player is displayed at the bottom of the screen.

At any time during the game, you may fire a bomb at your opponent by pressing the paddle fire button. A count-down reading will appear at the bottom of the screen showing the time until impact.

### Program 1. Canyon Runner, ML

```
6000- 4C 2B 61 A0 B5 A0 A0 CD
600B- C9 A0 B0 B0 F0 D2 A0 A0
6010- A9 A0 A0 B5 A3 C9 C8 E5
6018- D0 CC C1 D9 C5 D2 A0 B1
6020- A0 A0 A0 C1 CC D4 A0 A0
6028- A0 A0 A0 A0 A0 A0 A0 A0
6030- A0 A0 C1 CC D4 A0 A0 A0
6038- D0 CC C1 D9 C5 D2 A0 B2
6040- 8D A0 D0 CC C1 CE C5 D3
6048- A0 A0 A0 A0 A0 A0 A0 A0
6050- A0 A0 A0 A0 A0 A0 A0 A0
6058- A0 A0 A0 A0 A0 A0 A0 A0
6060- A0 A0 D0 CC C1 CE C5 D3
6068- 8D C3 CF D5 CE D4 A0 C4
6070- CF D7 CE A0 A0 A0 A0 A0
6078- A0 A0 A0 A0 A0 A0 A0 A0
6080- A0 A0 A0 C3 CF D5 CE D4
6088- A0 C4 CF D7 CE 00 A0 A0
6090- A0 A0 A0 A0 A0 A0 A0 C7
6098- C1 CD C5 A0 CF D6 C5 D2
60A0- AD D0 D2 C5 D3 D3 A0 D2
60A8- C5 D4 D5 D2 CE A0 A0 A0
60B0- A0 A0 A0 A0 A0 A0 A0 D3
60B8- C1 C4 A0 A0 A0 A0 A0 A0
60C0- D0 D2 C5 D3 D3 A0 C2 CF
60C8- D4 C8 A0 C2 D5 D4 D4 CF
60D0- CE D3 A0 D4 CF A0 D3 D4
60D8- C1 D2 D4 8D CC C5 D6 C5
60E0- CC BA A0 A0 A0 A0 A0 A0
60E8- A0 A0 A0 A0 A0 A0 A0 A0
60F0- A0 A0 A0 A0 A0 A0 A0 A0
60F8- A0 A0 A0 A0 C7 C1 CD C5
6100- BA 8D D0 CC C1 D9 C5 D2
6108- A0 B1 A0 A0 A0 A0 A0 A0
6110- A0 C4 C9 C6 C6 C9 C3 D5
6118- CC D4 D9 A0 A0 A0 A0 A0
```

6120- A0 A0 D0 CC C1 D9 C5 D2  
 6128- A0 B2 00 A9 E1 8D 0B 60  
 6130- A9 7A 8D 0C 60 20 71 61  
 6138- 20 E2 F3 AD F7 F6 20 F4  
 6140- F3 A9 00 8D 04 60 8D 05  
 6148- 60 20 AA 62 20 6C 67 20  
 6150- 21 65 20 24 66 20 0A 67  
 6158- 20 70 66 AD 3F 03 C9 01  
 6160- F0 03 20 7B 63 20 93 64  
 6168- 20 15 64 20 45 63 4C 4C  
 6170- 61 20 E2 F3 AD F7 F6 20  
 6178- F4 F3 A9 14 85 22 20 58  
 6180- FC A9 01 8D 3F 03 A9 04  
 6188- 8D 3D 03 8D 3E 03 A9 50  
 6190- 8D 3C 03 A2 00 8D BA 60  
 6198- F0 06 20 F0 FD E8 D0 F5  
 61A0- A9 07 85 24 A9 15 85 25  
 61A8- 20 22 FC AD 3C 03 C9 20  
 61B0- D0 05 A9 B1 4C C2 61 C9  
 61B8- 38 D0 05 A9 B2 4C C2 61  
 61C0- A9 B3 20 F0 FD A9 26 85  
 61C8- 24 AE 3F 03 8D B6 60 20  
 61D0- F0 FD A9 8D 20 F0 FD A9  
 61D8- 8D 20 F0 FD A9 04 85 24  
 61E0- AD 3D 03 18 69 B0 20 F0  
 61E8- FD A9 23 85 24 AD 3E 03  
 61F0- 18 69 B0 20 F0 FD AD 00  
 61F8- C0 10 11 8D 10 C0 29 7F  
 6200- C9 41 D0 0B A9 02 8D 3F  
 6208- 03 4C A0 61 4C 91 62 C9  
 6210- 44 D0 0B A9 03 8D 3F 03  
 6218- 4C A0 61 C9 53 D0 0B A9  
 6220- 01 8D 3F 03 4C A0 61 C9  
 6228- 31 D0 0B A9 20 8D 3C 03  
 6230- 4C A0 61 C9 32 D0 0B A9  
 6238- 38 8D 3C 03 4C A0 61 C9  
 6240- 33 D0 0B A9 50 8D 3C 03  
 6248- 4C A0 61 C9 5A D0 0B CE  
 6250- 3D 03 D0 03 EE 3D 03 4C  
 6258- A0 61 C9 58 D0 10 EE 3D  
 6260- 03 AD 3D 03 C9 0A D0 03  
 6268- CE 3D 03 4C A0 61 C9 0B  
 6270- D0 0B CE 3E 03 D0 03 EE  
 6278- 3E 03 4C A0 61 C9 15 D0  
 6280- 10 EE 3E 03 AD 3E 03 C9  
 6288- 0A D0 03 CE 3E 03 4C A0  
 6290- 61 AD 62 C0 30 03 4C A0  
 6298- 61 AD 61 C0 30 03 4C A0  
 62A0- 61 A9 02 8D 0F 60 8D 10

## 1: Games

---

62A8- 60 60 A9 14 85 22 20 58  
62B0- FC A2 00 BD 18 60 F0 07  
62B8- 20 F0 FD E8 4C B3 62 A9  
62C0- 14 8D 11 60 A9 0A 8D 12  
62C8- 60 A9 00 8D 15 60 8D 16  
62D0- 60 A9 19 8D 07 60 A9 00  
62D8- 8D 08 60 A9 A5 8D 09 60  
62E0- A9 00 8D 0A 60 A9 01 85  
62E8- E7 A9 70 85 E9 A9 00 85  
62F0- E8 A9 0A 8D 0D 60 A9 00  
62F8- 8D 0E 60 20 28 63 EE 0D  
6300- 60 AD 0D 60 38 E9 0A CD  
6308- 3C 03 D0 EF A9 96 8D 0D  
6310- 60 A9 00 8D 0E 60 20 28  
6318- 63 EE 0D 60 AD 0D 60 38  
6320- E9 96 CD 3C 03 D0 EF 60  
6328- A2 00 20 F0 F6 A9 00 AE  
6330- 0D 60 AC 0E 60 20 11 F4  
6338- AD 0D 60 AE 0E 60 A0 AC  
6340- 20 3A F5 60 60 AD 15 60  
6348- 18 6D 16 60 C9 00 F0 0D  
6350- A2 0F AD 30 C0 A9 04 20  
6358- A8 FC CA D0 F5 60 A9 10  
6360- 8D 17 60 A0 01 A2 01 A9  
6368- 50 20 A8 FC AD 30 C0 E8  
6370- D0 FD 88 D0 F0 CE 17 60  
6378- D0 E9 60 AD 61 C0 30 6F  
6380- AD 62 C0 30 7D AD 15 60  
6388- F0 26 CE 15 60 D0 21 AD  
6390- 13 60 CD 12 60 90 0A AD  
6398- 13 60 38 ED 12 60 4C A8  
63A0- 63 AD 12 60 38 ED 13 60  
63A8- CD 3D 03 B0 03 4C BD 65  
63B0- AD 16 60 F0 26 CE 16 60  
63B8- D0 21 AD 14 60 CD 11 60  
63C0- 90 0A AD 14 60 38 ED 11  
63C8- 60 4C D3 63 AD 11 60 38  
63D0- ED 14 60 CD 3E 03 B0 03  
63D8- 4C 7B 65 AD 3F 03 C9 03  
63E0- D0 0C AD 11 60 8D 13 60  
63E8- AD 12 60 8D 14 60 60 AD  
63F0- 15 60 D0 8C A9 0A 8D 15  
63F8- 60 AD 11 60 8D 13 60 4C  
6400- 80 63 AD 16 60 D0 0B A9  
6408- 0A 8D 16 60 AD 12 60 8D  
6410- 14 60 4C 85 63 A9 15 85  
6418- 25 20 22 FC A9 03 85 24  
6420- AD 0F 60 18 69 B0 20 F0  
6428- FD A9 0B 85 24 AD 11 60  
6430- C9 0A B0 05 A9 A0 20 F0



6438- FD A9 00 AE 11 60 20 24  
6440- ED A9 1A 85 24 AD 12 60  
6448- C9 0A B0 05 A9 A0 20 F0  
6450- FD A9 00 AE 12 60 20 24  
6458- ED A9 23 85 24 AD 10 60  
6460- 18 69 B0 20 F0 FD A9 8D  
6468- 20 F0 FD A9 8D 20 F0 FD  
6470- A9 0B 85 24 A9 00 AE 15  
6478- 60 20 24 ED A9 A0 20 F0  
6480- FD A9 25 85 24 A9 00 AE  
6488- 16 60 20 24 ED A9 A0 20  
6490- F0 FD 60 AD 00 C0 10 49  
6498- 29 7F C9 41 F0 0F C9 5A  
64A0- F0 18 C9 3B F0 21 C9 2E  
64A8- F0 2A 4C E1 64 AD 11 60  
64B0- C9 1E F0 2A EE 11 60 4C  
64B8- DE 64 AD 11 60 C9 01 F0  
64C0- 1D CE 11 60 4C DE 64 AD  
64C8- 12 60 C9 1E F0 10 EE 12  
64D0- 60 4C DE 64 AD 12 60 C9  
64D8- 01 F0 03 CE 12 60 2C 10  
64E0- C0 60 A9 A2 A2 00 8E E3  
64E8- 64 8E E2 64 A2 7F AD 70  
64F0- C0 AD 64 C0 29 80 0A 2A  
64F8- 6D E2 64 8D E2 64 AD 65  
6500- C0 29 80 0A 2A 6D E3 64  
6508- 8D E3 64 CA D0 E3 A9 7F  
6510- 38 ED E2 64 8D E2 64 A9  
6518- 7F 38 ED E3 64 8D E3 64  
6520- 60 20 E4 64 AD E2 64 C9  
6528- 46 90 17 C9 64 B0 03 4C  
6530- 4F 65 A2 03 CE 07 60 D0  
6538- 03 CE 08 60 CA D0 F5 4C  
6540- 4F 65 A2 03 EE 07 60 D0  
6548- 03 EE 08 60 CA D0 F5 AD  
6550- E3 64 C9 46 90 17 C9 64  
6558- B0 03 4C 7A 65 A2 03 CE  
6560- 09 60 D0 03 CE 0A 60 CA  
6568- D0 F5 4C 7A 65 A2 03 EE  
6570- 09 60 D0 03 EE 0A 60 CA  
6578- D0 F5 60 68 68 AD 0F 60  
6580- C9 00 F0 09 CE 0F 60 20  
6588- 96 65 4C 38 61 20 96 65  
6590- 20 FF 65 4C 35 61 A9 50  
6598- AE 07 60 AC 08 60 20 11  
65A0- F4 A2 02 20 30 F7 A6 1A  
65A8- A4 1B A9 00 20 5D F6 A2  
65B0- 00 88 D0 FD E8 E0 0A D0  
65B8- F8 20 5E 63 60 68 68 AD  
65C0- 10 60 C9 00 F0 09 CE 10

## 1: Games

---

65CB- 60 20 D8 65 4C 38 61 20  
65D0- D8 65 20 FF 65 4C 35 61  
65DB- A9 50 AE 09 60 AC 0A 60  
65E0- 20 11 F4 A2 02 20 30 F7  
65EB- A6 1A A4 1B A9 00 20 5D  
65F0- F6 A2 00 88 D0 BB E8 E0  
65FB- 0A D0 F8 20 5E 63 60 A9  
6600- 17 85 25 20 22 FC A9 00  
6608- 85 24 A2 00 BD 8E 60 20  
6610- F0 FD E8 E0 27 D0 F5 2C  
6618- 10 C0 AD 00 C0 10 FB C9  
6620- 8D D0 F4 60 A9 4B AE 07  
6628- 60 AC 08 60 20 11 F4 A2  
6630- 01 20 30 F7 A6 1A A4 1B  
6638- A9 00 20 5D F6 A5 EA C9  
6640- 3A F0 03 4C 7B 65 AD 3F  
6648- 03 C9 01 F0 22 A9 4B AE  
6650- 09 60 AC 0A 60 20 11 F4  
6658- A2 01 20 30 F7 A6 1A A4  
6660- 1B A9 00 20 5D F6 A5 EA  
6668- C9 3A F0 03 4C BD 65 60  
6670- A9 4B AE 07 60 AC 08 60  
6678- 20 11 F4 A2 01 20 30 F7  
6680- A6 1A A4 1B A9 00 20 5D  
6688- F6 AD 3F 03 C9 01 F0 19  
6690- A9 4B AE 09 60 AC 0A 60  
6698- 20 11 F4 A2 01 20 30 F7  
66A0- A6 1A A4 1B A9 00 20 5D  
66AB- F6 60 AD 0B 60 0A 0A 38  
66B0- 6D 0B 60 8D 0B 60 AD 0C  
66BB- 60 0A 0A 38 6D 0C 60 8D  
66C0- 0C 60 60 AD 0B 60 C9 55  
66CB- 90 07 C9 AC B0 0E 4C E6  
66D0- 66 AD 04 60 F0 10 CE 04  
66DB- 60 4C E6 66 AD 04 60 C9  
66E0- 31 F0 03 EE 04 60 AD 0C  
66EB- 60 C9 55 90 07 C9 AC B0  
66F0- 0E 4C 09 67 AD 05 60 F0  
66FB- 10 CE 05 60 4C 09 67 AD  
6700- 05 60 C9 31 F0 03 EE 05  
6708- 60 60 A9 AB 8D 06 60 20  
6710- AA 66 20 C3 66 A2 00 20  
6718- F0 F6 AD 04 60 18 69 0A  
6720- AA AD 06 60 A0 00 20 11  
6728- F4 AC 06 60 AD 04 60 18  
6730- 69 0A 6D 3C 03 A2 00 20  
6738- 3A F5 AD 05 60 18 69 96  
6740- AA A0 00 AD 06 60 20 11  
6748- F4 AC 06 60 AD 05 60 18

6750- 69 96 6D 3C 03 90 05 A2  
 6758- 01 4C 5E 67 A2 00 20 3A  
 6760- F5 EE 06 60 AC 06 60 C0  
 6768- AD D0 A7 60 A0 00 B9 A1  
 6770- 67 85 08 B9 62 68 85 09  
 6778- C8 C8 C8 C8 C8 B9 A1 67  
 6780- 85 06 B9 62 68 85 07 88  
 6788- 88 88 88 8C 03 60 A0 01  
 6790- B1 06 91 08 C8 C0 27 D0  
 6798- F7 AC 03 60 C0 AD D0 CE  
 67A0- 60 00 00 00 00 00 00 00  
 67A8- 00 80 80 80 80 80 80 80  
 67B0- 80 00 00 00 00 00 00 00  
 67B8- 00 80 80 80 80 80 80 80  
 67C0- 80 00 00 00 00 00 00 00  
 67C8- 00 80 80 80 80 80 80 80  
 67D0- 80 00 00 00 00 00 00 00  
 67D8- 00 80 80 80 80 80 80 80  
 67E0- 80 28 28 28 28 28 28 28  
 67E8- 28 AB AB AB AB AB AB AB  
 67F0- AB 28 28 28 28 28 28 28  
 67F8- 28 AB AB AB AB AB AB AB  
 6800- AB 28 28 28 28 28 28 28  
 6808- 28 AB AB AB AB AB AB AB  
 6810- AB 28 28 28 28 28 28 28  
 6818- 28 AB AB AB AB AB AB AB  
 6820- AB 50 50 50 50 50 50 50  
 6828- 50 D0 D0 D0 D0 D0 D0 D0  
 6830- D0 50 50 50 50 50 50 50  
 6838- 50 D0 D0 D0 D0 D0 D0 D0  
 6840- D0 50 50 50 50 50 50 50  
 6848- 50 D0 D0 D0 D0 D0 D0 D0  
 6850- D0 50 50 50 50 50 50 50  
 6858- 50 D0 D0 D0 D0 D0 D0 D0  
 6860- D0 00 20 24 28 2C 30 34  
 6868- 38 3C 20 24 28 2C 30 34  
 6870- 38 3C 21 25 29 2D 31 35  
 6878- 39 3D 21 25 29 2D 31 35  
 6880- 39 3D 22 26 2A 2E 32 36  
 6888- 3A 3E 22 26 2A 2E 32 36  
 6890- 3A 3E 23 27 2B 2F 33 37  
 6898- 3B 3F 23 27 2B 2F 33 37  
 68A0- 3B 3F 20 24 28 2C 30 34  
 68A8- 3B 3C 20 24 28 2C 30 34  
 68B0- 3B 3C 21 25 29 2D 31 35  
 68B8- 39 3D 21 25 29 2D 31 35  
 68C0- 39 3D 22 26 2A 2E 32 36  
 68C8- 3A 3E 22 26 2A 2E 32 36  
 68D0- 3A 3E 23 27 2B 2F 33 37

## 1: Games

---

```
68D8- 3B 3F 23 27 2B 2F 33 37
68E0- 3B 3F 20 24 28 2C 30 34
68E8- 3B 3C 20 24 28 2C 30 34
68F0- 3B 3C 21 25 29 2D 31 35
68F8- 39 3D 21 25 29 2D 31 35
6900- 39 3D 22 26 2A 2E 32 36
6908- 3A 3E 22 26 2A 2E 32 36
6910- 3A 3E 23 27 2B 2F 33 37
6918- 3B 3F 23 27 2B 2F 33 37
6920- 3B 3F 20 00
```

### Program 2. BASIC Loader for Canyon Runner

```
10 PRINT CHR$(4);"BLOAD CANYON.ML"
90 CK = 0
100 FOR I = 28672 TO 28761: READ A:CK = CK + A: POKE
  I,A: NEXT
104 IF CK < > 4288 THEN PRINT "ERROR IN DATA": END

105 CK = 0
110 FOR I = 24576 TO 26915:CK = CK + PEEK (I): NEXT

120 IF CK < > 265976 THEN PRINT "ERROR IN MACHI
  NE LANGUAGE"
130 CALL 24576
200 DATA 2,0,6,0,36,0,36,45
210 DATA 45,37,36,36,60,44,45,45
220 DATA 53,55,54,54,46,45,45,54
230 DATA 63,63,63,54,54,63,36,36
240 DATA 63,63,39,0,12,12,12,12
250 DATA 12,12,12,12,12,12,12,12
260 DATA 12,12,150,146,58,63,63,255
270 DATA 63,63,63,4,64,24,64,24
280 DATA 21,21,21,21,21,21,149,201
290 DATA 14,14,14,14,14,14,223,219
300 DATA 35,36,36,36,32,36,36,36
310 DATA 0,255,0,0,255,255,0,0
```

## 1: Games

---

```
68D8- 3B 3F 23 27 2B 2F 33 37
68E0- 3B 3F 20 24 28 2C 30 34
68E8- 3B 3C 20 24 28 2C 30 34
68F0- 3B 3C 21 25 29 2D 31 35
68F8- 39 3D 21 25 29 2D 31 35
6900- 39 3D 22 26 2A 2E 32 36
6908- 3A 3E 22 26 2A 2E 32 36
6910- 3A 3E 23 27 2B 2F 33 37
6918- 3B 3F 23 27 2B 2F 33 37
6920- 3B 3F 20 00
```

### Program 2. BASIC Loader for Canyon Runner

```
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90 CK = 0
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  I,A: NEXT
104 IF CK < > 4288 THEN PRINT "ERROR IN DATA": END

105 CK = 0
110 FOR I = 24576 TO 26915:CK = CK + PEEK (I): NEXT

120 IF CK < > 265976 THEN PRINT "ERROR IN MACHI
  NE LANGUAGE"
130 CALL 24576
200 DATA 2,0,6,0,36,0,36,45
210 DATA 45,37,36,36,60,44,45,45
220 DATA 53,55,54,54,46,45,45,54
230 DATA 63,63,63,54,54,63,36,36
240 DATA 63,63,39,0,12,12,12,12
250 DATA 12,12,12,12,12,12,12,12
260 DATA 12,12,150,146,58,63,63,255
270 DATA 63,63,63,4,64,24,64,24
280 DATA 21,21,21,21,21,21,149,201
290 DATA 14,14,14,14,14,14,223,219
300 DATA 35,36,36,36,32,36,36,36
310 DATA 0,255,0,0,255,255,0,0
```

# Chapter 2

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# Education



# Introduction

---

Your Apple never tires of quizzes and drills, and that makes it an excellent teacher. The teaching programs in this chapter turn your computer into a sophisticated educational tool, making learning more fun than ever before.

Preschoolers will delight in Garold R. Stone's "Letter and Number Play," a graphically exciting introduction to letters and numbers. Older children will enjoy Steve Hamilton's "First Math" and Soori Sivakumaran's "Snertle," programs that teach fundamental mathematics skills.

"Chemistry Lab," by Joanne Davis, will be of special interest to teachers. It uses animated graphics to illustrate basic concepts of chemistry, and it features an easy-to-use menu. And teachers and students alike will enjoy William Loercher's "Crosswords," a program that creates simple crossword puzzles from any given list of words.

Alan McCright's "Typing Teacher" will appeal to anyone who is learning to type. It is particularly valuable to computer users who would like to learn to type in programs.

Harvey B. Herman's "Memory Trainer" uses proven techniques to help students of all ages improve their memory. It's just the thing if you have a hard time recalling those names, dates, and phone numbers.

Finally, Rob Smythe's "Oscilloscope" will let you draw complex waveforms. Developed as a teaching tool, it is also an excellent demonstration of both the graphics and analytical capabilities of your Apple computer.



# Letter and Number Play

---

Garold R. Stone

Apple Translation by Patrick Parrish

*Even very young children can benefit from the educational power of the computer, as this program shows. It's designed to teach letters and numbers to preschoolers.*

This program was written to help my two-year-old son learn letters and numbers.

When the program starts, it's in the "alphabet" mode. A large letter A appears in the middle of the screen, while a small reverse video A appears near the bottom. Each time the child presses the space bar, the next letter in the alphabet replaces the previous one in the middle of the screen and the new letter is added to an alphabetic sequence at the bottom.

Initially, the program would only display letters in alphabetical order. But one day my son asked to see the Q when we were only up to D. As a result, I expanded the program so that he could put any letter at the top of the screen by pressing its key on the keyboard. After pressing any desired letter keys, he can continue through the alphabet simply by pressing the space bar again.

At any time you can press CTRL-L (the L stands for "letters") to start over with the letter A. If you get to the end of the alphabet, the string of letters at the bottom of the screen flashes ten times—a good opportunity to make a big deal out of the accomplishment and praise the child.

To round out the program, I added numbers too. To switch to numbers, press CTRL-N (for numbers). Pressing the space bar displays the next higher number in large print in the middle of the screen. Numbers greater than 9999 will not fit on the screen. Pressing any of the digits (0-9) displays that digit in large print at the top of the screen. To start counting over at one, press CTRL-N again. To return to the alphabet, press CTRL-L once again.

## Relaxed Learning

There are several ways that a parent can use this program. In my case, my son likes to sit on my lap and press the space bar to see the letters or numbers. I say the name of the figure that

he pressed, and he often repeats it after me. I may even ask him questions like "What is the first letter of the alphabet?" or "Can you find the A?" He can guess the name of the next letter or number or try to find a character on the keyboard. Sometimes he just wants to see some favorite letters and touch them on the screen.

Sessions with the program are rarely more than five minutes long. It's all quite relaxed, but the benefits are unmistakable: The child is learning the names, shapes, and order of the letters and numbers.

### Letter and Number Play

```
10 LOMEM: 16384
20 DIM L$(26)
30 HOME
40 VTAB 3: PRINT "FOR THE SUPERVISING ADULT:"
60 PRINT : PRINT " PRESS LETTER KEYS OR <SPACE>
  TO PLAY."
70 PRINT " <CONTROL> & <L> RESETS ALPHABET TO 'A
  '."
80 PRINT : PRINT : PRINT "PRESS <CONTROL> AND <N>
  FOR THE NUMBERS:"
90 PRINT : PRINT " PRESS NUMBER KEYS OR <SPACE>
  TO PLAY."
110 REM STORE LETTER COORDINATES IN A
120 DIM A(26,20): DIM N(10,20)
130 REM SET UP LETTERS
140 FOR I = 1 TO 26
150 FOR J = 1 TO 20
160 READ A(I,J)
170 NEXT J: NEXT I
180 GOSUB 1370: REM SET UP NUMBERS
190 PRINT : PRINT : PRINT "PRESS <SPACE> TO CONTI
  NUE, '/' TO STOP"
200 GET A$
210 GOSUB 2050
220 REM LETTERS
230 L$ = "": L = 1: GOSUB 1170: GOSUB 1270
240 GET A$
250 GOSUB 2050
260 IF A$ = CHR$(14) THEN GOSUB 1750: GOTO 230
  : REM NUMBERS
270 IF A$ = CHR$(12) THEN 230
280 IF A$ = " " THEN L = L + 1: B = 0: IF L > 26 THEN
  230
290 IF A$ = " " THEN IF L > 26 THEN 230
```

## 2: Education

---

```
300 IF A# = " " THEN GOSUB 1170: GOSUB 1270: GOTO
240
310 IF B < > 0 THEN T = L: L = B - 64: HCOLOR= 0:
Y7 = 30: GOSUB 1190: L = T: HCOLOR= 3
320 A = ASC (A#): T = L: REM REMEMBER L
330 IF A > = 65 AND A < = 90 THEN L = A - 64: B =
A: Y7 = 30: GOSUB 1190
340 L = T
350 GOTO 240
360 TEXT : HOME : END
370 REM LETTERS
380 REM ---A---
390 DATA 0,40,13,0,13,0,26,40,6,21
400 DATA 20,21,-1,-1,-1,-1,-1,-1,-1,-1
410 REM ---B---
420 DATA 0,0,0,40,0,1,25,1,25,1
430 DATA 25,39,0,39,25,39,0,20,25,20
440 REM ---C---
450 DATA 25,0,0,0,0,0,0,40,0,40
460 DATA 25,40,-1,-1,-1,-1,-1,-1,-1,-1
470 REM ---D---
480 DATA 0,0,0,40,0,1,25,1,25,1
490 DATA 25,39,25,39,0,39,-1,-1,-1,-1
500 REM ---E---
510 DATA 25,40,0,40,0,40,0,0,0,0
520 DATA 25,0,0,20,13,20,-1,-1,-1,-1
530 REM ---F---
540 DATA 0,40,0,0,0,0,25,0,0,20
550 DATA 13,20,-1,-1,-1,-1,-1,-1,-1,-1
560 REM ---G---
570 DATA 25,0,0,0,0,0,0,40,0,40
580 DATA 25,40,25,40,25,20,25,20,15,20
590 REM ---H---
600 DATA 0,0,0,40,25,0,25,40,0,20
610 DATA 25,20,-1,-1,-1,-1,-1,-1,-1,-1
620 REM ---I---
630 DATA 0,0,24,0,0,40,24,40,12,0
640 DATA 12,40,-1,-1,-1,-1,-1,-1,-1,-1
650 REM ---J---
660 DATA 25,0,25,40,25,40,0,40,0,40
670 DATA 0,30,-1,-1,-1,-1,-1,-1,-1,-1
680 REM ---K---
690 DATA 0,0,0,40,0,20,25,0,0,20
700 DATA 25,40,-1,-1,-1,-1,-1,-1,-1,-1
710 REM ---L---
720 DATA 0,0,0,40,0,40,25,40,-1,-1
730 DATA -1,-1,-1,-1,-1,-1,-1,-1,-1,-1
740 REM ---M---
750 DATA 0,0,0,40,0,0,13,20,13,20
```

```

760 DATA 26,0,26,0,26,40,-1,-1,-1,-1
780 DATA 0,40,0,0,0,0,25,40,25,40
790 DATA 25,0,-1,-1,-1,-1,-1,-1,-1,-1
800 REM ---O---
810 DATA 0,0,25,0,25,0,25,40,25,40
820 DATA 0,40,0,40,0,0,-1,-1,-1,-1
830 REM ---P---
840 DATA 0,40,0,0,0,0,25,0,25,0
850 DATA 25,20,25,20,0,20,-1,-1,-1,-1
860 REM ---Q---
870 DATA 0,0,25,0,25,0,25,40,25,40
880 DATA 0,40,0,40,0,0,20,35,30,45
890 REM ---R---
900 DATA 0,40,0,0,0,0,25,0,25,0
910 DATA 25,20,25,20,0,20,10,20,25,40
920 REM ---S---
930 DATA 25,0,0,0,0,0,0,20,0,20
940 DATA 25,20,25,20,25,40,25,40,0,40
950 REM ---T---
960 DATA 0,0,25,0,13,0,13,40,-1,-1
970 DATA -1,-1,-1,-1,-1,-1,-1,-1,-1,-1
980 REM ---U---
990 DATA 0,0,0,40,0,40,25,40,25,40
1000 DATA 25,0,-1,-1,-1,-1,-1,-1,-1,-1
1010 REM ---V---
1020 DATA 0,0,13,40,13,40,25,0,-1,-1
1030 DATA -1,-1,-1,-1,-1,-1,-1,-1,-1,-1
1040 REM ---W---
1050 DATA 0,0,5,40,5,40,13,0,13,0
1060 DATA 21,40,21,40,26,0,-1,-1,-1,-1
1070 REM ---X---
1080 DATA 0,0,25,40,0,40,25,0,-1,-1
1090 DATA -1,-1,-1,-1,-1,-1,-1,-1,-1,-1
1100 REM ---Y---
1110 DATA 0,0,13,20,13,20,26,0,13,20
1120 DATA 13,40,-1,-1,-1,-1,-1,-1,-1,-1
1130 REM ---Z---
1140 DATA 0,0,25,0,25,0,0,40,0,40
1150 DATA 25,40,-1,-1,-1,-1,-1,-1,-1,-1
1160 REM PRINT LETTER
1170 HOME :Y7 = 90
1180 HGR : HCOLOR= 3
1190 X7 = 130
1200 FOR J = 1 TO 20 STEP 4
1210 X1 = A(L,J):Y1 = A(L,J + 1):X2 = A(L,J + 2):Y
2 = A(L,J + 3)
1220 IF X1 < 0 THEN 1240
1230 H PLOT X1 + X7,Y1 + Y7 TO X2 + X7,Y2 + Y7
1240 NEXT J
1250 RETURN

```

## 2: Education

---

```
1260 REM PRINT ALPHABET
1270 L$ = L$ + CHR$ (L + 64)
1280 VTAB 22: HTAB 6: INVERSE : PRINT L$: NORMAL

1290 FOR I = 1 TO 250: NEXT
1300 IF L = 26 THEN GOSUB 1330
1310 RETURN
1320 REM FLASH ALPHABET
1330 VTAB 22: HTAB 6: FLASH : PRINT L$
1340 FOR I = 1 TO 3000: NEXT
1350 VTAB 22: HTAB 6: NORMAL : PRINT L$
1360 RETURN
1370 REM STORE DIGIT COORDINATES IN N
1380 FOR I = 0 TO 9
1390 REM SET UP A DIGIT
1400 FOR J = 0 TO 19
1410 READ N(I,J)
1420 NEXT J
1430 NEXT I: RETURN
1440 REM DIGITS
1450 REM ---0---
1460 DATA 0,0,20,0,20,0,20,40,20,40
1470 DATA 0,40,0,40,0,0,-1,-1,-1,-1
1480 REM ---1---
1490 DATA 5,10,13,0,13,0,13,40,0,40
1500 DATA 26,40,-1,-1,-1,-1,-1,-1,-1,-1
1510 REM ---2---
1520 DATA 0,10,12,0,12,0,24,10,24,10
1530 DATA 0,40,0,40,25,40,-1,-1,-1,-1
1540 REM ---3---
1550 DATA 0,0,20,0,20,0,20,40,20,40
1560 DATA 0,40,0,20,20,20,-1,-1,-1,-1
1570 REM ---4---
1580 DATA 20,0,0,35,0,35,25,35,20,0
1590 DATA 20,40,-1,-1,-1,-1,-1,-1,-1,-1
1600 REM ---5---
1610 DATA 19,0,5,0,5,0,0,19,0,19
1620 DATA 20,19,20,19,20,40,20,40,0,40
1630 REM ---6---
1640 DATA 2,0,0,20,0,20,22,20,22,20
1650 DATA 22,40,22,40,0,40,0,40,0,20
1660 REM ---7---
1670 DATA 0,0,25,0,25,0,0,40,-1,-1
1680 DATA -1,-1,-1,-1,-1,-1,-1,-1,-1,-1
1690 REM ---8---
1700 DATA 0,0,0,40,0,40,20,40,20,40
1710 DATA 20,0,0,20,20,20,20,0,0,0
1720 REM ---9---
1730 DATA 0,0,22,0,22,0,22,20,22,20
1740 DATA 0,20,0,20,0,0,22,20,20,40
```

```
1750 N1 = 1: GOSUB 2040
1760 GET A$: GOSUB 2050
1770 IF A$ = " " THEN N1 = N1 + 1: C2 = 0: GOSUB 2
040: GOTO 1760
1780 IF C2 = 1 THEN X = N2: HCOLOR= 0: Y7 = 30: X7 =
135: GOSUB 1980: HCOLOR= 3
1790 T = N1: N1 = ASC (A$) - 48: N2 = N1: C2 = 1: IF
N1 < 0 OR N1 > 9 THEN N2 = 1
1800 IF N1 > = 0 AND N1 < 10 THEN C5 = 1: GOSUB
1850
1810 N1 = T
1820 IF A$ = CHR$ (14) THEN N1 = 1: GOSUB 1850
1830 IF A$ = CHR$ (12) THEN RETURN
1840 GOTO 1760
1850 REM
1860 P = 1: F$ = STR$ (N1)
1870 X = VAL ( MID$ (F$, P, 1))
1880 IF VAL (A$) = N1 THEN Y7 = 30: GOSUB 1930: GOTO
1900
1890 GOSUB 1920
1900 P = P + 1: IF P < = LEN (F$) THEN 1870
1910 RETURN
1920 Y7 = 90
1930 X7 = 135: FOR Q = 1 TO LEN (F$): X7 = X7 - 33
: NEXT
1940 FOR Q = 1 TO P: X7 = X7 + 33: NEXT
1950 IF P > 1 OR C5 = 1 THEN 1980
1970 HGR : HCOLOR= 3
1980 FOR J = 0 TO 19 STEP 4
1990 X1 = N(X, J): Y1 = N(X, J + 1): X2 = N(X, J + 2): Y
2 = N(X, J + 3)
2000 IF X1 < 0 THEN 2030
2010 HPLOT X1 + X7, Y1 + Y7 TO X2 + X7, Y2 + Y7
2020 NEXT
2030 C5 = 0: RETURN
2040 HOME : GOSUB 1850: RETURN
2050 IF A$ = "/" THEN 360
2060 RETURN
```

# Snertle

---

Soori Sivakumaran

Apple Translation by Chris Poer

*By making simple selections from a menu, a child can change this arithmetic drill to fit his or her own tutoring needs. It features a smiling turtle and bold graphics sure to catch the young child's eye.*

“Snertle” is designed to help teach children the fundamentals of addition, subtraction, and multiplication. A turtle named Snertle is drawn on the screen to give encouragement and assistance to the player.

## **An Individual Challenge**

Snertle allows children to tailor math problems to fit their individual abilities and weaknesses. It first asks the child to select addition, subtraction, or multiplication problems. If addition or subtraction is selected, the child is then asked to specify the largest and smallest numbers (between 0 and 99) to be used in creating the problems.

If multiplication is chosen, the child may decide to practice a specific multiplication table or solve problems created randomly using numbers from 0 through 14. For example, if the 12 times table is selected, then one number in each question created will always be 12. The other number will be randomly selected from the range 0–14.

If the child chooses to attempt random multiplication problems, he or she must define the range of numbers (between 0 and 14) from which the problems can be created.

## **The Smiling Turtle**

Once a response is entered, Snertle checks it against the correct answer. If the response is correct, then the turtle will smile, *GOOD!* will appear on its shell, and a high beep will sound. If the response is incorrect, Snertle's head will disappear into its shell and the message *TRY AGAIN* will appear on its side.

The user always gets a second chance. If the new response is correct, Snertle will poke its head out from the shell. If the answer is again incorrect, the correct answer will be displayed on the screen.

The program will keep producing problems until the X key is pressed in response to a problem. The percentage of correctly answered questions is then calculated and displayed; it gives credit only for those problems answered correctly on the first attempt. Snertle then returns to the menu, where the child may END the program or select more problems.

## Snertle

```

110 TEXT : HOME : VTAB 2: HTAB 15: PRINT "***SNERT
    LE**": VTAB 5
120 PRINT : VTAB 5: HTAB 10: PRINT "SELECT ONE:"
130 PRINT : PRINT : HTAB 10: PRINT "1) ADDITION"
140 PRINT : HTAB 10: PRINT "2) SUBTRACTION"
150 PRINT : HTAB 10: PRINT "3) MULTIPLICATION"
155 PRINT : HTAB 10: PRINT "4) END PROGRAM"
160 PRINT : PRINT : HTAB 10: PRINT "(ENTER 1,2,3
    OR 4) ";: INPUT Q: IF Q < 1 OR Q > 4 THEN 160

185 C = 14: IF Q = 1 OR Q = 2 THEN C = 99
187 IF Q = 3 THEN 1000
188 IF Q = 4 THEN END
190 HOME : VTAB 3: HTAB 10: PRINT "ENTER LARGEST
    VALUE"
200 HTAB 10: PRINT "(MIN.:1 MAX.:";C;")";: INPUT
    R: IF R < 1 OR R > C THEN 200
230 HTAB 10: VTAB 10: PRINT "ENTER SMALLEST VALUE
    "
240 HTAB 10: PRINT "(MIN.:0 MAX.:";R;")";: INPUT
    S: IF S < 0 OR S > R THEN 240
263 HOME : VTAB 10: HTAB 7: PRINT "TYPE ";: INVERSE
    : PRINT "X";: NORMAL : PRINT " TO RETURN TO T
    HE MENU"
265 FOR I = 1 TO 2000: NEXT I: HOME
270 Z = 0: ZZ = 0: GR
275 GOSUB 1100: COLOR= 12: GOSUB 1170: GOSUB 1230

301 TR = 0: ZZ = ZZ + 1
305 L = INT ( RND (1) * (R - S + 1)) + S
310 IF Q = 3 AND T = 1 THEN 320
315 K = INT ( RND (1) * (R - S + 1)) + S
320 F$ = STR$ (K):W = 0
325 IF K < L AND Q = 2 THEN 305
330 W = 0: GOSUB 3000
340 F$ = STR$ (L)
345 W = 6: GOSUB 3000
346 ON Q GOSUB 6000,6000,6004
350 IF Q = 1 THEN M = K + L
355 IF Q = 2 THEN M = K - L

```



## 2: Education

---

```
365 IF Q = 3 THEN M = K * L
380 GOSUB 740:MM = 1: IF M > 9 THEN MM = 2
385 IF M > 99 THEN MM = 3
393 V = 0: COLOR= 12: GOSUB 1170
395 FOR J = 0 TO MM - 1
397 COLOR= 1: PLOT 21 - (5 * J),34
399 POKE - 16368,0
400 H$ = "":H = PEEK ( - 16384) - 128: IF H > 0 THEN
H$ = CHR$ (H)
407 IF H$ = "X" AND ZZ = 1 THEN POKE - 16368,0:
GOTO 110
410 IF H$ = "X" THEN TEXT : HOME : HTAB 15: PRINT
"PERCENTAGE="; INT (Z / (ZZ - 1) * 100): POKE
- 16368,0: GOTO 120
412 IF H < 48 OR H > 57 THEN 400
415 P = VAL (H$)
420 V = V + (P * 10 ^ J):W = 14:X = 21 - (5 * J): GOSUB
480: NEXT J
450 IF M = V THEN 470
451 FOR I = 1 TO 40: FOR J = 1 TO 2: NEXT J:L = PEEK
( - 16336): NEXT I
452 COLOR= 0: FOR I = 33 TO 38: HLIN 7,34 AT I: NEXT
I: COLOR= 1
456 IF TR = 1 THEN 460
458 TR = 1: COLOR= 0: GOSUB 1170: GOSUB 770:V = 0:
GOTO 395
460 M$ = STR$ (M)
461 IF MM < 3 THEN FOR I = 1 TO 3 - MM: READ X: NEXT
I
462 FOR OO = 1 TO MM
464 P = VAL ( MID$ (M$,OO,1))
465 READ X: GOSUB 480: NEXT OO: RESTORE
467 FOR I = 1 TO 900: NEXT
470 COLOR= 12: GOSUB 1170: IF TR = 0 THEN GOSUB
2500: GOSUB 755:Z = Z + 1: GOSUB 6500: HOME
471 GOSUB 2225: GOTO 301
480 COLOR= 1: IF P = 0 THEN GOSUB 720
485 ON P GOSUB 500,525,555,585,610,633,660,680,70
0: RETURN
500 VLIN 20 + W,24 + W AT X: VLIN 20 + W,24 + W AT
X + 1: RETURN
525 HLIN X,X + 3 AT 20 + W: PLOT X + 2,21 + W: PLOT
X + 3,21 + W: HLIN X,X + 3 AT 22 + W
530 VLIN 23 + W,24 + W AT X: VLIN 23 + W,24 + W AT
X + 1: PLOT X + 2,24 + W: PLOT X + 3,24 + W: RETURN
555 VLIN 20 + W,24 + W AT X + 2: PLOT X,20 + W: PLOT
X,22 + W: PLOT X,24 + W
560 PLOT X + 1,20 + W: PLOT X + 1,22 + W: PLOT X +
1,24 + W: RETURN
```

```
585 VLIN 20 + W,22 + W AT X: PLOT X + 1,22 + W: VLIN
    20 + W,24 + W AT X + 2: PLOT X + 3,22 + W: RETURN

610 HLIN X,X + 3 AT 20 + W: HLIN X,X + 3 AT 22 +
    W: HLIN X,X + 3 AT 24 + W: PLOT X + 2,23 + W:
    PLOT X + 3,23 + W

615 PLOT X,21 + W: PLOT X + 1,21 + W: RETURN
633 VLIN 20 + W,24 + W AT X: VLIN 20 + W,24 + W AT
    X + 1: VLIN 22 + W,24 + W AT X + 3: HLIN X +
    2,X + 3 AT 20 + W

635 PLOT X + 2,22 + W: PLOT X + 2,24 + W: RETURN

660 HLIN X + 1,X + 3 AT 20 + W: PLOT X + 3,21 + W
    : PLOT X + 2,22 + W
665 VLIN 23 + W,24 + W AT X + 1: RETURN
680 GOSUB 720: HLIN X + 1,X + 2 AT 22 + W: RETURN

700 HLIN X,X + 3 AT 20 + W: HLIN X,X + 3 AT 22 +
    W: HLIN X,X + 3 AT 24 + W: VLIN 20 + W,24 + W
    AT X + 3
705 VLIN 21 + W,22 + W AT X: RETURN
720 VLIN 20 + W,24 + W AT X: VLIN 20 + W,24 + W AT
    X + 3: HLIN X + 1,X + 2 AT 20 + W: HLIN X + 1
    ,X + 2 AT 24 + W: RETURN
740 HLIN 10,27 AT 32: RETURN
755 VTAB 21: HTAB 19: PRINT "GOOD!": FOR I = 1 TO
    300: NEXT I: RETURN
770 VTAB 21: HTAB 16: PRINT "TRY AGAIN": FOR I =
    1 TO 1000: NEXT I: HOME : RETURN
1000 HOME : VTAB 4: HTAB 13: PRINT "DO YOU WISH T
    O:"
1010 PRINT : HTAB 9: PRINT "1) PRACTICE TIMES TAB
    LES"
1020 PRINT : HTAB 9: PRINT "2) PRACTICE RANDOM NU
    MBERS"
1030 PRINT : HTAB 9: PRINT "(ENTER 1 OR 2) ";: INPUT
    T: IF T < 0 OR T > 2 THEN 1030
1050 IF T = 2 THEN 190
1060 HOME : VTAB 5: HTAB 11: PRINT "ENTER TIMES T
    ABLE (1-14)"
1070 INPUT K: IF K < 1 OR K > 14 THEN 1070
1090 S = 0:R = 14: GOTO 263
1100 J = 12:JJ = 20: COLOR= 4: FOR I = 0 TO 8: HLIN
    J,JJ AT I:J = J - 1:JJ = JJ + 1
1110 NEXT I: FOR I = 8 TO 11: HLIN J + 1,JJ - 1 AT
    I: NEXT I: RETURN
1170 HLIN 30,32 AT 5: FOR I = 6 TO 10: HLIN 29,33
    AT I: NEXT I: COLOR= 0: PLOT 32,7: RETURN
```

## 2: Education

---

```
1230 COLOR= 12: FOR I = 12 TO 15: HLINE 10,12 AT I
: HLINE 21,23 AT I: NEXT I
1240 FOR I = 16 TO 17: HLINE 10,14 AT I: HLINE 21,2
5 AT I: NEXT I: RETURN
2225 COLOR= 0: FOR I = 20 TO 38: HLINE 10,39 AT I:
NEXT I: COLOR= 1: RETURN
2500 COLOR= 0: PLOT 32,10: PLOT 31,9: COLOR= 1: RETURN

3000 IF LEN (F$) > 1 THEN 3030
3015 P = VAL ( MID$ (F$,1,1))
3020 X = 21: GOSUB 480
3025 RETURN
3030 P = VAL ( MID$ (F$,1,1))
3035 X = 16: GOSUB 480
3040 P = VAL ( MID$ (F$,2,1))
3045 X = 21: GOSUB 480
3050 RETURN
5000 DATA 12,16,22
6000 HLINE 11,14 AT 29: HLINE 11,14 AT 28: IF Q = 1
THEN VLINE 27,30 AT 12: VLINE 27,30 AT 13
6001 RETURN
6004 PLOT 12,27: PLOT 14,27: PLOT 13,28: PLOT 12,
29: PLOT 14,29: RETURN
6500 FOR I = 1 TO 20:L = PEEK ( - 16336): NEXT I
: FOR I = 1 TO 10: NEXT I: FOR I = 1 TO 40:L =
PEEK ( - 16336): NEXT I: RETURN
```

# First Math

---

Steve Hamilton

Apple Translation by Patrick Parrish

*This math game for children features graphics, color, and sound. It displays the correct answer after the child has entered an incorrect one. In addition, there's an exciting graphics demo and a musical fanfare after ten consecutive correct answers.*

I was introduced to home computing last May. I purchased a computer partly for my two young boys, so they would grow up with some knowledge about a computer. Since the older boy was just approaching kindergarten, I thought it would be at least a year or so before he would be ready to operate it. But he was ready long before I had anticipated.

