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LUNAR LANDER

by
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This game, using three pages of memory, provides a way to add two-dimensional movement to your display. This is done by using a control "bit" to point to the location to begin drawing on the screen. I got the idea for this method after reading the "Doodle Program" (Questdata #8) and thought it would be a simple way to point to a location on the screen. The control bit points to the upper left corner of a figure to be drawn. For this program it is a one byte wide by five byte high spacecraft. Two bytes per line are actually used for the display since the figure is shifted right to the location of the "bit" within the control byte.

A lunar lander, with you controlling its motion, attempts to make a landing. It moves downward from the pull of gravity with upward or sideways motion controlled by firing "rockets". This motion is simulated by incrementing movement counts each time through the program so that each successive time the spacecraft is drawn it is moved a greater distance.

How the Program Works

The program uses input from the keyboard to control the movement of the spaceship. A "0" turns the rockets off. A "1" moves the ship left and a "2" moves it right. Any other input will move the spaceship up. Only one rocket can be fired at a time. The input/movement subroutine takes the input and increments the approprate movement count. The up movement is subtracted from the down movement and the difference is used to move the control byte either up or down. The left movement is subtracted from the right movement with the difference used to shift the control "bit" either left or right. Once the new location for the spaceship has been determined the program goes to the display subroutine. The old location of the spaceship is first cleared. The first byte of the new location, set by the control byte, is checked to see if it is already occupied by the surface line. If it is, the temporary memory address is set to zero and the subroutine returns to the main program. If the location is not occupied, the data byte is drawn into the location and shifted right to the location of the control "bit". The display location is moved down one line and the check for occupancy and drawing is repeated. This continues until the spaceship is completely drawn. The main program is returned to and first checks if the temporary memory address is zero (the surface is hit) and branches to draw the crash if it is. This is done by first moving the display address up six lines, since it is at the surface, and pointing to the crash data and then going to the draw routine. If the spaceship was completely drawn the next line is checked (the display address is pointing there) to see if it is the surface. If it is blank, the program branches to a delay and then goes back to get another input. A check is made of the movement and if there is no left/right movement and the downward movement is 2 or less, a man is drawn and the program resets, otherwise it draws a crash and resets.

An added feature to the input/movement subroutine is a fuel count which is decremented each time through the program if any of the rocket inputs have been pressed. The count is shown on the hex display. When zero is reached, the "Q" comes on and the keyboard inputs are ignored with the spaceship falling to the surface.

Playing the Game

Load the program and C0 04 00 into the start of page 0 since the program begins on page 4. Push Run and the screen will show the display page. Pushing Input will clear the screen and draw the landing surface and the spaceship in the upper left corner. Push an initial rocket control, either the 0, 1, or 2 key, since an "up" key will roll the spaceship through the top of the screen and into the bottom resulting in a crash being drawn. Push the Input again to start the spaceship motion. Pushing the