The following is a simple math tutorial that I developed for him. In this program, the user is given a choice of exercises: addition, subtraction, multiplication or division. Upper and lower limits can be specified for each of the two numbers in each problem, and the computer will generate random problems using numbers within the range that you specified.

## First Math

```
100 GOSUB 670
110 GOTO 260
120 DIM X(100),Y(100)
130 P = 2 * (355 / 113): FOR I = 1 TO 100:ANGLE =
  P * (I / 100):X(I) = 15 * SIN (ANGLE):Y(I) =
  15 * COS (ANGLE): NEXT I
140 RETURN
150 POKE 230,32: CALL 62450: HGR : CALL - 1994: GR
  : COLOR= 7: PLOT 16,15: PLOT 24,15: COLOR= 4:
  PLOT 20,19
160 COLOR= 11: IF C1 = 0 THEN 190
170 PLOT 15,23: PLOT 25,23: PLOT 16,24: PLOT 24,2
  4: PLOT 17,25: PLOT 23,25: HLIN 18,22 AT 26
180 GOTO 200
190 HLIN 18,22 AT 23: PLOT 17,24: PLOT 23,24: PLOT
  16,25: PLOT 24,25: PLOT 15,26: PLOT 25,26
200 COLOR= 1
210 FOR I = 1 TO 100: PLOT X(I) + 20,Y(I) + 20: NEXT
  I
220 VTAB 22: HTAB 10: FLASH : IF C1 = 1 THEN PRINT
  " G O O D J O B !! ": NORMAL : GOTO 250
```

## 2: Education

---

```
230 NORMAL : VTAB 22: HTAB 6: PRINT "S O R R Y ,
    B U T ";B;" ";A$;" ";C;"=";" "; INVERSE : PRINT
    E: NORMAL
240 FOR I = 1 TO 2000: NEXT I
250 FOR I = 1 TO 1500: NEXT I: HOME : HGR : POKE
    34,0: HOME : TEXT : RETURN
260 HOME : INVERSE : VTAB 10: HTAB 12: PRINT "F I
    R S T   M A T H": NORMAL : VTAB 18: HTAB 4: PRINT
    ".....P L E A S E   W A I T"
270 GOSUB 120
280 HOME : VTAB 4: HTAB 7: PRINT "TO ";; INVERSE
    : PRINT "ADD";: NORMAL : PRINT "      " : TYPE
    "+"
290 VTAB 6: HTAB 7: PRINT "TO ";; INVERSE : PRINT
    "SUBTRACT";: NORMAL : PRINT "      " : TYPE "-"
300 VTAB 8: HTAB 7: PRINT "TO ";; INVERSE : PRINT
    "MULTIPLY";: NORMAL : PRINT "      " : TYPE "*"
310 VTAB 10: HTAB 7: PRINT "TO ";; INVERSE : PRINT
    "DIVIDE";: NORMAL : PRINT "      " : TYPE "/"
320 VTAB 13: HTAB 7: PRINT "YOUR CHOICE=" ;
330 INPUT A$: IF A$ < > ("*") AND A$ < > ("+") AND
    A$ < > ("-") AND A$ < > ("/") THEN 330
340 VTAB 17: HTAB 7: INPUT "HIGHEST NUMBER=?";UL
    : VTAB 19: HTAB 7: INPUT "LOWEST NUMBER=?";
    LL
350 R = UL + 1 - LL
360 C = INT ( RND (1) * R) + LL:B = INT ( RND (1)
    ) * R) + LL
370 IF A$ = ("+") THEN DEF FN A(X) = B + C
380 IF A$ = ("-") THEN DEF FN A(X) = B - C
390 IF A$ = ("*") THEN DEF FN A(X) = B * C
400 IF A$ = ("/") AND C = 0 THEN 360
405 IF A$ <> ("/") THEN 430
410 IF A$ = ("/") AND INT (B / C) < > B / C THEN
    360
420 IF A$ = ("/") THEN DEF FN A(X) = B / C
430 HOME : VTAB 7: HTAB 8: PRINT "CORRECT ANSWERS
    IN A ROW=";; INVERSE : PRINT D: NORMAL
440 E = FN A(X): VTAB 15: HTAB 15: PRINT B;" ";A$
    ;" ";C;"=";; INPUT F: IF F < > E THEN 480
450 HOME :C1 = 1: GOSUB 150
460 D = D + 1: IF D = 10 THEN 500
470 GOTO 360
480 HOME :C1 = 0: GOSUB 150
490 D = 0: GOTO 430
500 REM YOU WIN!!
510 D = 0: GOSUB 560
520 VTAB 22: HTAB 8: FLASH : PRINT " Y O U   D I
    D   I T !!!"
```

```
530 FOR I = 1 TO 5: POKE 768,1: POKE 769,200 - I *
    30: CALL 770: NEXT I: FOR I = 1 TO 10: POKE 7
540 68,1: POKE 769,40 + I * 20: CALL 770: NEXT I
    NORMAL : VTAB 24: HTAB 10: PRINT "TRY AGAIN (
    Y/N) ?"; GET A$: IF A$ = ("Y") THEN TEXT : GOTO
550 280
    TEXT : HOME : HTAB 5: VTAB 8: PRINT "...SEE Y
    A LATER...": END
560 POKE 230,32: CALL 62450: HGR : CALL - 1994: GR

570 FOR J = 1 TO 3
580 CL = 0:L0 = 0:H1 = 19:S1 = 1: GOSUB 620
590 CL = 17:L0 = 19:H1 = 0:S1 = - 1: GOSUB 620
600 NEXT J
610 RETURN
620 FOR I = L0 TO H1 STEP S1: COLOR= INT ( RND (
    1) * CL):X1 = 19 - I:X2 = 20 + I:Y1 = 19 - I:
    Y2 = 20 + I
630 HLIN X1,X2 AT Y1: VLIN Y1 + 1,Y2 AT X2
640 HLIN X2 - 1,X1 AT Y2: VLIN Y2 - 1,Y1 AT X1
650 NEXT I
660 RETURN
670 REM LOAD MUSIC ROUTINE
680 FOR I = 770 TO 795: READ M: POKE I,M: NEXT I
690 DATA 172,01,03,174,01,03,169,04,32,168,252,1
    73,48,192,232,208,253,136,208,239,206,0,03,20
    8,231,96
700 RETURN
```

# Crosswords

---

William Loercher

Apple Translation by Patrick Parrish

*With this program, your Apple will be able to construct simple crossword puzzles. The finished puzzle can be displayed on the screen or printed on your printer.*

If you've ever tried to make your own crossword puzzles, you know the procedure can be very time-consuming. But can your Apple create the puzzles? With this program, it surely can.

The program can be embellished in several ways. For instance, after all 23 rows are tested ( $Z=23$ ), you could add another section that tests the columns for word fits. This should result in a better puzzle. You could also keep track of the words that fit a given location in another array and then choose the longest word from that list.

Lines 2010–2110 are the DATA statements containing the words used in the puzzle. Feel free to substitute your own words for the ones given here.

## Crossword Puzzles

```
100 TEXT : HOME
110 HTAB 2: FOR X = 1 TO 38: PRINT "*"::: NEXT X
120 VTAB 1: FOR Y = 2 TO 23: FOR X = 2 TO 39 STEP
    37: VTAB Y: HTAB X: PRINT "*"::: NEXT X,Y
130 HTAB 2: VTAB 24: FOR I = 1 TO 38: PRINT "*":::
    NEXT I
140 A = 11: FOR F = 1 TO 16:A = A + 1:E = 18: READ
    A$
150 FOR B = 3 TO A: VTAB 19: HTAB B: PRINT " "A$:
    NEXT B
160 FOR C = 1 TO 10: HTAB 1
170 FOR D = 1 TO E: VTAB D + 1: NEXT D
180 HTAB A + 1: PRINT A$: HTAB A + 1: PRINT " ":E
    = E - 1: NEXT C: NEXT F
190 FOR X = 1 TO 20000: NEXT
200 A = 19: FOR F = 1 TO 7:E = 18: READ A$: FOR B =
    3 TO A - 1: VTAB 19: HTAB B: PRINT " "A$: NEXT
    B
210 VTAB 19: PRINT " *"
220 FOR C = 1 TO 13 - F: HTAB 1: FOR D = 1 TO E: VTAB
    D + 1: NEXT D
230 HTAB A: PRINT A$: HTAB A: PRINT " ":E = E - 1
    : NEXT C: POKE 1210,143: NEXT F
```

```

240 FOR X = 1 TO 19: READ A$: IF A$ = "0" THEN 27
    0
250 VTAB 14: HTAB X + 9: PRINT A$
260 GOTO 280
270 VTAB 14: HTAB X + 9: PRINT " "
280 FOR Y = 1 TO 200: NEXT Y: NEXT X
290 FOR I = 1 TO 2000: NEXT I: HOME
300 VTAB 4: INPUT "HOW MANY WORDS (MAX:110)?":N
310 VTAB 7: INPUT "HOW MANY VERTICAL WORDS (15-25
    WORKS WELL)?":K
320 VTAB 10: INPUT "RESULTS ON SCREEN OR PRINTER
    (S OR P)?":S$
330 DIM N$(N),L(N)
340 FOR X = 1 TO N: READ N$(X):L(X) = LEN (N$(X)
    ): NEXT X: HOME
350 INVERSE : FOR I = 1 TO 23: FOR J = 1 TO 39: HTAB
    J: VTAB I: PRINT " ": NEXT J: NEXT I: NORMAL

360 DIM XL%(23): FOR I = 0 TO 7
370 XL%(I) = 1024 + 128 * I
380 XL%(I + 8) = 1064 + 128 * I
390 XL%(I + 16) = 1104 + 128 * I: NEXT I
400 FOR Z = 1 TO K:E = 0
410 R = INT ( RND (1) * N) + 1: IF N$(R) = "0" THEN
    410
420 ROW = INT ( RND (1) * 23):COL = INT ( RND (1)
    ) * 40)
430 P = XL%(ROW) + COL
440 FOR X = 0 TO L(R) + 1:B = PEEK (XL%(ROW + X)
    + COL):C = PEEK (XL%(ROW + X) + COL - 1):D =
    PEEK (XL%(ROW + X) + COL + 1)
450 IF B < > 32 OR C < > 32 OR D < > 32 THEN X
    = L(R) + 1: NEXT X: GOTO 420
460 E = E + 1
470 NEXT X: IF E = L(R) + 1 THEN E = 0
480 POKE P,170: REM PLACE * ON EITHER SIDE OF WO
    RD
490 FOR X = 1 TO L(R): POKE (XL%(ROW + X) + COL),
    ASC ( MID$( N$(R),X,1)) + 64
500 NEXT X: POKE (XL%(ROW + X) + COL),170:N$(R) =
    "0": NEXT Z: REM GET ANOTHER WORD
510 Z = 0
520 Z = Z + 2:L = 0
530 IF Z > 23 THEN 770
540 FOR X = 1 TO N:E = 0:G = 0
550 IF N$(X) = "0" OR L + L(X) + 2 > 39 THEN NEXT
    X
560 IF X > N THEN 520
570 FOR Y = 1 TO L(X)
580 B = PEEK (XL%(Z) + L + Y)

```



## 2: Education

---

```
590 C = ASC ( MID$ ( N$(X),Y,1) ) + 64
600 IF B = 32 OR B = C THEN E = E + 1
610 IF B = 32 THEN G = G + 1
620 IF E = 0 THEN 660
630 IF B = 160 OR B = 170 OR G = L(X) THEN L = L +
1: GOTO 540
640 IF E = L(X) THEN 680
650 NEXT Y
660 NEXT X
670 L = L + 1: GOTO 540
680 B = PEEK (XL%(Z) + L + L(X) + 1)
690 IF B = 170 OR B = 32 THEN 710
700 L = L + 1: NEXT X: GOTO 520
710 B = PEEK (XL%(Z) + L)
720 IF B = 32 OR B = 170 THEN 740
730 L = L + 1: NEXT X: GOTO 520
740 POKE (XL%(Z) + L),170
750 FOR L1 = 1 TO L(X): POKE (XL%(Z) + L + L1), ASC
( MID$ ( N$(X),L1,1) ) + 64
760 NEXT L1: POKE (XL%(Z) + L + L1),170:N$(X) = "
0":L = L + L1: GOTO 540
770 IF S$ = "P" THEN 790
780 GOTO 1030
790 PR# 1: PRINT CHR$ (9)"255N"
800 FOR X = 0 TO 23:B = 20: FOR Y = 0 TO 39: IF Y
> 0 THEN B = 0
810 A = PEEK (XL%(X) + Y): IF A = 160 OR A = 170 OR
A = 32 THEN A = 237
820 B$ = CHR$ (A - 64)
830 PRINT SPC( B)B$;: IF Y = 39 THEN PRINT
840 NEXT Y: NEXT X: PR# 0: PRINT : GOTO 1030
850 DATA C,R,O,S,S,W,O,R,D, ,P,U,Z,Z,L,E
860 DATA P,R,O,G,R,A,M
870 DATA B,Y,0,W,I,L,L,I,A,M,0,L,O,E,R,C,H,E,R
1030 PRINT " DONE! ";: INVERSE : PRINT "E";: NORMAL
: PRINT "ND OR ";: INVERSE : PRINT "C";: NORMAL
: PRINT "ONTINUE?";
1033 GET R$: IF R$ = "" THEN 1033
1035 IF R$ = "C" THEN RUN
1040 HOME : PRINT "BYE!": END
2000 REM NUMBER OF WORDS=110
2010 DATA ASSENT,ASTERISK,BAG,BITE,BOOT,BUFFER,B
ULK,CELL,CEMENT,CLAIM
2020 DATA CAT,PERSON,CHAIR,CAN,PAPER,NUMBER,OWL,
PLATE,CIRCLE,PENCIL
2030 DATA VICTORY,LETTER,DOORWAY,SAIL,LOVE,MOTHE
R,SON,DAUGHTER,CAR,HAPPY
2040 DATA TOMORROW,TRUCK,BUSINESS,FEELINGS,SUNSE
T,BRIGHT,SUMMER,MOVIE,CHESS,PAINT
```

- 2050 DATA TENNIS, NET, BALL, RACKET, COURT, PLAYER, OF  
FICIAL, BOOTH, SCORE, POINT
- 2060 DATA PINS, RACK, NEEDLES, CHAIR, STOOL, CEILING,  
SOUND, PROFESSOR, TEACHER, SCHOOL
- 2070 DATA COMPUTE, KEYBOARD, BYTE, BIT, STOP, GO, END,  
MICROCOMPUTER, SOLUTION, FINE
- 2080 DATA ROOM, SAD, JOY, PEACE, BOATING, RIVER, LAKE,  
SWIMMING, BOARD, GRASS
- 2090 DATA EGG, EXHALE, GLORY, ILLUSIVE, IMMORAL, DESK  
, LET, LEVEL, MYSTERY, MYSELF
- 2100 DATA NAIL, TWO, MUTE, OFF, OFFER, PALM, PANEL, PEN  
NY, CENT, DOLLAR
- 2110 DATA RENDER, THE, WING, POLICE, HELP, TOIL, TREE,  
LIGHT, RUN, POLL

# Chemistry Lab

---

Joanne Davis

*This program, which will be of special interest to teachers, brings chemistry to life for elementary students. It features an easy-to-use menu and animated graphics. A color monitor is recommended.*

“Chemistry Lab” encourages elementary school students to hypothesize and review concepts by allowing them to duplicate laboratory experiences in chemistry. It uses standard chemical indicators to identify a variety of substance types, including acids, bases, sugars, or starches.

The program is menu-driven. After choosing a topic, the student is given instructions. Those are followed by a picture of an eyedropper containing the indicator (in the appropriate color), a beaker (containing the material to be tested), and the material and indicator names. The student predicts the result of the test, as he or she would before conducting a laboratory experiment, and INPUTs the prediction.

When the test is carried out, the eyedropper releases its contents drop-by-drop and the beaker fills with liquid. The liquid’s color indicates the presence of acid, sugar, etc. Comments then reinforce the material’s classification.

This procedure is repeated to test four more substances. More items can easily be added by DIMensioning the arrays and adding more DATA.

## Two Special Techniques

Two of the techniques used in this program should be of special interest. The animation is created by alternating between a color and black, and by time delays caused by empty FOR-NEXT loops. The inside of the dropper is blacked out a line at a time, with the delay making the action visible. The previous position of the drop is blacked out, and the drop is redrawn at a new location. Then the beaker is filled up (a line at a time).

Since the sugar and starch tests require virtually the same instructions, an easy way was found to make the needed alterations. The changes are READ in from DATA statements and inserted into the message.

A science curriculum can come alive with animated laboratory experiments. Try it and see.

## Chemistry Lab

```

20 TEXT : HOME
30 VTAB 8: HTAB 15: PRINT "*****"
40 HTAB 15: PRINT "WELCOME TO THE": HTAB 15: PRINT
  "CHEMISTRY LAB": HTAB 15: PRINT "*****
  **"
50 FOR TT = 1 TO 4500: NEXT
60 HOME : VTAB 5: PRINT "CHOOSE TEST 1, 2, OR 3:"
  : PRINT : HTAB 5: PRINT "1. ACID": HTAB 5: PRINT
  "2. STARCH": HTAB 5: PRINT "3. SUGAR"
65 HTAB 5: PRINT "4. QUIT"
70 GET CH$:CH = VAL (CH$): ON CH GOSUB 1000,2000
  ,2500,100
80 TEXT : GOTO 60
100 END
1000 REM ACID/BASE***PHENOL
1020 REM INSTRUC
1025 GOSUB 4000
1030 TEXT : HOME
1040 PRINT : PRINT : PRINT "YOU ARE GOING TO TEST
  SOME MATERIALS TO": PRINT "SEE IF THEY ARE A
  CIDS OR BASES. THE": PRINT "INDICATOR WILL TU
  RN ";; INVERSE : PRINT "PINK";: NORMAL : PRINT
  " IN AN ";; INVERSE : PRINT "ACID";: NORMAL :
  PRINT "."
1045 PRINT : PRINT "TYPE ";; INVERSE : PRINT "A";
  : NORMAL : PRINT " IF YOU THINK THAT THE MATE
  RIAL": PRINT "IS AN ACID."
1047 PRINT "TYPE ";; INVERSE : PRINT "B";: NORMAL
  : PRINT " IF YOU THINK THAT THE MATERIAL": PRINT
  "IS A BASE."
1050 PRINT : PRINT "HIT ANY KEY TO BEGIN.": GET A
  $
1070 HOME
1150 FOR X = 1 TO 5
1152 DROP = 15: GOSUB 5000
1155 VTAB 21
1160 PRINT "INDICATOR: ";; INVERSE : PRINT "PHENO
  LPHTHALEIN": NORMAL
1170 PRINT "NOW TESTING: ";; INVERSE : PRINT N$(X
  ): NORMAL
1180 PRINT : INVERSE : PRINT "A";: NORMAL : PRINT
  "CID OR ";; INVERSE : PRINT "B";: NORMAL : PRINT
  "ASE ?": GET AN$: IF AN$ < > "A" AND AN$ < >
  "B" THEN HOME : GOTO 1155
1190 IF ID$(X) = "A" THEN BEAK = 11: GOTO 1210
1200 BEAK = DROP
1210 GOSUB 6000

```

## 2: Education

---

```
1220 HOME : IF ID$(X) = "A" THEN PRINT N$(X); " I
      S AN ACID.": GOTO 1240
1230 PRINT N$(X); " IS A BASE."
1240 FOR TT = 1 TO 4000: NEXT TT
1250 NEXT X
1400 FOR TT = 1 TO 1000: NEXT TT
1500 RETURN
2000 Y = 1: GOSUB 4000: GOSUB 3000: RETURN
2500 Y = 2: GOSUB 4000: GOSUB 3000: RETURN
3000 REM STARCH/SUGAR INSTRUCTIONS
3010 TEXT : HOME
3020 PRINT : PRINT : PRINT "YOU ARE GOING TO TEST
      SOME MATERIALS TO": PRINT "SEE IF THEY CONTA
      IN ";B$(Y);"." : PRINT : PRINT "THE INDICATOR
      WILL TURN ";: INVERSE : PRINT C$(Y);: NORMAL
      : PRINT " IN A ": INVERSE : PRINT B$(Y);: NORMAL
      : PRINT "."
3030 PRINT : PRINT "TYPE ";: INVERSE : PRINT "Y";
      : NORMAL : PRINT " IF YOU THINK THAT THE MATE
      RIAL": PRINT "CONTAINS ";B$(Y);" ."
3040 PRINT : PRINT "HIT ANY KEY TO BEGIN.": GET A
      $
3050 HOME
3060 FOR X = 1 TO 5
3070 DROP = P(Y): GOSUB 5000
3080 VTAB 21
3090 PRINT "INDICATOR: ";: INVERSE : PRINT IN$(Y)
      : NORMAL
3092 :
3094 :
3096 :
3100 PRINT "NOW TESTING: ";: INVERSE : PRINT N1$(
      X): NORMAL
3110 PRINT : INVERSE : PRINT B$(Y);: NORMAL : PRINT
      " (Y/N) ?": GET AN$
3120 IF AN$ < > "Y" AND AN$ < > "N" THEN HOME
      : GOTO 3080
3130 ON Y GOSUB 3500,3600
3140 FOR TT = 1 TO 4000: NEXT TT
3150 NEXT X
3200 RETURN
3500 REM STARCH MESSAGE
3510 IF IH$(X) = "S" THEN BEAK = 3: GOTO 3530
3520 BEAK = DROP
3530 GOSUB 6000
3535 HOME
3540 IF IH$(X) = "S" THEN PRINT N1$(X); " CONTAIN
      S STARCH.": GOTO 3560
3550 PRINT N1$(X); " DOES NOT CONTAIN STARCH."
3560 RETURN
```

```
3600 REM SUGAR MESSAGE
3610 IF IR$(X) = "S" THEN BEAK = 9: GOTO 3625
3620 BEAK = DROP
3625 GOSUB 6000
3627 HOME
3630 IF IR$(X) = "S" THEN PRINT N1$(X); " CONTAIN
S SUGAR.": GOTO 3660
3650 PRINT N1$(X); " DOES NOT CONTAIN SUGAR."
3660 RETURN
4000 RESTORE
4005 FOR X = 1 TO 5
4010 READ N$(X), ID$(X), N1$(X), IH$(X), IR$(X)
4020 NEXT X
4030 FOR X = 1 TO 2
4040 READ B$(X), C$(X), IN$(X), P(X)
4050 NEXT X
4060 RETURN
5000 REM SCREEN**OUTLINE BEAK AND DROP
5010 GR : COLOR= 10
5020 VLIN 0,20 AT 14: VLIN 0,20 AT 18
5030 HLIN 15,17 AT 0: HLIN 13,19 AT 6
5040 HLIN 15,17 AT 21: VLIN 21,24 AT 16
5050 PLOT 9,28: VLIN 28,38 AT 10
5060 VLIN 28,38 AT 21: HLIN 11,20 AT 38
5065 REM INSIDE DROPPER
5070 COLOR= DROP
5080 VLIN 15,20 AT 15: VLIN 15,20 AT 16: VLIN 15,
20 AT 17
5500 RETURN
6000 REM ANIMATION
6010 COLOR= 0
6015 P = 31: S = - 16336
6020 FOR G = 15 TO 20
6025 PLOT 16, P
6030 HLIN 15,17 AT G: SO = PEEK (S) - PEEK (S) -
PEEK (S)
6033 GOSUB 6500
6035 FOR TT = 1 TO 400: NEXT TT
6037 COLOR= 0
6040 NEXT G
6050 FOR TT = 1 TO 400: NEXT TT
6100 COLOR= BEAK
6110 FOR G = 37 TO 32 STEP - 1
6120 HLIN 11,20 AT G: FOR TT = 1 TO 250: NEXT
6130 NEXT G
```

## 2: Education

---

```
6140 RETURN
6500 COLOR= DROP:P = P + 1: PLOT 16,P
6510 RETURN
7000 DATA SOAP,B,BREAD,S,S,LEMON JUICE,A,CRACKER,
S,Ø,COLA,A,CHOCOLATE,Ø,S,BAKING SODA,B,COLA,Ø
,S,VINEGAR,A,FLOUR,S,Ø
7010 DATA STARCH,PURPLE,IODINE,13,SUGAR,ORANGE,B
ENEDICTS SOLUTION,7
```

# Typing Teacher

---

Alan McCright

Apple Translation by Patrick Parrish

*Typing program listings is much easier if you know the keyboard and don't need to watch your fingers. The program given here helps you learn touch typing; it will show your progress, too, by giving you a score in characters per minute or in words per minute.*

Those who must rely on hunt-and-peck typing have probably discovered just how tedious it can be, especially when typing in programs. This program will familiarize you with keyboard layout and help you learn to touch type.

The idea is to let your fingers find the correct key without looking at the keyboard. When the program is run, a representation of the keyboard layout appears on the screen. The characters are printed in an approximation of their keyboard positions. Check the key's location on the display, and try to get your finger to move there without looking down at the keyboard.

When you start the program, a "clock" begins to run. The program puts a character on the screen, waits for your response, and checks to see if it matches the test character. If so, your score will be incremented by one. After approximately one minute, the test will end and your score will be printed.

Because the Apple lacks a realtime clock, a special counter routine is used. Incrementing occurs in line 320 (while waiting for a keyboard response) and again in line 350 (to account for the time required to process each response). After approximately a minute, a certain counter value will be reached (in line 330). The testing routine will halt, and a score will be displayed. The score can be given in words per minute by changing line 440 as follows:

```
440 HTAB12:VTAB7:INVERSE:PRINT"WORDS/MINUTE=";  
    "";CCTN/5:NORMAL
```

If you modify this program, check to be sure that the timing is still correct. If not, adjust line 350 as required.

Scoring assumes that the average English word is five letters long. However, since the characters are chosen at random (which I found ideal for learning to type in programs), each individual character has to be recognized rather than recalled



## 2: Education

---

as part of a word. Thus, scoring in words per minute will lead to some low (though accurate) scores, even for good typists.

How fast can the program run? In the word-per-minute mode, by deleting line 360 and all of the REMs, and holding down any key after running, a score of 60-70 words per minute is typical. However, when you are actually running a test, your own reaction time will keep you from reaching that level. You might want to modify the routine using word lists instead of random characters to get an idea of your effective speed.

### Typing Teacher

```
100 FOR I = 770 TO 795: READ M: POKE I,M: NEXT
110 HOME : PRINT : HTAB 14: INVERSE : PRINT "TYPI
    NG TEACHER": NORMAL
120 CCNT = 0: REM ZERO CHARACTER COUNTER
130 REM ** ROUTINE TO ENTER CHARACTER POSITION D
    ATA **
140 FOR ROW = 11 TO 17 STEP 2: REM ROW DATA TO P
    OKE
150 FOR COL = 9 TO 33 STEP 2: REM COLUMN DATA T
    O POKE
160 READ CHAR
170 IF CHAR = 0 THEN NEXT ROW: GOTO 150
180 IF CHAR = - 1 THEN 250
190 POKE 796 + (CHAR * 2),COL: POKE 796 + (CHAR *
    2) + 1,ROW
200 IF CHAR = 32 THEN 220
210 HTAB COL: VTAB ROW: INVERSE : PRINT CHR$ (CH
    AR): NORMAL
220 NEXT COL
230 GOTO 150
240 REM ** TIMER AND SELECT RANDOM CHARACTER **
250 HTAB 10: VTAB 20: INVERSE : PRINT "HIT ANY KE
    Y TO START": NORMAL : GET A$
260 HTAB 10: VTAB 20: FOR I = 1 TO 20: PRINT " ";
    : NEXT I
270 N = INT (( RND (1) * 47) + 44): REM CHOOSE A
    RANDOM CHARACTER
280 IF N > = 60 AND N < = 64 OR N = OLDCHAR THEN
    270
290 OLDCHAR = N
300 HTAB 20: VTAB 7: PRINT CHR$ (N): REM PRINT
    RANDOM NUMBER CHARACTER

310 REM **PROCESS YOUR RESPONSE**
```

```
320 IF PEEK ( - 16384) < 128 AND TIME < 2710 THEN
    TIME = TIME + 1: GOTO 320
330 IF TIME > = 2710 THEN 440
340 GET A$:CHAR = ASC (A$): POKE 768,30: POKE 76
    9,1: CALL 770:CCNT = CCNT + 1: REM *ADD ONE
    TO TOTAL*
350 TIME = TIME + 10
360 GOSUB 420
370 PRINT CHR$ (CHAR)
380 FOR I = 1 TO 10: NEXT I
390 GOSUB 420: INVERSE : PRINT CHR$ (CHAR): NORMAL

400 IF CHAR < > N THEN CCNT = CCNT - 1: POKE 768
    ,1: POKE 769,175: CALL 770
410 GOTO 270
420 IF CHAR < > N THEN POP : GOTO 400
430 HTAB ( PEEK (796 + 2 * CHAR)): VTAB ( PEEK (7
    97 + 2 * CHAR)): RETURN
440 HTAB 9: VTAB 7: INVERSE : PRINT "CHARACTERS/M
    INUTE =": " ";CCNT: NORMAL
450 HTAB 10: VTAB 20: INVERSE : PRINT " HIT 'R' T
    O RESTART ": NORMAL
460 POKE 768,250: POKE 769,2: CALL 770
470 GET A$: IF A$ = "R" THEN RUN
480 END
490 REM **MUSIC ML DATA**
500 DATA 172,01,03,174,01,03,169,04,32,168,252,1
    73,48,192,232,208,253,136,208,239,206,0,03,20
    8,231,96
510 REM **ASCII DATA FOR KEYBOARD**
520 DATA 49,50,51,52,53,54,55,56,57,48,58,45,0
530 DATA 81,87,69,82,84,89,85,73,79,80,0
540 DATA 65,83,68,70,71,72,74,75,76,59,0
550 DATA 32,90,88,67,86,66,78,77,44,46,47,-1
```

# Memory Trainer

---

Harvey B. Herman

Apple Translation by Patrick Parrish

*Can't remember your phone number? This program might help you improve your memory skills. Using similar training aids, some people have learned to memorize 80-digit numbers.*

An article entitled "Exceptional Memory" appeared recently in *American Scientist* (vol. 70, no. 6, 1982, p. 607). When most people read a random sequence, they can remember only five to nine digits, the apparent limit of short-term memory (STM). However, the authors described experiments in which a person with normal memory was trained to recall a sequence of more than 80 random digits.

Many people would call such a feat (recalling 80 digits) *exceptional*. But the authors said that this skill may not be uncommon. In fact, diligent practice frequently resulted in improvement in the ability to rapidly transfer information into long-term memory (LTM). A "normal" memory could thereby be transformed into an "exceptional" one.

It seemed like it would be easy to automate the task of memory training. Consequently, I wrote "Memory Trainer." Random digits are flashed on the screen at a specified rate; if the sequence is repeated correctly, the next sequence of digits is increased by one. When an error is made, the length of the sequence decreases by one. You can stop the experiment at any point, and the maximum sequence length achieved will be displayed.

## Memory Trainer

```
210 DIM N(76)
220 MA = 0: REM MA=MAX CORRECT SPAN
230 TEXT : HOME : INVERSE : PRINT "MEMORY TRAININ
    G PROGRAM": NORMAL
240 PRINT
250 INPUT "DIGIT RATE (1-10) ? ";DR
260 IF DR < 1 OR DR > 10 THEN 230
270 PRINT
280 INPUT "INITIAL SEQUENCE LENGTH ? ";SL
290 IF SL < 2 THEN SL = 2
300 IF SL > 76 THEN SL = 76
320 REM SEQ LEN - MIN 2:MAX 76
```

```

330 PRINT : INVERSE : PRINT "CURRENT DIGIT SPAN";
   : NORMAL : PRINT " ";SL
340 REM FLASH GET SET AND DIGITS
350 PRINT : FLASH : PRINT "GET SET";: FOR I = 1 TO
   300: NEXT I: NORMAL : HTAB 1: PRINT "GET SET"
   ;
360 PRINT CHR$ (7): PRINT "*";: FOR I = 1 TO 125
   0: NEXT I
370 FOR I = 1 TO SL
380 N(I) = INT ( RND (1) * 10)
400 HTAB 1: INVERSE : PRINT N(I);: FOR J = 1 TO 1
   00: NEXT J: NORMAL
410 HTAB 1: PRINT N(I);: IF I = SL THEN HTAB 1: PRINT
   " ";
420 FOR K = 1 TO DR * 100: NEXT K
430 NEXT I
450 PRINT : PRINT : PRINT "INPUT DIGITS":FL = 0
460 PRINT "
   ";
470 PRINT "
   " :
   VTAB 13: PRINT "*";: HTAB 1: INPUT " ";A$
480 IF LEN (A$) < > SL THEN FL = 1: GOTO 540
490 FOR I = 1 TO SL
500 IF VAL ( MID$ (A$,I,1)) < > N(I) THEN FL =
   1:I = SL
510 NEXT I
520 REM FL=0 - CORRECT - INCREASES SEQ LEN BY ON
   E
530 REM FL=1 - INCORRECT - DECREASES SEQ LEN BY
   ONE
540 IF FL = 1 THEN INVERSE : VTAB 15: PRINT "INC
   ORRECT";: NORMAL : PRINT " - TRY A SHORTER SP
   AN NEXT " :SL = SL - 1
550 IF FL = 1 THEN PRINT "
   " :REM 41 SPACES
560 IF FL = 1 THEN PRINT "
   " : VTAB 16
570 IF FL = 1 THEN FOR J = 1 TO SL + 1: PRINT RIGHT$
   ( STR$ (N(J)),1);: NEXT J: GOTO 620
580 VTAB 15: INVERSE : PRINT "CORRECT";: NORMAL :
   PRINT " - TRY A LONGER SPAN NEXT " :SL =
   SL + 1
590 IF MA < SL - 1 THEN MA = SL - 1
600 PRINT "
   " :REM 43 SPACES
610 PRINT "
   " : VTAB 18 :REM 43 SPACES

```

## 2: Education

---

```
620 HTAB 1: VTAB 19: INPUT "AGAIN (Y OR N) ? ";N$
    : VTAB 19: HTAB 18: PRINT "  ": IF SL < 1 THEN
    SL = 1
630 IF SL > 76 THEN SL = 76
640 IF LEFT$(N$,1) = "Y" THEN VTAB 6: GOTO 330

650 PRINT : HTAB 7: PRINT "HOPE YOU IMPROVED YOUR
    SPAN!": PRINT
660 HTAB 7: INVERSE : PRINT "HIGHEST CORRECT DIGI
    T SPAN";: NORMAL : PRINT "  ";MA: VTAB 23
```

# Oscilloscope

---

Rob Smythe

*Here is a program, designed especially for physics teachers, that makes good use of the Apple's high-resolution graphics.*

Unless your school's equipment is better than mine, you probably find it tricky to demonstrate waveforms in class. It's hard to stabilize an oscilloscope pattern whenever the input frequency is changed; if you're mixing several frequencies it can be almost impossible.

With this program, however, you can demonstrate complex waveforms on your Apple. You can show effects of varying amplitude and frequency, add up to five overtones (each with its own amplitude), and show the resultant wave pattern for up to six different notes (particularly useful for demonstrating the cause of beat notes).

When you run this program you will be presented with a table (initially showing that there are no notes in memory) and a menu prompting you for single keystroke selection of commands. Use the 1, 2, 3, 4, 5 or 6 key to set the amplitude and frequency of a note. Enter as many notes as you wish, or change them one by one. Press P to plot the resultant waveform. After the oscilloscope pattern is drawn and you have finished studying it, return to the menu by pressing any key.

The S key will let you alter the plotting speed, which is initially set at 4. This determines the increment along the x-axis (time axis) between plotted points. When using frequencies over about 500 Hz, you might have to set speed at 1 or 2 (because at coarser settings significant changes in wave shape might occur between points and be missed). Try 800 Hz at speed 4 and at speed 1 to see how this affects the display.

To clear all notes from the table, press C and confirm with a Y.

Try notes of amplitude 10 to 20 in a frequency range of 100 to 500. Create a complicated note using all overtones, with amplitudes 10 or less (so that you don't go off the top of the screen). Beat patterns look nice when you play notes of frequency 1000 and 1050 together.

Note that you can change TIME in line 2120 to allow for a different range of suitable frequencies. You might add TIME

## 2: Education

---

input to the menu, so that beats can be shown effectively with frequencies that are very close together.

### How It Works

Line(s)

1000-1020 Print table and menu routine  
1030 Formats numbers in display  
1100 Waits for single keystroke input  
1110 Inputs data  
1120 on Process data and reject invalid input  
2000's Plot routine  
2000-2100 Draw axes  
2150-2160 Pick X value in radians  
2170 Sums the waves  
2190 Scales X and Y to fit screen  
2200 Checks for off-scale values  
2210 Plots  
3000-3040 Subroutine to check that points are not off-scale

### Oscilloscope

```
50 G$ = CHR$ (7): REM ERROR BEEP
100 SP = 4: REM PLOTTING SPEED FROM 1 (SLOW=MOST
    ACCURATE) TO 5
997 :
998 REM DATA INPUT
999 :
1000 TEXT : HOME
1010 PRINT " NOTE AMP FREQ": PRINT
1020 FOR I = 1 TO 6: PRINT TAB( 7);I;" ";
1030 A$ = RIGHT$ (" " + STR$ (FR(I)),6): IF
    AMP(I) < 10 THEN PRINT " ";
1040 PRINT AMP(I);" ";A$
1050 PRINT : NEXT I
1060 PRINT : PRINT : PRINT "SPEED - ";SP
1070 VTAB 21
1080 PRINT "CHANGE NOTE: 1/2/3/4/5/6 PLOT: P"
1090 PRINT "CLEAR NOTES: C EXIT: E SPEED: S"
1100 POKE - 16368,0: WAIT - 16384,128
1110 GET A$:I = VAL (A$): IF I > 6 THEN PRINT G
    $: GOTO 1000
1120 IF I = 0 THEN PRINT 1180
1130 VTAB 21: CALL - 958: PRINT "NOTE ";I;" ";:
    INPUT "AMPLITUDE (1-10) ";A$:AMP(I) = VAL (
    A$): IF AMP(I) = 0 THEN 1130
1140 IF AMP(I) > 20 THEN PRINT G$;: GOTO 1130
```

```
1150 PRINT TAB( 9):: INPUT "FREQUENCY - ":FR(I):
    IF FR(I) < 0 OR FR(I) > 99999 THEN PRINT G$:
    :: VTAB 22: CALL - 868: GOTO 1150
1160 F(I) = FR(I) / 27.75
1170 GOTO 1000
1180 IF A$ = "E" THEN END
1190 IF A$ = "P" THEN 2000
1200 IF A$ = "C" THEN 1240
1210 IF A$ < > "S" THEN PRINT G$: GOTO 1000
1220 VTAB 21: CALL - 958: INPUT "ENTER SPEED (1-
5) - ":SP: IF SP < 1 OR SP > 5 OR INT (SP) <
> SP THEN PRINT G$: GOTO 1220
1230 GOTO 1000
1240 VTAB 21: CALL - 958: PRINT "CLEAR ALL NOTES
IN MEMORY? (Y/N) ": GET A$: IF A$ < > "Y" THEN
1000
1250 FOR I = 1 TO 6:F(I) = 0:FR(I) = 0:AMP(I) = 0
: NEXT : GOTO 1000
1997 :
1998 REM PLOTTING ROUTINE
1999 :
2000 HOME
2010 VTAB 24
2020 HGR
2030 HCOLOR= 3
2040 HPLOT 0,80 TO 279,80
2050 HPLOT 0,16 TO 0,143
2060 FOR I = 0 TO 279 STEP 70
2070 HPLOT I,78 TO I,82: HPLOT 279,78 TO 279,82
2080 NEXT I
2090 FOR I = 16 TO 144 STEP 16
2100 HPLOT 0,I TO 4,I
2110 NEXT I
2120 TIME = 400
2130 S = 280 / TIME
2140 HPLOT 0,80
2150 FOR I = 0 TO TIME STEP SP
2160 X = I * 3.14159 / 180
2170 Y = 0: FOR J = 1 TO 6:Y = AMP(J) / 5 * SIN (
F(J) * X) + Y: NEXT J
2180 Y = 80 - Y * 16
2190 X = I * S
2200 GOSUB 3000
2210 HPLOT TO X,Y
2220 NEXT I
2230 POKE - 16368,0: WAIT - 16384,128
```



## 2: Education

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```
2240 GET A$
2250 GOTO 1000
2997 :
2998 REM SUBROUTINE CHECK RANGE
2999 :
3000 IF X < 0 THEN X = 0
3010 IF X > 279 THEN X = 279
3020 IF Y < 0 THEN Y = 0
3030 IF Y > 159 THEN Y = 159
3040 RETURN
```

# Chapter 3

---

# Home Applications



# Introduction

---

Your Apple is a willing helper in everything from financial planning to weather forecasting, and the five programs in this chapter will help you put it to work.

For instance, George Miller's "Weather Forecaster" combines proven scientific principles with your Apple's computing power to make accurate local weather forecasts. It won't stop the rain, but at least you'll know when to carry your umbrella.

Counting calories? Gerald P. Graham's "Calorie Cop" will help you watch your waistline with computer precision.

"IRA Planner," by Richard and Betty Givan, shows you exactly how your IRA fund will grow. It can be of great help in planning your retirement nest egg.

David Swain's "Home Energy Calculator" can be useful, too, in checking to see which energy saving schemes will actually pay off. Then you can confirm your results with Larry L. Bihlmeyer's "Utility Bill Audit," a comprehensive program for evaluating utility bills.

# Weather Forecaster

---

George W. Miller

Apple Translation by Patrick Parrish

*The National Weather Service uses computers when forecasting the weather. With this program, you can use your Apple to turn out weather forecasts of your own.*

Everybody talks about the weather. "Weather Forecaster" won't let you do anything about it, but at least it will help you be prepared.

To use this program, you'll need a barometer (available at many hardware stores and department stores). You'll also need a weather vane or other device to indicate wind direction. If you don't have a weather vane, you can use a compass and observe the wind yourself.

## The Word on Weather

This program is based on sound scientific principles. In the Northern Hemisphere, winds blow counterclockwise around a low pressure system and clockwise around a high pressure system. Thus, if you stand outside with the wind at your back, a low pressure system will be on your left. If the barometer is falling, this low is heading in your direction.

By considering the wind direction along with changes in barometric pressure, you can get some idea of what kind of weather to expect. Your Apple can figure this out in a matter of seconds, and the program will even tell you what the normal weather for the month should be.

One word of warning. This is a very long program. Save it often as you type it in. It can be very frustrating to lose the program after several hours work due to a momentary power glitch.

## Using the Program

The Weather Forecaster menu offers a great deal of help. For example, you can store data in RAM, generate a weather forecast, display the data you have stored, display normal conditions for your area, STOP the program, search for a specific date, and make corrections—all directly from the menu.

Note that high and low temperatures are entered as four characters, one of which is a plus or minus sign (for instance, +076 or -012). To avoid the necessity of right justifying, each entry *must* have four characters. Barometric pressure is entered as a five-character entry, for instance, 30.15. General weather conditions are entered as a single digit, 1-7, from the following table:

- 1 = FAIR
- 2 = CLOUDY
- 3 = RAIN
- 4 = SNOW
- 5 = THUNDERSHOWERS
- 6 = SNOW FLURRIES
- 7 = HEAVY RAIN

Precipitation, in inches, must be input as a five-character entry (such as 02.75). Snowfall, in inches, must be given as a two character entry.

Wind direction takes the form of a four-character entry. The first two characters reflect wind direction and come from the following list:

- |         |         |
|---------|---------|
| 01 = N  | 05 = S  |
| 02 = NE | 06 = SW |
| 03 = E  | 07 = W  |
| 04 = SE | 08 = NW |

The last two characters are wind speed in miles per hour, and speed and direction are combined to create a complete wind entry. For instance, you would use an entry of 0705 for wind from the west at five miles per hour.

You'll have to determine the average temperatures, rainfall, and snowfall amounts for your area. A good source of this information is *The Weather Almanac*, edited by James A. Ruffner and Frank E. Bair, published by Avon Books. It's available from most libraries. Look up the city nearest you and make your substitutions in lines 915-970.

The subroutine starting at line 3000 allows you to check the weather conditions on any day in your file. You enter the date in question, and the computer searches for that data. If the date is in memory, the computer will display the information.

This subroutine contains a disk error trapping routine (line 3200) that gives you the disk error number and the line

### 3: Home Applications

---

in the program where it has occurred. If a correctable disk error occurs, return to the main program and resave the data so that no data is lost.

#### Weather Forecaster

```
5 GOTO 80
7 HOME : VTAB 5: HTAB 5: RETURN
10 PRINT P$; INPUT B$: IF B$ = "" THEN 110
12 IF LEN (B$) < > B THEN HOME : PRINT "INPUT
    MISTAKE": FOR I = 1 TO 500: NEXT I: PRINT P$;
    : INPUT B$
15 RETURN
20 A$(L) = A$(L) + B$: RETURN
80 DIM A$(365)
90 GOSUB 2000
100 REM WEATHER FORECASTER
110 TEXT : HOME
120 HTAB 12: INVERSE : PRINT "WEATHER ANALYSIS": NORMAL
125 VTAB 5: HTAB 7: PRINT "TO LOAD DATA: ENTER ";
    : INVERSE : PRINT "L": NORMAL
130 VTAB 7: HTAB 7: PRINT "UPDATE DATA: ENTER ";;
    INVERSE : PRINT "U": NORMAL
140 VTAB 9: HTAB 7: PRINT "FORECAST FROM DATA: EN
    TER ";; INVERSE : PRINT "F": NORMAL
150 VTAB 11: HTAB 7: PRINT "DISPLAY DATA: ENTER "
    ;; INVERSE : PRINT "D": NORMAL
160 VTAB 13: HTAB 7: PRINT "DISPLAY NORMALS: ENTE
    R ";; INVERSE : PRINT "N": NORMAL
170 VTAB 15: HTAB 7: PRINT "TO MEMORIZE DATA: ENT
    ER ";; INVERSE : PRINT "M": NORMAL
180 VTAB 17: HTAB 7: PRINT "SEARCH DATE: ENTER ";
    : INVERSE : PRINT "S": NORMAL
190 VTAB 19: HTAB 7: PRINT "CORRECTIONS: ENTER ";
    : INVERSE : PRINT "C": NORMAL
195 VTAB 21: HTAB 7: PRINT "TO QUIT: ENTER ";; INVERSE
    : PRINT "Q": NORMAL
200 VTAB 23: HTAB 3: PRINT "CHOICE? ";; GET Y$
205 IF Y$ = "U" THEN 250
210 IF Y$ = "F" THEN 400
215 IF Y$ = "D" THEN 700
220 IF Y$ = "N" THEN 900
225 IF Y$ = "S" THEN 1250
230 IF Y$ = "C" THEN 1500
235 IF Y$ = "M" OR Y$ = "L" THEN 3000
240 IF Y$ = "Q" THEN 2500
245 GOTO 200
250 HOME : HTAB 16: VTAB 2: INVERSE : PRINT "DATA
    UPDATE": NORMAL
```

### 3: Home Applications

---

```
255 IF L = 365 THEN PRINT "FILE FULL": FOR I = 1
    TO 2000: NEXT I: GOTO 110
260 L = L + 1
270 VTAB 5:P$ = "ENTER DATE (AS 01-05-83)":B = 8
    : GOSUB 10
275 A$(L) = LEFT$(B$,2) + MID$(B$,4,2) + RIGHT$(
    B$,2)
285 PRINT :P$ = "ENTER HIGH TEMPERATURE (AS +076)
    : ":B = 4: GOSUB 10: GOSUB 20
290 PRINT :P$ = "ENTER LOW TEMPERATURE (AS -006):
    ": GOSUB 10: GOSUB 20
295 PRINT :P$ = "ENTER BAROMETRIC PRES. (IN INCHE
    S - AS 30.15)": ":B = 5: GOSUB 10: GOSUB 20
300 PRINT : PRINT "ENTER GENERAL WEATHER CONDITIO
    N": PRINT "1 = FAIR": HTAB 23: PRINT "2 = CL
    OUDY": PRINT "3 = RAIN": HTAB 23: PRINT "4 =
    SNOW"
305 PRINT "5 = THUNDERSHOWERS": HTAB 23: PRINT "
    6 = SNOW FLURRIES": PRINT "7 = HEAVY RAIN"
315 P$ = "":B = 1: GOSUB 10: GOSUB 20
325 PRINT :P$ = "ENTER PRECIPITATION (INCHES - AS
    02.75)": ":B = 5: GOSUB 10: GOSUB 20
335 PRINT :P$ = "ENTER SNOWFALL AMOUNT (AS 07)": "
    :B = 2: GOSUB 10: GOSUB 20
345 HOME : PRINT "ENTER WIND DIRECTION AND SPEED:
    "
350 HTAB 3: PRINT "USE THIS CODE:": PRINT "01=N",
    "02=NE","03=E": PRINT "04=SE","05=S","06=SW"
355 PRINT "07=W","08=NW"
360 PRINT : PRINT "ENTER DIRECTION AND SPEED AS F
    OUR":P$ = "DIGIT NUMBER - AS 0312)": ":B = 4: GOSU
    10: GOSUB 20
365 HOME : VTAB 3: PRINT "DATE: "; LEFT$(A$(L),6
    ): PRINT "HI TEMP: "; MID$(A$(L),7,4)
370 PRINT "LOW TEMP: "; MID$(A$(L),11,4): PRINT
    "BAROMETRIC PRESSURE: "; MID$(A$(L),15,5)
375 PRINT "CONDITIONS: "; MID$(A$(L),20,1): PRINT
    "PRECIPITATION: "; MID$(A$(L),21,5)
380 PRINT "SNOWFALL: "; MID$(A$(L),26,2): PRINT
    "WINDS: "; MID$(A$(L),28,4)
385 HTAB 3: PRINT "RECALL THE CODE: ": PRINT "01=
    N","02=NE","03=E","04=SE","05=S","06=SW","07=
    W","08=NW"
387 IF D = 1 THEN RETURN
390 VTAB 20: PRINT "IS THIS CORRECT (Y/N)? ": GET
    B$: IF B$ = "N" THEN 270
392 IF C = 1 THEN RETURN
395 GOTO 110
```



### 3: Home Applications

---

```
400 HOME : HTAB 17: VTAB 2: INVERSE : PRINT "FORE
CAST": NORMAL
405 VTAB 5: INPUT "ENTER BAROMETRIC PRESSURE: ";A
$:A = VAL (A$): IF A$ = "" THEN 110
410 VTAB 7: PRINT "IS BAROMETER ?": PRINT : PRINT
"1.STEADY","2.SLOW RISE": PRINT "3.RAPID RISE
","4.SLOW FALL"
412 PRINT "5.RAPID FALL": PRINT : PRINT "(RAPID C
HANGE IS ANY CHANGE IN": PRINT "EXCESS OF 0.0
6 PER HOUR.)"
415 INPUT B$:B = VAL (B$): IF B$ = "" THEN 110
417 PRINT : PRINT "WIND FROM: ?"
420 PRINT "1=N","2=NE","3=E","4=SE","5=S","6=SW",
"7=W","8=NW"
425 INPUT C$:C = VAL (C$): IF C$ = "" THEN 110
430 IF A > = 30.2 AND B = 4 AND C > = 6 AND C <
= 8 THEN 625
440 IF A > = 30.2 AND B = 1 AND C > = 6 AND C <
= 8 THEN 620
445 IF A > = 30.1 AND B = 1 AND C > = 6 AND C <
= 8 THEN 600
450 IF A > = 30.1 AND B = 3 AND C > = 6 AND C <
= 8 THEN 605
455 IF A > = 30.1 AND B = 4 AND C > = 6 AND C <
= 8 THEN 610
460 IF A > = 30.1 AND B = 5 AND C > = 6 AND C <
= 8 THEN 615
465 IF A > = 30.1 AND B = 4 AND (C = 4 OR C = 5)
THEN 630
470 IF A > = 30.1 AND (B = 4 OR B = 5) AND (C =
4 OR C = 5) THEN 635
475 IF A > = 30.1 AND (B = 4 OR B = 5) AND C > =
2 AND C < = 4 THEN 645
485 IF A > = 30.1 AND B = 4 AND (C = 2 OR C = 3)
THEN 650
490 IF A > = 30.1 AND B = 5 AND (C = 2 OR C = 3)
THEN 655
492 IF A < = 29.8 AND B = 5 AND C > = 1 AND C <
= 3 THEN 680
493 IF A < = 29.8 AND B = 5 AND C > = 3 AND C <
= 5 THEN 675
494 IF A < = 29.8 AND B = 3 THEN 685
495 IF A < = 30.1 AND B = 4 AND C > = 2 AND C <
= 4 THEN 660
500 IF A < = 30.1 AND B = 5 AND C > = 2 AND C <
= 4 THEN 665
505 IF A < = 30.1 AND B = 2 AND (C = 5 OR C = 6)
THEN 670
590 GOSUB 7: PRINT "LITTLE CHANGE FOR NEXT DAY
OR TWO.": GOTO 690
```

### 3: Home Applications

---

```
600 GOSUB 7: PRINT "FAIR, LITTLE CHANGE IN TEMP":  
    PRINT "FOR NEXT DAY OR TWO.": GOTO 690  
605 GOSUB 7: PRINT "FAIR TODAY, RAINY AND WARMER"  
    : PRINT "WITHIN 48 HOURS.": GOTO 690  
610 GOSUB 7: PRINT "WARMER, RAIN WITHIN 24 TO 36"  
    : PRINT "HOURS.": GOTO 690  
615 GOSUB 7: PRINT "WARMER, RAIN WITHIN 18 TO 24"  
    : PRINT "HOURS.": GOTO 690  
620 GOSUB 7: PRINT "CONTINUED FAIR WITH LITTLE": PRINT  
    "OR NO CHANGE IN TEMPERATURE.": GOTO 690  
625 GOSUB 7: PRINT "FAIR AND WARMER FOR NEXT 48 H  
    OURS.": GOTO 690  
630 GOSUB 7: PRINT "RAIN WITHIN 24 HOURS.": GOTO  
    690  
635 GOSUB 7: PRINT "WINDY, WITH RAIN WITHIN": PRINT  
    "12 TO 24 HOURS.": GOTO 690  
640 GOSUB 7: PRINT "RAIN IN 12 TO 18 HOURS.": GOTO  
    690  
645 GOSUB 7: PRINT "WINDY AND RAIN WITHIN 12 HOUR  
    S.": GOTO 690  
650 GOSUB 7: PRINT "IN SUMMER WITH LIGHT WINDS: "  
    : PRINT "RAIN MAY NOT FALL FOR DAYS.": PRINT  
    "IN WINTER: ": PRINT "RAIN WITHIN 24 HOURS.":  
    GOTO 690  
655 GOSUB 7: PRINT "IN SUMMER: RAIN LIKELY WITHIN  
    ": PRINT "12 TO 24 HOURS.": PRINT "IN WINTER:  
    ": PRINT "RAIN OR SNOW WITH INCREASING WINDS  
    .": GOTO 690  
660 GOSUB 7: PRINT "RAIN FOR NEXT DAY OR TWO.": GOTO  
    690  
665 GOSUB 7: PRINT "RAIN WITH HIGH WINDS FOLLOWED  
    ": PRINT "WITHIN 24 HOURS BY CLEARING AND COO  
    LER": PRINT "TEMPERATURES.": GOTO 690  
670 GOSUB 7: PRINT "CLEARING WITHIN A FEW HOURS."  
    : PRINT "FAIR FOR NEXT SEVERAL DAYS.": GOTO 6  
    90  
675 GOSUB 7: PRINT "SEVERE STORM WARNING. WINDY,"  
    : PRINT "WITH RAIN OR SNOW IMMINENT": PRINT "  
    FOLLOWED WITHIN 24 HOURS BY CLEARING": PRINT  
    "AND COLDER.": GOTO 690  
680 GOSUB 7: PRINT "SEVERE STORM WARNING. SEVERE"  
    : PRINT "NORTHEAST GALES, HEAVY RAIN OR SNOW,  
    ": PRINT "FOLLOWED IN WINTER BY A COLD": PRINT  
    "WAVE.": GOTO 690  
685 GOSUB 7: PRINT "CLEARING AND COLDER."  
690 HTAB 6: VTAB 23: INVERSE : PRINT "PRESS ANY K  
    EY TO CONTINUE": GET B#: NORMAL : GOTO 110  
700 D = 1: HOME : IF L = 0 THEN 708
```

### 3: Home Applications

---

```
703 X = L: FOR I = 1 TO X:L = I: GOSUB 365: PRINT
: PRINT "PRESS C TO CONTINUE ";; GET B$: IF B
$ < > "C" THEN I = X
705 PRINT : NEXT I:L = X:D = 0: GOTO 110
708 D = 0: PRINT "NO DATA FOUND.": FOR T = 1 TO 20
00: NEXT T: GOTO 110
900 HOME : HTAB 15: INVERSE : PRINT "WEATHER NORM
S": NORMAL
905 PRINT : HTAB 4: PRINT "TEMP"
910 HTAB 2: PRINT "HI LO MO RAIN SNOW"
915 PRINT : PRINT "J 48 27 38 3.51 6.1": PRINT
"F 51 29 40 3.37 6.6"
920 PRINT "M 59 37 48 3.88 2.5": PRINT "A 71 4
6 59 3.16 0.3"
930 PRINT "M 78 55 67 3.37 0.0": PRINT "J 84 6
3 74 3.93 0.0"
940 PRINT : PRINT "J 87 67 77 4.27 0.0": PRINT
"A 86 66 76 4.19 0.0"
950 PRINT "S 80 59 70 3.64 0.0": PRINT "O 70 4
7 59 3.18 0.1"
955 PRINT "N 60 37 49 2.59 2.1": PRINT "D 50 3
0 40 3.38 6.0"
960 PRINT : PRINT "YR 63 43 53 37.96 35.4"
970 HTAB 8: PRINT "DATA FROM NWS GBO.,N.C.": HTAB
8: PRINT "ELEVATION 830 FT."
980 PRINT : INVERSE : PRINT "PRESS ANY KEY TO CON
TINUE";: GET B$: NORMAL : GOTO 110
1250 HOME : HTAB 16: VTAB 2: INVERSE : PRINT "SEA
RCH DATE": NORMAL :D = 1
1260 VTAB 5:P$ = "ENTER DATE (AS 01-05-83): ":B =
8: GOSUB 10:C$ = LEFT$ (B$,2) + MID$ (B$,4,
2)
1270 X = L: FOR I = 1 TO L: IF C$ = LEFT$ (A$(I),
4) THEN T = I:I = L: NEXT I:L = T: GOSUB 365:
L = X:D = 0: GOTO 690
1275 NEXT I: PRINT : PRINT "DATE NOT FOUND": GOTO
690
1500 HOME : HTAB 16: VTAB 2: INVERSE : PRINT "COR
RECTIONS": NORMAL :C = 1
1510 VTAB 5:P$ = "ENTER DATE (AS 01-05-83) TO CHA
NGE: ":B = 8: GOSUB 10:C$ = LEFT$ (B$,2) + MID$
(B$,4,2)
1570 X = L: FOR I = 1 TO L: IF C$ = LEFT$ (A$(I),
4) THEN T = I:I = L: NEXT I:L = T: GOSUB 275:
L = X:C = 0: GOTO 690
1575 NEXT I: PRINT : PRINT "DATE NOT IN FILE": GOTO
690
2000 TEXT : HOME
2010 HTAB 13: VTAB 10: INVERSE : PRINT "WEATHER A
NALYSIS": NORMAL : FOR I = 1 TO 1000: NEXT I
```

### 3: Home Applications

---

```
2020 HOME : HTAB 5: VTAB 3: PRINT "THIS PROGRAM I
S DESIGNED TO STORE ON";
2030 PRINT "DISK A YEAR'S WORTH OF DATA IN THE DI
SK": PRINT "FILE ENTITLED 'WEATHER FILE'. IT
IS"
2040 PRINT "SUGGESTED THAT FOR STORAGE OF MORE TH
AN"
2050 PRINT "ONE YEAR OF DATA, A SEPARATE WEATHER"
2060 PRINT "RECORD BE MAINTAINED."
2080 HTAB 5: VTAB 11: PRINT "THIS PROGRAM WILL OF
FER A FORECAST"
2090 PRINT "OF EXPECTED WEATHER CONDITIONS USING"
2100 PRINT "BAROMETRIC PRESSURE AND WIND DIRECTIO
N."
2110 HTAB 5: VTAB 16: PRINT "YOU WILL BE SURPRISE
D AT THE"
2120 PRINT "ACCURACY OF THE METHOD, YET IT IS BAS
ED"
2130 PRINT "ON SOUND SCIENTIFIC PRINCIPLES."
2140 VTAB 22: HTAB 8: INVERSE : PRINT "PRESS ANY
KEY TO CONTINUE";: NORMAL
2150 GET C$: HOME : RETURN
2500 HOME : VTAB 13: INPUT "HAVE YOU MEMORIZED TH
E DATA (Y/N) ?";H$: IF H$ = "N" THEN 110
2510 END
3000 REM APPLE DISK SAVE OR LOAD
3010 HOME : PRINT
3015 ONERR GOTO 3200
3020 D$ = CHR$ (4)
3022 PRINT D$;"OPEN WEATHER FILE": IF Y$ = "M" THEN
3040
3024 PRINT D$;"READ WEATHER FILE"
3026 INPUT L: FOR I = 1 TO L: INPUT A$(I): NEXT I
3030 GOTO 3060
3040 PRINT D$;"WRITE WEATHER FILE"
3050 PRINT L: FOR I = 1 TO L: PRINT A$(I): NEXT I
3060 PRINT D$;"CLOSE WEATHER FILE": POKE 216,0: GOTO
110
3200 HOME : VTAB 5: PRINT "ERROR # "; PEEK (222);
" OCCURRED AT LINE "; PEEK (219) * 256 + PEEK
(218)
3210 VTAB 10: PRINT "HINT: HAVE YOU PREVIOUSLY SA
VED THE": PRINT "DATA FILE TO DISK?"
3220 PRINT D$;"CLOSE WEATHER FILE": POKE 216,0: GOTO
690
```

# IRA Planner

---

Richard and Betty Givan

*You've seen the bank ads: "Retire a Millionaire." Type in this short program and see for yourself how IRA accounts compute. The program uses very little memory.*

Most get-rich schemes have proven to be of questionable legality and dubious worth. The latest promotion, however, is endorsed by the U.S. Government and seems foolproof. It's the Individual Retirement Account (IRA), expanded in 1982 to allow up to a \$2000 (\$2250 in a joint plan with a nonworking spouse) yearly deposit to be put into a private retirement account.

This amount is deductible from the person's gross income during the year deposited, decreasing the income tax accordingly. The retirement fund is then free to grow at the prevailing competitive interest rate—compounded daily and tax free—until it is withdrawn during retirement. Although taxes are then due, presumably the taxpayer will be in a lower tax bracket at that time and thus will have to pay a lesser tax.

## **The Relationship Between Inflation and Interest**

The allure of the plan lies in the rapid growth of the principal through compound interest at the current high rates. That's why you see ads in which banks all but guarantee that you can be a millionaire upon retirement via a \$2000 yearly deposit for 35 years at a 12 percent return. Actually, your account *would* be worth an astounding \$1,161,059. Who would have thought that such a modest sacrifice would let you retire a millionaire!

As with all get-rich plans, however, there is a catch—but in this case it's a matter of economics. The IRA promotion campaigns conveniently overlook the devastating effects of inflation on your million dollar nest egg. At the same time that compound interest is building your fortune, inflation is eroding it. Historically, the interest rate is fairly well dictated by the rate of inflation. Although temporary imbalances occur, economists generally agree that, in the long run, the interest rate will seek out a level approximately 3 to 4 percent higher than the inflation rate.

If the rate of inflation were to stay at 9 percent, for example, your retirement fortune of \$1,161,059 would really be worth only \$56,875 in terms of 1982 dollars. You may have a carload of dollars in the year 2017, but the Cadillac you buy to haul them home would cost \$306,000 and the gasoline to power it would be \$25 a gallon!

This is not to say that an IRA is a bad way to save. It does offer immediate tax relief, and that in itself might provide you with the incentive to put aside some funds for your golden years. But it would be well to put the numbers in perspective when planning for your future.

The program asks you several questions: the amount of money you wish to set aside each year; the tax bracket you are currently in (which can be found by reference to the IRS booklet accompanying your tax forms, but is not really essential to the rest of the program); your age when you begin and end the plan; and the average interest and inflation rates you expect to experience.

The program then displays the tax savings you would receive the first year in the plan. (Your income and tax rate would probably fluctuate too much to benefit from attempting to compute these over the life of your IRA.) The sum of your deposits is displayed, followed by the principal of the account increased by accumulated interest. Then the *real spending power* of your final nest egg is shown by reducing the principal to reflect the inflation rate. You can see its worth in terms of the 1982 dollar. Bear in mind that this money is taxable when withdrawn, too.

One note: The two questions about inflation and interest ask for the figures *expressed as decimals*. For example, if you want to calculate 12 percent inflation, you should type .12. Similarly, 6 percent interest would be entered as .06.

#### IRA Planner

```
20 HOME
40 PRINT "AT WHAT AGE DO YOU PLAN"
50 INPUT "TO OPEN AN IRA ACCOUNT? ";A
60 VTAB 8: INPUT "AT WHAT AGE DO YOU PLAN TO RETI
RE? ";AI
70 Y = AI - A
80 VTAB 16: PRINT "HOW MUCH DO YOU PLAN TO"
```

### 3: Home Applications

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```
90 INPUT "DEPOSIT EACH YEAR? ";D:C = D
100 HOME : PRINT "WHAT IS YOUR TAX BRACKET?"
110 INPUT "(ENTER % AS DECIMAL EX. 30% AS .30) ";
P
120 VTAB 8: PRINT "WHAT IS THE AVERAGE INTEREST R
ATE YOU"
130 PRINT "EXPECT FOR THE ACCOUNT OVER THE "
140 INPUT "YEARS IT EXISTS?(% AS DECIMAL) ";R
160 VTAB 16: PRINT "WHAT IS THE AVERAGE INFLATION
RATE"
170 PRINT "YOU EXPECT DURING THE YEARS BETWEEN"
180 PRINT "OPENING THE ACCOUNT AND RETIREMENT"
190 INPUT "(% AS DECIMAL) ";I
200 S = D * P
210 HOME : PRINT "YOU WILL SAVE $"; INT (S);" ON
TAXES THIS YEAR."
215 VTAB 8: PRINT "<MORE>"
220 T = D * Y
230 GET R$: IF R$ = "" THEN 230
235 HOME : PRINT "THE TOTAL AMOUNT DEPOSITED INTO
YOUR ACCOUNT OVER ";Y:
237 PRINT " YEARS IS": PRINT "$"; INT (T);"."
250 FOR J = 1 TO Y
260 X = D * (1 + R / 365) ^ 365
270 D = X + C
280 NEXT J
290 PRINT "<MORE>"
295 GET R$: IF R$ = "" THEN 295
300 PRINT "WHEN YOU RETIRE, THE AMOUNT IN YOUR"
310 PRINT "ACCOUNT WILL BE $"; INT (X);"."
315 Z = (1 + I) ^ Y
320 W = X / Z
330 VTAB 12: PRINT "WHICH IS WORTH $"; INT (W);"
IN 1984 DOLLARS"
340 PRINT "TRY AGAIN?"
350 GET R$: IF R$ = "" THEN 350
360 IF R$ = "Y" THEN RUN
370 HOME : PRINT "BYE"
```

# Home Energy Calculator

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David Swaim

Apple Version by David Florance

*You (and your computer) may become extremely popular when your neighbors learn that you can analyze the energy-saving benefits of home improvements.*

In recent years, there has been a great deal of interest in saving energy in the home. No one needs to be reminded that fuel costs are rising, and everyone wants to reduce energy bills. The way to do this is simple: reduce household energy consumption. There are a number of ways this can be done.

You can change your habits (for instance, by setting the thermostat back to a lower temperature and wearing heavier clothes) or you can add more effective insulation to your home. Most people find it easier to follow the latter course. But which improvements will save you the most money? Which will cost the least to implement? Finally, which will yield the greatest savings for the least amount of cost? That last question is the important one, and this program will give you the answer.

## **Predicting Effectiveness**

If you know the weather as well as the heat loss characteristics of a house, you can estimate heating costs. By calculating the heating costs based on heat loss characteristics of the house both before and after the improvements, you can figure the estimated savings due to the improvements. That is what this program does.

To gather the preliminary data, you will need to make some measurements and observations. The first thing the program calculates is the heat loss of the house, and that depends on three things: the thermal resistance (R-value) of the structure; the total area of the structure exposed to the elements; and the temperature difference between the inside and outside of the house. You simply need to know the area, R-value, and the difference in temperature.

The only problem is that different parts of the house have different R-values. For example, windows will have a lower R-value than walls. However, you can divide the external area of the house into five categories (windows, doors, walls, ceiling,



### 3: Home Applications

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and floor). The program requests information on each of these five categories in turn.

For windows it requests height, width, and number of windows, as well as type of frame and number of layers of glass. The number of types and/or sizes of windows is requested first. Most houses will have several sizes of windows, and there may be storm windows on some and not on others. The program allows for up to ten different types and/or sizes of windows. If you need more, change the dimension of S in statement 180.

Only one size and type of door is allowed. If you have sliding glass doors, you should consider them as windows. You'll need to know the height, width, and number of doors. Remember: Consider exterior doors only.

Information needed concerning the external walls consists of two things: the type of construction and the R-value of the insulation in the wall. If you enter a negative number for the R-value of the wall insulation, the program will give you a list of typical R-values for wall insulation. To get the area of the wall, the program asks for the ceiling height, total perimeter of the house, and the number of stories in the house. The program will calculate the gross wall area from this data and subtract the total window and door area to obtain the proper wall area.

#### Measurements

The only items you have to find for yourself concern the ceiling and floor. For the ceiling, you will be asked for the number of inches of insulation in the attic and the type of insulating material. For the floor, the type of foundation is requested.

Additional heat loss comes from two other sources. The first is infiltration of outside air through cracks in windows and doors. The program asks if the windows and doors are weather-stripped. It uses this information (and the total length of the cracks around windows and doors) to calculate the total infiltration.

The second source of heat loss is via the heat ducts running from the furnace to the heat registers. The program asks if your heat ducts are insulated and where they are located.

That concludes the input needed for calculating the total heat loss of the house. At that point the heat losses are dis-

played, and you are asked if you wish to make improvements to the house.

If the answer is Y, you will be asked if you wish to improve each item. You can make improvements to a single item or to any number of items.

As you probably noticed, the first question you were asked is what the outside design temperature is. The outside design temperature for my area (Atlanta, Georgia) is 23 degrees. The outside design temperatures for other areas are tabulated in Table 1. For a more complete list, consult one of the references listed at the end of this article.

**Table 1: Winter Design Temperatures**

CITY	TEMPERATURE
MONTGOMERY AL	26
JUNEAU AK	-4
PHOENIX AZ	34
LITTLE ROCK AR	23
SACRAMENTO CA	32
DENVER CO	3
HARTFORD CT	5
DOVER DE	15
TALLAHASSEE FL	29
ATLANTA GA	23
BOISE ID	10
SPRINGFIELD IL	4
INDIANAPOLIS IN	4
DES MOINES IA	-3
TOPEKA KS	6
LEXINGTON KY	10
BATON ROUGE LA	30
AUGUSTA ME	-3
BALTIMORE MD	20
BOSTON MA	10
LANSING MI	6
ST. PAUL MN	-10
JACKSON MS	24
JEFFERSON CITY MO	6
HELENA MT	-13
LINCOLN NE	0
CARSON CITY NV	7
CONCORD NH	-7
TRENTON NJ	16
SANTA FE NM	11

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ALBANY NY	5
RALEIGH NC	20
BISMARCK ND	-19
COLUMBUS OH	7
OKLAHOMA CITY OK	15
SALEM OR	25
HARRISBURG PA	13
PROVIDENCE RI	10
COLUMBIA SC	23
PIERRE SD	-9
NASHVILLE TN	16
AUSTIN TX	29
SALT LAKE CITY UT	9
BURLINGTON VT	-7
RICHMOND VA	18
OLYMPIA WA	25
CHARLESTON WV	14
MADISON WS	-5
CHEYENNE WY	-2

Actually, you do not need to enter any specific temperature as long as it is less than 75 degrees, the inside design temperature used by the program. The program will still give you valid results for savings and payback. However, using the correct outside design temperature gives you the advantage of seeing what the necessary furnace size would be with and without the improvements. In fact, heating engineers use the same basic method to size furnaces for houses.

When the program finishes calculating the heat loss of the house *after* improvements, it is ready to do the cost analysis. First you are asked for the type of heating fuel you use: electricity, fuel oil, or natural gas. Next you must input the cost per fuel unit of the heating fuel. Note that this unit cost is in dollars, so if natural gas in your area is 25 cents per therm, you should input .25 dollars per therm.

Using this data, and the number of heating degree days for your area, the program calculates the total energy needed to heat the house for the entire heating season. The degree days and name of the city are part of line 7010, and you should change this line to reflect your own location. Some sample degree days for different cities are listed in Table 2; a more complete list can be found in any of the references.

**Table 2: Yearly Heating Degree Days**

CITY	DEGREE DAYS
MONTGOMERY AL	2291
JUNEAU AK	9075
PHOENIX AZ	1765
LITTLE ROCK AR	3219
SACRAMENTO CA	2419
DENVER CO	5524
HARTFORD CT	6235
WILMINGTON DE	4930
TALLAHASSEE FL	1485
ATLANTA GA	2961
BOISE ID	5809
SPRINGFIELD IL	5429
INDIANAPOLIS IN	5699
DES MOINES IA	6588
TOPEKA KS	5182
LEXINGTON KY	4683
BATON ROUGE LA	1560
PORTLAND ME	7511
BALTIMORE MD	4111
BOSTON MA	5634
LANSING MI	6909
MINNEAPOLIS MN	8382
JACKSON MS	2239
ST. LOUIS MO	4484
HELENA MT	8129
LINCOLN NE	5864
RENO NV	6332
CONCORD NH	7383
TRENTON NJ	4980
ALBUQUERQUE NM	4348
ALBANY NY	6201
RALEIGH NC	3393
BISMARCK ND	8851
COLUMBUS OH	5211
OKLAHOMA CITY OK	3725
SALEM OR	4754
HARRISBURG PA	5251
PROVIDENCE RI	5954
COLUMBIA SC	2484
RAPID CITY SD	7345
NASHVILLE TN	3578
AUSTIN TX	1711

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SALT LAKE CITY UT	6052
BURLINGTON VT	8269
RICHMOND VA	3865
OLYMPIA WA	5236
CHARLESTON WV	4476
MADISON WS	7863
CHEYENNE WY	7381

The last thing you must input is the total cost of the improvements you made. At that point, the program calculates the payback period in years.

I learned a great deal about my own home from running this program. Much of what I concluded was what I expected, but some conclusions surprised me. The program can definitely help home owners in assessing home energy improvements; it can also help you spot dishonest energy-saving schemes pretty quickly.

#### References

*ASHRAE Handbook 1981 Fundamentals*. Atlanta, Georgia: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Incorporated, 1981.

*Other Homes and Garbage*. Jim Leckie, Gil Masters, Harry Whitehouse, and Lilly Young. San Francisco, California: Sierra Club Books, 1975.

*Refrigeration and Air-Conditioning*. Air-Conditioning and Refrigeration Institute. Englewood Cliffs, New Jersey: Prentice-Hall, 1979.

### Home Energy Calculator

```
150 GOSUB 8000
170 REM INITIALIZATION
180 DIM A(6),Q(6),R(6),RW(4,3),D(4),IW(2,3),S(10)
190 DIM RF(3),TC(3),N$(5),IC(5),DM(2,3,3),IN(2)
200 REM WINDOW R VALUES
210 DATA 1.01,2.22,1.815,3.155
220 DATA .909,1.667,1.437,2.137
230 DATA .909,2,1.724,2.564
240 REM DOOR R VALUES
250 DATA .41,.75,.95,1.1
260 REM FLOOR R VALUES AND TEMP CORR
270 DATA 3.2,0,3.2,30,1.23,0
280 REM CEILING INSULATION R PER INCH
```

```

290 DATA 3.5,3,2.5,4.5,5.5
300 N$(1) = "WINDOWS":N$(2) = "DOORS":N$(3) = "WALLS"
310 N$(4) = "CEILING":N$(5) = "FLOOR "
320 REM DUCT MULTIPLIERS
330 DATA .2,.15,.1,.15,.1,.05,.1,.05,.05
340 DATA .2,.15,.1,.1,.1,.05,.05,.05,.05
350 REM AIR CHANGES PER FOOT OF CRACK
360 DATA 39,74,52,24,32,33
370 REM READ WINDOW R VALUES
380 FOR F = 1 TO 3
390 FOR G = 1 TO 4
400 READ RW(G,F)
410 NEXT G,F
420 REM READ DOOR R VALUES
430 FOR I = 1 TO 4: READ D(I): NEXT I
440 REM READ FLOOR R VAL AND TEMP CORR
450 FOR I = 1 TO 3: READ RF(I),TC(I): NEXT I
460 REM READ INSULATION R PER INCH
470 FOR I = 1 TO 5: READ IC(I): NEXT I
480 REM READ DUCT MULTIPLIERS
490 FOR KD = 1 TO 2
500 FOR K = 1 TO 3
510 FOR J = 1 TO 3
520 READ DM(KD,J,K)
530 NEXT J,K,KD
540 REM READ AIR CHANGES FOR INFILTRATION
550 FOR I = 1 TO 2
560 FOR J = 1 TO 3
570 READ IW(I,J)
580 NEXT J,I
590 REM INSIDE DESIGN TEMPERATURE
600 IT = 75:PK = 1
610 PRINT "WINTER OUTSIDE DESIGN TEMPERATURE":
620 INPUT OT
630 DT = IT - OT
640 GOSUB 1000: REM WINDOWS
650 GOSUB 2000: REM DOORS
660 GOSUB 3000: REM WALLS
670 GOSUB 4000: REM CEILING
680 GOSUB 5000: REM FLOOR
690 GOSUB 5200: REM DUCTS
700 GOSUB 6000: REM REPORT RESULTS
710 Q1 = TQ / DT
720 PRINT "DO YOU WISH TO MAKE IMPROVEMENTS":
730 INPUT A$
740 PK = 2: IF LEFT$(A$,1) < > "Y" THEN 999
750 HOME : INPUT "DO YOU WISH TO IMPROVE WINDOWS?
(Y/N)":A$

```

### 3: Home Applications

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```
760 IF LEFT$ (A$,1) = "Y" THEN GOSUB 1000
770 HOME : INPUT "DO YOU WISH TO IMPROVE DOORS?(Y
/N)";A$
780 IF LEFT$ (A$,1) = "Y" THEN GOSUB 2000
790 HOME : INPUT "DO YOU WISH TO IMPROVE WALLS?(Y
/N)";A$
800 IF LEFT$ (A$,1) = "Y" THEN GOSUB 3000
810 HOME : INPUT "DO YOU WISH TO IMPROVE CEILING?
(Y/N)";A$
820 IF LEFT$ (A$,1) = "Y" THEN GOSUB 4000
830 HOME : INPUT "DO YOU WISH TO IMPROVE FLOOR?(Y
/N)";A$
840 IF LEFT$ (A$,1) = "Y" THEN GOSUB 5000
850 HOME : INPUT "DO YOU WISH TO IMPROVE DUCTS?(Y
/N)";A$
860 IF LEFT$ (A$,1) = "Y" THEN GOSUB 5200
870 GOSUB 6000: REM REPORT RESULTS
880 Q2 = TQ / DT
890 PRINT : PRINT "HIT RETURN TO GET SAVINGS"
900 GET A$: IF A$ = "" THEN 900
910 GOSUB 7000: REM CALCULATE A YEAR OF SAVINGS
999 END
1000 REM WINDOW SUBROUTINE
1010 I = 1: IF PK > 1 THEN 1040
1020 HOME : PRINT "HOW MANY DIFFERENT SIZES OF WI
NDOWS";
1030 INPUT NX
1040 IX = 1: CW = 0: A(I) = 0: Q(I) = 0
1050 PRINT : INPUT "ARE WINDOWS WEATHERSTRIPPED?(
Y/N)";WW$
1070 IF LEFT$ (WW$,1) = "Y" THEN IX = 2: GOTO 10
80
1075 IF LEFT$ (WW$,1) = "N" THEN 1080
1077 HOME : INVERSE : PRINT "Y";: NORMAL : PRINT
"ES OR ";: INVERSE : PRINT "N";: NORMAL : PRINT
"O PLEASE"
1078 GOTO 1050
1080 FOR J = 1 TO NX
1090 PRINT "SIZE ";J: IF PK > 1 THEN 1160
1100 PRINT "NUMBER OF WINDOWS";
1110 INPUT NW
1120 PRINT "SIZE OF WINDOWS (H,W) FT";
1130 INPUT H,W
1140 S(J) = H * W * NW
1150 CW = CW + (H + W) * NW
1160 A(I) = A(I) + S(J)
1170 PRINT "TYPE OF WINDOWS"
1180 PRINT " 1. SINGLE GLASS"
1190 PRINT " 2. SINGLE + STORM"
```

### 3: Home Applications

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```
1200 PRINT " 3. DOUBLE PANE"
1210 PRINT " 4. TRIPLE (DOUBLE + STORM)"
1220 INPUT G
1230 PRINT "TYPE OF WINDOW FRAME"
1240 PRINT " 1. WOOD"
1250 PRINT " 2. METAL OR JALOUSIE"
1260 PRINT " 3. FIXED"
1270 INPUT F
1280 RM = RW(G,F)
1290 Q(I) = Q(I) + S(J) * DT / RM
1300 R(I) = RM
1310 PRINT "";
1320 NEXT J
1330 IN(I) = 0.018 * DT * IW(IX,F) * CW
1340 RETURN
2000 REM DOORS SUBROUTINE
2010 I = 2: IF PK > 1 THEN 2080
2020 HOME : PRINT "NUMBER OF DOORS";
2030 INPUT N
2040 PRINT "SIZE OF DOORS (H,W) FT";
2050 INPUT H,W
2060 A(I) = H * W * N
2070 CD = (H + W) * N
2080 PRINT "TYPE OF DOORS"
2090 PRINT " 1. WOOD"
2100 PRINT " 2. WOOD + STORM"
2110 PRINT " 3. METAL URETHANE CORE"
2120 PRINT " 4. METAL POLYSTYRENE CORE"
2130 INPUT T
2140 R(I) = D(T)
2150 Q(I) = A(I) * DT / R(I)
2160 DW = 138
2170 INPUT "ARE DOORS WEATHERSTRIPPED?(Y/N)";DW$
2190 IF LEFT$(DW$,1) = "Y" THEN DW = 69: GOTO 2
200
2194 IF LEFT$(DW$,1) = "N" THEN 2200
2196 HOME : INVERSE : PRINT "Y";: NORMAL : PRINT
"ES OR ";: INVERSE : PRINT "N";: NORMAL : PRINT
"O PLEASE"
2198 GOTO 2170
2200 IN(I) = 0.018 * DT * DW * CD
2210 RETURN
3000 REM WALLS SUBROUTINE
3010 I = 3:HO = .17:HI = .68
3020 HOME : PRINT "TYPE OF WALL CONSTRUCTION"
3030 PRINT " 1. BRICK VENEER"
3040 PRINT " 2. STONE"
3050 PRINT " 3. WOOD SHINGLES"
3060 PRINT " 4. STUCCO"
```



### 3: Home Applications

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```
3070 PRINT " 5. MASONRY BLOCK"
3080 PRINT " 6. LOG"
3090 PRINT " 7. OTHER:"
3100 PRINT " ENTER CALCULATED R VALUE DIRECT
LY"
3110 PRINT " WHEN ASKED FOR INSULATION R VAL
UE"
3120 INPUT TY
3130 ON TY GOTO 3140,3150,3160,3170,3180,3190,320
0
3140 RM = .2 * 3.5: GOTO 3210: REM BRICK
3150 RM = .08 * 5: GOTO 3210: REM STONE
3160 RM = .87: GOTO 3210: REM WOOD
3170 RM = .2 * 2: GOTO 3210: REM STUCCO
3180 RM = 2: GOTO 3210: REM MASONRY
3190 RM = 1.25 * 8: GOTO 3210: REM LOG
3200 RM = 0: REM OTHER
3210 PRINT " FOR LIST OF R VALUES FOR INSULATIO
N"
3220 PRINT " ENTER -1 FOR INSULATION R VALUE"
3230 PRINT "INSULATION R VALUE";
3240 INPUT RI
3250 IF RI < 0 THEN GOSUB 3500: GOTO 3230
3260 R(I) = HO + RM + RI + HI: IF PK > 1 THEN 3340

3270 HOME : PRINT "HOW MANY STORIES IN HOUSE";
3280 INPUT NT
3290 PRINT "WHAT IS THE CEILING HEIGHT (FT)";
3300 INPUT CH
3310 PRINT "WHAT IS TOTAL PERIMETER (FT)";
3320 INPUT P
3330 A(I) = NT * CH * P - A(1) - A(2)
3340 Q(I) = A(I) * DT / R(I)
3350 RETURN
3500 REM LIST OF INSULATION R VALUES
3510 PRINT "LIST OF INSULATION R VALUES, WALLS"
3520 PRINT " NO INSULATION (AIR) = .94"
3530 PRINT " BATT INSULATION IN WALL = 11"
3540 PRINT " HALF INCH ASPHALT BOARD = 2.4
3550 PRINT " 1/2 IN GYPSUM OR PLASTER = 1.39
3560 PRINT " 1/4 IN WOOD FIBER BOARD = 1.12
3570 PRINT " FIR OR PINE SHEATHING = 1.92
3580 PRINT " 3/4 IN PLYWOOD PANELS = 1.88
3590 PRINT " 1/2 IN PLYWOOD = 1.57
3600 PRINT : PRINT
3610 RETURN
4000 REM CEILING ROUTINE
4010 I = 4
4020 HI = .61:HO = .61: IF PK > 1 THEN 4060
4030 HOME : PRINT "WHAT IS TOTAL CEILING AREA"
```

### 3: Home Applications

---

```
4040 PRINT "OF THE HOUSE";
4050 INPUT A(I)
4060 PRINT "HOW MANY INCHES OF INSULATION IN CEIL
ING";
4070 INPUT CI
4080 PRINT "TYPE OF INSULATING MATERIAL"
4090 PRINT " 1. FIBERGLASS"
4100 PRINT " 2. MINERAL WOOL"
4110 PRINT " 3. VERMICULITE OR PERLITE"
4120 PRINT " 4. CELLULOSE FIBER"
4130 PRINT " 5. U-F FOAM"
4140 INPUT T
4150 RM = CI * IC(T)
4160 R(I) = HO + RM + HI
4170 Q(I) = A(I) * DT / R(I)
4180 RETURN
5000 REM FLOOR ROUTINE
5010 I = 5: IF PK > 1 THEN 5040
5020 HOME : PRINT "WHAT IS TOTAL FLOOR AREA";
5030 INPUT A(I)
5040 PRINT "HOW MANY INS OF INSULATION IN FLOOR";

5050 INPUT FI: IF PK > 1 THEN 5110
5060 PRINT "TYPE OF FOUNDATION"
5070 PRINT " 1. OPEN CRAWLSPACE"
5080 PRINT " 2. ENCLOSED CRAWLSPACE OR BASEMENT
"
5090 PRINT " 3. CONCRETE SLAB"
5100 INPUT TF
5110 R(I) = HO + FI * 3.1 + RF(TF) + HI
5120 Q(I) = A(I) * (DT - TC(TF)) / R(I)
5130 RETURN
5200 REM DUCTS
5210 DI = .1
5220 IF TF = 3 THEN KD = 3: RETURN
5230 INPUT "IS YOUR DUCTWORK INSULATED?(Y/N)";D$
5240 IF PK > 1 THEN 5310
5245 IF VAL(D$) < > 0 THEN HOME : INVERSE : PRINT
"Y";: NORMAL : PRINT "ES OR";: INVERSE : PRINT
" N";: NORMAL : PRINT "O PLEASE": GOTO 5230
5247 IF D$ < > "Y" AND D$ < > "N" THEN 5230
5250 PRINT "LOCATION OF HEAT DUCTS:"
5260 PRINT " 1. ATTIC OR CRAWLSPACE"
5270 PRINT " 2. UNCONDITIONED BASEMENT"
5280 PRINT " 3. IN SLAB FLOOR"
5290 PRINT " 4. INSIDE CONDITIONED SPACE"
5300 INPUT KD
5310 RETURN
6000 REM WRITE A REPORT
```

### 3: Home Applications

---

```
6010 HOME : VTAB 1: HTAB 11: PRINT "HEAT LOSS EVA  
LUATION"  
6020 PRINT : PRINT :TQ = 0  
6030 PRINT " ITEM";: HTAB 10: PRINT "AREA";: HTAB  
20: PRINT "R-VAL";: HTAB 30: PRINT "HEAT LOSS  
"  
6040 HTAB 8: PRINT " SQ.FT.";" BTU/  
HR": PRINT  
6050 FOR I = 1 TO 5  
6060 A(I) = INT (A(I) * 100 + .5) / 100  
6070 R(I) = INT (R(I) * 100 + .5) / 100  
6080 Q(I) = INT (Q(I) + .5)  
6090 PRINT N$(I);: HTAB 10: PRINT A(I);: HTAB 20:  
PRINT R(I);: HTAB 30: PRINT Q(I)  
6100 TA = TA + A(I):TQ = TQ + Q(I)  
6110 NEXT I  
6120 REM PRINT INFILTRATION LOSS  
6130 PRINT "INFILTRATION";: HTAB 30: PRINT INT (  
(IN(1) + IN(2)) / 2 + .5)  
6140 TQ = TQ + (IN(1) + IN(2)) / 2  
6150 REM CALCULATE DUCT LOSS  
6160 X = TQ / (A(5) * CH * NT):J = 3:K = 3  
6170 IF X < 45 THEN K = 2  
6180 IF X < 35 THEN K = 1  
6190 DI = .15 + .05 * (3 - K)  
6200 IF LEFT$(D$,1) = "N" AND KD < 2 THEN 6240  
6205 IF KD > 2 THEN DI = 0: GOTO 6240  
6210 IF OT < 15 THEN J = 2  
6220 IF OT < 0 THEN J = 1  
6230 DI = DM(KD,J,K)  
6240 PRINT "DUCT LOSS";: HTAB 30: PRINT INT (DI *  
TQ + .5)  
6250 TQ = TQ + TQ * DI  
6260 HTAB 10: PRINT "-----";: HTAB 30: PRINT "  
-----"  
6270 PRINT "TOTAL";: HTAB 10: PRINT INT (TA);: HTAB  
30: PRINT INT (TQ)  
6272 PRINT : PRINT : PRINT "<MORE>"  
6275 GET R$: IF R$ = "" THEN 6275  
6280 PRINT : PRINT  
6290 PRINT "DESIGN CONDITIONS:"  
6300 PRINT " OUTSIDE DESIGN TEMP";,OT  
6310 PRINT " INSIDE DESIGN TEMP";,IT  
6320 PRINT "TEMPERATURE DIFFERENCE";,DT  
6330 RETURN  
7000 REM FIND SAVINGS USING DEGREE-DAYS  
7010 DD = 2961:DD$ = "MODERATE CLIMATE"  
7012 E1 = INT (Q1 * DD * 24)  
7014 E2 = INT (Q2 * DD * 24)
```

```

7030 PRINT "TYPE OF HEATING FUEL USED"
7040 PRINT " 1. ELECTRICITY"
7050 PRINT " 2. NATURAL GAS"
7060 PRINT " 3. FUEL OIL"
7070 INPUT FT:PC = .55
7080 ON FT GOTO 7100,7200,7300
7090 GOTO 7030
7100 REM ELECTRICITY
7110 HOME : INPUT "IS HEATING UNIT A HEAT PUMP?(Y
/N)";HP$:ER = 3413
7130 IF LEFT$(HP$,1) < > "Y" THEN 7150
7140 INPUT "ENTER EER OF HEAT PUMP...";ER:ER = ER
* 1000
7150 INPUT "AVERAGE $ COST PER KWH--$";CO:FU$ = "
KWH"
7160 E1 = INT (E1 / ER + .5)
7165 M1 = E1 * CO
7170 E2 = INT (E2 / ER + .5)
7175 M2 = E2 * CO
7180 MS = M1 - M2
7190 GOTO 7400
7200 REM NATURAL GAS
7210 HOME : INPUT "AV. $ COST PER THERM OF NAT. GA
S--- $";CO
7220 E1 = INT (E1 / (103000 * PC) + .5)
7225 M1 = E1 * CO
7230 E2 = INT (E2 / (103000 * PC) + .5)
7235 M2 = E2 * CO
7240 MS = M1 - M2
7250 FU$ = "THERMS": GOTO 7400
7300 REM FUEL OIL
7310 HOME : INPUT "AVERAGE $ COST PER GAL.OF FUEL
OIL---- $";CO
7320 E1 = INT (E1 / (138000 * PC) + .5)
7325 M1 = E1 * CO
7330 E2 = INT (E2 / (138000 * PC) + .5)
7335 M2 = E2 * CO
7340 MS = M1 - M2:FU$ = "GALLONS"
7400 REM GIVE RESULTS
7410 M1 = INT (M1 * 100) / 100
7420 M2 = INT (M2 * 100) / 100
7430 MS = INT (MS * 100) / 100
7440 HOME : INPUT "TOT. $ COST OF IMPROVEMENTS--$"
;CI
7450 PB = INT (CI / MS * 1000) / 1000
7460 REM REPORT SAVINGS AND PAYBACK
7470 HOME : VTAB 1: HTAB 11: PRINT "ANALYSIS OF I
MPROVEMENTS"
7480 PRINT : PRINT

```

### 3: Home Applications

---

```
7490 HTAB 24: PRINT "ENERGY NEEDED"
7500 HTAB 1: PRINT "ORIGINAL HOUSE"; HTAB 27: PRINT
E1; PRINT " "; FU$
7510 HTAB 1: PRINT "IMPROVED HOUSE"; HTAB 27: PRINT
E2; PRINT " "; FU$
7520 HTAB 26: PRINT "-----"
7530 HTAB 8: PRINT "SAVINGS"; HTAB 27: PRINT E1 -
E2; PRINT " "; FU$
7540 PRINT
7550 HTAB 24: PRINT "OPER. COSTS"
7560 HTAB 1: PRINT "ORIGINAL HOUSE"; HTAB 27: PRINT
"$"; M1
7570 HTAB 1: PRINT "IMPROVED HOUSE"; HTAB 27: PRINT
"$"; M2
7580 HTAB 26: PRINT "-----"
7590 HTAB 8: PRINT "SAVINGS"; HTAB 27: PRINT "$"
; MS
7600 HTAB 8: PRINT : PRINT "PAYBACK"; HTAB 27: PRINT
PB; PRINT " YEARS"
7610 PRINT : PRINT
7620 PRINT "ABOVE IS BASED ON ONE YEAR OF OPERATI
ON"
7630 PRINT "IN "; DD$
7640 RETURN
8000 REM DRAW HOUSE
8010 HOME : GR : COLOR= 07
8015 VLIN 14,28 AT 12
8020 VLIN 14,28 AT 24
8030 HLIN 12,23 AT 14
8040 HLIN 12,23 AT 28
8050 FOR X = 0 TO 8: PLOT 10 + X,15 - X: PLOT 18 +
X,7 + X: NEXT X
8060 VLIN 24,28 AT 17: VLIN 24,28 AT 18: VLIN 24,
28 AT 19
8070 COLOR= 02: VLIN 25,26 AT 18: COLOR= 12: VLIN
16,17 AT 14: VLIN 16,17 AT 15
8080 VLIN 16,17 AT 21: VLIN 16,17 AT 22
8090 VLIN 23,24 AT 14: VLIN 23,24 AT 15
8100 VLIN 23,24 AT 21: VLIN 23,24 AT 22
8110 VTAB 22: HTAB 8: INVERSE : PRINT "HOME ENERG
Y CALCULATOR": NORMAL
8115 HTAB 12: PRINT "PRESS ANY KEY"
8120 GET R$: IF R$ = "" THEN 8120
8130 TEXT : HOME : RETURN
```

# Utility Bill Audit

---

Larry L. Bihlmeyer

*With the high price of today's utilities, it's a good idea to check your bills for accuracy. Here's a practical program enabling you to verify your electric, gas, water, and phone bills.*

"Utility Bill Audit" is a versatile program that lets you check electric, gas, water, and phone bills. It also makes it easy to split the costs of those bills among the people living in your household. In addition, if you are interested in energy savings it will help you monitor electricity and gas consumption.

## Personalizing the Program

Before using Utility Bill Audit, you need to have a thorough understanding of how each bill is calculated in the program. First, a particular bill is split up according to the values (2, 1, 2, 4) given in the DATA statement in line 1640. They are assigned to the variable N(X) and represent the number of individuals who must pay for each bill. In its present form, the program assumes that the electric and water bills will be paid by two individuals, the phone bill by four, and the gas bill by one. However, it's unlikely that these numbers will correspond to the financial arrangements in your household. Be sure to substitute the appropriate values before you continue. Of course, if the bills are paid by one individual, simply replace the numbers in line 1640 with 1,1,1,1.

Since the program works on the actual cost of utilities, based on local rates, certain information about those rates must be provided. That information is READ in lines 380 and 400 from the DATA statements in lines 1650-1680.

Notice that the first three DATA statements in this sequence have nine entries and apply to the electric, gas, and water bills respectively. Consider line 1650 as an example. The first entry in that line is the name of the utility (ELECTRIC) for which the rates that follow apply. The second entry is the unit of measurement for that particular utility (KWH, for kilowatt hours). The next entry is the minimum service charge for the utility (\$5.40 for electricity). The fourth entry is the tax rate based on the sum of the service charge and the rate

### 3: Home Applications

---

charge (0 percent for electric use). Those first four DATA entries are READ in as A\$(1), B\$(1), M(1), and Z(1), respectively.

The next two numbers are cutoff limits for each electric rate and are represented in the program by L1(1) and L2(1). The last three numbers are the actual rate charged per KWH use for each level of usage (R1(1), R2(1), and R3(1) in the program). Thus, the program is set up so that the rate charged for electricity is \$.0495 for the first 350 KWH, \$.0565 for the next 950 KWH (1300 minus 350), and \$.0541 for any usage exceeding 1300 KWH.

The DATA statement in line 1680 is easier to follow. It includes the utility (PHONE), the minimum service charge (\$13.50), and the tax rate on the service charge and long distance calls (3 percent).

So get out your most recent bills and read off the various rates (per KWH for electric and per CCF or hundred cubic feet for gas and water). If the rates are not given on a bill, contact the utility company to get a schedule of the latest rates. Then substitute your local rates for those in the DATA statements in lines 1650–1680.

### Program Operation

After inserting the correct rates, run the program. You will then be asked which utility bill you wish to check. The first three menu choices are electric, gas, and water. Bills for these three utilities are all calculated in the routine beginning at line 560.

Look at an electric bill as an example. When the routine at line 560 is executed, you will be required to INPUT the present and previous meter readings. Those values can be read directly from your latest electric bill. Next, you must INPUT the number of days in the billing period. Then you will be asked to INPUT any adjustments to the bill, either positive (for example, connection fees or previous balances) or negative (credits).

The program will calculate the amount of electricity consumed for the given period (defined as U in line 720). Then, depending on the value of U relative to the rate limits L1(1) and L2(X) (lines 740 and 750), an amount owed (T) before tax and adjustments will be calculated (lines 760, 780, and 800). Next, the tax on this amount will be determined (T1). Finally, a total electric bill—the sum of the minimum charge, usage

cost, tax, and adjustments—will be calculated (T3) in line 830.

The results are then PRINTed on the screen with provisions for formatting the output to two places past the decimal. Any numbers beyond the second decimal place are simply dropped. If you prefer rounded numbers, you could easily modify the program to give them.

The routine beginning at line 560, as mentioned, also calculates the gas and water bills. They are based on the rates READ from the DATA statements in lines 1660 and 1670. Notice the sets of large numbers (precisely, 99999) in line 1660. The rates for gas where I live are the same, regardless of the amount used. By using large numbers here for the cutoff limits, L1(2) and L2(2), for this utility, it's unlikely that the actual usage will exceed these amounts (see lines 740 and 750). Thus, the charge for this commodity will always be based on the first rate, or R1.

The rates for water, as READ from the DATA statement in line 1670, are based on a single cutoff limit (L1(3)) of 1000 CCF. For less than this, a usage rate (R1(3)) of \$.144 per CCF is charged. If water usage exceeds 1000 CCF, a second rate (R2(3)) of \$.160 is charged. Again, using a very large number (99999) for the second cutoff limit (L2(3)) assures that the overall usage cost is based only on two rates.

### Analyzing the Phone Bill

Phone bills are checked in a separate routine beginning at line 1110. Adjustments to the bill are initially INPUT in the same manner as they are with the electric, gas, and water bills. Next, the person responsible for each long distance charge is asked to INPUT the amount of each long distance call. A separate routine (lines 1260–1360) allows the individual to correct any typing mistakes. Finally, the amount owed by each individual is displayed.

The portion of the phone bill that each person must pay is the sum of the appropriate long distance tolls, a proportional amount of both the service charge and the billing adjustments, and a proportional amount of the tax levied on the service and long distance calls. Again, if only one person in the household foots the bills, the last number in line 1640 should be 1.

In addition to enabling you to catch billing errors and helping you to easily divide up household bills, this program



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can help you monitor costs. If you add an energy-saving device that is supposed to save 10 percent of your total electric bill, take a meter reading when it is installed and verify the savings with a later reading. You can also project weekly, monthly, and yearly savings for any utility in this manner.

#### Utility Bill Audit

```
90 DIM A$(4),B$(4),L1(3),L2(3),M(4),R1(3),R2(3),R
   3(3),W(50),Z(4)
100 GOTO 340
110 A1 = 0
120 PRINT "INPUT ADJUSTMENTS TO BILL(+ OR - , '0'
   WHEN DONE)"
130 INPUT E
140 A1 = A1 + E
150 IF E = 0 THEN 170
160 GOTO 130
170 GOSUB 250
180 GOSUB 290
190 RETURN
200 PRINT "": REM HOME
210 RETURN
220 PRINT " ";A$(X);" BILL(CONT?)"
230 PRINT
240 RETURN
250 FOR I = 1 TO 3
260 PRINT
270 NEXT I
280 RETURN
290 PRINT "INPUT C TO CONTINUE";
300 INPUT C$
310 GOSUB 200
320 RETURN
340 FOR I = 1 TO 4
350 READ N(I)
360 NEXT I
370 FOR I = 1 TO 3
380 READ A$(I),B$(I),M(I),Z(I),L1(I),L2(I),R1(I),
   R2(I),R3(I)
390 NEXT I
400 READ A$(4),M(4),Z(4)
410 GOSUB 200
420 PRINT " UTILITY BILL AUDIT"
430 GOSUB 250
440 PRINT " 1. ELECTRIC BILL"
450 PRINT " 2. GAS BILL"
460 PRINT " 3. WATER BILL"
470 PRINT " 4. PHONE BILL"
```

```
480 PRINT " 5. ALL OF THE ABOVE"
490 PRINT " 6. EXIT"
500 PRINT
510 PRINT
520 PRINT " CHOOSE AN OPTION ";
530 INPUT P
540 IF (P < 1) + (P > 6) THEN 530
550 ON P GOTO 1020,1050,1080,1110,1590,1690
560 GOSUB 200
570 PRINT "      ";A$(X);" BILL"
580 PRINT
590 PRINT "PREVIOUS METER READING"
600 INPUT E1
610 PRINT
620 PRINT "PRESENT METER READING"
630 INPUT E2
640 PRINT
650 PRINT "INPUT DAYS IN THE BILLING PERIOD"
660 INPUT D
670 GOSUB 250
680 GOSUB 290
690 GOSUB 200
700 GOSUB 220
710 GOSUB 110
720 U = E2 - E1
730 Y = U / D
740 IF U > L2(X) THEN 800
750 IF U > L1(X) THEN 780
760 T = M(X) + R1(X) * U
770 GOTO 810
780 T = M(X) + R1(X) * L1(X) + R2(X) * (U - L1(X))
790 GOTO 810
800 T = M(X) + R1(X) * L1(X) + R2(X) * (L2(X) - L1
(X)) + R3(X) * (U - L2(X))
810 T1 = T * Z(X)
820 T2 = T + T1
830 T3 = T2 + A1
840 GOSUB 200
850 GOSUB 220
860 PRINT "USE FOR THE PERIOD IS "; INT (U * 100)
/ 100;" ";B$(X)
870 PRINT
880 PRINT "USE/DAY IS "; INT (Y * 100) / 100;" ";
B$(X);" OR $";
890 PRINT INT (T2 / D * 100) / 100;"/DAY INCLUDI
NG TAX"
900 PRINT
910 PRINT A$(X);" BILL:"
```

### 3: Home Applications

---

```
920 PRINT " W/OUT TAX   :$"; INT (T * 100) / 100
930 PRINT " TAX IS     :$"; INT (T1 * 100) / 100
940 PRINT " ADJ'TS     :$"; A1
950 PRINT
960 PRINT " *TOTAL*    :$"; INT (T3 * 100) / 100
970 IF N(X) = 1 THEN 990
980 PRINT "SPLIT ";N(X);" WAYS:$"; INT (T3 / N(X)
    * 100) / 100
990 PRINT
1000 GOSUB 290
1010 RETURN
1020 X = 1
1030 GOSUB 560
1040 GOTO 430
1050 X = 2
1060 GOSUB 560
1070 GOTO 430
1080 X = 3
1090 GOSUB 560
1100 GOTO 430
1110 GOSUB 200
1120 X = 4
1130 PRINT "          ";A$(X);" BILL"
1140 PRINT
1150 GOSUB 110
1160 FOR K = 1 TO N(X)
1170 I = 1
1180 IF N(X) = 1 THEN 1200
1190 PRINT "FOR PERSON #";K;",";
1200 PRINT "INPUT CHARGE FOR EACH LONG DISTANCE C
    ALL (INPUT '0' WHEN DONE)"
1210 INPUT W(I)
1220 IF W(I) = 0 THEN 1250
1230 I = I + 1
1240 GOTO 1210
1250 GOSUB 200
1260 PRINT " PERSON #";K;",";
1270 FOR J = 1 TO I - 1
1280 PRINT "CALL #";J;"   :$";W(J)
1290 PRINT
1300 PRINT "IS THIS CORRECT (Y/N)"
1310 INPUT C$
1320 IF C$ = "Y" THEN 1350
1330 PRINT "TYPE IN CORRECTION"
1340 INPUT W(J)
1350 PRINT
1360 NEXT J
1370 GOSUB 200
1380 GOSUB 220
```

### 3: Home Applications

---

```
1390 T = 0
1400 FOR J = 1 TO I - 1
1410 T = T + W(J)
1420 NEXT J
1430 PRINT "SERVICE: $"; INT (M(X) / N(X) * 100
) / 100
1440 PRINT
1450 PRINT "LD CALLS: $":T
1460 PRINT
1470 PRINT "ADJ'TS : $"; INT (A1 / N(X) * 100) /
100
1480 PRINT
1490 T1 = T + INT (M(X) / N(X) * 100) / 100
1500 T2 = INT (T1 * Z(X) * 100) / 100
1510 PRINT "TOTAL TAX: $":T2
1520 PRINT
1530 PRINT
1540 PRINT " TOTAL BILL: $":T1 + T2 + INT (A1 /
N(X) * 100) / 100
1550 GOSUB 250
1560 GOSUB 290
1570 NEXT K
1580 GOTO 430
1590 FOR F = 1 TO 3
1600 X = F
1610 GOSUB 560
1620 NEXT F
1630 GOTO 1110
1640 DATA 2,1,2,4
1650 DATA ELECTRIC,KWH,5.40,0,350,1300,.0495,.05
65,.0541
1660 DATA GAS,CCF,4.05,0,99999,99999,.49541,0,0
1670 DATA WATER,CCF,3.26,0,500,99999..144,.160,0
1680 DATA PHONE,13.50,.03
1690 END
```

# Calorie Cop

---

Gerald P. Graham

Apple translation by Kevin Martin

*This program determines your calorie output for a variety of activities (ranging from sitting still to weight lifting) and gives you your total daily energy output. With onscreen instructions and an easy-to-understand menu, it's simple to use.*

In the December 1982 issue of *COMPUTE!* magazine, Charles Brannon presented a program for calculating the calories in your diet. It also estimated your daily needs and then predicted how long it would take you to lose any weight you wanted to lose.

"Calorie Cop" is a companion program that tells you the caloric output, per pound of body weight, for each activity you perform. It also determines the calories that you actually expend for each activity, allowing you to see your total daily energy output.

When you run the program you are given instructions, followed by a seven-page alphabetical menu of activities from archery to wrestling. Just press the letter corresponding to your activity; if you don't see it, press RETURN to turn the pages until you find it. If your chosen activity is not listed, then use one that is comparable.

Keep in mind that the results should be modified by knowledge of the context of the activities. In cases where an unskilled person is competing against a skilled person, for instance, the former usually works harder. Desire and effort are also factors. One research study involved filming very heavy individuals playing tennis doubles. The very heavy players were found to be standing still 65 percent of the time. While vigorous tennis doubles requires .046 calories per minute per pound of weight, standing is worth only .011 calories per minute per pound.

To exit the program type a 0 when you are prompted for CHOICE. Before ENDing, the program will tell you the total number of calories used.

*Do not use this or any other diet/exercise program except under the advice and consent of your physician.*

## Calorie Cop

```
1 WI = 40:LE = 24
5 HOME
10 PRINT : PRINT : PRINT : PRINT
15 PRINT TAB(WI / 2 - 5);"CALORIE COP"
30 FOR I = 1 TO 1000: NEXT I
40 HOME
50 PRINT "THIS PROGRAM WILL TELL YOU HOW MANY"
55 PRINT : PRINT "CALORIES YOU USE FOR A PARTICULAR"
60 PRINT : PRINT "ACTIVITY. YOU WILL BE PROVIDED"
65 PRINT : PRINT "ACTIVITY MENU THAT WILL TELL YOU"
70 PRINT : PRINT "MANY CALORIES EACH ACTIVITY USES"
75 PRINT : PRINT "MINUTE FOR EACH POUND OF YOUR BODY"
80 PRINT : PRINT "WEIGHT. IT WILL ALSO GIVE YOU"
85 PRINT : PRINT "OF ALL CALORIES USED."
90 PRINT : PRINT "PRESS ANY KEY WHEN FINISHED";
95 GET A$
250 IF CAL = 1 THEN 730
260 GOSUB 1020
270 FOR I = 1 TO LE - 4
280 READ ACTIVITY$,CL
290 IF ACTIVITY$ = "END" THEN 330
300 PRINT CHR$(64 + I);"-";ACTIVITY$
320 NEXT I
330 I = I - 1
340 PRINT : PRINT "CHOICE ";
350 GET A$
355 IF (A$ < "A" OR A$ > CHR$(I + 64)) AND A$ <
    > "0" AND A$ < > CHR$(13) THEN 350
360 IF A$ < > CHR$(13) THEN 410
370 NX = NX + 1: IF ACTIVITY$ = "END" THEN RESTORE
    :NX = 0
400 GOTO 260
410 RESTORE
430 IF A$ = "0" THEN 660
440 FOR I = 1 TO NX * (LE - 4) + ASC(A$) - 64
450 READ ACTIVITY$,CL
460 NEXT I
470 HOME
480 PRINT : PRINT "ACTIVITY: ";ACTIVITY$
490 PRINT : PRINT "THIS ACTIVITY USES:": PRINT CL
```

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```
500 PRINT "CALORIES PER MINUTE PER"
510 PRINT "POUND"
520 PRINT : PRINT "ENTER LENGTH OF ABOVE"
530 PRINT "ACTIVITY IN MINUTES";
540 INPUT MIN
545 IF MIN = 0 THEN 590
547 IF MIN < 0 THEN 540
550 PRINT : PRINT "ENTER YOUR BODY WEIGHT"
555 IF MIN < 0 THEN 540
560 PRINT "IN POUNDS";
570 INPUT LBS
572 IF LBS < 0 THEN 570
575 OUTPUT = LBS * MIN * CL
577 PRINT "CALORIES USED FOR THIS"
578 PRINT "ACTIVITY=" ; OUTPUT
579 PRINT : PRINT "TOTAL CALORIES USED"
580 PRINT "SO FAR=" ; : CAL = CAL + OUTPUT: PRINT C
    AL
582 PRINT "PRESS RETURN TO CONTINUE..."
585 GET A$: IF A$ < > CHR$ (13) THEN 585
590 RESTORE :NX = 0: GOTO 260
660 HOME
665 PRINT : PRINT : PRINT "YOUR TOTAL CALORIES": PRINT ⊕
    "ARE "; CAL
670 PRINT : PRINT : PRINT : PRINT "THAT'S ALL FOL
    KS!"
680 FOR PAUSE = 1 TO 1000: NEXT PAUSE
690 END
1020 HOME
1030 PRINT "--<ACTIVITY MENU>--"
1035 RETURN
1036 REM BE SURE TO INCLUDE THE DATA STATEMENTS
    IN PROGRAM 4
1040 DATA ARCHERY, .034
1050 DATA BADMINTON-MODERATE, .039
1060 DATA BADMINTON-VIGOROUS, .065
1070 DATA BASEBALL, .031
1080 DATA BASEBALL-PITCH&CATCH, .040
1090 DATA BASKETBALL-MODERATE, .047
1100 DATA BASKETBALL-VIGOROUS, .066
1110 DATA BED MAKING, .031
1120 DATA BICYCLING-DOWNHILL, .018
1130 DATA BICYCLING-SLOW-LEVEL, .030
1140 DATA BICYCLING-MODERATE, .050
1150 DATA BICYCLE-FAST-UPHILL, .072
1160 DATA BOXING-IN RING, .101
1170 DATA BOXING-SPARRING, .063
1180 DATA BOWLING, .028
1190 DATA CANOEING, .029
```

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1200	DATA	CONVERSING, .011
1210	DATA	COOKING, .013
1220	DATA	DANCING-SLOW, .029
1230	DATA	DANCING-MODERATE, .045
1240	DATA	DANCING-FAST, .064
1250	DATA	DRESSING&UNDRESSING, .030
1260	DATA	DRIVING A CAR, .019
1270	DATA	DUSTING, .010
1280	DATA	EATING, .011
1290	DATA	EXERCISES-ABDOMINAL, .020
1300	DATA	EXERCISES-BALANCING, .016
1310	DATA	EXERCISES-JUMPING, .043
1320	DATA	EXERCISES-BENDING, .023
1330	DATA	FENCING-MODERATE, .033
1340	DATA	FENCING-VIGOROUS, .057
1350	DATA	FIELD HOCKEY, .063
1360	DATA	FIELD HOCKEY-GOALIE, .030
1370	DATA	FISHING, .016
1380	DATA	FOOTBALL-BACKS&ENDS, .050
1390	DATA	FOOTBALL-LINEMEN, .040
1400	DATA	GARDENING, .030
1410	DATA	GOLF-CROWDED&WALKING, .030
1420	DATA	GOLF-UNCROWDED&WALK, .035
1430	DATA	GYMNASTICS-LIGHT, .030
1440	DATA	GYMNASTICS-HEAVY, .056
1450	DATA	HANDBALL, .063
1460	DATA	HIKING, .042
1470	DATA	HILL&STAIR CLIMBING, .060
1480	DATA	HORSEBACK RIDE-WALK, .019
1490	DATA	HORSEBACK RIDE-TROT, .046
1500	DATA	HORSEBACK RIDE-GALLOP, .067
1510	DATA	IRONING, .018
1520	DATA	JUDO, .087
1530	DATA	JUMPING ROPE, .087
1540	DATA	KARATE, .087
1550	DATA	LACROSSE, .063
1560	DATA	LACROSSE-GOALIE, .030
1570	DATA	LISTENING TO RADIO, .010
1580	DATA	MOTOR BOATING, .016
1590	DATA	MOUNTAIN CLIMBING, .086
1600	DATA	PAINTING-INSIDE, .015
1610	DATA	PAINTING-OUTSIDE, .035
1620	DATA	PLAYING CARDS, .011
1630	DATA	PLAYING DRUMS, .030
1640	DATA	PLAYING HORN, .013
1650	DATA	PLAYING PIANO, .018
1660	DATA	RACQUETBALL, .063
1670	DATA	RESTING-LYING DOWN, .008
1680	DATA	RESTING-SITTING, .009



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1690	DATA	ROWING-SLOW, .036
1700	DATA	ROWING-VIGOROUS, .118
1710	DATA	RUNNING-11 MIN./MILE, .071
1720	DATA	RUNNING-10 MIN./MILE, .078
1730	DATA	RUNNING-9 MIN./MILE, .085
1740	DATA	RUNNING-8 MIN./MILE, .092
1750	DATA	RUNNING-7 MIN./MILE, .100
1760	DATA	RUNNING-6 MIN./MILE, .110
1770	DATA	RUNNING-5 MIN./MILE, .130
1780	DATA	SAILING, .020
1790	DATA	SCRUBBING, .032
1800	DATA	SEWING OR KNITTING, .010
1810	DATA	SHOPPING, .028
1820	DATA	SHOWERING, .034
1830	DATA	SINGING-STANDING, .017
1840	DATA	SITTING-QUIETLY, .010
1850	DATA	SITTING-WRITING, .013
1860	DATA	SKATING-MODERATE, .036
1870	DATA	SKATING-VIGOROUS, .064
1880	DATA	SKIING-DOWNHILL, .059
1890	DATA	SKIING-LEVEL-SLOW, .054
1900	DATA	SKIING-LEVEL-FAST, .078
1910	DATA	SLEEPING, .007
1920	DATA	SOCCER, .063
1930	DATA	SOCCER-GOALIE, .030
1940	DATA	SQUASH, .070
1950	DATA	STANDING, .011
1960	DATA	STATIONARY RUNNING, .078
1970	DATA	STUDYING, .014
1980	DATA	SWIM-CRAWL-30YDS/MIN, .058
1990	DATA	SWIM-CRAWL-40YDS/MIN, .071
2000	DATA	SWIM-BKSTRK-30YDS/MN, .035
2010	DATA	SWIM-BKSTRK-40YDS/MN, .055
2020	DATA	SWIM-BREAST-30YDS/MN, .048
2030	DATA	SWIM-BREAST-40YDS/MN, .064
2040	DATA	SWIM-BUTTERFLY, .078
2050	DATA	TABLE TENNIS-MOD, .046
2060	DATA	TABLE TENNIS-VIG, .065
2070	DATA	TELEPHONING, .011
2080	DATA	TENNIS-SNGLS-MOD, .046
2090	DATA	TENNIS-SNGLS-VIG, .065
2100	DATA	TENNIS-DBLES-MOD, .038
2110	DATA	TENNIS-DBLES-VIG, .046
2120	DATA	TYPING, .015

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2130 DATA VOLLEYBALL-BEG.-MOD.,.020  
2140 DATA VOLLEYBALL-BEG.-VIG.,.036  
2150 DATA VOLLEYBALL-SKILL-MOD.,.040  
2160 DATA VOLLEYBALL-SKILL-VIG.,.065  
2170 DATA WALKING-2 MPH,.022  
2180 DATA WALKING-3 MPH,.030  
2190 DATA WALKING-4 MPH,.039  
2200 DATA WALKING-5 MPH,.064  
2210 DATA WASHING DISHES,.015  
2220 DATA WASHING HANDS & FACE,.020  
2230 DATA WATCHING TV,.010  
2240 DATA WATER SKIING,.053  
2250 DATA WEIGHT LIFTING-ARMS,.050  
2260 DATA WEIGHT LIFTING-LEGS,.060  
2270 DATA WEIGHT LIFTING-BODY,.065  
2280 DATA WRESTLING,.091  
2290 DATA END,0,0



# Chapter 4

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# Programming



# Introduction

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Many Apple users enjoy programming, and the utilities and programming techniques described in this chapter will make the experience even more satisfying.

For instance, John Sarver's "Apple Fast Sort" can be incorporated into your programs to make short work out of sorting long lists.

You can dress up your programs with the custom directory headers described in G.J. Vulling's "Custom Headers." Similar techniques are described by Dan Jordan in "Apple Input and Menu Screens."

"Using Commas, Colons, and Quote Marks in Apple Input Statements," by Craig Peterson, will tell you how to solve that particularly knotty programming problem.

Finally, Michael P. Antonovich's "Undeletable Lines" shows you an innovative way to personalize programs—by creating lines that cannot be deleted by ordinary means.

# Apple Editing Hints

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Patrick Moyer

*Most computer owners develop a love-hate relationship with at least one feature of their machines. For the Apple this feature is often the editing functions. Here is a review of Apple editing controls and protocols and some tips on making the process easier and more effective.*

The Apple uses a combination of screen editing and line editing. Changes are made by moving the cursor to a particular line which has been listed on the screen and retyping that line. This retyping is usually accomplished with the right arrow key. As the right arrow is pressed, the cursor moves to the right, reentering all it passes over. A change is made by typing over what is already there, or by inserting the correction through a combination of cursor moves.

## **Physical, Logical**

Therefore, to make a change, we must specify the line to be changed. In this case, we are talking about a line of BASIC, not a line displayed on the screen. The BASIC line is called a *logical line*, as opposed to the *physical line* that is displayed on the screen. A logical line may contain multiple BASIC statements and may be up to 255 characters long. The physical display line is the 40-letter width of the screen.

Before a BASIC line can be changed, it must be listed. It is best to clear the screen with the HOME command initially. This eliminates confusion about what was changed and what wasn't.

When a line is listed, the computer puts one space between words or variables, two spaces after the line number, seven spaces at the end of the first physical line, and five spaces on the right and left sides of the remaining physical lines.

Most of the time, these extra spaces and lines are of little consequence. One can just merrily right-arrow over them with no harm. The one exception occurs in string information (characters in quotes). This causes a problem. If a string is broken between two or more physical lines during the listing process, and you right-arrow to retype, 12 additional spaces will be inserted between the last character on the first line and the

first character on the next line. Certainly not what's wanted. The common solution is to avoid the right arrow and use the cursor with the <ESC>K sequence instead.

### Simplified Cursor Control

There's an even simpler solution. Let's edit a line step by step to demonstrate this technique

(<ESC> is the ESC KEY, <RET> is the RETURN KEY):

Here's the line as originally typed:

```
10PRINT"THIS IS A LONG LINE OF STRING  
DATA"<RET>
```

List the line. It looks like this:

```
LIST10<RET>  
10 PRINT "THIS IS A LONG LINE OF STR  
ING DATA"
```

We then type <ESC>I, repeating the I key until the cursor is over the second digit of the line number; J is pressed to move the cursor one space to the left. (This J keypress is important. If you forget it and continue the editing process, you will gain a line in your program. Line 0 will be created, but more about that later.)

Once you've moved left, leave <ESC> mode. This is done by pressing any key not having meaning in <ESC> mode. Because some keys not normally used for cursor movement do have special meaning, it's best to press the space bar. Remember, this will not move the cursor.

We can now use the right arrow to "retype" the line to the place of the change. The repeat key can be used to speed this process. Let's say you've used the right arrow until it appears after the last quote. The line on the screen looks no different. However, if we LIST the line, we now see this:

```
10 PRINT "THIS IS A LONG LINE OF STR  
ING DATA"
```

If we type RUN we get:

```
RUN<RET>  
THIS IS A LONG LINE OF STR   ING DAT  
A
```

### Eliminating Problem Margins

The common solution, again, is to right-arrow to the R in STR,



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then type <ESC> and press K repeatedly to move the cursor until you reach the I in ING. Anyone who has done this often will know how easy it is to forget <ESC> K, and end up with a string of K's.

The solution is simply to eliminate those extra margins unless you need them. Let's start with the same original line:

```
10PRINT"THIS IS A LONG LINE OF STRING  
DATA"<RET>
```

To edit the line we type:

```
HOME:POKE33,30:LIST10<RET>
```

The HOME gives us a clean screen to work with; the LIST puts the line to be edited on the screen. A POKE instruction places a single number into an address in the computer's memory. Address 33 controls the width of the screen display. Placing the number 30 in it reduces the size of the screen to 30 characters wide rather than 40.

*Caution:* The POKE must be done before the LIST for this method to work. The HOME is optional, but prevents a very confusing screen. (Try it. You'll see what I mean.) The screen will erase and display:

```
10 PRINT"THIS IS A LONG LINE OF S  
TRING DATA"
```

As you can see, the line is 30 characters wide without the extra margin spaces. Move the cursor to the line number as usual. The right arrow may be used without ill effect. It will go directly from the S on the first display line to the T on the second line without inserting any blanks. This eliminates the need to use the <ESC> K sequence.

Once you have finished editing, you will need to type TEXT. This command will return you to normal 40-character screen mode.

### Duplicating Lines

One strength of Apple editing is the ability to duplicate lines. Let's try an example:

```
HOME: POKE33,30:LIST10<RET>  
10 PRINT"THIS IS A LINE TO BE  
DUPLICATED"
```

Next move the cursor up to the line using the normal <ESC>I. When the cursor arrives over the number, move it left until it is over the first digit of the number. Then press the space bar as before; but prior to using the right arrow, retype the line number, say, 20. Then use the right arrow to “retype” the line as described above until you reach the end of the logical line. At this point, press RETURN. If you LIST the program, you’ll see:

```
HOME:POKE33,30:LIST<RET>
10 PRINT“THIS IS A LINE TO BE
DUPLICATED”
20 PRINT“THIS IS A LINE TO BE
DUPLICATED”
```

Once you have moved your cursor up to the number and changed it, you do not have to reuse the entire line. You can treat it like any line to be edited further if necessary.

### Easy Program Merge

This technique can also be used on a limited scale to merge two programs. Let’s say you have a favorite subroutine of three or four lines which you wish to add to a program. You could use the merge function of the “Renumber” program on the *System Master*, or the program that is part of the *Programmer’s Toolkit*. If you don’t have these programs or you don’t have them handy, here is a simple procedure:

1. Save the program you are working on.
2. Load the program which contains the lines to be copied to your new program.
3. Clear the screen, change width, and list lines (using HOME:POKE33,30:LIST statements).
4. Now, load the program the lines are to be added to.
5. Using the normal <ESC> and right-arrow commands, edit each line without changes. It’s best to edit the last line first and work up the screen, entering each line one at a time. This is because when multiple lines are listed and edited, once <RET> is pressed, the line number below it is partially destroyed and has to be retyped by hand. There’s

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nothing wrong with changing the line numbers to fit your new program if the current line numbers are a problem.

6. Once all lines are edited, save the program. If you list it, you'll find the lines are now part of your program.

Finally, if you want to cancel a particular change, as long as you have not pressed <RET> yet, cancel the editing of the line by typing <CTRL> X. Be sure that you press the <CTRL> key first, then X. The machine will answer with a backward slash. If you list the line, it will be unchanged.

# Apple Fast Sort

---

John Sarver

*Using this program, you will be able to alphabetize a list in near-record time.*

Until now, it may have taken you a long time to alphabetize a list of names or programs. In fact, in a recent test using a BASIC bubble sort routine, it took my Apple eight hours and 57 minutes to sort 1000 randomly created strings. But with this subroutine you'll be able to put both one- and two-dimensional Apple arrays in alphabetical order in only one minute and 45 seconds.

String values, when assigned, are stored at the very top of Apple's free RAM. As more strings are assigned, they are stored below the strings already in memory. A table, created when you use the DIM statement, keeps track of where each string is in RAM.

Some important information is stored at the beginning of this table. The first byte represents the first character in the variable name. The second byte represents the second character in the variable name plus \$80 (adding \$80 designates it as a string array rather than an integer or decimal point number array). The next pair of bytes gives the length of this pointer table.

The fifth byte is the number of dimensions that you have used with the DIM statement. If you used a two-dimensional array, the next two bytes tell how many variables are in the second part of the dimension. If it's a three-dimensional array, it uses the next four bytes, and so on.

The final two bytes indicate the number of strings in the first dimension. The table begins there, and each variable is located by a three-byte pointer. The first byte is the length of the record, and the next two point to where the first character of the variable is stored. Those pointers are always in order from the zero dimension to the  $n$ th dimension.

At the end of this grouping of pointers are the pointers for the first group of the second dimensioned part of the array. Following this is the second group of pointers for the second dimensioned part of the array, and so on. If you used a one-dimensional array, there would be only one group of pointers.

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As you can see, there is no need to sort the strings themselves. It's much quicker just to sort the pointers. Pointer sorting wastes no time in garbage collection—and, in most cases, the length of the strings does not affect the time of execution.

### Simple to Use

Using this sort is quite simple. Apple stores the last variable used in \$81 and \$82, so you may need to insert a statement in your BASIC program such as A\$(0)=A\$(0) (see line 90 of Program 2). You can also POKE these values in if you are putting this utility on another machine.

The sort can be easily changed to use the zero dimension of an array if you wish. To do this, simply change the following lines in the BASIC loader (Program 1):

```
120 IF CK <> 56854 THEN PRINT "CHECK DATA
STATEMENTS FOR ERROR":STOP
200 DATA 169,0,133,253,133,239,169,1
400 DATA 165,6,105,2,133,6,169,0
```

If you are using a two-dimensional array, you will need to store the records that are to be put in order by using the zero subscript of the second dimension (that is, A\$(1,0), A\$(2,0), etc.). The accompanying arrays (A\$(1,1), A\$(2,1), A\$(1,2), A\$(2,2), etc.) will be kept with their respective zero-subscripted record.

The sort will automatically ascertain if you are using a one- or two-dimensional array and will adjust itself accordingly. You may use any number of subscripts desired in one-dimensional arrays and in the first part of the two-dimensional array. Some of the corresponding subarrays would not be properly aligned.

Program 1, the ML fast sort loader, loads the machine language sorting routine into RAM. You should save this on disk by typing:

```
BSAVE SORT, A$944A, L$1B6
```

Program 2 illustrates how you might use the routine.

### Program 1. ML Fast Sort Loader

```
100 REM THIS PROGRAM INSTALLS BUT DOES NOT RUN T
HE ML FAST SORT
110 FOR I = 37962 TO 38399: READ A:CK = CK + A: POKE
I, A: NEXT
```

```
120 IF CK < > 56857 THEN PRINT "CHECK DATA STAT
EMENTS FOR ERROR": STOP
130 TEXT : HOME : PRINT "TYPE 'BSAVE SORT,A#944A,
L#1B6'"
140 PRINT "TO SAVE SORT ROUTINE ON DISK"
150 NEW
200 DATA 169,0,133,253,169,1,133,239
210 DATA 133,31,166,107,134,6,166,108
220 DATA 134,7,165,129,160,0,209,6
230 DATA 208,3,32,126,148,200,208,246
240 DATA 232,134,7,228,112,208,239,209
250 DATA 6,208,3,32,126,148,200,196
260 DATA 111,208,244,96,165,130,200,208
270 DATA 2,230,7,209,6,240,10,192
280 DATA 0,208,2,198,7,136,165,129
290 DATA 96,192,0,208,2,198,7,136
300 DATA 24,152,101,7,133,7,169,0
310 DATA 101,7,133,7,104,104,56,160
320 DATA 4,177,6,233,1,240,8,200
330 DATA 200,177,6,133,31,169,2,24
340 DATA 101,6,105,5,133,6,169,0
350 DATA 101,7,133,7,160,0,177,6
360 DATA 133,249,133,251,133,26,200,177
370 DATA 6,133,250,133,25,162,2,24
380 DATA 165,250,101,25,133,25,165,251
390 DATA 101,26,133,26,202,208,240,24
400 DATA 165,6,105,5,133,6,169,0
410 DATA 101,7,133,7,56,165,250,229
420 DATA 239,133,250,133,252,176,10,165
430 DATA 239,240,6,198,249,165,249,133
440 DATA 251,165,6,133,237,165,7,133
450 DATA 238,169,0,198,250,197,250,208
460 DATA 42,197,249,240,5,198,249,24
470 DATA 144,33,197,253,240,18,133,253
480 DATA 198,252,165,251,133,249,165,252
490 DATA 133,250,208,213,165,251,208,1
500 DATA 96,56,233,1,133,249,133,251
510 DATA 24,144,198,24,165,237,133,235
520 DATA 105,3,133,237,165,238,133,236
530 DATA 105,0,133,238,160,0,132,254
540 DATA 177,235,208,6,177,237,240,177
550 DATA 208,54,209,237,240,8,144,6
560 DATA 177,237,240,165,133,254,133,255
570 DATA 162,0,200,177,235,149,0,177
580 DATA 237,149,2,232,192,2,208,242
590 DATA 160,0,177,0,209,2,240,4
600 DATA 144,135,176,12,200,196,255,208
610 DATA 241,165,254,208,3,76,19,149
620 DATA 169,1,133,253,160,0,177,235
630 DATA 72,177,237,145,235,104,145,237
```

```
640 DATA 200,192,3,208,241,166,31,202
650 DATA 240,45,24,165,235,101,25,133
660 DATA 27,165,236,101,26,133,28,165
670 DATA 237,101,25,133,29,165,238,101
680 DATA 26,133,30,160,0,177,27,72
690 DATA 177,29,145,27,104,145,29,200
700 DATA 192,3,208,241,202,208,3,76
710 DATA 19,149,24,165,27,101,25,133
720 DATA 27,165,28,101,26,133,28,165
730 DATA 29,101,25,133,29,165,30,101
740 DATA 26,133,30,24,144,205,141,183
```

### Program 2. Using Fast Sort

```
10 HIMEM: 37962
20 D$ = CHR$(4)
30 PRINT D$"BLOOD SORT"
40 INPUT "HOW MANY RECORDS";N
45 DIM A$(N)
50 FOR A = 1 TO N
60 PRINT "WHAT IS RECORD #";A;
70 INPUT " ";A$(A)
80 NEXT
90 A$(0) = A$(0)
100 CALL 37962
110 FOR A = 1 TO N
120 PRINT A$(A)
130 NEXT
140 END
```

# Custom Headers

---

G. J. Vullings

*This program lets you create customized directory headers, with inverse or normal input. For Apples with DOS 3.2.1 or 3.3.*

Have you ever wished to identify the theme of a series of programs on a disk or improve the appearance of the directory as it appears on the screen? "Custom Catalog" may be what you've been looking for. It will create seven bogus files at the top of the directory, and those files will provide a header for the disk's directory by displaying contents, ownership, DOS version, or whatever you wish.

The program is designed to run with DOS 3.2.1 or 3.3. It will permit either inverse or normal input and will allow toggling between the two input states. These features give you some element of artistic control over your disk directories.

## Choose Your Input Types

The program should be used only with newly initialized disks, since it will occupy the first seven entries in the directory. Thus, if the program is used with established disks, the first seven programs will become inaccessible. To implement Custom Catalog, initialize a disk the normal way and then delete the HELLO program. Run Custom Catalog and, when prompted, insert the disk to be customized.

You have an initial choice of input states (normal or inverse) and can then design seven lines of 23 characters each (using all but control characters) to represent your identifying remarks or messages. The program sets aside a buffer of 256 bytes, using the input/output block at decimal location 896. There it stores the last sector of the directory track (track 17, sector 12 or track 17, sector 15, depending on the DOS version being used).

Each directory entry occupies 35 bytes. The first two represent the track and sector of the track/sector list (header). They are directed to an empty sector, generally track 17, sector 1. The third byte represents the file type. Here we will use 00 to indicate an unlocked text file.

The next 30 bytes represent the filename. We will make the first seven bytes backspaces to eliminate the "t" (for text)





ferred to change the DISK VOLUME message to any 11 (or fewer) characters of your choice.

There are many ways in which you can use this program. You can create additional custom features, for example, or you might want to create flashing entries, which you can get by translating to the required ASCII values.

### How It Works

Line(s)	
30-220	The input routine, which allows input in two modes as well as forwardspace and backspace editing.
250-260	Translate keyboard ASCII into screen ASCII and store into disk buffer.
280-290	Toggle input status.
310-330	Backspace edit routine.
350-390	Forwardspace edit routine. Translate screen ASCII to keyboard ASCII.
410-450	Point each of the bogus header files to empty track 17, sector 1; declare each file to be of type "text-unlocked" of length zero; and set the end marker.
470	Inputs a series of seven backspaces into the filenames so that the lock indicator, file type, and sector count do not appear on screen.
480	Checks the memory size of your Apple and sets up a disk buffer, making the program virtually memory-size independent.
500-570	Organize screen display.
590-620	Set HIMEM: to protect the buffer and initialize the variables.
640-670	Use track 17, sector 0, to find the directory, thus making it possible to use the program with either DOS 3.2.1 or 3.3, or even with disks having directories on tracks other than track 17.
680-800	Main routine.
820-840	Write the catalog header to the disk.
860-920	Change DISK VOLUME message.
940-990	Finishing touches.
1020-1040	Set up the input/output block for the READ/WRITE track sector routine.

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### Custom Catalog

```
5 TEXT : HOME : ONERR GOTO 1000
10 GOTO 480
20 REM

***.INPUT ROUTINE.***

30 FOR I = 0 TO 6
40 VTAB VTB + I: HTAB HTB
50 CN = 1
60 INVERSE
70 IF NOT INV THEN NORMAL
80 GET CH$: IF CH$ < > CHR$ (13) THEN 110
90 IF CN > 23 THEN 200
100 FOR Z = CN TO 23:CH$ = " ": PRINT CH$;: GOSUB
    250:CN = CN + 1: NEXT : GOTO 200
110 IF CH$ = CHR$ (27) THEN GOSUB 270: GOTO 60
120 IF CH$ = CHR$ (8) THEN GOSUB 300: GOTO 60
130 IF CN > 23 THEN 200
140 IF CH$ = CHR$ (21) THEN GOSUB 340: GOTO 160

150 IF ASC (CH$) < 32 THEN 60
160 PRINT CH$:
170 GOSUB 250
180 CN = CN + 1
190 GOTO 60
200 GOSUB 460
210 GOSUB 400
220 NEXT
230 RETURN
240 REM

***.SCRN ASC INTO BUFFER.***

250 IF ASC (CH$) > = 32 AND ASC (CH$) < 64 THEN
    POKE BFR + I * 35 + 10 + CN, ASC (CH$) + ( NOT
    INV > 0) * 128: RETURN
260 POKE BFR + I * 35 + 10 + CN, ASC (CH$) - (INV
    > 0) * 64 + ( NOT INV > 0) * 128: RETURN
270 REM

***.CHANGE INPUT STATE.***

280 IF INV THEN INV = 0: RETURN
290 INV = 1: RETURN
300 REM

***.BACKSPACE ROUTINE.***
```

```

310 CN = CN - 1: IF CN = 0 THEN POP : GOTO 50
320 PRINT CH$:
330 RETURN
340 REM

***.FORWARDSPACE ROUTINE.***

350 ASKII = PEEK ( PEEK (40) + 256 * PEEK (41) +
      PEEK (36))
360 IF ASKII < 32 THEN CH$ = CHR$ (ASKII + 64): RETURN
370 IF ASKII < 64 THEN CH$ = CHR$ (ASKII): RETURN

390 CH$ = CHR$ (ASKII - 128): RETURN
400 REM

***.PLACE COMMON POINTERS.***

410 POKE BFR + I * 35 + 1,TRK
420 POKE BFR + I * 35 + 2,1
430 POKE BFR + I * 35 + 3,0
440 POKE BFR + I * 35 + 34,0
450 POKE BFR + I * 35 + 35,0: RETURN
460 REM

***.PUT BKSPACES IN DIRECTORY.***

470 FOR M = 4 TO 10: POKE BFR + I * 35 + M,136: NEXT
      : RETURN
475 REM

***.SET DISK BUFFER.***

480 BL = PEEK (115):BH = PEEK (116) - 1:BUFR = B
      L + BH * 256
490 REM

***.INITIALIZE SCREEN.***

500 TEXT : HOME : VTAB 2: INVERSE : FOR I = 1 TO
      40: PRINT "=";: NEXT
510 PRINT "=          APPLE II CATALOG CUSTOMIZER
      ="
520 PRINT "=";
530 FOR I = 1 TO 38: PRINT " ";: NEXT
540 PRINT "=";
550 PRINT "=          " : NORMAL : PRINT "BY G.
      J. VULLINGS";: INVERSE : PRINT "          ="
560 FOR I = 1 TO 40: PRINT "=";: NEXT : NORMAL

```

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```
570 POKE 34,6
580 REM
```

```
***.INITIALIZE VARIABLES.***
```

```
590 HIMEM: BUFR:IOB = 904:ITRK = IOB + 4:ISECT =
    IOB + 5:IBUFP = IOB + 8:ICMD = IOB + 12:ST =
    IOB + 13:RWTS = 896:D$ = CHR$(13) + CHR$(
    4):RD = 1:WRT = 2:BFR = BUFR + 10
600 GOSUB 1020: POKE IBUFP,BL: POKE IBUFP + 1,BH
610 HOME : VTAB 20: PRINT "INSERT DISK TO BE CUSTOMIZED"
620 VTAB 22: PRINT "THEN PRESS ";; INVERSE : PRINT
    " RETURN ";; NORMAL : GET Z$: PRINT Z$
630 REM
```

```
***.READ CATALOG INTO BUFFER.***
```

```
640 TRK = 17:SECTR = 0
650 POKE ITRK,TRK: POKE ISECT,SECTR: POKE ICMD,RD
    : CALL RWTS
660 TRK = PEEK (BUFR + 1):SECTR = PEEK (BUFR + 2
    )
670 POKE ITRK,TRK: POKE ISECT,SECTR: CALL RWTS
675 REM
```

```
***.MAIN ROUTINE.***
```

```
680 HOME : VTAB 20: PRINT "(I)NVERSE OR (N)ORMAL
    ";; GET A$: PRINT A$:VTB = 12:HTB = 8
690 INV = 0
700 IF A$ = "I" THEN INV = 1
710 Z1$ = "000000000011111111112222"
720 Z2$ = "12345678901234567890123"
730 VTAB 10: HTAB HTB: PRINT Z1$: HTAB HTB: PRINT
    Z2$
740 TB = 12: FOR Z = 0 TO 6
750 VTAB TB + Z: HTAB 7: PRINT "+";: IF INV THEN
    INVERSE
760 FOR J = 1 TO 23: PRINT " ";; NEXT : NORMAL : PRINT
    "+"
770 NEXT
780 VTAB 20: CALL - 958: HTAB 5: PRINT "INPUT LI
    NES OF CUSTOM CATALOG"
790 VTAB 22: PRINT " PRESS ";; INVERSE : PRINT "
    ESC ";; NORMAL : PRINT " TO CHANGE DISPLAY ST
    ATUS"
800 GOSUB 30: NORMAL
810 REM
```

```

***.WRITE SECTOR TO DISK.***

820 PRINT : VTAB 20: CALL - 958: PRINT "IS THIS
    WHAT YOU WANT? (Y/N) ";; GET ZZ$: PRINT ZZ$
830 IF ZZ$ = "N" THEN 680
840 POKE ICMD,WR: CALL RWTS
850 REM

***.CHANGE DISK VOLUME.***

860 PRINT : PRINT "IS ";; INVERSE : PRINT " DISK
    VOLUME ";;: NORMAL : PRINT " TO BE REPLACED?
    (Y/N) ";; GET Z$: PRINT Z$
870 IF Z$ < > "Y" THEN 930
880 TRK = 2:SECTR = 2: POKE ITRK,TRK: POKE ISECT,S
    ECTR: POKE ICMD,RD: CALL RWTS
890 INPUT "INPUT 11 CHARACTER HEADER: ";MS$:LN =
    LEN (MS$): IF LN > = 11 THEN MS$ = LEFT$ (
    MS$,11): GOTO 910
900 FOR I = LN + 1 TO 11:MS$ = MS$ + " ": NEXT
910 J = 0: FOR I = BUFR + 176 TO BUFR + 186: POKE
    I, ASC ( MID$ (MS$,11 - J,1)) + 128:J = J + 1
    : NEXT
920 POKE ICMD,WR: CALL RWTS
930 REM

***.DISPLAY CATALOG AND FINISH.***

940 HOME : PRINT D$"CATALOGD1"
950 PRINT : PRINT "MORE CUSTOMIZING? (Y/N) ";; GET
    ZZ$: PRINT ZZ$
960 IF ZZ$ = "Y" THEN 610
970 TEXT : HOME : VTAB 10: HTAB 11: FLASH : PRINT
    " SEE YA' LATER!! ": NORMAL
980 VTAB 23: END
990 RETURN
1000 HOME : PRINT "***.ERROR.***": END
1010 REM

***.SET-UP IOB.***

1020 FOR I = 1 TO 25: READ I%: POKE 896 + I - 1,I
    %: NEXT I: RETURN
1030 DATA 160,136,169,3,32,181,183,96,1,96,1,0,1
    7,15,251,183,0,128,0,0
1040 DATA 2,2,254,96,1,59,236,236,59,59,236,236,
    59,27,236,28,29,30,236,236

```

# Apple Input and Menu Screens

---

Dan Jordan

*The formatting routines described here will let you personalize your programs, and also make them easier to use.*

Menus and formatted screens are two excellent tools that you can use to make programs more user-friendly. The programs given here are simple illustrations of how these techniques can be applied.

The "Menu Screen Routine" (Program 1) generates a menu and uses a selection bar to help the user choose program functions. To create the illusion of bar movement, lines 370-390 blot out the existing bar and lines 310-340 place a new bar on the next line.

The "Input Screen Routine" (Program 2) prints a form on the screen and indicates, by the length of the inverse blank field, the amount of data to be entered. A subroutine can be added to check for field length, if desired. The correction routine (lines 500-570) lets you correct a data section without affecting any other part of the program.

PRINT CHR\$(7) rings a bell, prompting the user to answer a question printed on the screen. Using GET rather than INPUT saves keystrokes when answering these screen prompts (the RETURN key need not be hit to enter data that is input with a GET).

## Program 1. Menu Screen Routine

```
190 HOME
200 PRINT "***** MENU *****"
210 PRINT "1-STEP NUMBER 1"
220 PRINT "2-STEP NUMBER 2"
230 PRINT "3-STEP NUMBER 3"
240 PRINT "4-STEP NUMBER 4"
250 PRINT "5-STEP NUMBER 5"
260 PRINT "6-STEP NUMBER 6"
270 PRINT : PRINT
280 PRINT "HIT (RETURN) TO SELECT --OR--"
290 PRINT "HIT ANY OTHER KEY TO CHANGE SELECTION"
300 I = 2
310 VTAB I
```

\*\*\*.WRITE SECTOR TO DISK.\*\*\*

```
820 PRINT : VTAB 20: CALL - 958: PRINT "IS THIS
    WHAT YOU WANT? (Y/N) ";; GET ZZ$: PRINT ZZ$
830 IF ZZ$ = "N" THEN 680
840 POKE ICMD,WR: CALL RWTS
850 REM
```

\*\*\*.CHANGE DISK VOLUME.\*\*\*

```
860 PRINT : PRINT "IS ";; INVERSE : PRINT " DISK
    VOLUME ";;: NORMAL : PRINT " TO BE REPLACED?
    (Y/N) ";; GET Z$: PRINT Z$
870 IF Z$ < > "Y" THEN 930
880 TRK = 2:SECTR = 2: POKE ITRK,TRK: POKE ISECT,S
    ECTR: POKE ICMD,RD: CALL RWTS
890 INPUT "INPUT 11 CHARACTER HEADER: ";MS$:LN =
    LEN (MS$): IF LN > = 11 THEN MS$ = LEFT$ (
    MS$,11): GOTO 910
900 FOR I = LN + 1 TO 11:MS$ = MS$ + " ": NEXT
910 J = 0: FOR I = BUFR + 176 TO BUFR + 186: POKE
    I, ASC ( MID$ (MS$,11 - J,1)) + 128:J = J + 1
    : NEXT
920 POKE ICMD,WR: CALL RWTS
930 REM
```

\*\*\*.DISPLAY CATALOG AND FINISH.\*\*\*

```
940 HOME : PRINT D$"CATALOGD1"
950 PRINT : PRINT "MORE CUSTOMIZING? (Y/N) ";; GET
    ZZ$: PRINT ZZ$
960 IF ZZ$ = "Y" THEN 610
970 TEXT : HOME : VTAB 10: HTAB 11: FLASH : PRINT
    " SEE YA' LATER!! ": NORMAL
980 VTAB 23: END
990 RETURN
1000 HOME : PRINT "***.ERROR.***": END
1010 REM
```

\*\*\*.SET-UP IOB.\*\*\*

```
1020 FOR I = 1 TO 25: READ I%: POKE 896 + I - 1,I
    %: NEXT I: RETURN
1030 DATA 160,136,169,3,32,181,183,96,1,96,1,0,1
    7,15,251,183,0,128,0,0
1040 DATA 2,2,254,96,1,59,236,236,59,59,236,236,
    59,27,236,28,29,30,236,236
```



# Apple Input and Menu Screens

---

Dan Jordan

*The formatting routines described here will let you personalize your programs, and also make them easier to use.*

Menus and formatted screens are two excellent tools that you can use to make programs more user-friendly. The programs given here are simple illustrations of how these techniques can be applied.

The "Menu Screen Routine" (Program 1) generates a menu and uses a selection bar to help the user choose program functions. To create the illusion of bar movement, lines 370-390 blot out the existing bar and lines 310-340 place a new bar on the next line.

The "Input Screen Routine" (Program 2) prints a form on the screen and indicates, by the length of the inverse blank field, the amount of data to be entered. A subroutine can be added to check for field length, if desired. The correction routine (lines 500-570) lets you correct a data section without affecting any other part of the program.

PRINT CHR\$(7) rings a bell, prompting the user to answer a question printed on the screen. Using GET rather than INPUT saves keystrokes when answering these screen prompts (the RETURN key need not be hit to enter data that is input with a GET).

## Program 1. Menu Screen Routine

```
190 HOME
200 PRINT "***** MENU *****"
210 PRINT "1-STEP NUMBER 1"
220 PRINT "2-STEP NUMBER 2"
230 PRINT "3-STEP NUMBER 3"
240 PRINT "4-STEP NUMBER 4"
250 PRINT "5-STEP NUMBER 5"
260 PRINT "6-STEP NUMBER 6"
270 PRINT : PRINT
280 PRINT "HIT (RETURN) TO SELECT --OR--"
290 PRINT "HIT ANY OTHER KEY TO CHANGE SELECTION"
300 I = 2
310 VTAB I
```

```
315 HTAB 17
320 INVERSE
330 PRINT " ";
340 NORMAL
350 GET X$
360 IF X$ = CHR$(13) THEN Y = I - 1: GOTO 490
370 VTAB I
380 HTAB 17
390 PRINT " "
400 I = I + 1
410 IF I > = 8 THEN I = 2
420 GOTO 310
490 VTAB 14
500 ON Y GOTO 1000,2000,3000,4000,5000,6000
1000 REM STEP NO.1 PROCEDURES
1010 PRINT "STEP NO. 1"
1020 GOTO 7000
2000 REM STEP NO.2 PROCEDURES
2010 PRINT "STEP NO. 2"
2020 GOTO 7000
3000 REM STEP NO.3 PROCEDURES
3010 PRINT "STEP NO. 3"
3020 GOTO 7000
4000 REM STEP NO.4 PROCEDURES
4010 PRINT "STEP NO. 4"
4020 GOTO 7000
5000 REM STEP NO.4 PROCEDURES
5010 PRINT "STEP NO. 5"
5020 GOTO 7000
6000 REM STEP NO.6 PROCEDURES
6010 PRINT "STEP NO. 6"
6020 GOTO 7000
7000 END
```

## Program 2. Input Screen Routine

```
180 CLEAR
190 DIM A$(5,100)
200 HOME
210 PRINT "*****NAME & ADDRESS INPUT *****"
220 PRINT "1-NAME-----"
230 PRINT "2-ADDRESS LINE 1"
240 PRINT "3-ADDRESS LINE 2"
250 PRINT "4-CITY STATE ZIP"
260 PRINT "5-TELEPHONE NO.-"
270 FOR I = 2 TO 6
280 VTAB I
290 HTAB 17
300 INVERSE
```

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```
310 PRINT "                                "; REM 20 SPACES
320 NORMAL
330 NEXT I
335 X = 1
340 FOR I = 2 TO 6
345 VTAB I: HTAB 17
350 INPUT A$(I - 1,X)
360 NEXT I
370 PRINT : PRINT CHR$(7)
380 PRINT "DO YOU WISH TO MAKE A CORRECTION (Y OR
      N)?"
390 GET X$
400 IF X$ = "Y" THEN GOTO 500
410 IF X$ = "N" THEN GOTO 450
420 VTAB 7: GOTO 370
450 PRINT CHR$(7);
460 PRINT "DO YOU HAVE ANY MORE TO ENTER (Y OR N)
      ?";
470 GET X$
480 IF X$ = "N" THEN GOTO 1000
485 IF X$ = "Y" THEN X = X + 1: GOTO 200
490 VTAB 8: GOTO 450
500 PRINT CHR$(7);
510 PRINT "ENTER LINE NUMBER YOU WISH TO CORRECT"
      ;
520 GET Y
530 Y = Y + 1
540 VTAB Y
550 HTAB 17
560 INPUT A$(Y - 1,X)
570 VTAB 7
580 GOTO 370
1000 REM PRINT OR SAVE TO DISK
1010 END
```

# Using Commas, Colons, and Quote Marks in Apple INPUT Statements

---

Craig Peterson

*Want to make Applesoft INPUT more versatile? Try adding the "Comma Input Routine" to your programs. It also works with disk input.*

Have you ever wanted to input commas, colons, or quotation marks as part of an INPUT statement but found that your Apple kept coming back with EXTRA IGNORED?

You might have tried using GET statements, as described in Apple's *Contact 4*, but all that B\$=B\$+A\$ stuff meant that you frequently had to endure string garbage cleanup delays. *Contact 6* offered an alternative solution, totally avoiding garbage collection, but it presented a subtle problem you might not have been aware of. The input routine used to fill the input buffer made no allowance for the high bit of each character in the input line. The routine used to fill the input buffer left the high bit set, just as it came from the keyboard, but Applesoft wanted the high bit to be zero for its string characters. The line will print correctly and will appear on the screen just like what you typed in. But you'll never get a match if you use a line like IF IN\$ = "Q". In addition, if you try to VAL (IN\$), when IN\$ was input as "1234", you'll get a value of 0.

The solution to this dilemma is to use the program listed below. The subroutine shown in lines 1000 to 1020 (for Applesoft ROM BASIC) will gather any input (including commas, colons, and quote marks) and place it into the variable IN\$. The only exempt characters are those used in the standard keyboard escape sequences.

Location 54572 is the Applesoft equivalent of the monitor's keyboard input routine, except that it strips the high bit from all of the input characters. So line 1000 fills the input buffer with normal Applesoft string characters gathered from the keyboard. Line 1010 finds the length of the string, and line 1020 finds the IN\$ variable and sets its pointers to the

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keyboard buffer. Then IN\$ is relocated into RAM, away from the keyboard buffer.

It's not necessary for IN\$ to be the first variable. Lines 1000-1020 can be placed anywhere in your program. The pointers for IN\$ are found through locations 131 and 132, which hold the address of the pointers for the last-used variable. It's fast, it totally avoids string garbage build-up, and it's done in BASIC.

One additional note: Not only does this routine work well for keyboard input, but it also performs the same feat for disk input—a feature that can be particularly handy. Commas or other previously forbidden characters in the middle of a name file cause no difficulty when read from the disk. Please note, however, that this routine limits the size of an input string to 239 characters, just like the Applesoft INPUT statement does.

### Comma Input Routine

```
10 HOME : VTAB 4: PRINT "INPUT ANYTHING THAT YOU  
WANT..": PRINT : GOSUB 1000: PRINT : PRINT "V  
OILA..": PRINT : PRINT IN$: END  
20 :  
30 REM LINES 1000 TO 1020 ARE A SUBROUTINE THAT  
PUTS ANY INPUT INTO IN$  
40 :  
1000 CALL 54572  
1010 FOR B = 512 TO 751: IF PEEK (B) < > 0 THEN  
NEXT  
1020 IN$ = "": POKE PEEK (131) + 256 * PEEK (132  
) + 1,0: POKE PEEK (131) + 256 * PEEK (132 +  
2,2: POKE PEEK (131) + 256 * PEEK (132),B -  
512:IN$ = MID$ (IN$,1): RETURN
```

# Undeletable Lines

---

Michael P. Antonovich

*Have you ever wanted to create “permanent” program lines (for instance, to put your name into a program in such a way that another computer user could not delete it and claim the program as his own)? With this program, you’ll be able to do just that.*

Ordinarily, Applesoft does not allow you to enter lines with numbers greater than 63999. But it can be done. This article shows you how—and the lines so entered are effectively undeletable.

The Apple stores program lines beginning at memory location \$800 (the \$ sign indicates that the number is in hexadecimal). Enter the following small program to illustrate the way a program is stored.

```
1 REM
2 A=8
3 PRINT A
4 END
```

To see how the Apple stores this program, enter the monitor with a CALL-151. However, before listing the program, there is one other piece of information that you need to determine. To add lines to an existing program, you need to know where the current program ends in memory, and you can page through the memory to find the program’s last byte. But that’s the hard way. The Apple also stores the location of the last memory byte in locations \$69 and \$6A.

Filing that away temporarily, enter the monitor to check your program:

```
CALL-151
*69.6A
0069-1E 08
*800.81F
0800-00      07 08 01 00 B2 00 0F
0808-08      02 00 41 D0 38 00 16
0810-08      03 00 BA 41 00 1C 08
0818-04      00 80 00 00 00 FF FF
```

Although you may not recognize it, that’s a memory dump of your program.

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Now examine how your BASIC lines were translated to the above hex dump. The first byte, \$00 at location \$800, has no special meaning to our program. In fact, location \$800 will always contain \$00. The program lines begin after that point. Each line is prefixed by four bytes, and the first pair of bytes stores the starting byte address of the next line. In this example, locations \$801 and \$802 indicate that the next line will begin at memory location \$807. Remember that the location is split into two bytes; note too that they are stored in what seems (to us humans) to be reversed order.

The second pair of bytes contains the line number assigned to the program line. In this example we started with the line number 1. Thus memory locations \$803 and \$804 indicate that the first line number is 1. In addition to the four bytes which prefix each line, each line is ended with single byte 00 to separate it from the next line. Therefore, there is a five-byte overhead for each program line used. If multiple statements are combined with a colon (using one byte) on a single line, you can save four bytes for each extra line you eliminate. If you have any doubts, try it yourself with the above program.

The second program line begins at memory address \$807. The first four bytes indicate that the next statement will begin at location \$80F and will have statement number 2. The next three bytes (41 D0 38) represent the tokens for the equality ( $A=8$ ).

The information you need to understand these tokens is found in Appendix F and Appendix K of the *Applesoft Reference Manual*. Appendix F lists the decimal tokens for all of the keywords used by the Apple. However, when in the monitor, you need the hexadecimal equivalent of the tokens. For example, the hex equivalent for END is \$80, for REM is \$B2, and for PRINT is \$BA. You might want to take the time now to write the hexadecimal equivalents next to the decimal values for all of the tokens.

Variable names, numbers, and strings are not listed in Appendix F. These must be constructed by using the individual ASCII character representations. In the manual, Appendix K gives the ASCII character set with equivalent decimal and hexadecimal codes. Again, you are interested in the hexadecimal codes. In this example, we need the A or \$41 and the 8 or \$38.

That leaves the equal sign (=). Both Appendix F and Appendix K give hex codes for the equal sign, but each gives a different code. Which one is correct? To construct a variable name, number, or string of characters, use Appendix K. Any symbol used in an arithmetic expression (such as =, (, ), etc.) should be taken from Appendix F.

Finally, even though the program ends with an END statement, the Apple does not know that it has reached the end of the program. Instead, it recognizes the end when it finds the byte pair 00 00 in the locations where it expects to find the next line number.

Now that you know how the Apple interprets the program and stores it in memory, you are ready to add those "undeletable" lines. Normally, Applesoft only recognizes line numbers in the range 0–63999. Converting 63999 to hexadecimal, you get \$F9FF—but you *can* write larger hexadecimal numbers than that in two bytes. In fact, you should be able to use numbers from \$FA00 through \$FFFF (that is, from 64000 through 65536). Even though the Apple won't let you enter such line numbers via the keyboard, you now know enough about how the Apple stores program lines to sneak them in.

Let's keep this example simple. Assume that you want to store your name and the date as REM statements; you could just as easily make them PRINT statements. In any case, these are the statements you want:

```
64000 REM MICHAEL P. ANTONOVICH
64001 REM JUNE 28, 1984
```

Now enter the monitor (CALL-151) and type the following:

```
81C:37 08 00 FA
820:B2 4D 49 43 48 41 45 4C
828:20 50 2E 20 41 4E 54 4F
830:4E 4F 56 49 43 48 00 4A
838:08 01 FA B2 4A 55 4E 45
840:20 33 30 2C 20 31 39 38
848:31 00 00 00
```

Before you return to Applesoft, you must reset the end-of-program pointer. If you don't, then any variables you store will write over the new lines you just added the first time you run your program.



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This example now ends at memory location \$84C, and that information must be put into locations \$69 and \$6A:

```
69:4C 08
```

Now, reenter Applesoft (using CTRL-C RETURN) and list the program. There are lines 64000 and 64001 at the end. Try to delete them. You can't! You can save this program, reload it, run it, and copy it, and still those two lines will be there. In fact the only way to get rid of them is to enter the monitor, find where you want the program to end, change the last two bytes to 00 00, and change the program ending location in addresses \$69 and \$6A. It's easy, but only if you know how.

REM statements are not the only things that you can put into undeletable lines. You can store anything you want, from program lines using tokens and character strings to machine language programs.

### Invisible and Unlistable

Using your monitor to manipulate BASIC, you can also keep lines from listing at all. To make this program print the 8, but to prevent line 3 from appearing in the program listing, simply change one hexadecimal number to 16:

```
0800 00 07 08 01 00 B2 00 16
```

In each case, note that the tokens we have been using are *not* machine language. All microcomputers use tokens to store keywords. All BASIC program lines are stored in the above manner, not in machine language, and the program lines must be interpreted each and every time that they are run.

# ML Tracer

---

Thomas G. Gordon  
Apple Version by Tim Victor

*Attempting to debug a machine language program can sometimes be a trying experience, especially when the program always seems to exit into the twilight zone. And trying to study a program in ROM can be just as frustrating, even with a disassembler (where do branch instructions go?). Here's an excellent programming utility that helps solve this problem.*

Anyone who has ever worked with machine language knows how helpful it can be to be able to single-step through a program. "ML Tracer" allows you to step through a machine language routine one event at a time and print out the contents of all of the microprocessor registers after each instruction. It also allows you to follow all branches, jumps, and returns. The program will display the address, opcode, mnemonic, and operand of each instruction.

When Tracer is run, there will be a ten-second delay while the DATA statements are read. You'll then be asked for the hex address of the ML program you wish to examine. You can change the contents of any register, before each instruction is executed. Press A for the accumulator, X for the X register, Y for the Y register, S for the stack pointer, P for the processor status, or I for the instruction pointer (program counter). When you're through loading registers, press RETURN once more to execute the next instruction.

Hexadecimal numbers are used for all input and output. If you enter an address as a one-, two-, or three-digit hexadecimal number, zeros will be added on the left to make a four-digit number. If too many digits are entered, the rightmost four digits will be used. The same applies to changing the value in a register. The number that you enter will be converted to a two-digit hexadecimal number using the same rules.

## **The Execution Subroutine**

The program is written mostly in BASIC, but contains two machine language subroutines. The first, the initialization subroutine, copies the lowest three pages (768 bytes) of RAM,

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which are used by BASIC, to a location above the BASIC program. The other, the execution subroutine, exchanges the two three-page blocks of data and loads all the registers with their saved values, then executes one instruction (which has been POKEd in from BASIC). When the instruction has been executed, the registers are saved and BASIC's original lower three pages of memory are restored.

Lines 10000–10031 contain four-character extended mnemonics for the 6502's instruction set. The fourth character is a tag code identifying the addressing mode of the instruction. In lines 110–120, the mode is identified and the proper subroutine is called.

There are several instructions which cannot be allowed to actually execute in the machine language subroutine. If any control transfer instructions (JMP, JSR, RTS, RTI, or a conditional branch) were executed, control would not be returned properly to the BASIC program. These instructions are simulated in BASIC instead, so that they appear to execute successfully. The SEI and CLI instructions are ignored, since interrupts are always disabled during the execution subroutine.

### How Does It Work?

The simplest way to see how the program works is to trace through an example. Suppose the instruction LDA #20 resides at addresses \$03C0–\$03C1. For this instruction, the extended mnemonic is LDAB, where LDA stands for Load Accumulator, and B is the tag code for immediate addressing. The hexadecimal representation for LDA immediate is \$A9, which is equivalent to decimal 169.

Line 50, the top of the main loop, calls the keyboard pause routine at line 7000, which also handles changing registers. In line 55, the variable C is loaded with 169 by PEEKing the memory addressed by B, the instruction pointer. The value of B, 960 in this example, is then converted to hexadecimal characters in line 2000 and PRINTed.

In line 60, NOP instructions are POKEd into the execution routine to take up space after one- or two-byte instructions. The hexadecimal value of the opcode is printed next, and then the mnemonic is retrieved from the array R\$( ). If the mnemonic is a blank, this instruction is undefined and an error message is displayed. Otherwise, the standard (three-

character) mnemonic is PRINTed, the opcode is POKEd into the execution routine at OP, and the program counter is incremented to 961.

The ASCII code for B is 66, so the ON GOSUB in line 120 transfers control to line 400. Here, the symbol for the addressing mode, #\$, is printed. The one-byte operand routine, at line 3000, PEEKs location 961, pointed to by the program counter. This number is POKEd into OP+1, then converted to hexadecimal and PRINTed. After incrementing the program counter to point to the start of the next instruction, a RETURN is executed at line 3000.

At line 5000, the execution routine is CALLED. The contents of the registers are displayed, and control passes back to line 120. Here, a GOTO 50 takes us back to the top of the loop, where the instruction at \$3C2 will be executed.

### Tracing Is Educational Too

You will find that this program is most useful for testing small ML programs, such as those called as subroutines from BASIC. It's also good for examining sections of larger programs when you're not sure how a particular routine works. If you're learning machine language, you'll find that the register display is an enormous help in understanding the effects and side effects of each instruction, especially the bits (flags) of the processor status register.

Do be careful, though. Any program is vulnerable when dealing with something as powerful as machine language, and this one is no exception. There are more ways to kill a BASIC program from ML than anyone can name in one sitting, so always be conscientious about saving your programs. After you type this one in, save it before you even think about running it. One typographical error could cause the program to erase itself, or at least lock up the computer.

There are also some ML programs that this tracer can't follow, such as those which disconnect the keyboard or video display (whether intentionally or accidentally). If everything is saved on disk or tape (for real security, take the diskette or cassette out of the drive), you can experiment as much as you want, and then if disaster struck all you'd have to do is just turn the computer off and reload the program.

## 4: Programming

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### ML Tracer

```
10 GOSUB 6000
35 POKE A,0: POKE X,0: POKE Y,0: POKE P,52: POKE
   S,255
40 PRINT "START ADDRESS (HEX)";: INPUT H$
42 IF H$ = "" THEN H$ = "C000"
45 H$ = RIGHT$(H$,4): GOSUB 1500:B = D: PRINT "A
   NY KEY TO STEP"
50 GOSUB 7000:D = FRE (0)
55 PRINT :C = PEEK (B):D = B: GOSUB 2000: PRINT
   H$ " ";
60 POKE OP + 1,234: POKE OP + 2,234
70 D = C: GOSUB 2000: PRINT RIGHT$(H$,2) " ";
80 IF R$(C) = "" THEN PRINT "INVALID OPCODE": PRINT
   : GOTO 35
90 R$ = LEFT$(R$(C),3): PRINT R$ " ";: POKE OP,C:
   B = B + 1
100 IF R$ = "BRK" THEN PRINT : GOTO 35
110 U$ = RIGHT$(R$(C),1): IF U$ = " " THEN GOSUB
   200: GOTO 50
120 ON ASC (U$) - 64 GOSUB 300,400,500,600,700,8
   00,900,1000,1100,1200,1300: GOTO 50
199 REM >IMPLIED MODE<
200 IF R$ = "RTS" THEN GOSUB 4000:B = D: GOSUB 4
   000:B = D * 256 + B + 1: GOSUB 5005: RETURN
203 IF R$ < > "RTI" THEN 208
205 GOSUB 4000: POKE P,D: GOSUB 4000:B = D: GOSUB
   4000:B = D * 256 + B: GOSUB 5005: RETURN
208 IF R$ = "SEI" OR R$ = "CLI" THEN GOSUB 5005:
   RETURN
210 GOSUB 5000: RETURN
299 REM >ABSOLUTE MODE<
300 PRINT "$";: GOSUB 2500
310 IF R$ = "JMP" THEN B = PEEK (OP + 1) + PEEK
   (OP + 2) * 256: GOSUB 5005: RETURN
320 IF R$ < > "JSR" THEN 340
330 B = B - 1:D = INT (B / 256): GOSUB 3500:D = B
   - INT (B / 256) * 256: GOSUB 3500
335 B = PEEK (OP + 1) + PEEK (OP + 2) * 256: GOSUB
   5005: RETURN
340 GOSUB 5000: RETURN
399 REM >IMMEDIATE MODE<
400 PRINT "$$";: GOSUB 3000: GOSUB 5000: RETURN
499 REM >ZERO PAGE MODE<
500 PRINT "$";: GOSUB 3000: GOSUB 5000: RETURN
599 REM >ABSOLUTE,X<
600 PRINT "$";: GOSUB 2500: PRINT ",X";: GOSUB 50
   00: RETURN
699 REM >ABSOLUTE,Y<
```

```

700 PRINT "$";: GOSUB 2500: PRINT ",Y";: GOSUB 50
00: RETURN
799 REM >(INDIRECT,X)<
800 PRINT "($";: GOSUB 3000: PRINT ",X)";: GOSUB
5000: RETURN
899 REM >(INDIRECT),Y<
900 PRINT "($";: GOSUB 3000: PRINT "),Y";: GOSUB
5000: RETURN
999 REM >ZERO PAGE,X<
1000 PRINT "$";: GOSUB 3000: PRINT ",X";: GOSUB 5
000: RETURN
1099 REM >ZERO PAGE,Y<
1100 PRINT "$";: GOSUB 3000: PRINT ",Y";: GOSUB 5
000: RETURN
1199 REM >RELATIVE JUMP<
1200 PRINT "TO ";:D = PEEK (B):B = B + 1:D = D -
(D > 127) * 256:D = B + D:B1 = D
1210 GOSUB 2000: PRINT "$"H$;:BM = BM( INT (C / 6
4)):BC = INT ( PEEK (P) / BM):BC = BC - 2 *
INT (BC / 2)
1220 IF BC = ( INT (C / 32) - 2 * INT (C / 64)) THEN
B = B1
1230 GOSUB 5005: RETURN
1299 REM >INDIRECT JUMP<
1300 PRINT "(";: GOSUB 2500: PRINT ")";:B = PEEK
(OP + 1) + PEEK (OP + 2) * 256
1310 B = PEEK (B) + PEEK (B + 1) * 256: GOSUB 50
05: RETURN
1499 REM > HEX TO DEC <
1500 D = 0: FOR I = 1 TO LEN (H$):J = ASC ( MID$
(H$,I,1)) - 48:D = D * H + J - 7 * (J > 9): NEXT
: RETURN
1999 REM > DEC TO HEX <
2000 H$ = "": FOR I = 1 TO 4:E = INT (D / H):J =
D - E * H:H$ = CHR$ (J + 48 + 7 * (J > 9)) +
H$:D = E: NEXT
2005 RETURN
2499 REM > 2BYTE OPERAND <
2500 D = PEEK (B + 1): POKE OP + 2,D: GOSUB 2000:
PRINT RIGHT$ (H$,2);: GOSUB 3000:B = B + 1:
RETURN
2999 REM > 1BYTE OPERAND <
3000 D = PEEK (B): POKE OP + 1,D: GOSUB 2000: PRINT
RIGHT$ (H$,2);:B = B + 1: RETURN
3499 REM > PUSH <
3500 J = PEEK (S): POKE ML + 512 + J,D
3505 IF J = 0 THEN PRINT : PRINT "WARNING: STACK
OVERFLOW":J = 256
3510 POKE S,J - 1: RETURN

```

## 4: Programming

---

```
3999 REM      > POP <
4000 J = PEEK (S):D = PEEK (ML + 513 + J)
4005 IF J = 255 THEN PRINT : PRINT "WARNING: STA
      CK UNDERFLOW":J = - 1
4010 POKE S,J + 1: RETURN
4999 REM      > EXECUTE ONE INSTRUCTION <
5000 CALL (ML + 23)
5005 PRINT : FOR K = 0 TO 4:D = PEEK (A + K): GOSUB
      2000
5010 PRINT MID$ (" A= X= Y= S= P=",3 * K + 1,3);
      : PRINT RIGHT$ (H$,2);: NEXT : PRINT : RETURN

5999 REM      > INITIAL STUFF <
6000 ML = 2 * 4096 + 8 * 256
6001 A = ML + 240:X = A + 1:Y = X + 1:S = Y + 1:P =
      S + 1:H = 16:OP = ML + 92
6002 DIM R$(255): DIM BM(3): FOR I = 0 TO 3: READ
      B:BM(I) = B: NEXT
6003 FOR T = 0 TO 255: READ R$(T): NEXT
6004 READ R$: IF R$ < > "END" THEN PRINT "ERROR
      IN OPCODES": PRINT "CHECK FOR TYPO'S": END
6005 I = 0: FOR T = ML TO ML + 164: READ B: POKE T
      ,B:I = I + B: NEXT
6008 IF I < > 17737 THEN PRINT "ERROR IN ML DAT
      A": PRINT "CHECK FOR TYPO'S": END
6010 CALL ML
6015 HOME : PRINT "6502 ML TRACER"
6020 RETURN
6999 REM      > PAUSE <
7000 GET A$: IF A$ = "" THEN 7000
7010 IF A$ = "I" THEN D = B:L = 4: GOSUB 7100:B =
      D: GOTO 7000
7020 IF A$ = "A" THEN D = PEEK (A):L = 2: GOSUB
      7100: POKE A,D: GOTO 7000
7030 IF A$ = "X" THEN D = PEEK (X):L = 2: GOSUB
      7100: POKE X,D: GOTO 7000
7040 IF A$ = "Y" THEN D = PEEK (Y):L = 2: GOSUB
      7100: POKE Y,D: GOTO 7000
7050 IF A$ = "S" THEN D = PEEK (S):L = 2: GOSUB
      7100: POKE S,D: GOTO 7000
7060 IF A$ = "P" THEN D = PEEK (P):L = 2: GOSUB
      7100: POKE P,D: GOTO 7000
7065 IF A$ = CHR$ (3) THEN STOP
7070 RETURN
7100 PRINT A$="";: GOSUB 2000:A$ = H$: INPUT H$: IF
      H$ = "" THEN H$ = A$
7110 H$ = RIGHT$ (H$,L): GOSUB 1500: RETURN
9000 DATA 128,64,1,2
10000 DATA BRK ,ORAF,, ,ORAC,ASLC,
```

```

700 PRINT "$"; GOSUB 2500: PRINT ",Y"; GOSUB 50
00: RETURN
799 REM >(INDIRECT,X)<
800 PRINT "($"; GOSUB 3000: PRINT ",X)"; GOSUB
5000: RETURN
899 REM >(INDIRECT),Y<
900 PRINT "($"; GOSUB 3000: PRINT "),Y"; GOSUB
5000: RETURN
999 REM >ZERO PAGE,X<
1000 PRINT "$"; GOSUB 3000: PRINT ",X"; GOSUB 5
000: RETURN
1099 REM >ZERO PAGE,Y<
1100 PRINT "$"; GOSUB 3000: PRINT ",Y"; GOSUB 5
000: RETURN
1199 REM >RELATIVE JUMP<
1200 PRINT "TO "; D = PEEK (B): B = B + 1: D = D -
(D > 127) * 256: D = B + D: B1 = D
1210 GOSUB 2000: PRINT "$" H$; BM = BM ( INT ( C / 6
4)): BC = INT ( PEEK (P) / BM): BC = BC - 2 *
INT ( BC / 2)
1220 IF BC = ( INT ( C / 32) - 2 * INT ( C / 64)) THEN
B = B1
1230 GOSUB 5005: RETURN
1299 REM >INDIRECT JUMP<
1300 PRINT "("; GOSUB 2500: PRINT ")"; B = PEEK
(OP + 1) + PEEK (OP + 2) * 256
1310 B = PEEK (B) + PEEK (B + 1) * 256: GOSUB 50
05: RETURN
1499 REM > HEX TO DEC <
1500 D = 0: FOR I = 1 TO LEN (H$): J = ASC ( MID$
(H$, I, 1)) - 48: D = D * H + J - 7 * (J > 9): NEXT
: RETURN
1999 REM > DEC TO HEX <
2000 H$ = "": FOR I = 1 TO 4: E = INT (D / H): J =
D - E * H: H$ = CHR$ (J + 48 + 7 * (J > 9)) +
H$: D = E: NEXT
2005 RETURN
2499 REM > 2BYTE OPERAND <
2500 D = PEEK (B + 1): POKE OP + 2, D: GOSUB 2000:
PRINT RIGHT$ (H$, 2); GOSUB 3000: B = B + 1:
RETURN
2999 REM > 1BYTE OPERAND <
3000 D = PEEK (B): POKE OP + 1, D: GOSUB 2000: PRINT
RIGHT$ (H$, 2); B = B + 1: RETURN
3499 REM > PUSH <
3500 J = PEEK (S): POKE ML + 512 + J, D
3505 IF J = 0 THEN PRINT : PRINT "WARNING: STACK
OVERFLOW": J = 256
3510 POKE S, J - 1: RETURN

```



## 4: Programming

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```
3999 REM > POP <
4000 J = PEEK (S):D = PEEK (ML + 513 + J)
4005 IF J = 255 THEN PRINT : PRINT "WARNING: STA
    CK UNDERFLOW":J = - 1
4010 POKE S,J + 1: RETURN
4999 REM > EXECUTE ONE INSTRUCTION <
5000 CALL (ML + 23)
5005 PRINT : FOR K = 0 TO 4:D = PEEK (A + K): GOSUB
    2000
5010 PRINT MID$ (" A= X= Y= S= P=",3 * K + 1,3);
    : PRINT RIGHT$ (H$,2);: NEXT : PRINT : RETURN

5999 REM > INITIAL STUFF <
6000 ML = 2 * 4096 + 8 * 256
6001 A = ML + 240:X = A + 1:Y = X + 1:S = Y + 1:P =
    S + 1:H = 16:OP = ML + 92
6002 DIM R$(255): DIM BM(3): FOR I = 0 TO 3: READ
    B:BM(I) = B: NEXT
6003 FOR T = 0 TO 255: READ R$(T): NEXT
6004 READ R$: IF R$ < > "END" THEN PRINT "ERROR
    IN OPCODES": PRINT "CHECK FOR TYPO'S": END
6005 I = 0: FOR T = ML TO ML + 164: READ B: POKE T
    ,B:I = I + B: NEXT
6008 IF I < > 17737 THEN PRINT "ERROR IN ML DAT
    A": PRINT "CHECK FOR TYPO'S": END
6010 CALL ML
6015 HOME : PRINT "6502 ML TRACER"
6020 RETURN
6999 REM > PAUSE <
7000 GET A$: IF A$ = "" THEN 7000
7010 IF A$ = "I" THEN D = B:L = 4: GOSUB 7100:B =
    D: GOTO 7000
7020 IF A$ = "A" THEN D = PEEK (A):L = 2: GOSUB
    7100: POKE A,D: GOTO 7000
7030 IF A$ = "X" THEN D = PEEK (X):L = 2: GOSUB
    7100: POKE X,D: GOTO 7000
7040 IF A$ = "Y" THEN D = PEEK (Y):L = 2: GOSUB
    7100: POKE Y,D: GOTO 7000
7050 IF A$ = "S" THEN D = PEEK (S):L = 2: GOSUB
    7100: POKE S,D: GOTO 7000
7060 IF A$ = "P" THEN D = PEEK (P):L = 2: GOSUB
    7100: POKE P,D: GOTO 7000
7065 IF A$ = CHR$ (3) THEN STOP
7070 RETURN
7100 PRINT A$="";: GOSUB 2000:A$ = H$: INPUT H$: IF
    H$ = "" THEN H$ = A$
7110 H$ = RIGHT$ (H$,L): GOSUB 1500: RETURN
9000 DATA 128,64,1,2
10000 DATA BRK ,ORAF,,,,ORAC,ASLC,
```

```

10001 DATA PHP ,ORAB,ASL ,,,ORAA,ASLA,
10002 DATA BPLJ,ORAG,,,,ORAH,ASLH,
10003 DATA CLC ,ORAE,,,,ORAD,ASLD,
10004 DATA JSRA,ANDF,,,BITC,ANDC,ROLC,
10005 DATA PLP ,ANDB,ROL , ,BITA,ANDA,ROLA,
10006 DATA BMIJ,ANDG,,,,ANDH,ROLH,
10007 DATA SEC ,ANDE,,,,AMDD,ROLD,
10008 DATA RTI ,EORF,,,,EORC,LSRC,
10009 DATA PHA ,EORB,LSR , ,JMPA,EORA,LSRA,
10010 DATA BVCJ,EORG,,,,EORH,LSRH,
10011 DATA CLI ,EORE,,,,EORD,LSRD,
10012 DATA RTS ,ADCF,,,,ADCC,RORC,
10013 DATA PLA ,ADCB,ROR , ,JMPK,ADCA,RORA,
10014 DATA BVSJ,ADCG,,,,ADCH,RORH,
10015 DATA SEI ,ADCE,,,,ADCD,RORD,
10016 DATA ,STAF,,,STYC,STAC,STXC,
10017 DATA DEY , ,TXA , ,STYA,STAA,STXA,
10018 DATA BCCJ,STAG,,,STYH,STAH,STXI,
10019 DATA TYA ,STAE,TXS , , ,STAD,,
10020 DATA LDYB,LDAF,LDXB,,LDYC,LDAC,LDXC,
10021 DATA TAY ,LDAB,TAX , ,LDYA,LDAALDXA,
10022 DATA BCSJ,LDAG,, ,LDYH,LDAA,LDXI,
10023 DATA CLV ,LDAE,TSX , ,LDYD,LDAD,LDXE,
10024 DATA CPYB,CMPF,,,CPYC,CMPC,DECC,
10025 DATA INY ,CMPB,DEX , ,CPYA,CMPA,DECA,
10026 DATA BNEJ,CMPG,,,,CMPH,DECH,
10027 DATA CLD ,CMPE,,,,CMPD,DECD,
10028 DATA CPXB,SBCF,,,CPXC,SBCC,INCC,
10029 DATA INX ,SBCB,NOP , ,CPXA,SBCA,INCA,
10030 DATA BEQJ,SBCG,,,,SBCI,INCI,
10031 DATA SED ,SBCE,,,,SBCD,INCD,
10032 DATA END
20000 DATA 162,0,181,0,157,0,41,189
20001 DATA 0,1,157,0,42,189,0,2
20002 DATA 157,0,43,232,208,236,96,120
20003 DATA 162,0,181,0,168,189,0,41
20004 DATA 149,0,152,157,0,41,189,0
20005 DATA 1,168,189,0,42,157,0,1
20006 DATA 152,157,0,42,189,0,2,168
20007 DATA 189,0,43,157,0,2,152,157
20008 DATA 0,43,232,208,213,186,138,174
20009 DATA 243,40,154,141,243,40,172,242
20010 DATA 40,174,241,40,173,244,40,72
20011 DATA 173,240,40,40,234,234,234,8
20012 DATA 141,240,40,104,141,244,40,142
20013 DATA 241,40,140,242,40,186,138,174
20014 DATA 243,40,154,141,243,40,162,0
20015 DATA 181,0,168,189,0,41,149,0
20016 DATA 152,157,0,41,189,0,1,168

```

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```
20017 DATA 189,0,42,157,0,1,152,157
20018 DATA 0,42,189,0,2,168,189,0
20019 DATA 43,157,0,2,152,157,0,43
20020 DATA 232,208,213,88,96
```

# All About the Status Register

---

Louis F. Sander

*The status registers have always been a mystery to the beginning machine language programmer. This article will help clear up the mystery.*

All but the simplest machine language programs make use of the 6502's seven processor status flags, and any ML programmer worth his salt masters their functions and uses. Like almost everything in ML programming, the flags operate in a straightforward and unambiguous way, but they are full of mystery for the beginner.

If you've started ML programming, but are confused by that NV-BDIZC business, this article will help you understand it. It includes a fully explained ML demo program.

These explanations will assume that you have some ML knowledge and at least a beginning grasp of hexadecimal arithmetic.

Let's start by defining a *register*, which is a circuit inside a processor. Registers have the characteristics of memory locations, in that data can be written to them or read from them. But they often don't have addresses as such, since they are used internally by the microprocessor itself. The accumulator is the most familiar register, but there are many others in your computer.

The 6502 has an internal 8-bit register, variously called the flags register, processor status register, or P register, the bits of which are set or cleared by the results of various operations. In this context, *set* means equal to 1, and *cleared* means equal to 0. At times the bits are set and cleared, or *conditioned*, automatically by the 6502 chip itself; other times they are conditioned by specific program instructions. Any book on 6502 programming will show you each instruction's effect on the status bits.

## Bit Branches

Programs can check these bits and use the results of the check for whatever purpose the programmer has in mind, often to decide on a branch. The bits are sometimes called flags, and

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indeed, they work like the little red flags on rural mailboxes—the postal patron can raise the flag to let the mailman know there's outgoing mail, and the mailman can lower it to signal he's emptied the box. Here are the names and purposes of the eight bits in the status register, moving from left (high-order bit) to right (low-order bit):

**N (bit 7)**—Negative flag. (Some books call it *S*, for sign.) The *N* flag matches the high bit of the result of whatever operation the processor has just completed. If you load  $\$FF$  (1111 1111) into the *Y* register, for example, since the high bit of the *Y* register is set, the *N* flag will be set, too. *ML* programmers make good use of the *N* flag. (By the way, even though this is the eighth bit, we call it bit 7, because computers start numbering things at 0.) In a computer technique called twos complement arithmetic, the high-order bit of a number is set to 1 if the number is negative, and cleared to 0 if it's positive, and that's where the *N* flag gets its name.

**V (bit 6)**—Overflow flag. This flag is important in twos complement arithmetic, but elsewhere it is rarely used. In the interest of simplicity, we'll say no more about it.

Bit 5 has no name, and is always set to 1. Since nothing can change it, it is of no use to the programmer.

**B (bit 4)**—Break flag, set whenever a *BRK* instruction is executed, clear at all other times. Rarely used by beginners.

**D (bit 3)**—Decimal flag. When *D* is set by the programmer, the 6502 does its arithmetic in BCD, binary coded decimal, which is yet another exotic type of computer math. Fortunately for nonexperts, it's seldom used, and the beginner's only concern with the *D* flag is to be sure it is not set unintentionally, because when it *is*, program behavior can be bizarre.

**I (bit 2)**—Interrupt mask. When this bit is set, the computer will not honor interrupts, such as those used for keyboard scanning in many computers. It is widely used, but so different from the other flags that we'll say no more about it.

**Z (bit 1)**—Zero flag. This one's used a great deal, and basically the computer sets it when the result of any operation is zero. Load the *X* register with  $\$00$ , and you set the zero flag. Subtract  $\$32$  from  $\$32$ , and you do the same. Many 6502 instructions affect the *Z* flag, and there's always a "zero or not-zero" aspect to it, but it's not always obvious to the novice when a zero condition exists. This is probably the most im-

portant of the flags, and if you master it, mastery of the others will be easy.

C (bit 0)—Carry flag. Carry is set whenever the accumulator rolls over from \$FF to \$00 (just like the odometer on a car, rolling over from all nines to all zeros). It's also set by various rotation and comparison instructions. The carry flag is about as important as the Z flag, and a little more mysterious, at least to me, but its operation is really rather simple.

### 6502 Monitor

The foregoing brief description of the 6502's 8-bit processor status register and the seven status flags it contains may have cleared some mystery away, but it surely isn't comprehensive. That sort of description is found in ML programming books, to which you are now referred, and which will be much easier to understand once you've mastered what is presented here. Let's get that mastery by running a simple test program, using a machine language *monitor* to observe its effects on the status register.

A monitor is nothing more than a machine language program that makes it easier to work with other ML programs. Apples have a simple monitor built into the ROM.

The monitor is a wonderful tool for the beginning ML programmer, and if you've dabbled with ML, you've at least used it to examine memory locations and to save ML programs on tape or disk. I used mine for those things for many months, but never paid much attention to the registers display. That's the line of labeled numbers the monitor prints on the screen when a BRK instruction is encountered. (You can also get a register display by typing CTRL-E and RETURN at a monitor prompt.) It looks like this:

```
330D-  A=00  X=5E  Y=04  P=30  S=F8
```

The first number shows the contents of the PC register, the address in the 6502's program counter, which is nothing more than the address of the next instruction to be executed. Because of various quirks, the value shown in the register display is the address two bytes after the BRK. (The register display you get with CTRL-E does not include the PC value.)

A, X, and Y show the contents of the accumulator, X, and Y registers, respectively, at the moment the monitor was activated. P gives the contents of the processor status register,

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expressed in hexadecimal form. People with 6502s in their cerebral cortices may be able to determine individual flag statuses from a hex display, but it's a burdensome interpretation for the rest of us. Who can figure out whether \$FB means the Z flag is set or clear? Not me, I can guarantee you. The table is a handy guide for interpreting that byte. With it, you can tell at a glance which flags are set or cleared in a given status byte, and just what each flag means. And that ability can be a golden key to better machine language programming.

### Decoding Status Displays

First Digit		Second Digit	
0		0	<b>D I Z C</b>
1		1	<b>D I Z C</b>
2	<b>N V - B</b>	2	<b>D I Z C</b>
3	<b>N V - B</b>	3	<b>D I Z C</b>
4		4	<b>D I Z C</b>
5		5	<b>D I Z C</b>
6	<b>N V - B</b>	6	<b>D I Z C</b>
7	<b>N V - B</b>	7	<b>D I Z C</b>
8		8	<b>D I Z C</b>
9		9	<b>D I Z C</b>
A	<b>N V - B</b>	A	<b>D I Z C</b>
B	<b>N V - B</b>	B	<b>D I Z C</b>
C		C	<b>D I Z C</b>
D		D	<b>D I Z C</b>
E	<b>N V - B</b>	E	<b>D I Z C</b>
F	<b>N V - B</b>	F	<b>D I Z C</b>

This table decodes two-digit hex displays of the processor status register. Bold face indicates bit set; regular face, bit clear.

S gives the value of the stack pointer, which is yet another useful value that's beyond our present scope. The value will vary from time to time and from machine to machine.

### Stepping Through Flags

Now that you've seen a description of the register display, plus that handy table, let's use them to experiment with the important flags. Our experiment will have the dual benefit of making us more fluent in ML, and giving us practice using the register display.

The program at the end of this article is an instructive, but do-nothing, ML program that occupies an innocuous corner of

memory. From left to right, each line shows a memory address, the bytes held by it and maybe its upward neighbor, and the mnemonic for the machine language instruction that those bytes represent. The program's first seven lines set all the 6502's flags and registers to zero, then break to the monitor, where we can review their status.

### Single, Simple Operations

The rest of the program is a series of single, simple operations, each followed by a break to the monitor. We're about to go through them one by one, and see what happens to the negative, break, zero, and carry flags. We'll leave V, D, and I for another day, for the reasons previously mentioned.

The figure will be used to track our demonstration.

Steps 1–3. Our first step will be to put the ML demo program into memory. Do it now, by carefully following Steps 1, 2, and 3. If you've never worked with ML before, don't worry—the process is easy, and we'll take you through it step by step. When you finish Step 3, come back here for further instructions.

At the end of Step 3, the monitor should still be active, and your screen should be showing you its distinctive monitor prompt. You're now ready to run the ML demo program, which you do by executing your monitor's G command. Be sure to use the correct syntax; it is illustrated in the figure. Monitor commands are fussy about spaces, etc., so pay close attention to details at this point. Now go do Step 4, which will start execution of the machine language routine at address \$3300. That routine will run until a BRK instruction is executed, at which point processing will stop and the monitor's register display will appear on the screen. When that happens, which should be immediately, come back here.

Step 4. Study the register display, disregarding S, and observe that A, X, and Y are all set to \$00. Use the figure to confirm that \$30 means that all P flags are clear, except for the B and the meaningless bit that's always set. Remember what the B flag is for, and it will be easy to see why it's set. Our program was designed to zero everything out, and it worked as it was designed. So far, so good. (If things are not so good, you've made a mistake. Repeat your work from the beginning.)



### Nothing Has Changed

Step 5. Now perform Step 5, and notice what has happened. The program has loaded \$80 (1000 0000) into the accumulator, and the monitor AC display so indicates. Since the leftmost bit of \$80 is a 1, the computer set its own N flag. The program counter has advanced, but nothing else has changed. (If your stack pointer changed, never mind—the monitor, not our program, changed it.) The BRK brought us back to the monitor. Simple, isn't it?

Step 6. The LDA has loaded \$7F (0111 1111) into the accumulator, setting N to match its highest bit. The register display shows the \$7F, and proves that N is now clear, while all other flags remain the same. Now do Step 7.

Step 7. Putting \$00 (0000 0000) in the accumulator sets the Z bit, since zeros beget zeros. Notice how the PC is stepping right along with us, and do Step 8.

Step 8. \$FF (1111 1111) is *not* a zero, so the zero flag is cleared. Its high bit is a 1, so the N flag is set. Move on to the next step.

Step 9. The ADC instruction adds 1 to the accumulator. Like driving another mile when the speedometer reads 99999, this rolls the accumulator over to \$00 (0000 0000). We can tell when this happens, because the rollover automatically sets the carry flag. The carry bit is often used in just this way, to tell when a counter has reached its maximum. In our example, Z is also set, since the operation resulted in a zero. When you've absorbed those simple details, go on to Step A.

### Screen Dialogue

- |  |  |
|--|--|
| <b>Step 1</b> To activate the monitor, type CALL-151, then press RETURN.   | JCALL -151   |
| <b>Step 2</b> Put the program into memory by making these entries <i>exactly</i> as shown. Press RETURN at the end of each line. | *3300:08 18 A9 00 AA AB C9 FF<br>*3308:00 A9 80 00 A9 7F 00 A9<br>*3310:00 00 A9 FF 00 69 01 00<br>*3318:69 01 00 C9 02 00 00 00 |
| <b>Step 3</b> Check your work by entering this command and comparing your screen display with the program.                       | *3300L   |
| <b>Step 4</b> Type the G command, then press RETURN. When this line appears, return to the text.                                 | *3300G<br>330A- A=00 X=00 Y=00 P=30 S=C9   |

Step 5 This and the following steps are identical to Step 4, except for the numbers entered and displayed.	*33096 330D-     A=80 X=00 Y=00 P=B0 S=C7
Step 6 As above.	*330C6 3310-     A=7F X=00 Y=00 P=30 S=C5
Step 7 As above.	*330F6 3313-     A=00 X=00 Y=00 P=32 S=C3
Step 8 As above.	*33126 3316-     A=FF X=00 Y=00 P=B0 S=C1
Step 9 As above.	*33156 3319-     A=00 X=00 Y=00 P=33 S=BF
Step A As above.	*33186 331C-     A=02 X=00 Y=00 P=30 S=BD
Step B As above. This is the last step in our demonstration.	*331B6 331F-     A=02 X=00 Y=00 P=33 S=BB

### Bump A Counter

Step A. The last operation did not roll over the accumulator, so the carry bit was cleared. What it did was to add 1 to the zero in the accumulator, giving a result of 2. How on earth do  $1 + 0 = 2$ ? The answer is in the carry bit. An ADC adds its operand plus the carry bit to the contents of the accumulator, then reconditions C based on the result. That's very useful, because often when a counter rolls over, we want to increment a higher-order counter, so nothing gets lost in the counting. Many programs look for the carry bit, and bump a counter if it's set. Our own little program didn't go that far, but it did show us how such things can be done. Now do the next G.

Step B. What's this? We compared a 2 to a 2, and the zero and carry flags got set. That's a special use of flags in comparing numbers. CMP and the other comparison instructions don't store their results anywhere, but they *do* condition the N, Z, and C flags in a special way that facilitates branching after the comparison. Read up on the CMP, CPX, and CPY instructions for full information on how they set the flags.

We're now at the end of our flag-waving tour. If you kept with us this far, you're in the know about some elementary but important attributes of the processor status register, and you may have improved your knowledge of your monitor. Dig into those ML texts that you didn't understand last time, and

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you'll be surprised how easy they've become. If you're really feeling like an expert, come up with a branch instruction to take our program back to \$3300.

### Machine Language Demonstration Program

3300	DB	CLD
3301	18	CLC
3302	A9 00	LDA #\$00
3304	AA	TAX
3305	AB	TAY
3306	C9 FF	CMP #\$FF
3308	00	BRK
3309	A9 80	LDA #\$80
330B	00	BRK
330C	A9 7F	LDA #\$7F
330E	00	BRK
330F	A9 00	LDA #\$00
3311	00	BRK
3312	A9 FF	LDA #\$FF
3314	00	BRK
3315	69 01	ADC #\$01
3317	00	BRK
3318	69 01	ADC #\$01
331A	00	BRK
331B	C9 02	CMP #\$02
331D	00	BRK

# Chapter 5

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## Sound and Graphics



# Introduction

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Sound and graphics have always been important elements of many home computer applications, and the programs in this chapter will help you get the most out of your Apple's sound and graphics capabilities.

Every programmer will enjoy Blaine Mathieu's "Apple Sounds," a comprehensive two-part guide to creating custom sounds on the Apple. It shows you how to produce a variety of sound effects—but it goes beyond that. Using the programs in the articles, you'll be able to create and play musical compositions too.

Other programs in this chapter will let you put Apple graphics to work, and the results may amaze you. J.F. Johnson's "Apple Shape Generator," for instance, takes the work out of creating shapes on your Apple. It automatically performs all necessary numerical conversions and creates the shape table too.

Equally versatile is "The Apple Hi-Res Painter," by James Totten. It's a full-featured, menu-driven drawing tool that will let you create virtually any drawing you desire.

Would you like to add depth to your graphics creations? Tim R. Colvin's "3-D Plotting" illustrates one approach—and you can easily modify his programs to produce 3-D drawings of your own.

Finally, Chayim Avinor's "Spiralizer" creates intricate spiral shapes under your direction. You can draw shapes one at a time or combine them for special effects.

# Apple Sounds—from Beeps to Music, Part 1

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Blaine Mathieu

*In this first of two articles, the author takes you from creating the simplest possible sound on the Apple to producing musical notes. Several useful demonstration programs are included.*

Since I first acquired an Apple II+ about a year and a half ago, I have been fascinated by the strange noises I often hear. In this first of two articles I hope to save you all the trouble I went through in learning how to use Apple sounds. Readers who already understand how to use CTRL-G and -16336 may want to skip the next section and go on to "Paddle Sounds."

## Beeps and Clicks

Before you read this section, you should enter Program 1 on your computer and save it. Then run the program. If you entered it correctly, you should see SOUND at the top, a line from the program, and a small menu.

The first sound that you ever heard from your Apple's speaker was probably the so-called bell sound. You can reproduce this in immediate mode by holding down the control key (CTRL) and pressing the G key. In line 30 a CHR\$(7) is being printed (7 is the numeric code for CTRL-G). Note: If you are in Integer BASIC, you will have to use the format shown in line 35. In this line you'll see a PRINT with two quotes. Inside these quotes is a CTRL-G. The REM statement in line 37 shows how to type line 35. (As you can see, control characters don't show up in a line listing or when you type them. An interesting side effect is that when you LIST your program, you will hear all the bell sounds in your program that are printed using the method in line 35.)

In Program 1, the computer waits for you to hit a key. If you hit R, it will repeat any sound that might be produced by the above program lines. If you hit C, you will proceed to the next sound in Program 1. Any other key (except RESET) will cause no change.

### Clicking

Now hit C to go on to the second sound (SOUND #2). In this program a simple FOR-NEXT loop is set up to beep the Apple's speaker ten times. Note the semicolon at the end of line 80; this prevents the screen from scrolling. If I hadn't used the semicolon, the imaginary cursor would move down the screen as each CTRL-G was printed until the screen started to scroll upward. In most cases, that's undesirable.

Looking at SOUND #3, you will notice the number -16336, which is the memory address of the Apple's speaker. Every time this address is accessed, the Apple gives a little push on its speaker, creating a small click. PEEKing, as I have done in line 130, is just one simple way of accessing this address. If you missed the sound the first time, press R to hear it again.

SOUND #4 includes another simple loop that will PEEK the speaker's memory address 100 times. Instead of typing -16336 every time I wanted to use it, I assigned -16336 to the variable NO (for NOise). You may use any variable you wish.

In SOUND #5, you'll notice line 250, which strings a lot of clicks together. This produces a longer noise than in SOUND #3 and a higher-pitched noise than in SOUND #4. As a rule, the closer your PEEKs, the higher-pitched your noise is going to be. In line 250 you will notice that you PEEKed -16336 a total of 15 times, a purely arbitrary number.

Finally, SOUND #6 demonstrates most of what you've learned about clicks. It uses a FOR-NEXT loop to cause line 320 to repeat 100 times. Line 320 has an assortment of minus and plus signs to show that it rarely makes a difference what you do to this location, as long as you access it.

Now on to something a little more exciting and complicated.

### Paddle Sounds

Program 2 requires paddles or a joystick. It's a simple BASIC program which reads a byte from the DATA statement and POKes it into memory locations 768 (\$300) to 786 (\$312). The routine begins by CALLing 768. If you entered the program correctly, you should hear a fairly high-pitched whine;



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as you move the paddles or joystick, this whine will change in pitch. You may leave the program by pressing RESET or CTRL-RESET, depending on your model.

Here is the source code for the machine language:

```
100          ORG  $300          ;768 DECIMAL
200 PDLZERO EQU  $00
300 PDLONE  EQU  $01
400 PREAD   EQU  $FB1E
500 SPEAKER EQU  C030
600 START   LDX  #PDLZERO     ;SET UP FOR PADDLE
                                ZERO
700          JSR  PREAD        ;GET DELAY FROM
                                PADDLE ZERO
800          STA  SPEAKER      ;TWEAK SPEAKER
900          LDX  #PDLONE     ;REPEAT PROCESS FOR
                                PADDLE ONE
1000         JSR  PREAD
1100         STA  SPEAKER
1200         JMP  START        ;START OVER
```

Here is a quick explanation of how it works:

1. Put the paddle number in the X register.
2. Jump to the PREAD subroutine (see *Apple II Reference Manual*). PREAD acts as a delay, dependent on the paddle setting.
3. Tweak the speaker by accessing -16336 (\$C030).
4. Repeat for next paddle.
5. Jump to beginning.

The pitch of the noise depends on how close together the tweaks are. The lower the paddle setting, the higher the pitch of the noise.

### Making Music

Now we'll look at a program that lets you produce notes (and thus music) on your Apple. Of course, there are some limitations; you won't be playing Beethoven's Fifth Symphony. You'll need peripheral boards to do things such as that. However, this program will let you do quite a lot with the hardware already in your Apple.

"Note Maker" (Program 3) is a simple BASIC program that POKEs in a machine language subroutine, sets up a few parameters, and CALLs the subroutine. The program continues running until a key is pressed. Try running it. If you've

never heard notes from your Apple, you may be quite surprised.

After the program has POKEd in the subroutine, it POKEs one random number (pitch) into location 768 (\$300) and POKEs another random number (duration) into 769 (\$301). The maximum value that can be POKEd into these locations is 255.

The source code is given below:

```
100          ORG $300          ;768 DECIMAL
200 TWEAK    EQU $C300
300 PITCH    EQU $300
400 DURATION EQU $301
500          DS 2              ;MAKE SPACE FOR
                                PITCH AND
                                DURATION
600 START    LDA TWEAK        ;TWEAK THE
                                SPEAKER
700 BRANCH1  DEY
800          BNE BRANCH2
900          DEC DURATION     ;DURATION =
                                DURATION-1
1000         BEQ RETURN      ;IF DURATION = 0
                                THEN RETURN
1100 BRANCH2  DEX
1200         BNE BRANCH1
1300         LDX PITCH
1400         JMP START        ;CONTINUE TO
                                SOUND
                                NOTE
1500 RETURN  RTS              ;GO BACK TO OPER-
                                ATING SYSTEM
```

In essence, the program works much like "Paddle Sounds." The main difference is that instead of the paddles controlling the pitch of the sound, locations 768 and 769 control the pitch and duration. The source code contains comments that should help you understand what is happening.

As you can see, whenever you want a sound routine, you're going to have to access location -16336 (\$C030). Try experimenting with this program by POKeing in your own note values and hearing the results.

In Part 2, we'll look at a program called "Apple Music Writer," which will let you edit and play your own songs. Until then, experiment with the programs here. You're sure to come up with some surprising results.

### Program 1: Sounds and Variations

```
10 I = 10: HOME
20 PRINT "SOUND #1": PRINT : LIST 30,37
30 PRINT CHR$(7)
35 PRINT "": REM CTRL-G
37 REM PRINT"CTRL-G"
40 GOTO 10000
50 I = 50: HOME ,
60 PRINT "SOUND #2": PRINT : LIST 70,90
70 FOR LOOP = 1 TO 10
80 PRINT CHR$(7);
90 NEXT
100 GOTO 10000
110 I = 110: HOME
120 PRINT "SOUND #3": PRINT : LIST 130
130 X = PEEK (- 16336)
140 GOTO 10000
150 I = 150: HOME
160 PRINT "SOUND #4": PRINT : LIST 170,200
170 NO = - 16336
180 FOR LOOP = 1 TO 100
190 X = PEEK (NO)
200 NEXT
210 GOTO 10000
220 I = 220: HOME
230 PRINT "SOUND #5": PRINT : LIST 240,260
240 NO = - 16336
250 X = PEEK (NO) + PEEK (NO) + PEEK (NO) + PEEK
      (NO) + PEEK (NO) + PEEK (NO) + PEEK (NO) +
      PEEK (NO) + PEEK (NO) + PEEK (NO) + PEEK
      (NO) + PEEK (NO) + PEEK (NO) + PEEK (NO) +
      PEEK (NO)
260 REM FIFTEEN TIMES
270 GOTO 10000
280 I = 280: HOME
290 PRINT "SOUND #6": PRINT : LIST 300,330
300 NO = - 16336
310 FOR LOOP = 1 TO 100
320 X = PEEK (NO) - PEEK (NO) + PEEK (NO) - PEEK
      (NO) + PEEK (NO) - PEEK (NO) + PEEK (NO)
330 NEXT
10000 POKE - 16368,0: VTAB 20: HTAB 1: CALL - 9
      58: PRINT "'R' FOR REPEAT, 'C' TO CONTINUE ";
      : GET A$
10010 IF A$ < > "R" AND A$ < > "C" THEN 10000
10020 IF A$ = "C" THEN 10100
10030 IF I = 10 THEN 30
10040 IF I = 50 THEN 70
```

```
10050 IF I = 110 THEN X = PEEK ( - 16336): GOTO
      130
10060 IF I = 150 THEN 170
10070 IF I = 220 THEN 240
10080 IF I = 280 THEN 300
10100 IF I = 10 THEN 50
10110 IF I = 50 THEN 110
10120 IF I = 110 THEN 150
10130 IF I = 150 THEN 220
10140 IF I = 220 THEN 280
10150 TEXT : HTAB 1: PRINT "END OF LISTING#1"
```

### Program 2. Paddle Sounds

```
20 FOR LOC = 768 TO 786: READ BYTE: POKE LOC, BYTE
   : NEXT LOC
30 DATA 162,0,32,30,251,141,48,192,162,1,32,30,25
   1,141,48,192,76,0,3
40 CALL 768
```

### Program 3. Note Maker

```
10 FOR LOC = 770 TO 790: READ BYTE: POKE LOC, BYTE
   : NEXT
20 POKE 768, INT ( RND (1) * 255) + 1: POKE 769, INT
   ( RND (1) * 100) + 1: CALL 770: X = PEEK ( -
   16384): IF X < 127 THEN POKE - 16368,0: GOTO
   20
30 DATA 173,48,192,136,208,5,206,1,3,240,9,202,2
   08,245,174,0,3,76,2,3,96
40 POKE - 16368,0
```

# Apple Sounds—from Beeps to Music, Part 2

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Blaine Mathieu

*In this article, the author combines ideas and programs from Part 1 to create the “Apple Music Writer.” An easy-to-use tool for composing or reproducing songs, it offers a great variety of commands.*

“Apple Music Writer” is a program that allows any Apple owner to easily create music or reproduce favorite songs.

When you run the program, you’ll see the title screen and hear a short tune. After the tune ends, you will be prompted by the word COMMAND? and a flashing cursor. At the top of the screen you should see a list of the possible commands; on the right will be a list of note names and their corresponding values.

## Commands

It’s important that you understand and know how to use the commands, so it’s helpful to go over them in the order that they appear on the screen. Press RETURN after each command, and feel free to experiment as we go along.

**A (ADDNOTE).** This command will let you begin your music file (song) and add to it. Every time you press A (and RETURN) you will be prompted to enter the note, a comma, and the duration. For example:

**NOTE#1**

**NOTE,DURATION 128,200**

The maximum usable note value is 255. The same is true for the duration value. After you’ve entered your values, you will hear what the new note will sound like in the song.

**E (EDIT).** If you’ve made a mistake, you can fix it by typing E (and, as always, RETURN). You will then be asked the number of the note you want to edit. If the note you want to edit is not part of the music file, you will be reprompted for the note number. If you entered a valid note number, you will be given the old values for that note and prompted for new values.

The same data entry rules apply as for ADDNOTE. Say you want to edit note number one and replace the old values with new ones of 64 and 200:

```
COMMAND? E
EDIT NOTE#1
NOTE#1 OLD: NOTE=128 DUR=200
NOTE,DURATION: 64,200
```

**P (PLAY).** Typing P will put you into Play mode. This will play your song and print it to the screen at the same time. Because it is both listing and playing your music file, the playing will not be at the same speed as in your program. It will be slower and more pronounced.

After entering P you will be prompted for the starting and ending notes. If you simply press RETURN instead of entering values, defaults will be set (D is the default) and the whole song will be played.

**S (SAVE).** This command will save your music file to disk, if you have DOS loaded into your computer. First you will be prompted for a filename, which will be the name used when the file is saved. Then you'll be prompted for the number of the first and last note of your file that you want saved to disk.

The next question is FOR FUTURE ADDITION?. If you answer Y, a file will be created that can be reloaded into Apple Music Writer at any time. You should use this option if you feel you may want to add more notes or edit your song at a later date. If you enter N, the file will be one that you can easily turn into a BASIC program to play your song when run

If you answer the FOR FUTURE ADDITION? question with an N, you will be asked for the starting line number of your soon-to-be-created BASIC music program. Then you will be asked if you want a FULL LOADER PROGRAM. If you answer Y, the BASIC program created will include the necessary information. If you answer N, the routine will not be included. You would answer N if the program you wanted to add the music to already included some sort of "Note" routine.

(Note: To turn the text file created by this program into a BASIC program, you will need to type *EXEC filename.*)

Finally, you will be prompted to check for errors. If everything is all right, enter Y and the file will be saved. If you

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enter N, you have to repeat the entire SAVE process. Here is an example of what the average SAVE command might include:

```
COMMAND? S
(Screen is cleared)
FILENAME? SONG.1
STARTING NOTE NUMBER:2
ENDING NOTE NUMBER:10
FOR FUTURE ADDITION? N
STARTING LINENUMBER: 100
FULL LOADER PROGRAM ? Y
IS EVERYTHING OK? Y
```

Your music file would now be saved under the filename SONG.1. The file would consist of notes two through ten, and the generated program would start at line 100. The generated program would include the machine language "Note" routine.

**L (LOAD).** If you answer Y to the FOR FUTURE ADDITION? question back in the SAVE command, you can load an old music file back into the computer. The catch is that you will lose any data that you entered into the computer beforehand. If you don't want to lose your data, then answer N to the question about losing your data. Just enter the appropriate filename, and you can manipulate or add to your data once again.

**N (NORPLAY).** As mentioned earlier, when you P (play and list) your song, it will play at a slower speed because it has to list the note values at the same time. To alleviate that problem, you can use the NORMAL PLAY command. This will play your song in the same tempo as it will normally be played by your generated program. Just enter the proper values (or use the defaults) and listen.

**D (DELETE).** After entering D in response to the COMMAND? prompt, you will be asked which note or notes you want to delete. If you hit RETURN after the first question without typing anything else, the default will be used and the last note in the music file will be deleted. If you enter a value for the first question, you will be asked the number of the last note up to which you want to delete. The appropriate notes will then be deleted. You'll then go back to the COMMAND? mode.

**I (INSERT).** This command is the exact opposite of the Delete command. Simply answer the few setup questions and enter the data. Note: You cannot leave the Insert mode until

you have entered all the data you said you were going to enter.

**R (RESTART).** This command lets you start over at note one with a clean slate.

**C (CATALOG).** The Catalog command will return a fairly standard DOS catalog.

**Q (QUIT).** Use this command to exit the program, but you will lose all data that hasn't been saved to disk. If you quit by accident, GOTO 200 will usually let you reenter the program with no data lost.

**.** (**DOS**). Typing a period followed by any normal DOS command will execute that command. A common use for this might be:

**COMMAND? .DELETE FILENAME**

Caution: Some DOS commands will cause the Apple Music Writer to cease functioning, thus causing a loss of data.

**H (HARD).** If you have a printer connected to your Apple, you can get a hard copy of your music file by entering H from the COMMAND? mode. You may have to edit lines 1210 and 1220 to accommodate different printers.

### Hints for Easier Use

**Saving.** One good idea is to save two copies of your music file to the disk. One copy should be done in the FUTURE ADDITION? mode so you can edit or add to it at a later date. If you wish, the other copy can be done in the *create program*, or FUTURE ADDITION? N mode. Always remember to use a different filename.

**Tempo.** When you enter your durations, remember that if your quarter note has a value of 50, your half note will have a value of 100 and so on. You should decide what duration you want a certain note to have and work from there. Rests are accomplished by using a note value of one.

**Limits.** The number of notes you can have in one song is limited. As the program is written, the limit is 500 notes. However, it can be changed by changing the value of L in line 120.

**Notes.** The note listings on the side of the screen are especially helpful if you are transposing sheet music to disk. The numbers listed are for the Music Writer's middle octave. For the higher octave, divide the number by two; for the lower octave, multiply the number by two. For example, the note F



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could be represented by the numbers 36, 72, and 144. You can also make a separate list of all the notes and their numbers. Remember, F-sharp is the same as G-flat and so on. Once again, the number zero is equivalent to the number 256.

**EXEC.** In order to use a program that you made in the FUTURE ADDITION? N mode, you must EXEC it. EXEC is a DOS command that prints a sequential text file to the screen as if it were typed from the keyboard. In this way, you can EXEC your file and run it as a BASIC program. Later on, you can save it.

Another feature is that you can load an old BASIC program and EXEC your sound routine into it. For this to work properly, however, you must have picked a starting line number for your music file that will not conflict with lines in the program to which the routine is being added.

**Insert.** If you have to type in a large amount of repetitive data, one useful trick is to enter the last note of that data and then Insert the rest. That eliminates the bother of repeatedly typing A from COMMAND? mode. Note, however, that this is useful only if you know beforehand exactly what data you want to enter.

**Keys.** There are a number of key codes that you can use with the Apple Music Writer. If at any time the screen is getting too cluttered, an ESC-SHIFT-P should do the trick. You can stop a Catalog or a play/list at any time with CTRL-S (and restart it by pressing any key).

Finally, in this program, CTRL-C RETURN can be a useful but sometimes dangerous command. I would recommend using CTRL-C only as a last resort. If for any reason you find yourself bumped out of Apple Music Writer, you can usually reenter the program, without losing any data, by typing GOTO 200.

I encourage you to experiment. Nothing can take the place of hands-on experience with a program. Just be sure you know what's going to happen at all times before you take on a big musical project.

## Apple Music Writer

```

20 REM INITIALIZATION
30 TEXT : HOME : VTAB 1: PRINT "A=ADDNOTE E=EDIT
    P=PLAY S=SAVE L=LOAD N=NORPLAY D=
    DELETE I=INSERT R=RESTART C=CATALOG Q=QUIT
    .=DOS H=HARD": PRINT "-----
    -----": POKE 34,5
40 VTAB 6: HTAB 34: PRINT "G =64": PRINT TAB( 34
    )"F#=68": PRINT TAB( 34)"F =72": PRINT TAB(
    34)"E =76": PRINT TAB( 34)"D#=81": PRINT TAB(
    34)"D =86": PRINT TAB( 34)"C#=91"
50 PRINT TAB( 34)"C =96": PRINT TAB( 34)"B =102
    ": PRINT TAB( 34)"A#=108": PRINT TAB( 34)"A
    =115": PRINT TAB( 34)"G#=121": PRINT TAB(
    34)"G =128": PRINT TAB( 34)"/2 FOR": PRINT TAB(
    34)"HIGHER": PRINT TAB( 34)"*2 FOR": PRINT TAB(
    34)"LOWER": POKE 33,32
60 FOR LOC = 770 TO 790: READ BYTE: POKE LOC,BYTE
    : NEXT
70 DATA 173,48,192,136,208,5,206,1,3,240,9,202,2
    08,245,174,0,3,76,2,3,96
80 HOME : INVERSE : VTAB 10: HTAB 9: PRINT "APPLE
    MUSIC WRITER": VTAB 12: HTAB 17: PRINT "BY":
    VTAB 14: HTAB 11: PRINT "BLAINE MATHIEU": NORMAL
90 FOR R = 1 TO 26: READ P,D: POKE 768,P: POKE 76
    9,D: CALL 770: NEXT R
100 DATA 172,75,162,75,152,75,144,75,108,100,1,30
    ,144,75,108,100,1,30,144,75,108,255,1,10,108,
    75,96,75,91,75,86,75,108,75,96,75,86,100
110 DATA 1,10,115,75,96,100,1,10,108,150,144,150,
    216,200,
120 HOME :L = 500: DIM N(L),D(L),N$(L),D$(L),NN(L
    ),ND(L)
130 REM MAIN ROUTINES START
140 VTAB 5: GOTO 190
150 I = I + 1
160 PRINT : INVERSE : PRINT "NOTE#"I: NORMAL : INPUT
    "NOTE,DURATION ";N$(I),D$(I): IF N$(I) = "" OR
    D$(I) = "" THEN N$(I) = N$(I - 1):D$(I) = D$(
    I - 1)
170 N(I) = VAL (N$(I)):D(I) = VAL (D$(I)): IF N(
    I) > 255 OR N(I) < 0 OR D(I) > 255 OR D(I) <
    0 THEN 160
180 POKE 768,N(I): POKE 769,D(I): CALL 770
190 ONERR GOTO 370
200 PRINT : INPUT "COMMAND? ";A$

```

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```
210 IF A$ = "A" AND I = L THEN PRINT "YOU ARE AT
    YOUR LIMIT!!!"; GOTO 200
220 IF A$ = "A" THEN 150
230 IF I < = 0 AND (A$ = "E" OR A$ = "P" OR A$ =
    "H" OR A$ = "N" OR A$ = "I" OR A$ = "S") THEN
    PRINT "SORRY, NO NOTES":I = 0: GOTO 190
240 IF A$ = "Q" THEN 450
250 IF A$ = "E" THEN 470
260 IF A$ = "P" THEN 390
270 IF A$ = "S" THEN 530
280 IF A$ = "D" THEN 1410
290 IF A$ = "L" THEN 990
300 IF A$ = "R" THEN I = 0
310 IF A$ = "C" THEN PRINT CHR$(4)"CATALOG"
320 IF LEFT$(A$,1) = "." THEN 1120
330 IF A$ = "H" THEN 1160
340 IF A$ = "N" THEN 1250
350 IF A$ = "I" THEN 1310
360 GOTO 190
370 PRINT "ERROR#" PEEK (222): GOTO 190
380 REM PLAY ROUTINE
390 PRINT : INPUT "STARTING NOTE (D=1): ";SN$:SN =
    VAL (SN$): IF SN$ = "" THEN SN = 1
400 PRINT : INPUT "ENDING NOTE (D=LAST): ";EN$:EN
    = VAL (EN$): IF EN$ = "" THEN EN = I
410 IF SN < 1 OR SN > I OR EN < 1 OR EN > I THEN
    390
420 PRINT : INVERSE : PRINT "START OF SONG": PRINT
    : NORMAL : FOR X = SN TO EN: POKE 768,N(X): POKE
    769,D(X): PRINT "NOTE#";X;: HTAB 10: PRINT "N
    OTE=";N(X);: HTAB 19: PRINT "DURATION=";D(X):
    CALL 770: NEXT X
430 INVERSE : PRINT : PRINT "END OF SONG": NORMAL
440 GOTO 190
450 TEXT : HOME : PRINT "GOODBYE": END
460 REM EDIT ROUTINE
470 INPUT "EDIT NOTE# ";NN: IF NN > I OR NN < 1 THEN
    470
480 PRINT : INVERSE : PRINT "NOTE#"NN;: NORMAL : PRINT
    " OLD: NOTE="N(NN);" DUR="D(NN)"
490 INPUT "NOTE,DURATION: ";N$(NN),D$(NN):N(NN) =
    VAL (N$(NN)):D(NN) = VAL (D$(NN)): IF N(NN)
    > 255 OR N(NN) < 0 OR D(NN) > 255 OR D(NN) <
    0 THEN 480
500 POKE 768,N(NN): POKE 769,D(NN): CALL 770
510 GOTO 190
520 REM SAVE ROUTINE
530 ONERR GOTO 860
```

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```
540 HOME : INPUT "FILENAME? ";FI$: IF FI$ = "" THEN
540
550 PRINT : INPUT "STARTING NOTE NUMBER: ";SN: IF
SN < 1 OR SN > I THEN 550
560 PRINT : INPUT "ENDING NOTE NUMBER: ";EN: IF E
N > I OR EN < 1 THEN 560
570 PRINT : INPUT "FOR FUTURE ADDITION? ";A$: IF
A$ < > "N" AND A$ < > "Y" THEN 570
580 IF A$ = "Y" THEN POKE 216,0:F2 = 1: GOTO 640

590 F2 = 0
600 PRINT : INPUT "STARTING LINENUMBER: ";SL: IF
SL > 63900 OR SL < 0 THEN 600
610 PRINT : INPUT "FULL LOADER PROGRAM? ";A$:A$ =
LEFT$ (A$,1): IF A$ < > "Y" AND A$ < > "N"
THEN 610
620 IF A$ = "Y" THEN FL = 1
630 IF A$ = "N" THEN FL = 0
640 PRINT : INPUT "IS EVERYTHING OK? ";A$: IF LEFT$
(A$,1) = "Y" AND F2 = 1 THEN 880
650 IF LEFT$ (A$,1) = "Y" AND F2 < > 1 THEN 670

660 GOTO 190
670 D$ = CHR$ (4): PRINT D$"OPEN"FI$
680 PRINT D$"DELETE"FI$
690 PRINT D$"OPEN"FI$
700 PRINT D$"WRITE"FI$
710 IF FL < > 1 THEN GOTO 740
720 PRINT SL;"FORLOC=770T0790:READBYTE:POKELOC, BY
TE:NEXT":SL = SL + 2
730 PRINT SL;"DATA173,48,192,136,208,5,206,1,3,24
0,9,202,208,245,174,0,3,76,2,3,96":SL = SL +
2
740 PRINT SL;"FORR=1TO";EN - SN + 1;":READP,D:POK
E768,P:POKE769,D:CALL770:NEXTR":SL = SL + 2
750 FOR Z = SN TO EN
760 N = N + 1: IF N = 20 THEN N = 1
770 IF N < > 1 THEN 810
780 PRINT
790 PRINT SL;"DATA";
800 SL = SL + 2
810 PRINT N(Z);",";D(Z);: IF N < > 19 THEN PRINT
",";
820 NEXT Z
830 PRINT
840 PRINT D$"CLOSE"
850 GOTO 190
860 PRINT : PRINT CHR$ (7);"ERROR#"; PEEK (222):
PRINT D$"CLOSE": GOTO 190
```

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```
870 REM 2ND SAVE ROUTINE
880 ONERR GOTO 980
890 D$ = CHR$ (4): PRINT D$"OPEN"FI$
900 PRINT D$"DELETE"FI$
910 PRINT D$"OPEN"FI$
920 PRINT D$"WRITE"FI$
930 FOR S = SN TO EN
940 PRINT N(S): PRINT D(S)
950 NEXT S
960 PRINT D$"CLOSE"
970 GOTO 190
980 REM LOAD ROUTINE
990 ONERR GOTO 1090
1000 INPUT "YOU WILL LOSE YOUR DATA, OK? ";OK$:OK
    $ = LEFT$(OK$,1): IF OK$ < > "Y" AND OK$ <
    > "N" THEN 1000
1010 IF OK$ = "N" THEN POKE 216,0: GOTO 190
1020 PRINT : INPUT "FILENAME: ";FI$: IF FI$ = "" THEN
    1020
1030 D$ = CHR$ (4): PRINT D$"VERIFY"FI$: PRINT D$
    "OPEN"FI$
1040 PRINT D$"READ"FI$
1050 FOR Z = 1 TO L
1060 INPUT N(Z): INPUT D(Z)
1070 IF N(Z) < = 255 AND D(Z) < = 255 THEN NEXT
    Z: POKE 216,0: PRINT D$"CLOSE":I = Z - 1: GOTO
    190
1080 PRINT : PRINT "INCOMPATIBLE FILE!!!": PRINT
    D$"CLOSE": POKE 216,0: GOTO 190
1090 PRINT D$"CLOSE": IF PEEK (222) = 5 THEN POKE
    216,0:I = Z - 1: GOTO 190
1100 PRINT : PRINT "ERROR#": PEEK (222): PRINT D$
    "CLOSE": GOTO 190
1110 REM HANDLE DOS COMMANDS
1120 ONERR GOTO 1140
1130 DC$ = RIGHT$(A$, LEN (A$) - 1): PRINT CHR$
    (4);DC$: POKE 216,0: GOTO 190
1140 PRINT "ERROR#" PEEK (222): PRINT CHR$ (4)"C
    LOSE": POKE 216,0: GOTO 190
1150 REM PRINTER ROUTINE
1160 PRINT : INPUT "PRINTER READY? ";A$: IF A$ <
    > "Y" AND A$ < > "N" THEN 1160
1170 IF A$ = "N" THEN 200
1180 PRINT : INPUT "STARTING NOTE TO BE PRINTED -
    - DEFAULT=1: ";ST$: IF ST$ = "" THEN ST$ = "
    1"
1190 PRINT : INPUT "ENDING NOTE TO BE PRINTED --
    DEFAULT=ALL: ";EN$: IF EN$ = "" THEN EN$ =
    STR$ (I)
```

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```
1200 ST = VAL (ST$):EN = VAL (EN$): IF ST < 1 OR
ST > I OR EN < 1 OR EN > I OR EN < ST THEN 11
80
1210 PRINT : INPUT "NAME OF SONG: ";FI$: IF FI$ =
"" THEN 1210
1220 PR# 1: PRINT : PRINT FI$: PRINT : FOR X = ST
TO EN: PRINT "NOTE#";X;: HTAB 10: PRINT "NOT
E=";N(X);: HTAB 19: PRINT "DURATION=";D(X): NEXT
X
1230 PRINT : PRINT "END OF SONG": PR# 0: GOTO 190

1240 REM NORMAL PLAY ROUTINE
1250 PRINT : INPUT "STARTING NOTE (D=1): ";SN$:SN
= VAL (SN$): IF SN$ = "" THEN SN = 1
1260 PRINT : INPUT "ENDING NOTE (D=LAST): ";EN$:E
N = VAL (EN$): IF EN$ = "" THEN EN = I
1270 IF SN < 1 OR SN > I OR EN < 1 OR EN > I THEN
1250
1280 FOR Z = SN TO EN: POKE 768,N(Z): POKE 769,D(
Z): CALL 770: NEXT Z
1290 GOTO 190
1300 REM INSERT ROUTINE
1310 POKE 216,0: PRINT : INPUT "INSERT BEFORE WHA
T NOTE? ";IB: IF IB < 1 OR IB > I THEN 1310
1320 PRINT : INPUT "HOW MANY NOTES TO INSERT? ";H
M: IF HM > I - I OR HM < 1 THEN 1320
1330 FOR Z = IB TO IB + HM - 1
1340 PRINT : INVERSE : PRINT "NOTE#"Z: NORMAL : INPUT
"NOTE,DURATION: ";NN(Z),ND(Z): IF NN(Z) < 0 OR
NN(Z) > 255 OR ND(Z) < 0 OR ND(Z) > 255 THEN
1340
1350 POKE 768,NN(Z): POKE 769,ND(Z): CALL 770
1360 NEXT Z
1370 FOR Z = I TO IB STEP - 1:N(Z + HM) = N(Z):D
(Z + HM) = D(Z): NEXT Z
1380 FOR Z = IB TO IB + HM - 1:N(Z) = NN(Z):D(Z) =
ND(Z): NEXT Z
1390 I = I + HM
1400 GOTO 190
1410 REM DELETE ROUTINE
1420 PRINT : INPUT "DELETE FROM NOTE (D=LAST): ";
DF$: IF DF$ = "" THEN I = I - 1: IF I = - 1 THEN
I = 0: GOTO 190
1430 IF DF$ = "" THEN 190
1440 PRINT : INPUT "TO NOTE: ";DT$:DF = VAL (DF$
):DT = VAL (DT$): IF DT < 1 OR DT > I OR DF <
1 OR DF > I OR DF > DT THEN 1420
1450 FOR Z = DT + 1 TO I:N(Z - (DT - DF + 1)) = N
(Z):D(Z - (DT - DF + 1)) = D(Z): NEXT Z
1460 I = I - (DT - DF + 1): GOTO 190
```

# Apple Shape Generator

---

J. F. Johnson

*Applesoft allows shapes to be manipulated from within a BASIC program, but the process of creating shapes and entering them into a shape table can be tedious and error-prone. This program simplifies the process, automatically performing all required binary-to-hex conversions and creating a shape table.*

Many of the shape-drawing routines currently available for the Apple allow a shape to be created within a given rectangular drawing area. Such techniques are fine for creating relatively small shapes. However, as the size of the shape increases, the amount of wasted space (that is, the number of bytes which are "off" and represent only the background) becomes considerable.

This program creates shapes using an approach explained in the Applesoft manual (Chapter 9). The head-to-tail vector method is used to initially define the shape. These vectors are then "unwrapped" and sequentially combined in pairs for conversion from individual binary codes into equivalent hexadecimal codes. Each hexadecimal byte represents one byte in the shape definition.

The shape is then added to a table in memory, and the table's index is updated. Shapes which would otherwise require as much as 8K thus need less than 1K.

You can do a number of things with the shape generator:

- Construct a shape table comprised of 1-255 shapes.
- Create a table with a maximum length of 6K.
- Alter any shape after it has been entered into the table, or add "buffer bytes" at the end of a shape definition so that it can be slightly enlarged relative to its original definition.
- Correct mistakes which occur while entering vectors during a shape definition.
- View all the shapes in the current table.
- Display any particular shape, with the effect of ROT and SCALE variations (using the game paddles) immediately displayed on the hi-res screen.
- BSAVE and then BLOAD and modify any shape table. Existing shapes can be changed, or new ones can be added

(assuming the table does not contain the maximum number of shapes originally designated).

- Erase existing shape tables to create new tables or load existing ones.

### Use an EXEC File to Initialize

Shape Generator is written in Applesoft. Program 2 creates a text file (named "Key Shape Loader") which reassigns the beginning-of-program pointer (104, 103) and then runs the program.

By EXECing the text file "Key Shape Loader," the required POKEs are completed and "Key Shape Maker," Program 1, runs automatically. Be sure to save Program 1 with the filename "Key Shape Maker."

The program is loaded at \$6001 (24577), just above the second hi-res page of graphics. The second hi-res page is used for the temporary storage of vectors that define the current shape. These vectors are then paired and converted into their equivalent hexadecimal code, with the resulting hex code defining the shape stored on the second hi-res page. If the shape is to be saved, the hex code is then transferred to the shape table. The creation and display of all shapes utilize the first hi-res page. The shape table is stored at \$800 (2048), and its length may not exceed \$2000 (8196) since the first hi-res page is used for display purposes.

### Execution

The user is initially prompted for the number of shapes (1–255) that will be entered into the table. Since extra shapes are invariably required at some future date, it is always better to enter a number larger than what is currently estimated. Since the table need not be completed at one setting, the partially constructed table can be BSAVED and then BLOADED at a future date. Additional shapes can then be added (up to the original number specified) or current shapes can be redefined.

The maximum number of shapes is then POKEd into \$801. Room for the shape table index (starting at \$802) is then allocated. The index stores the locations of all shapes relative to the start of the table (\$800). The index must contain two bytes for each stored shape. If the estimated number of shapes to be stored is later found to be too low, you'll be out of luck. Location \$800 initially contains a value of zero; it's incremented by one each time a shape is added to the table.



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The shapes are created using two sets of four keys. Plotting vectors are entered using the I, K, M, and J keys, while nonplotting vectors are entered using the E, D, X, and S keys. Both sets of keys are arranged on the keyboard in a north-east-south-west fashion. You can use your right-hand set for plotting and your left-hand set for nonplotting. The back arrow key (←) may be used to sequentially erase vectors starting with the last one entered, and is very useful for correcting any mistakes. The keystroke ! (Shift-1) terminates shape definition.

When drawing begins, a single-dot cursor is positioned on the first hi-res screen (it marks the point at which drawing will begin) and the shape is then displayed as it is constructed.

Any nonplotting vectors which cross any existing outline of the shape will result in the boundary being erased where the crossover occurs. However, when the final shape is displayed for verification, it will show the contiguous boundary that was originally constructed.

Also displayed during construction are the current X and Y coordinates of the cursor, the three-digit binary code of each vector as it is entered, and the maximum number of bytes which may be used to define the present shape.

When the definition of the shape is ended (by pressing !, or Shift-1), the keystroke vectors are converted to hexadecimal code and the resulting shape is displayed once more before being stored. If you decide to save it, it will be appended to the current table. The corresponding index locations will be updated, and location \$800 will be incremented by one. If the shape is not saved, the defining of additional shapes simply continues.

### Shape Table Commands

Several subroutines allow you to experiment with various shape table commands. That makes it much easier to explore the capabilities (as well as the limitations) of shapes within Applesoft and may facilitate inclusion of shape tables within programs. To use these subroutines, call item 1 (DISPLAY SHAPES IN CURRENT TABLE) from the main menu; then call item 2 (VIEW ONLY ONE SHAPE) from the subsequent menu and follow the prompts.

The SCALE command allows the expansion of a defined shape. Since the original shape was constructed using the

smallest SCALE value, figures can only be expanded using this command. You'll soon discover, however, that the contiguous boundary of a shape may become segmented when its size is enlarged through SCALEing; in fact, the shape can quickly become unrecognizable. That problem can usually be overcome by redefining the same shape boundary using a different sequence of plotting/nonplotting vectors. The ability to redefine any given shape will allow the user to experiment.

Rotations in the plane of the screen are controlled by the ROT command. An inverse relationship exists between the number of unique rotational values defined by the ROT command and the SCALE command. Increasing ROT from 0 to 64 will rotate it 360 degrees about the origin. As the value for SCALE increases from 0, more unique rotational values are recognized between the ROT values of 0 and 64; thus, the incremental rotational angle decreases. By making the original shape very small, and then expanding it using the SCALE command, a smaller angle of rotation can be realized between the ROT value of 0 and 64. The values for both of the commands may be varied for a chosen shape, with the effects on the shape displayed on the screen.

### Using the Shapes

To display the shapes from Applesoft, use either DRAW or XDRAW. XDRAW complements the current color of the shape at its present location and is very convenient for displaying and erasing shapes. DRAW requires that HCOLOR be changed from a value of 3 to 0 if the shape is to be drawn and then erased. These commands may also display the same shape differently. If any nonplotting vectors cross the boundary of plotting vectors in the original shape definition, then DRAW (HCOLOR=3) will display a contiguous shape.

XDRAW, however, effectively erases any regions of plotting/nonplotting vector overlap. This should be taken into consideration when defining shape boundaries. The shape display for verification purposes (prior to appending the shape to the current table) is displayed using DRAW(HCOLOR=3). During viewing of a shape with ROT and SCALE variations, the shape is drawn and erased using XDRAW.

Key Shape Maker creates a shape table starting at \$800 (2048) in RAM. It may be BLOADED into another region if there exists a conflict with the storage of the controlling

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Applesoft program, or one with a machine language program which must occupy this region.

There are two DOS entry points which store both the starting address and length of a BLOADed file. Since the user specifies the starting address of a binary file, only the length must be determined. This is accomplished in the following manner.

After BSAVEing your shape table to disk, BLOAD it back into memory. This may be done in direct mode or under Key Shape Maker control. If the shape table has been loaded by an Applesoft program, press the reset button. Then enter the following as a direct execution instruction:

```
PRINT PEEK(43616)+PEEK(43617)*256<ret>
```

The base ten number that appears on the screen immediately will be the length of the shape table (see Appendix E of the DOS manual, "DOS Entry Points And Schematics"). With that information, you have some flexibility in BLOADing the shape table into various regions of RAM. For example, a shape table of byte length 350 may be BLOADed at location 24577 (immediately above the second hi-resolution page) with the following Applesoft instruction:

```
100 PRINT CHR$(4)"BLOAD SHAPE TABLE-1, A24577,L350"
```

Finally, you must supply the location of the shape table. The pointer designating the beginning of the current shape table is located on the zero page of memory and consists of the locations \$E8 (232) and \$E9 (233). The integer value obtained by dividing the starting address by 256 is POKEd into 233, with the remainder POKEd into 232. For example,  $24577/256=96$ , with a remainder of 1, and would be POKEd as shown:

```
110 POKE 233,96: POKE 232,1
```

Your Applesoft program will then be able to use the shape table currently residing in RAM.

### Program 1. Key Shape Maker

```
6Ø REM TS=START OF SHAPE TABLE///VC=MARKER USE  
D IN DISPLAY OF 6 DIGITS REPRESENTING 2 VECTO  
RS///VS=MARKER FOR START OF TEMPORARY STORAGE  
FOR VECTOR TABLE AND ENSUING TEMPORARY STORA  
GE DERIVED SHAPE///16395=START OF TEMPORARY S  
HAPE TABLE
```

```

70 A$ = "PRESS ! TO STOP DRAWING SHAPE."
80 TS = 2048: POKE TS,0: VC = 16389: VS = 16396: LI =
  2050: MI = 2051: D$ = CHR$ (4): GOTO 4000
100 HCOLOR= 3: H PLOT X,Y: FOR J = 1 TO 20: NEXT J
  : HCOLOR= 0: H PLOT X,Y: X = PDL (0) / .913: Y =
  PDL (1) / 1.6: IF PEEK ( - 16287) > 127 OR
  PEEK ( - 16286) > 127 THEN RETURN
105 GOTO 100
110 S1 = INT (1 + PDL (0) * ( PEEK (TS) - 1) / 2
  40): ROT= 0: HCOLOR= 3: SCALE= 1: RETURN
115 S2 = INT (1 + PDL (0) * ( PEEK (TS) - 1) / 2
  40): RETURN
120 XDRAW S1 AT X,Y: V TAB 24: H TAB 1: CALL - 868
  : PRINT "SHAPE #"S1".";
125 GOSUB 115: IF PEEK ( - 16287) > 127 THEN RETURN
130 IF S2 < > S1 THEN XDRAW S1 AT X,Y: S1 = S2: GOTO
  120
135 GOTO 125
140 GOSUB 110
145 V TAB 5: H TAB 1: CALL - 868: PRINT "SHAPE #"S
  1".";
150 GOSUB 115: IF S2 < > S1 THEN S1 = S2: GOTO 1
  45
152 IF PEEK ( - 16287) > 127 THEN RETURN
154 GOTO 150
158 S1 = INT ( PDL (1) * 7 / 240): RETURN
159 S2 = INT ( PDL (1) * 7 / 240): RETURN
160 GOSUB 158
162 V TAB 10: H TAB 1: CALL - 868: PRINT "HCOLOR="
  S1".";
164 GOSUB 159: IF S2 < > S1 THEN S1 = S2: GOTO 1
  62
166 IF PEEK ( - 16286) > 127 THEN RETURN
168 GOTO 164
170 GOTO 166
172 R1 = PDL (0) / 3: S1 = PDL (1) / 3: RETURN
173 R2 = PDL (0) / 3: S2 = PDL (1) / 3: RETURN
174 GOSUB 172
175 HCOLOR= HC: ROT= R1: SCALE= S1: DRAW SH AT XI
  ,YI: V TAB 24: H TAB 1: CALL - 868: PRINT "ROT
  =" INT (R1) SPC( 8) "SCALE=" INT (S1);
176 GOSUB 173: IF R2 < > R1 OR S2 < > S1 THEN R
  1 = R2: S1 = S2: CALL 62450: GOTO 175
177 IF PEEK ( - 16287) > 127 OR PEEK ( - 16286)
  > 127 THEN RETURN
178 GOTO 176
200 POKE TS + 1, VAL (NS$): RETURN : REM MAXIMUM
  NUMBER OF SHAPES THAT CAN BE ENTERED INTO TH
  IS TABLE

```

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```
203 PA = 256 * PEEK (MI) + PEEK (LI) + TS: RETURN
205 PA = TS + 4 + 2 * VAL (NS#): RETURN : REM
    IS LOCATION IN TABLE WHERE FIRST SHAPE WILL B
    E SAVED
210 LS = TS + 2 * SH:MS = TS + 1 + 2 * SH:DD = 256
    * ( PEEK (MS + 2) - PEEK (MS)) + ( PEEK (LS
    + 2) - PEEK (LS)): RETURN
212 LI = TS + 2 * ( PEEK (TS) + 1):MI = LI + 1: RETURN
    : REM  INIT INDEX FOR TABLE THAT HAS BEEN LO
    ADED
215 LI = LI + 2:MI = MI + 2: RETURN : REM  INCREM
    ENT INDEX LOCATION FOR NEXT SHAPE
220 LI = LI - 2:MI = MI - 2: RETURN : REM  DECREM
    ENT INDEX LOCATION FOR FIRST SHAPE TO BE DRAW
    N IN LOADED OR ALTERED TABLE
225 IP = VS: RETURN : REM  INITIALIZE LOCATION WHE
    RE PLOTTED VECTORS ARE STORED TEMPORARILY UNT
    IL THEY ARE CONVERTED INTO A SHAPE
230 N = VS + 1:SL = VS + 1: RETURN : REM  INITIALI
    ZE TWO COUNTERS WHICH ARE USED DURING THE CON
    VERSION OF STORED VECTORS INTO A SHAPE
235 PA = TS + 256 * PEEK (MS) + PEEK (LS): RETURN
    : REM  LOCATION IN TABLE OF START OF NEXT SHA
    PE
240 POKE LI, INT (((PA - TS) / 256) - INT ((PA -
    TS) / 256)) * 256 + .5): POKE MI, INT ((PA -
    TS) / 256): RETURN : REM  POKE STARTING LOC
    ATION FOR GIVEN SHAPE IN APPROPRIATE INDEX LO
    CATION
250 A = 0:B = 0:C = 0: RETURN : REM  INITIALIZE A
    ,B,C TO ZERO
255 L = IP - VS:K = INT (L / 2) + INT ((L / 2 -
    INT (L / 2)) * 2 + .05): RETURN : REM  L=#BY
    TES CONTAINING VECTORS//K=#BYTES REQUIRED TO
    STORE SHAPE;1 SHAPE BYTE PER 2 VECTOR BYTES
260 POKE 233,64: POKE 232,9: POKE 16393,1: POKE 1
    6395,4: POKE 16396,0: RETURN : REM  DEFINE U
    NIT SHAPE TABLE WHERE TEMPORARILY DEFINED SHA
    PE EXISTS
265 POKE 233,8: POKE 232,0: RETURN : REM  LOCATIO
    N OF SHAPE TABLE
270 RS = PEEK (TS + 1) - PEEK (TS): RETURN : REM
    RS=# OF SHAPES THAT MAY STILL BE ENTERED IN
    TO SHAPE TABLE
299 REM  PLOT/ERASE POINT AT CURRENT X,Y UNTIL KE
    Y PRESS OCCURS.
```

```

300 XO = X:YO = Y: HCOLOR= 3: H PLOT XO,YO: FOR J =
  1 TO 20: NEXT J: HCOLOR= 0: H PLOT XO,YO: FOR
  J = 1 TO 20: NEXT J: IF PEEK ( - 16384) < 12
  8 THEN 300
310 HCOLOR= 3: POKE - 16368,0:Z = PEEK ( - 1638
  4): RETURN
324 REM PLOT PRESENT POINT IF ENTERED VECTOR IS
  A PLOT-THEN-MOVE VECTOR
325 HCOLOR= 3: H PLOT XO,YO: RETURN
329 REM ERASE PREVIOUS POINT PLOTTED
330 HCOLOR= 0: H PLOT XO,YO: RETURN
349 REM EVALUATE KEY PRESS IN TERMS OF NEW X, Y C
  OORDINATES.
350 F1 = 0
352 IF Z = 73 OR Z = 69 THEN Y = Y - 1: GOSUB 362
  : RETURN : REM MOVE UP
354 IF Z = 75 OR Z = 68 THEN X = X + 1: GOSUB 364
  : RETURN : REM MOVE RIGHT
356 IF Z = 77 OR Z = 88 THEN Y = Y + 1: GOSUB 366
  : RETURN : REM MOVE DOWN
358 IF Z = 74 OR Z = 83 THEN X = X - 1: GOSUB 368
  : RETURN : REM MOVE LEFT
360 F1 = 1: RETURN : REM FLAG F1 SET TRUE IF NO
  U,R,D,L MOVE
362 IF Y < 0 THEN Y = 0:F1 = 1
363 RETURN
364 IF X > 279 THEN X = 279:F1 = 1
365 RETURN
366 IF Y > 159 THEN Y = 159:F1 = 1
367 RETURN
368 IF X < 0 THEN X = 0:F1 = 1
369 RETURN
399 REM EVALUATE 3 DIGIT BINARY EQUIVALENT OF IN
  DIVIDUAL VECTOR
400 F1 = 0: IF Z = 73 THEN A = 1:B = 0:C = 0: RETURN
402 IF Z = 75 THEN A = 1:B = 0:C = 1: RETURN
404 IF Z = 77 THEN A = 1:B = 1:C = 0: RETURN
406 IF Z = 74 THEN A = 1:B = 1:C = 1: RETURN
408 IF Z = 69 THEN A = 0:B = 0:C = 0: RETURN
410 IF Z = 68 THEN A = 0:B = 0:C = 1: RETURN
412 IF Z = 88 THEN A = 0:B = 1:C = 0: RETURN
414 IF Z = 83 THEN A = 0:B = 1:C = 1: RETURN
418 F1 = 1: RETURN
424 REM PRINT PRESENT COORDINATES OF X,Y
425 VTAB 21: HTAB 1: CALL - 868: PRINT "X="X,"Y=
  "Y: RETURN

```

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```
449 REM ERASE CURRENT POINT AND MOVE BACK ONE PO
INT
450 PP = PEEK (IP): IF IP = VS THEN RETURN : REM
CAN'T ERASE PAST ORIGIN OF SHAPE
455 IF PP = 0 OR PP = 4 THEN Y = Y + 1: GOSUB 475
: RETURN
460 IF PP = 1 OR PP = 5 THEN X = X - 1: GOSUB 475
: RETURN
465 IF PP = 2 OR PP = 6 THEN Y = Y - 1: GOSUB 475
: RETURN
470 IF PP = 3 OR PP = 7 THEN X = X + 1: GOSUB 475
: RETURN
475 XO = X:YO = Y: GOSUB 330: POKE IP,0:IP = IP -
1: RETURN
499 REM POKE VECTOR INTO RAM LOCATION IP
500 IP = IP + 1: POKE IP,4 * A + 2 * B + C: RETURN

509 REM POKE BINARY EQUIVALENT OF VECTOR MOVE
510 P(1 + I * 3) = A:P(2 + I * 3) = B:P(3 + I * 3)
= C
515 IF I = 1 THEN FOR J = 0 TO 5: POKE 1872 + J,
48: NEXT J: FOR J = 0 TO 2: POKE 1875 + J,P(4
+ J) + 48: NEXT J: RETURN
520 FOR J = 0 TO 2: POKE 1872 + J,P(1 + J) + 48: NEXT
J: RETURN
525 FOR J = 1 TO 6:P(J) = 0: NEXT J: RETURN
600 HGR2 : HGR : SCALE= 1: ROT= 0: HCOLOR= 3:XX =
139:YY = 80:X = XX:Y = YY: RETURN : REM HI
-RES INITIALIZATION
700 BL = 8190 - PA:DI = 24576 - 16396:VL = DI: RETURN
: REM NEW TABLE BYTE LIMITS
710 NS = PEEK (2048):LI = TS + 2 * (NS + 1):MI =
TS + 1 + 2 * (NS + 1):PA = TS + 256 * PEEK (
MI) + PEEK (LI)
720 BL = 8190 - PA: IF DI < 2 * (8190 - PA) THEN V
L = DI: RETURN
730 VL = 2 * (8190 - PA): RETURN
765 F1 = 0: IF VL < 100 THEN F1 = 1
767 RETURN
770 F2 = 0: VTAB 21: PRINT "THERE ARE "8190 - PA"
BYTES REMAINING FOR MORE": PRINT "SHAPES IN C
URRENT TABLE IF YOU HAVE NOT CONSTRUCTED THE
LAST SHAPE."
775 IF 8190 - PA < 100 THEN PRINT "NO MORE SHAPE
S MAY BE ADDED TO CURRENT TABLE.":F2 = 1
780 RETURN
800 F3 = 0:VL = VL - 1: VTAB 21: HTAB 33: CALL -
868: PRINT VL
```

```
805 IF VL < 200 THEN VTAB 22: HTAB 1: PRINT "ONLY
Y "VL - 190" MOVES LEFT.": FOR J = 1 TO 1000
: NEXT J: HTAB 1: CALL - 868: IF VL < = 191
THEN F3 = 1
810 RETURN
975 VTAB 24: HTAB 5: CALL - 958: PRINT "PRESS AN
Y LETTER TO CONTINUE.": GET Z$:J = FRE (0):
RETURN
999 REM INITIALIZE SHAPE TABLE PARAMETERS
1000 TEXT : HOME : PRINT TAB( 5);"THE NUMBER OF
SHAPES THAT MAY BE ENTERED IN A SHAPE TABL
E IS IN THE RANGE OF 1-255. IT IS ALWAYS BEST
TO ALLOW EXTRA ROOM FOR ADDITIONAL SHAPES
YOU MAY WISH TO INCLUDE IN THE FUTURE."
1010 INPUT " ENTER A NUMBER BETWEEN 1 AND 255
, THEN PRESS RETURN.":NS$: IF VAL (NS$) < 1
OR VAL (NS$) > 255 THEN 1000
1020 GOSUB 200: REM POKE MAX # OF SHAPES THAT C
AN BE ENTERED INTO THIS TABLE
1030 GOSUB 205: REM INITIAL RAM LOCATION FOR FIR
ST SHAPE
1040 GOSUB 240: REM START OF FIRST SHAPE
1050 GOSUB 700: REM BL,DI,VL
1055 RETURN
1060 GOSUB 250: REM INITIALIZE COMPONENTS OF VEC
TOR MOVE
1070 GOSUB 600: REM HI-RES INIT
1080 RETURN
1200 TEXT : HOME : PRINT TAB( 5);"BEFORE ACTUALL
Y DRAWING A SHAPE, THE BLINKING DOT MAY BE
MOVED TO ANY POSITION ON THE SCREEN. USE
THE E,S,D AND X KEYS FOR DOT POSITIONING ON
LY."
1205 PRINT "PRESS ! WHEN READY TO DRAW A SHAPE."
1210 PRINT TAB( 5);"THE SHAPE YOU ARE TO DRAW MA
Y THEN BE COMPRISED OF PLOTTING AS WELL AS N
ONPLOTTING VECTORS. USE THE E,S,D AND X KE
YS FOR NONPLOTTING VECTORS, AND THE I,J,K A
ND M KEYS FOR PLOTTING VECTORS."
1220 PRINT "THE LEFT ARROW KEY (<-) MAY BE USED T
O ERASE MISTAKES, AND THE ! KEY TO TERM- IN
ATE THE SHAPE.": PRINT
1240 PRINT TAB( 1);"-NONPLOTTING-"; SPC( 9);"-PL
OTTING-"
1250 PRINT TAB( 2);"E-MOVE UP" SPC( 7)"I-PLOT TH
EN MOVE UP": PRINT TAB( 2);"S-MOVE LEFT" SPC(
5)"J-PLOT THEN MOVE LEFT"
```



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```
1260 PRINT TAB( 2);"D-MOVE RIGHT" SPC( 4)"K-PLOT
    THEN MOVE RIGHT": PRINT TAB( 2);"X-MOVE DOW
    N" SPC( 5)"M-PLOT THEN MOVE DOWN"
1270 PRINT TAB( 12);"<- ERASER": PRINT TAB( 12
    );"! STOP"
1280 GOSUB 975
1285 HOME : VTAB 23: PRINT "PRESS ! WHEN YOU ARE
    READY TO DRAW YOUR SHAPE.": GOSUB 600: GOSUB
    425
1290 GOSUB 300: IF Z = 33 THEN XI = X:YI = Y: HOME
    : RETURN
1300 GOSUB 350: GOSUB 425: GOTO 1290
1350 GOSUB 225: GOSUB 425: GOSUB 525:I = 0: GOSUB
    515: VTAB 22: HTAB 1: PRINT A$: IF NOT F5 THEN
    GOSUB 720: GOSUB 800: IF F3 THEN RETURN
1360 I = 1 - I: REM TOGGLE
1370 IF F5 THEN HTAB 1: VTAB 24: CALL - 868: PRINT
    "YOU HAVE UP TO "2 * DD - 3 - (IP - 16394)" M
    OVES LEFT.": IF 2 * DD - 3 - (IP - 16394) =
    0 THEN RETURN
1380 GOSUB 300: IF Z = 33 THEN RETURN
1390 IF Z = 8 THEN GOSUB 450: GOSUB 425: GOTO 13
    60: REM ERASE LAST MOVE
1400 IF Z = 69 AND I = 0 THEN VTAB 22: HTAB 1: PRINT
    "THIS MOVE HAS NO EFFECT ON THE SHAPE.": FOR
    J = 1 TO 2000: NEXT J: HTAB 1: CALL - 868: PRINT
    A$: GOTO 1370
1405 GOSUB 350: IF F1 THEN 1370: REM EVAL KEY P
    RESS FOR NEW X,Y : SET FLAG F1 IF ILLEGAL
1410 GOSUB 400: REM EVALUATE 3 DIGIT BINARY EQUI
    VALENT OF KEY PRESS
1420 GOSUB 500: REM SAVE VECTOR MOVE WITH POKE
1430 GOSUB 510: REM DISPLAY 'ACCUMULATOR' WITH T
    EXT POKES
1440 GOSUB 425: REM PRINT NEW X,Y COORDS TO SCR
    EEN
1450 IF Z > 72 AND Z < 78 THEN GOSUB 325: REM
    PLOT POINT ON HI-RES FOR APPROPRIATE PLOTTING
    VECTOR
1455 IF NOT F5 THEN GOSUB 800: IF F3 THEN RETURN

1460 GOTO 1360
1500 GOSUB 230
1510 GOSUB 255
1520 FOR J = 1 TO K: POKE N,( PEEK (SL) + 8 * PEEK
    (SL + 1)):SL = SL + 2:N = N + 1: NEXT J: POKE
    N,0: REM POKE SHAPE 'ON TOP OF' VECTORS
1530 GOSUB 260: HGR : HCOLOR= 3: DRAW 1 AT XI,YI:
    GOSUB 265
```

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---

```
1540 HOME : VTAB 21: PRINT "DO YOU WISH TO SAVE T
HIS SHAPE (Y/N)?":: GET Z$: IF Z$ < > "Y" AND
Z$ < > "N" THEN 1540
1545 IF F5 THEN RETURN
1550 IF Z$ = "N" THEN RETURN
1560 FOR J = N + 1 TO N + 2 + .25 * (N - VS + 1):
POKE J,0: NEXT J: REM EXPAND SHAPE 25% BY
ADDING ZEROS AT END
1570 N = J - 1: FOR J = VS + 1 TO N: POKE PA, PEEK
(J):PA = PA + 1: NEXT J: REM TRANSFER SHAPE
FROM TEMPORARY LOCATION TO SHAPE TABLE
1580 NS = PEEK (TS):NS = NS + 1: POKE TS,NS: REM
INCREASE # SHAPES IN INDEX BY 1
1590 GOSUB 215: GOSUB 240: REM POKE DATA INTO T
HIS INDEX LOCATION///INCREMENT INDEX LOCATION
OF NEXT SHAPE
1610 RETURN
1700 GOSUB 600: HOME : VTAB 21: PRINT "USE THE GA
ME PADDLES TO POSITION THE DOTAT WHICH POINT
THE SHAPE WILL BE DRAWN. PRESS EITHER BUTTON
WHEN READY TO VIEW SHAPES.";
1720 X = 140:Y = 80: GOSUB 100:NS = PEEK (2048): HOME
: VTAB 21: PRINT "USE THE X GAME PADDLE TO VI
EW ALL SHAPESIN CURRENT TABLE. PRESS BUTTON
WHEN FINISHED VIEWING.": GOSUB 110: GOSUB
120: RETURN
1750 TEXT : HOME : PRINT TAB( 5);"THE FOLLOWING
SEQUENCE WILL BE FOLLOWED IN VIEWING A S
HAPE."
1755 PRINT : PRINT "1) INPUT SHAPE NO. USING X GA
ME PADDLE.": PRINT : PRINT "2) INPUT HCOLOR U
SING Y GAME PADDLE.": PRINT : PRINT "3) MOVE
SHAPE TO DESIRED POSITION.": PRINT : PRINT "4
) USE X PADDLE TO VARY ROT, AND Y P
ADDLE TO VARY SCALE.": GOSUB 975
1760 HOME : PRINT TAB( 5);"USE THE X GAME PADDLE
TO CHOOSE YOURSHAPE NO. PRESS THE PADDLE'S
BUTTON WHEN FINISHED.": GOSUB 140:SH = S1
1765 PRINT : PRINT TAB( 5);"INPUT THE HCOLOR USI
NG THE Y PADDLE.PRESS ITS BUTTON WHEN FINISHE
D.": GOSUB 160:HC = S1
1770 HGR : HOME : VTAB 21: PRINT TAB( 5);"USE TH
E GAME PADDLES TO LOCATE THE POINT WHERE THE
SHAPE WILL BE DRAWN. PRESS EITHER BUTTON
WHEN FINISHED.": GOSUB 100:XI = INT (X):YI =
INT (Y)
```

## 5: Sound and Graphics

---

```
1775 HOME : VTAB 21: PRINT TAB( 5);"USE PADDLES
    TO VARY ROTATION (X) ANDSCALE (Y). PRESS EIT
    HER BUTTON TO STOP.": VTAB 23: PRINT "SHAPE #
    "SH SPC( 3)"HCOLOR="HC SPC( 3)"X="XI SPC( 3)"
    Y="YI: GOSUB 174: RETURN
1800 FOR J = N - VS + 1 TO DD:N = N + 1: POKE N,0
    : NEXT J
1810 N = VS + 1:J = 256 * PEEK (MS) + PEEK (LS) +
    TS: FOR K = 1 TO DD - 1: POKE J, PEEK (N):J =
    J + 1:N = N + 1: NEXT K: RETURN
3500 GOSUB 1000
3501 GOSUB 1060: REM ENTRY FOR ADDING TO EXISTIN
    G TABLE
3502 HOME : GOSUB 770: GOSUB 975: IF F2 THEN RETURN

3505 GOSUB 270: HOME : TEXT : PRINT RS" SHAPES MA
    Y BE ADDED TO THE CURRENT": PRINT "TABLE WHIC
    H CONTAINS "; PEEK (2048);" SHAPES.": GOSUB 9
    75
3510 IF NOT RS THEN 3575
3515 HOME : PRINT TAB( 5);"DO YOU WISH TO DRAW A
    SHAPE": PRINT "Y/N?": GET Z$: IF Z$ < > "Y
    " AND Z$ < > "N" THEN 3515
3520 IF Z$ = "N" THEN 3575
3525 GOSUB 1200
3530 GOSUB 1350
3535 GOSUB 1500
3540 GOTO 3502
3575 RETURN
3650 GOSUB 8000: ONERR GOTO 20000
3660 PRINT : PRINT D$"BLOAD"NA$",A"TS: GOSUB 270:
    GOSUB 212: GOSUB 203: GOSUB 700: POKE 216,0:
    RETURN
3670 HOME : PRINT TAB( 5);"YOUR FILE NAME LENGTH
    IS ZERO. DO YOU STILL WISH TO BLOAD A SHAP
    E TABLE FROM DISKETTE (Y/N)?: GET Z$: IF Z
    $ < > "Y" AND Z$ < > "N" THEN 3670
3680 IF Z$ = "N" THEN RETURN
3690 IF Z$ = "Y" THEN 3650
4000 HOME : IF PEEK (TS) > 0 THEN 4100
4010 PRINT TAB( 5);"PRESS THE NUMBER OF YOUR CHO
    ICE.": PRINT : PRINT "1) DRAW SHAPES/CONSTRUC
    T A SHAPE TABLE.": PRINT "2) BLOAD A SHAPE TA
    BLE THAT HAS BEEN CONSTRUCTED WITH THIS
    ROUTINE.": PRINT "3) QUIT."
4014 GET Z$: IF VAL (Z$) < 1 OR VAL (Z$) > 3 THEN
    HOME : GOTO 4010
4016 IF Z$ = "3" THEN 30000
4020 ON VAL (Z$) GOSUB 3500,3650
```

## 5: Sound and Graphics

---

```
4030 GOTO 4000
4100 HOME : PRINT TAB( 5);"PRESS THE NUMBER OF Y
OUR CHOICE.": PRINT
4105 PRINT : PRINT "1) DISPLAY SHAPES IN CURRENT
TABLE.": PRINT : PRINT "2) ADD SHAPES TO CURR
ENT TABLE.": PRINT : PRINT "3) CHANGE A SHAPE
IN CURRENT TABLE."
4110 PRINT : PRINT "4) BSAVE CURRENT TABLE TO DIS
KETTE.": PRINT : PRINT "5) DELETE TABLE CURRE
NTLY IN MEMORY.": PRINT : PRINT "6) QUIT.": PRINT

4120 GET Z$: IF VAL (Z$) < 1 OR VAL (Z$) > 6 THEN
4100
4130 IF Z$ = "6" THEN 30000
4150 HOME : ON VAL (Z$) GOSUB 5200,5400,5600,580
0,6000
4160 GOTO 4000
5200 TEXT : HOME : IF PEEK (TS) = 0 THEN PRINT
"THESE ARE NO SHAPES IN TABLE.": GOSUB 975: RETURN

5205 GOSUB 265: PRINT TAB( 5);"PRESS THE NUMBER
OF YOUR CHOICE.": PRINT : PRINT "1) VIEW ALL
SHAPES.": PRINT : PRINT "2) VIEW ONLY ONE SHA
PE.": PRINT : PRINT "3) RETURN TO MAIN MENU."

5210 GET Z$: IF VAL (Z$) < 1 OR VAL (Z$) > 3 THEN
5200
5215 IF Z$ = "3" THEN RETURN
5220 ON VAL (Z$) GOSUB 1700,1750: GOTO 5200
5400 GOSUB 3501: RETURN
5600 TEXT : HOME : IF PEEK (TS) = 0 THEN PRINT
TAB( 5);"THERE IS NO TABLE CURRENTLY IN
MEMORY.": GOSUB 975: RETURN
5610 PRINT TAB( 5);"THERE ARE " PEEK (2048)" SHA
PES IN TABLE.": INPUT " ENTER THE NUMBER O
F THE SHAPE YOU WISH TO CHANGE, OR A ! TO R
ETURN TO THE MAIN MENU.":SH$: IF SH$ = "!" THEN
F5 = 0: RETURN
5620 SH = VAL (SH$): IF SH < 1 OR SH > PEEK (TS)
THEN 5600
5630 F5 = 1: GOSUB 210: GOSUB 1200: GOSUB 1350: GOSUB
1500
5640 IF Z$ = "Y" THEN GOSUB 1800
5660 GOTO 5600
5800 IF PEEK (TS) = 0 THEN PRINT "THESE ARE NO
SHAPES IN TABLE.": GOSUB 975: RETURN
```

## 5: Sound and Graphics

---

```
5805 PRINT "IF YOU WISH TO SAVE THIS TABLE ON A
      DIFFERENT DISKETTE, PUT IT IN THE DRIVE AT
      THIS TIME.": PRINT : PRINT "PUT THE UTILITY
      DISKETTE BACK INTO THE DRIVE AFTER THE DISK
      DRIVE'S RED LIGHT GOES OFF.": GOSUB 975: GOSUB
      8000: PRINT
5810 PRINT : PRINT D$"BSAVE"NA$",A"TS",L"PA - TS:
      RETURN
5820 HOME : PRINT TAB( 5);"YOUR FILE NAME LENGTH
      IS ZERO. DO YOU STILL WISH TO SAVE THE SHA
      PE TABLE THAT IS CURRENTLY IN MEMORY (Y/N)?"
      ;: GET Z$: IF Z$ < > "Y" AND Z$ < > "N" THEN
      5820
5830 IF Z$ = "N" THEN RETURN
5840 GOTO 5800
6000 HOME : PRINT TAB( 5);"TYPE THE WORD ";: FLASH
      : PRINT "DELETE";: NORMAL : PRINT " TO DESTRO
      Y": PRINT "THE SHAPE TABLE THAT IS CURRENTLY
      IN MEMORY. TYPE ";: FLASH : PRINT "SAVE";
6002 NORMAL : PRINT " IF YOU DO NOT WISH TODestro
      Y THE SHAPE TABLE THAT CURRENTLY IS IN MEMOR
      Y."
6005 PRINT : INPUT " PRESS THE RETURN KEY AFT
      ER YOUR CHOSEN ENTRY -> ";Z$
6010 IF Z$ < > "DELETE" AND Z$ < > "SAVE" THEN
      6000
6020 IF Z$ = "DELETE" THEN RUN
6030 RETURN
8000 HOME : PRINT TAB( 5);"ENTER THE NAME OF THE
      TABLE, THEN PRESS RETURN. THE TOTAL LENGT
      H CAN NOT EXCEED 30 CHARACTERS, AND THE FIRST
      CHARACTER MUST BE A LETTER."
8005 NA$ = "":X = 2:Y = 6: HTAB X: VTAB Y
8010 GET Z$
8020 IF LEN (NA$) = 0 AND ASC (Z$) < 65 OR LEN
      (NA$) = 0 AND ASC (Z$) > 90 THEN VTAB 10: HTAB
      1: PRINT "THE FIRST CHARACTER MUST BE A LETTE
      R.": FOR I = 1 TO 1500: NEXT I: HTAB 1: CALL
      - 868: HTAB X: VTAB Y: GOTO 8010
8030 IF Z$ = "," THEN VTAB 10: HTAB 1: PRINT "DO
      NOT USE ANY COMMAS";: FOR I = 1 TO 1500: NEXT
      I: HTAB 1: CALL - 868: HTAB X: VTAB Y: GOTO
      8010
8040 IF ASC (Z$) = 8 AND LEN (NA$) > 1 THEN X =
      X - 1: HTAB X: CALL - 868:NA$ = LEFT$ (NA$,
      LEN (NA$) - 1): GOTO 8010
8050 IF ASC (Z$) = 8 AND LEN (NA$) = 1 THEN X =
      X - 1: HTAB X: CALL - 868:NA$ = "": GOTO 801
      0
```

```
8055 IF ASC (Z$) = 13 OR LEN (NA$) > 29 THEN RETURN
8060 PRINT Z$;:NA$ = NA$ + Z$:X = X + 1: HTAB X: GOTO
    8010
8070 IF ASC (Z$) = 13 THEN RETURN
20000 ER = PEEK (222):LN = PEEK (218) + PEEK (2
    19) * 256
20010 IF LN = 3660 THEN 21000: REM FILE NOT FOU
    ND ERROR WHEN ATTEMPTING TO LOAD A SHAPE TABL
    E
20020 IF ER = 11 AND LN = 5810 THEN PRINT "FIRST
    CHARACTER IN FILE NAME MUST BE A LETTER,
    AND NO COMMAS MAY APPEAR IN THE NAME. PRES
    S ANY KEY TO CONTINUE.": GET Z$:Z$ = "4": GOTO
    4150
20050 STOP
21000 POKE 34,7: HOME : PRINT TAB( 5);"YOUR INPU
    T FILE NAME DOES NOT EXIST ON DISKETTE. DO Y
    OU WISH TO SEE A CATALOG LISTING OF THE
    DISKETTE THAT IS CURRENTLY IN THE DRIVE (Y/N)
    ?": POKE 34,0
21010 GET Z$: IF Z$ < > "Y" AND Z$ < > "N" THEN
    21000
21020 IF Z$ = "N" THEN GOTO 21050
21030 PRINT : PRINT D$"CATALOG"
21040 PRINT : PRINT TAB( 5);"PRESS ANY LETTER TO
    CONTINUE.": GET Z$
21050 POKE 216,0: GOTO 4000
30000 END
```

### Program 2. Key Shape Loader Maker

```
10 D$ = CHR$ (4)
15 PRINT D$"MON C,I,0"
20 PRINT D$"OPEN KEY SHAPE LOADER"
30 PRINT D$"WRITE KEY SHAPE LOADER"
40 PRINT "POKE 104,96"
50 PRINT "POKE 103,1"
60 PRINT "POKE 24576,0"
70 PRINT "RUN KEY SHAPE MAKER"
80 PRINT D$"CLOSE KEY SHAPE LOADER"
90 END
```

# Apple Hi-Res Painter

---

James Totten

*“Hi-Res Painter” is a graphics editor for use with a 32K Apple. It lets you use any one of six colors (or combine several colors into new ones); select from three different drawing pens; label pictures with upper- and lowercase lettering; color in squares and rectangles; and more. A color monitor is desirable but not required.*

When manually using the Apple’s hi-res graphics, a lot of work is required to get even modest results. Since I use the graphics quite often (they are one reason I bought the computer), I didn’t like spending hours to draw a fairly impressive title page, chart, or other picture. I needed a useful graphics utility, and “Hi-Res Painter” was the result.

## Menu Options

Hi-Res Painter runs from four menus: the main menu, the accessory menu, the disk menu, and the picture menu.

When you start, you automatically get the main menu. From there you can go to any of the other menus simply by pressing the first letter of its name. That letter is highlighted on the screen.

Pressing A will take you to the accessory menu. There, you can choose from Print, Fill, Keyboard, and Main. The Print option will work only for those who own either a Trendcom or Silentype printer.

However, the Fill option works for everyone. Select two points on the screen, one at the upper-left corner of the square you want to fill, and the other at the lower-right corner. Presto! The keyboard option lets you change from paddle or joystick control to keyboard control. With keyboard control, move the pen with the I, J, K, and M keys, as well as the U, N, O and comma keys. Use the Main option to return to the main menu.

The next menu is the disk menu, called by pressing D. It lets you Name, Delete, Load, or Rename any picture; Save will save the picture currently on the screen. Again, Main will return you to the main menu.

The final menu, the picture menu, is called by pressing P. The available options are View, Label, Drop (called by pressing

B), Color, Draw, Erase, Pens, and Main. The first option gives you a complete view (without text) of the graphics screen that you are working on; if you use it, remember to press M to get back to the main menu. Label will let you do just that, asking you for a date, name, or whatever, which is then transferred to the graphics screen.

The Drop option fills the screen (rather quickly) with a color of your choice. Color will allow you to choose a new color. Press the first letter of each as in the menu selections.

Use of Draw is obvious. To draw continuous lines simply move the cursor. You can also draw lines radiating from a single point. Experiment with your joysticks or paddles to get a feel for this option's many capabilities.

Use of Erase is straightforward, too. However, a note of warning is in order. If a picture is erased, it cannot be recalled unless it is on disk.

The Pens option, used with Draw, is actually two options in one. With it you can change the size of your pen (press 1, 2, or 3 and watch the screen), as well as turn your pen on or off. And again, pressing M returns you to the main menu. You can draw using paddles or a joystick, or you can switch the controls to use the keyboard.

To produce the most interesting designs, do not be afraid to try some experimentation. Fantastic pictures can be drawn much more easily than you might expect, and you'll soon find that this program is bringing out talents you never knew you had.

### Hi-Res Painter

```
20 LOMEM: 24576: ONERR GOTO 1045
21 DIM PX(2),PY(2),C$(6),P$(1)
25 FOR L = 1 TO 4:MX(L) = 0:MY(L) = 0: NEXT L:D$ =
    CHR$(4):C = 3:P = 0:BC = 0
30 KI = - 16384:RK = - 16368:B0 = - 16287:B1 =
    - 16286:TG = - 16301:FG = - 16302
35 P$(0) = "OFF":P$(1) = "ON":C$(1) = "GREEN":C$(2)
    ) = "PINK":C$(3) = "WHITE"
40 C$(4) = "BLACK":C$(5) = "ORANGE":C$(6) = "LT.BL
    UE":I = 1:P$ = "NOT NAMED"
41 IF PEEK (233) < > 64 THEN PRINT D$"BLOOD CH
    ARACTERS/SH2": POKE 232,0: POKE 233,64
42 SCALE= 1: ROT= 0:X = 139:Y = 80
```



## 5: Sound and Graphics

---

```
43 TEXT : HOME : NORMAL : VTAB 10: PRINT TAB( 11
   )"THE HI-RES PAINTER": PRINT TAB( 7)"--(
   )--": PRINT TAB( 11)"BY JAME
   S R. TOTTEN"
44 POKE RK,0: VTAB 24: PRINT "<< TO BEGIN PUSH AN
   Y KEY EXCEPT RESET >>"
45 IF PEEK (KI) < 128 THEN 45
46 POKE RK,0
50 HGR : HCOLOR= C: POKE TG,0: POKE 34,20: HOME
55 PRINT "PAINTER MENU NUMBER 1 (MAIN)": PRINT
60 PRINT "A)CCESSORY D)ISKETTE P)ICTURE >";
   : GET K$
65 IF K$ = CHR$ (27) THEN POKE RK,0: POKE 34,0:
   TEXT : HOME : END
70 IF K$ = "P" THEN 100
75 IF K$ = "A" THEN 450
80 IF K$ = "D" THEN 300
85 POKE RK,0: HOME : GOTO 55
100 POKE RK,0: HOME
105 PRINT "PAINTER MENU NUMBER 4 (PICTURE)": PRINT
110 PRINT "(V)IEW L)ABEL B)DROP C)OLOR
   D)RAW E)RASE P)ENS M)AIN >"; GET K$
115 IF K$ = "M" THEN 85
120 IF K$ = CHR$ (27) THEN POKE RK,0: POKE 34,0
   : TEXT : HOME : END
125 IF K$ = "E" THEN HGR : BC = 0: GOTO 100
130 IF K$ = "V" THEN 145
132 IF K$ = "C" THEN 150
134 IF K$ = "B" THEN 240
136 IF K$ = "D" THEN 185
138 IF K$ = "P" THEN 164
140 IF K$ = "L" THEN 218
142 POKE RK,0: HOME : GOTO 105
145 POKE FG,0
146 IF PEEK (KI) > 127 THEN POKE TG,0: GOTO 100
147 GOTO 146
150 POKE RK,0: HOME : PRINT "CURRENT COLOR
   : "; INVERSE : PRINT C$(C): NORMAL : PRINT
152 PRINT "G)REEN O)RANGE W)HITE
   B)LACK L)T.BLUE P)INK >"; GET K$
154 IF K$ = "G" THEN C = 1: GOTO 100
155 IF K$ = "P" THEN C = 2: GOTO 100
156 IF K$ = "W" THEN C = 3: GOTO 100
158 IF K$ = "B" THEN C = 4: GOTO 100
159 IF K$ = "O" THEN C = 5: GOTO 100
160 IF K$ = "L" THEN C = 6: GOTO 100
162 GOTO 150
```

```

164 XC = INT ( PDL (0));YC = INT ( PDL (1))
165 POKE RK,0: HOME : PRINT "PEN OPERATIONS": PRINT

166 PRINT "S)ET CURSOR SIZE      T)URN ON/OFF  >";:
    GET K$
167 IF K$ = "S" THEN 172
168 IF K$ < > "T" THEN 165
169 P = P + 1: IF P > 1 THEN P = 0
170 HOME : PRINT : PRINT "PEN IS NOW "P$(P): FOR
    L = 1 TO 300: NEXT L
171 GOTO 100
172 POKE RK,0: HOME : PRINT "TYPE A NUMBER FROM 1
    TO 3 FOR CURSOR      SIZE (1=SMALLEST). CURSOR
    IS SHOWN ON  SCREEN. WHEN DONE, PUSH RETURN
    . >";: GET K$
174 IF K$ = CHR$ (13) THEN 100
176 IF K$ = "1" THEN CS = 0
177 IF K$ = "2" THEN CS = 4
178 IF K$ = "3" THEN CS = 8
179 HCOLOR= BC: FOR L = XC - 1 TO XC + 8: HPLOT L
    ,YC - 1 TO L,YC + 8: NEXT L: HCOLOR= C
180 FOR L = XC TO XC + CS: HPLOT L,YC TO L,YC + C
    S: NEXT L
182 GOTO 172
185 IF K THEN 1010
186 POKE RK,0: HOME : PRINT : PRINT "TO BEGIN OR
    STOP DRAWING PUSH ANY KEY ";: GET K$
187 POKE FG,0: POKE RK,0
190 IF CS = 0 THEN LL = 1:RL = 279:TL = 0:BL = 19
    1
191 IF CS = 4 THEN LL = 1:RL = 274:TL = 0:BL = 18
    6
192 IF CS = 8 THEN LL = 1:RL = 270:TL = 0:BL = 18
    2
194 HCOLOR= C
196 X = INT ( PDL (0)):Y = INT ( PDL (1))
198 IF X < LL THEN X = LL
200 IF X > RL THEN X = RL
202 IF Y > BL THEN Y = BL
204 FOR L = X TO X + CS: HPLOT L,Y TO L,Y + CS: NEXT
    L
205 IF PEEK (KI) > 127 THEN POKE TG,0: GOTO 100

206 IF P THEN 210
208 HCOLOR= BC: FOR L = X TO X + CS: HPLOT L,Y TO
    L,Y + CS: NEXT L: HCOLOR= C
209 IF PEEK (KI) > 127 THEN POKE TG,0: GOTO 100

210 IF CS = 0 THEN IF PEEK (B1) > 127 THEN CALL
    - 198:X0 = X:Y0 = Y

```

## 5: Sound and Graphics

---

```
212 IF CS = 0 THEN IF PEEK (B0) > 127 THEN HPLO
X,Y TO X0,Y0
215 GOTO 196
218 POKE RK,0: HOME : PRINT : INPUT "ENTER LABEL
>";L$
219 IF L$ = "" THEN 218
220 HOME : PRINT : PRINT "DO YOU WANT IT ON TOP O
R BOTTOM (T/B)? ";; GET K$
222 IF K$ = "B" THEN Y = 100: GOTO 226
224 IF K$ = "T" THEN Y = 6: GOTO 226
225 GOTO 220
226 L = LEN (L$): IF L > 26 THEN 218
228 X = 137 - INT ((L / 2) * 8)
230 FOR P = 1 TO L: IF ASC ( MID$ (L$,P,1)) < 62
THEN K = ASC ( MID$ (L$,P,1)) - 31: GOTO 23
2
231 K = ASC ( MID$ (L$,P,1)) - 3
232 HCOLOR= 0: FOR L = X - 2 TO X + 7: HPLOT L,Y -
1 TO L,Y + 8: NEXT L: HCOLOR= 3
233 DRAW K AT X,Y:X = X + 8: NEXT P
234 HCOLOR= C: GOTO 100
240 POKE RK,0: HOME : PRINT "COLORS FOR BACKDROP.
..": PRINT : PRINT "(G)REEN (B)LUE (P)INK (W)H
ITE (O)RANGE": PRINT ">";: GET K$
242 IF K$ = "G" THEN HCOLOR= 1:BC = 1: GOTO 248
243 IF K$ = "B" THEN HCOLOR= 6:BC = 6: GOTO 248
244 IF K$ = "P" THEN HCOLOR= 2:BC = 2: GOTO 248
245 IF K$ = "W" THEN HCOLOR= 3:BC = 3: GOTO 248
246 IF K$ = "O" THEN HCOLOR= 5:BC = 5: GOTO 248
247 GOTO 240
248 HPLOT 0,0: CALL 62454
250 BD = 1: GOTO 100
300 POKE RK,0: HOME
302 PRINT "PAINTER MENU NUMBER 3 (DISKETTE)": PRINT
304 PRINT "(N)AME (D)ELETE (S)AVE
(L)OAD (R)ENAME (M)AIN >";: GET K$
306 IF K$ = "M" THEN 85
308 IF K$ = CHR$ (27) THEN POKE RK,0: POKE 34,0
: TEXT : HOME : END
310 IF K$ = "N" THEN 320
311 IF K$ = "S" THEN 335
312 IF K$ = "L" THEN 355
313 IF K$ = "R" THEN 385
314 IF K$ = "D" THEN 370
315 GOTO 300
320 POKE RK,0: HOME : PRINT "USE NO COMMAS OR COL
ONS IN NAME.": PRINT : INPUT "> ";P$
325 IF P$ = "" THEN 320
330 HOME : PRINT "NAME: "P$: NORMAL
```

```
332 PRINT : PRINT "IS THIS CORRECT? ";: GET K$: IF
    K$ = "N" THEN 320
333 IF K$ = "Y" THEN 300
334 POKE RK,0: GOTO 330
335 IF P$ = "NOT NAMED" THEN HOME : CALL - 198:
    POKE RK,0: PRINT : PRINT "PICTURE HAS NOT BE
    EN NAMED": FOR L = 1 TO 550: NEXT L: GOTO 300

340 POKE RK,0: HOME : PRINT "PICTURE NAME: "P$: PRINT
345 PRINT "SAVE WITH THIS NAME? ";: GET K$: PRINT
    K$: IF K$ = "Y" THEN 350
346 IF K$ = "N" THEN 300
347 GOTO 340
350 PRINT D$"BSAVE "P$",A$2000,L$1FFF": GOTO 300
355 POKE RK,0: HOME : PRINT : INPUT "NAME? ";P$
356 IF P$ = "" THEN 355
358 HOME : PRINT "PICTURE NAME: "P$: PRINT
360 PRINT "IS THIS NAME CORRECT? ";: GET K$: PRINT
    K$
362 IF K$ = "N" THEN 300
363 IF K$ = "Y" THEN 365
364 GOTO 358
365 PRINT D$"BLOAD "P$
366 GOTO 300
370 POKE RK,0: HOME : PRINT : INPUT "NAME? ";P$
371 IF P$ = "" THEN 370
372 HOME : PRINT "PICTURE NAME: "P$: PRINT
375 PRINT "DELETE THIS PICTURE? ";: GET K$: PRINT
    K$
376 IF K$ = "Y" THEN 380
377 IF K$ = "N" THEN 300
378 GOTO 372
380 PRINT D$"DELETE "P$: GOTO 300
385 POKE RK,0: HOME : PRINT "USE NO COMMAS OR COL
    ONS IN NEW NAME": PRINT
388 INPUT "CURRENT NAME? ";P1$: IF P1$ = "" THEN
    385
390 INPUT "NEW NAME? ";P2$: IF P2$ = "" THEN 385
393 HOME : PRINT "OLD NAME: "P1$: PRINT "NEW NAME
    : "P2$: PRINT
395 PRINT "ARE THESE BOTH CORRECT? ";: GET K$: PRINT
    K$: IF K$ = "N" THEN 385
396 IF K$ = "Y" THEN 400
398 GOTO 393
400 PRINT D$"RENAME "P1$","P2$: GOTO 300
450 POKE RK,0: HOME
452 PRINT "PAINTER MENU NUMBER 2 (ACCESSORY)": PRINT
454 PRINT "P)RINT F)ILL K)EYBOARD M)AIN >";
    : GET K$
456 IF K$ = "M" THEN POKE RK,0: HOME : GOTO 55
```

## 5: Sound and Graphics

---

```
458 IF K$ = CHR$ (27) THEN TEXT : POKE RK,0: HOME
: END
459 IF K$ = "P" THEN 475
460 IF K$ = "F" THEN 500
461 IF K$ = "K" THEN 465
462 GOTO 450
465 POKE RK,0: HOME : IF K THEN K = 0: GOTO 468
466 IF NOT K THEN K = 1
468 IF K = 0 THEN PRINT : PRINT "KEYBOARD IS OFF
"
469 IF K = 1 THEN PRINT : PRINT "KEYBOARD IS ON"

470 FOR L = 1 TO 300: NEXT L: GOTO 450
475 POKE RK,0: HOME : PRINT "PICTURE PRINTING OPT
IONS -": PRINT
476 PRINT "I)NVERSED N)ORMAL
R)OTATED C)ONTINUE >"; GET K$
478 IF K$ = "N" THEN ST = 0: GOTO 475
480 IF K$ = "I" THEN ST = 1: GOTO 475
482 IF K$ = "R" THEN RR = 1: GOTO 475
484 IF K$ = "C" THEN 488
486 GOTO 475
488 POKE RK,0: HOME : PRINT : PRINT "TURN PRINTER
ON AND PRESS ANY KEY "; GET K$
490 IF RR AND ST THEN POKE 1145,88: CALL - 1603
8: GOTO 450
492 IF RR THEN POKE 1145,120: CALL - 16038: GOTO
450
494 IF ST THEN POKE 1400,0: CALL - 16036: GOTO
450
496 CALL - 16044: GOTO 450
500 POKE RK,0: HOME : INPUT "UPPER LEFT POINT (X,
Y) >";UX$,UY$: IF UX$ = "" OR UY$ = "" THEN
500
505 IF ( VAL (UX$) < 0) OR ( VAL (UX$) > 279) THEN
500
506 IF ( VAL (LY$) < 0) OR ( VAL (LY$) > 191) THEN
VTAB PEEK (37): GOTO 507
507 INPUT "LOWER RIGHT POINT (X,Y) >";LX$,LY$: IF
LX$ = "" OR LY$ = "" THEN VTAB PEEK (37): GOTO
507
508 IF ( VAL (LX$) < 0) OR ( VAL (LX$) > 279) THEN
VTAB PEEK (37): GOTO 507
510 HOME : PRINT : PRINT "PRESS A KEY TO BEGIN FI
LL "; GET K$: PRINT K$
511 HCOLOR= C
515 FOR L = VAL (UX$) TO VAL (LX$): HPLLOT L, VAL
(UY$) TO L, VAL (LY$): NEXT L
520 GOTO 450
```

```

1010 POKE RK,0: HOME : PRINT : PRINT "TO BEGIN OR
      STOP DRAWING PUSH RETURN ";: GET K$
1012 POKE FG,0: POKE RK,0
1015 IF CS = 0 THEN LL = 1:RL = 279:TL = 0:BL = 1
      91
1016 IF CS = 4 THEN LL = 1:RL = 274:TL = 0:BL = 1
      86
1017 IF CS = 8 THEN LL = 1:RL = 270:TL = 0:BL = 1
      82
1018 HCOLOR= C
1019 FOR L = X TO X + CS: HPLOT L,Y TO L,Y + CS: NEXT
      L
1020 IF NOT P THEN HCOLOR= BC: FOR L = X TO X +
      CS: HPLOT L,Y TO L,Y + CS: NEXT L: HCOLOR= C
1021 IF PEEK (KI) < 128 THEN 1019
1023 L = PEEK (KI)
1024 IF L = 201 THEN Y = Y - 1: GOTO 1036
1025 IF L = 205 THEN Y = Y + 1: GOTO 1036
1026 IF L = 202 THEN X = X - 1: GOTO 1036
1027 IF L = 203 THEN X = X + 1: GOTO 1036
1028 IF L = 213 THEN X = X - 1:Y = Y - 1: GOTO 10
      36
1029 IF L = 206 THEN X = X - 1:Y = Y + 1: GOTO 10
      36
1030 IF L = 207 THEN X = X + 1:Y = Y - 1: GOTO 10
      36
1031 IF L = 172 THEN X = X + 1:Y = Y + 1: GOTO 10
      36
1032 IF (CS = 0) AND (L = 211) THEN XO = X:YO = Y
      : CALL - 198: GOTO 1036
1033 IF (CS = 0) AND (L = 196) THEN HPLOT X,Y TO
      XO,YO: GOTO 1036
1034 IF L = 141 THEN POKE TG,0: GOTO 100
1035 POKE RK,0: GOTO 1021
1036 IF X < LL THEN X = LL
1037 IF X > RL THEN X = RL
1038 IF Y > BL THEN Y = BL
1039 IF Y < TL THEN Y = TL
1040 POKE RK,0: GOTO 1019
1045 HOME : PRINT : PRINT "DISK ERROR CODE" PEEK
      (222): PRINT "CHECK SYNTAX AND TRY AGAIN": PRINT
      CHR$ (7);: GET K$
1050 POKE RK,0: HOME : GOTO 55

```

# 3-D Plotting

---

Tim R. Colvin

*How many times have you admired those three-dimensional graphics plots in ads for video monitors and printers? Now, with these easy-to-use programs, you can create three-dimensional images of your own.*

These two programs, "Rectan" and "Spheri," will plot three-dimensional figures using information that you provide.

You don't really need to delve into the mathematics which produce the images. You can just fiddle with the examples given to produce many effective displays. Let's look at some graphic examples. First type in each program and save it to tape or disk.

Then load Rectan (Program 1). To have Rectan draw a hyperbolic paraboloid, or "saddle function" (it resembles a riding saddle), let line 790 be the following:

```
790 Z=X*X/4-Y*Y/9
```

and give the following inputs:

```
-2,2,-3,3,25,25,45
```

For another interesting design, use this line:

```
790 Z=-1/(X*X+Y*Y+.5)
```

and give the following inputs:

```
-1,1,-1,1,20,20,45
```

The program will print SCREEN SCALING IN PROGRESS. The program is scaling the image to fit on the screen, which can require a lot of time. The rule is: The more complicated the description of the surface, the longer that step takes.

## The Plotting Begins

When the previous step is completed, the screen will clear and high-resolution plotting will begin. When the plot is finished, the color of the top left corner of the screen will change. The program will be locked in a loop, so you can admire your creation for as long as you wish.

Despite the fine graphics they produce, these programs have a couple of limitations. Screen pixels are taller than they are wide, which makes spheres look slightly less round than they should. Also, you see the surface as if it were transparent

and contour lines were drawn on it. A more advanced program would remove lines that you couldn't see if the surface were not transparent.

### A Spheri Demonstration

To see a torus (doughnut shape), type NEW to clear memory. Then load Spheri (Program 2). Use the following lines for lines 820-840:

```
820 XT=(4+C1)*C2
```

```
830 YT=(4+C1)*S2
```

```
840 ZT=S1
```

and give the following inputs:

```
0,360,0,360,25,25,45
```

If you prefer to draw a sphere, use these lines instead:

```
XT=C1*C2
```

```
YT=C1*S2
```

```
ZT=S1
```

and give the following inputs:

```
0,360,0,180,15,15,45
```

### An Illusion of Depth

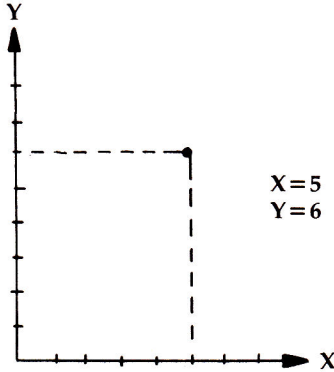
These programs use *rectangular* and *spherical coordinate systems* to create an illusion of depth in the screen image. You're probably familiar with the X-Y coordinate system used to specify the location of a point on a flat surface. For example, in Figure 1 the point is located five units over on the X axis and six units up on the Y axis. The point is said to be at location 5,6.

Such a simple system works well for specifying the location of a point in a two-dimensional design on a flat surface, but for 3-D plotting you need a third coordinate.

Several coordinate systems are commonly used to plot three-dimensional surfaces. The particular system you should use depends on the shape you want to draw. Any system can be used, but if you choose the right system, you can simplify your calculations considerably.



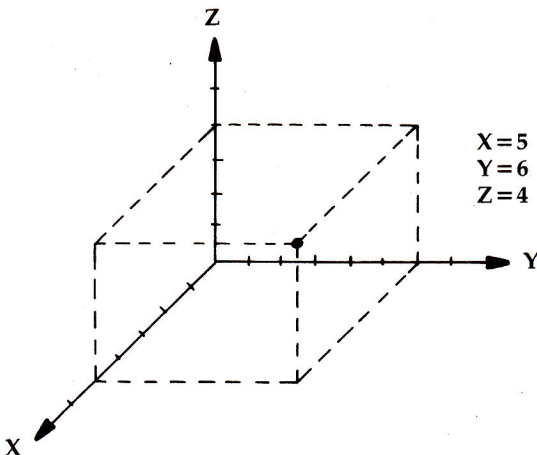
**Figure 1: Two-Dimensional Rectangular Coordinates**



**A Simple Solution**

The easiest system to understand is simply an extension of the rectangular (X-Y) coordinate system you are already familiar with. All you need to add is a third coordinate (Z) for the third dimension. For example, the point shown in Figure 2 is located five units out on the X axis, six units over on the Y axis, and four units up on the Z axis. The point is said to be at location 5,6,4.

**Figure 2: Three-Dimensional Rectangular Coordinates**

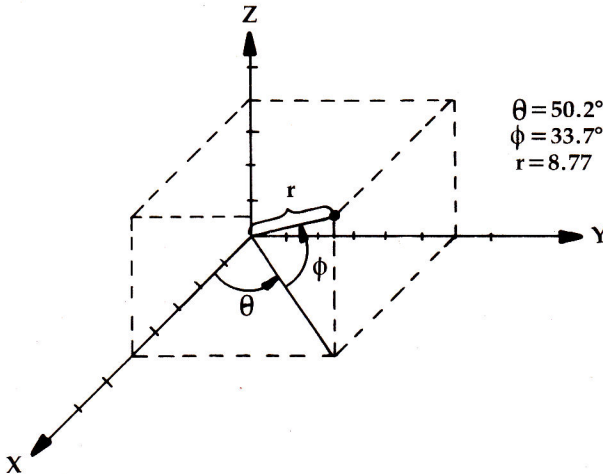


## A System for the Stars

If the design you wish to draw is roughly the shape of a sphere, you should use *spherical coordinates*. In that system, a point is described by two angles and by a distance from the origin. For example, astronomers use spherical coordinates to describe the position of a star relative to the earth. For example, the *azimuthal angle* of a star, designated by the Greek letter theta ( $\theta$ ), is the direction you must face to view the star. If north is taken to be zero degrees, then a star that lies due east would have an azimuthal angle of 90 degrees. The *elevation angle*, designated by the Greek letter phi ( $\phi$ ), specifies how much you must tilt your head back to look directly at the star. If the horizon is taken to be zero degrees, a star that is directly overhead would have an elevation angle of 90 degrees. Finally, the *radial distance*, designated by the letter  $r$ , is the distance from Earth to that star.

Using spherical coordinates, the point shown in Figure 2 has an azimuthal angle of 50.2 degrees, an elevation angle of 33.7 degrees, and a radial distance of 8.77 units, as shown in Figure 3.

**Figure 3: Spherical Coordinates**



### The Mathematics of 3-D Plotting

Rectan plots surfaces using rectangular coordinates (X,Y,Z). The values for X and Y are specified; the value of Z is then given by  $Z=f(X,Y)$  for some function f.

To use Rectan, specify the function f(X,Y) in line 790. For example,  $Z=X^2/4-7*Y/9$  defines a hyperbolic paraboloid.

Spheri plots surfaces using spherical coordinates. This method describes a point on the surface using three parameters: radial distance from the origin, r; azimuthal angle, theta ( $\theta$ ); and elevation angle, phi ( $\phi$ ).

To use Spheri, specify X,Y, and Z (called XT,YT, and ZT in lines 820-840) as functions of r, theta, and phi in lines 820-840.

### Parameters and Slices

The two programs are structured in much the same way, allowing you to specify parameter ranges. In Rectan you choose ranges for X and Y; in Spheri, you select ranges for theta and phi.

You will also be asked to enter the number of *slices* for the parameters. Each slice corresponds to a contour line on the surface. A contour line is a line along which one of the parameters is held constant.

Finally, you specify an observation angle. That is the angle which allows you to see a three-dimensional surface on a two-dimensional video screen. The most commonly used angle is 45 degrees.

### Program 1. Rectan

```
100 HCOLOR= 3
130 HOME
140 INPUT "LOWER X LIMIT:";A1
150 INPUT "UPPER X LIMIT:";B1
160 INPUT "LOWER Y LIMIT:";A2
170 INPUT "UPPER Y LIMIT:";B2
180 INPUT "SLICES IN X:";N
190 INPUT "SLICES IN Y:";M
200 INPUT "OBSERVATION ANGLE:";Q
210 PRINT "SCREEN SCALING IN PROGRESS"
215 U = .0174532925
220 Q = Q * U
230 CS = COS (Q)
240 SI = SIN (Q)
```

```
250 H1 = (B1 - A1) / 279:H2 = (B2 - A2) / (N - 1)
260 H3 = (B1 - A1) / (M - 1):H4 = (B2 - A2) / 279
270 M1 = 9999999:M2 = M1:N1 = - M1:N2 = N1
280 FOR Y = A2 TO B2 STEP H2
290 FOR X = A1 TO B1 STEP H1
300 GOSUB 610
310 NEXT
320 NEXT
330 FOR X = A1 TO B1 STEP H3
340 FOR Y = A2 TO B2 STEP H4
350 GOSUB 610
360 NEXT
370 NEXT
380 HGR2
420 T1 = (N1 - M1) / 2
430 T2 = (N2 - M2) / 2
440 W = T1 / T2
450 IF W < 1.46333333 THEN 480
460 XS = 139:ZS = 139 / W
470 GOTO 490
480 XS = 95 * W:ZS = 95
490 FOR Y = A2 TO B2 STEP H2
500 FOR X = A1 TO B1 STEP H1
510 GOSUB 690
520 NEXT
530 NEXT
540 FOR X = A1 TO B1 STEP H3
550 FOR Y = A2 TO B2 STEP H4
560 GOSUB 690
570 NEXT
580 NEXT
600 END
610 GOSUB 790
620 XT = X - Y * CS
630 ZT = Z - Y * SI
640 IF XT > N1 THEN N1 = XT
650 IF XT < M1 THEN M1 = XT
660 IF ZT > N2 THEN N2 = ZT
670 IF ZT < M2 THEN M2 = ZT
680 RETURN
690 GOSUB 790
700 XT = 140 + INT (XS * (X - Y * CS - N1 + T1) /
T1)
710 ZT = 96 - INT (ZS * (Z - Y * SI - N2 + T2) /
T2)
720 HPLOT XT,ZT
780 RETURN
790 Z = - 1 / (X * X + Y * Y + .5)
800 RETURN
```

### Program 2. Spheri

```
100 HCOLOR= 3
130 HOME
140 INPUT "LOWER THETA LIMIT:";A1
150 INPUT "UPPER THETA LIMIT:";B1
160 INPUT "LOWER PHI LIMIT:";A2
170 INPUT "UPPER PHI LIMIT:";B2
180 INPUT "SLICES IN THETA:";N
190 INPUT "SLICES IN PHI:";M
200 INPUT "OBSERVATION ANGLE:";Q
210 PRINT "SCREEN SCALING IN PROGRESS"
215 U = .0174532925
220 Q = Q * U
230 CS = COS (Q)
240 SI = SIN (Q)
250 H1 = (B1 - A1) / 279:H2 = (B2 - A2) / (N - 1)
260 H3 = (B1 - A1) / (M - 1):H4 = (B2 - A2) / 279
270 M1 = 99999999:M2 = M1:N1 = - M1:N2 = N1
280 FOR Y = A2 TO B2 STEP H2
290 FOR X = A1 TO B1 STEP H1
300 GOSUB 610
310 NEXT
320 NEXT
330 FOR X = A1 TO B1 STEP H3
340 FOR Y = A2 TO B2 STEP H4
350 GOSUB 610
360 NEXT
370 NEXT
380 HGR2
420 T1 = (N1 - M1) / 2
430 T2 = (N2 - M2) / 2
440 W = T1 / T2
450 IF W < 1.46333333 THEN 480
460 XS = 139:ZS = 139 / W
470 GOTO 490
480 XS = 95 * W:ZS = 95
490 FOR Y = A2 TO B2 STEP H2
500 FOR X = A1 TO B1 STEP H1
510 GOSUB 690
520 NEXT
530 NEXT
540 FOR X = A1 TO B1 STEP H3
550 FOR Y = A2 TO B2 STEP H4
560 GOSUB 690
570 NEXT
580 NEXT
600 END
610 GOSUB 790
```

```
620 XT = XT - YT * CS
630 ZT = ZT - YT * SI
640 IF XT > N1 THEN N1 = XT
650 IF XT < M1 THEN M1 = XT
660 IF ZT > N2 THEN N2 = ZT
670 IF ZT < M2 THEN M2 = ZT
680 RETURN
690 GOSUB 790
700 XT = 140 + INT (XS * (XT - YT * CS - N1 + T1)
    / T1)
710 ZT = 96 - INT (ZS * (ZT - YT * SI - N2 + T2) /
    T2)
715 IF XT < 0 THEN XT = 0
716 IF XT > 279 THEN XT = 279
720 HPLOT XT,ZT
780 RETURN
790 XA = X * U:C1 = COS (XA):S1 = SIN (XA)
800 YA = Y * U:C2 = COS (YA):S2 = SIN (YA)
820 XT = (4 + C1) * C2
830 YT = (4 + C1) * S2
840 ZT = S1
850 RETURN
```

# Spiralizer

---

Chayim Avinor

*This program uses high-resolution graphics to create dazzling patterns based on complex geometrical principles—and its onscreen menu makes it very easy to use.*

“Spiralizer” is a program for creating patterns on the Apple’s high-resolution screen. The results may remind you of pictures drawn with a spirograph, which uses toothed wheels of different sizes to control the motion of a pen. However, Spiralizer can create a far greater array of patterns than its mechanical predecessors.

The patterns are actually made by two radii. One of them is turning around a stationary or linearly moving center (depending on your input), and the center of the other radius is the free end of the first one. You are given control of the relative speed and length of the radii and some additional handy features.

## Using the Program

After typing RUN and RETURN, you are asked to enter the relative speed between the two radii. This is actually the number of loops the pattern is going to have. You can choose an answer between  $-50$  and  $50$ . If you type  $4$  and RETURN, your pattern will have four complete loops. If you type  $-6$  there will be six loops, but they’ll be on the inner side of the pattern.

Use the back arrow to delete a character. If you simply press RETURN without typing in a number, the program will default to a speed value of  $5$  (and will display it in the menu). Large numbers cause the program to draw straight segments, because of the large steps involved.

A pattern with three loops is easy to imagine, but what would a pattern with two loops look like? How about one loop? Could a pattern possibly have zero loops? Try the numbers and see.

Next, you’re asked for the radius, and your input determines the ratio between the radii. You can choose any number between  $1$  and  $60$ . A small number would make the inner radius small and the outer radius large, and vice versa. If de-

sired, simply press RETURN and take the default value of 35.

After choosing the radius, specify spin. An answer larger than 1 will make the pattern rotate while it's drawn (and, of course, will change the number of loops). You can choose numbers from 1 (no spin) to 18. When spinning, the lines remain smooth and curvy, but it takes more time to draw a complete pattern. If you decide to quit while a pattern is being drawn, press any key and the program will return to the menu. To escape from the program, use RESET.

### Added Features

Now things become more complicated. You are asked to specify movement or decrement. If you choose M, for movement, the whole pattern will move while it is being drawn. For example, if you choose M with a spin of 1, the pattern will be drawn five times while it moves. If the spin is greater than 1, the pattern will move until it finishes rotating. If the spin is greater than 1 but less than 9, you will not be asked for this input.

Pressing D will cause the pattern to decrease in size while being drawn. The rules are the same as for M. If you press RETURN, the default value is NONE, and none of the above actions will take place.

Finally, you are asked if you want to clear the screen. If you decide not to, then the new pattern will be drawn on the previous one. This feature allows you to make interesting overlays of patterns.

For a nice sample, I suggest you try the following INPUTs: for speed, enter 7; for radius, 50; for spin, 18; then choose M for movement and type Y to clear the screen.

Experiment with different values, and you'll see some stunning designs.

### Spiralizer

```
10 ONERR GOTO 90
60 R$ = CHR$(8): HCOLOR= 3:H$ = "    " + R$ + R$
   + R$ + R$
70 HOME : HGR
80 VTAB 9: HTAB 15: FLASH : PRINT "SPIRALIZER": NORMAL

90 POKE - 16368,0:Z = 5: HTAB 1: VTAB 21: PRINT
   "SPEED (-50,50)? ": GOSUB 380:K = Z
100 IF Z < - 50 OR Z > 50 THEN 90
110 K = K - 1
```



## 5: Sound and Graphics

---

```
120 Z = 35: PRINT "RADIUS (1,60)? ";; GOSUB 380:R =
  Z
130 IF Z < 1 OR Z > 60 THEN VTAB 22: GOTO 120
140 R = R + 13:S = 1
150 Z = 1: PRINT "SPIN (1,18)? ";; GOSUB 380
160 IF Z < 1 OR Z > 18 THEN VTAB 23: GOTO 150
170 A = 1 / Z: IF Z > 1 AND Z < 9 THEN 240
180 SM = 1:M = 2: PRINT "MOVEMENT OR DECREMENT (M/
  D)? "H$;
190 GET X$: IF X$ = CHR$(13) THEN M = 0:SM = 0:
  PRINT "NONE";: GOTO 240
200 IF X$ = "M" THEN SM = 0: GOTO 230
210 IF X$ = "D" THEN M = 0: GOTO 230
220 GOTO 190
230 PRINT X$;
240 VTAB 21: HTAB 24: PRINT "CLEAR (Y/N)? "H$;; GET
  T$: IF T$ < > "N" THEN PRINT "YES": TEXT : CALL
  62450: HGR
250 IF T$ = "N" THEN PRINT "NO"
260 W = 1:Z = 139: IF M = 2 THEN Z = 80: IF A = 1 THEN
  W = 5:M = 1:Z = 122
270 IF SM - A = 0 THEN W = 5
280 IF A < 1 THEN K = K + A
290 C = 0.001: IF A < 1 / 9 THEN M = M / 2:C = C /
  2
300 J = R:I = 79 - R
310 H$PLOT Z,0
320 REM -MAIN LOOP-
330 FOR T = 0 TO 6.2831 / A * W STEP 0.06283:F =
  PEEK ( - 16384): POKE - 16368,0: IF F > 127
  THEN 90
340 IF SM THEN J = R * S:I = 79 * S - J:S = S - C
350 H$PLOT TO Z + T * M - SIN (T) * J + SIN (T *
  K) * I,79 - COS (T) * J - COS (T * K) * I: NEXT
360 GOTO 90
370 REM -INPUT SUBROUTINE-
380 L0 = 0:L1 = 1:B$ = ""
390 PRINT H$;; GET A$
400 IF A$ = "-" AND L0 = 0 THEN PRINT A$::B$ = A
  $:L0 = 1:L1 = 2: GOTO 390
```

```
410 IF A$ = CHR$(13) AND L0 > 0 THEN Z = VAL (
    B$): PRINT : RETURN
420 IF A$ = CHR$(13) THEN PRINT Z: RETURN
430 IF A$ = R$ AND L0 > 1 THEN PRINT A$;:B$ = LEFT$
    (B$, LEN (B$) - 1):L0 = L0 - 1: GOTO 390
440 IF A$ = R$ AND L0 = 1 THEN PRINT A$;:B$ = ""
    :L0 = 0: GOTO 390
450 IF L0 > L1 THEN 390
460 IF A$ < "0" OR A$ > "9" THEN 390
470 PRINT A$;:B$ = B$ + A$:L0 = L0 + 1: GOTO 390
```



# Appendix

## A Beginner's Guide to Typing In Programs



# A Beginner's Guide to Typing In Programs

---

## What Is a Program?

A computer cannot perform any task by itself. Like a car without gas, a computer has *potential*, but without a program, it isn't going anywhere. Most of the programs published in this book are written in a computer language called Applesoft BASIC. It is easy to learn and works on the Apple II, II+, IIfx, and IIC.

## BASIC Programs

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

## About DATA Statements

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

If a single number in any one DATA statement is mistyped, your machine could lock up, or crash. The keyboard may seem dead, and the screen may go blank. But don't panic; no damage is done. To regain control, you have to reset your computer (in effect, you turn it off and then turn it back on). That will erase whatever program was in memory, *so always save a copy of your program before you run it*. If your computer crashes, you can load the program and look for your mistake.

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

### Get to Know Your Machine

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

### A Quick Review

1. Type in the program a line at a time, in order. Press RETURN at the end of each line. Use backspace or the back arrow to correct mistakes.
2. Check the line you've typed against the line in the book. You can check the entire program again if you get an error when you run the program.

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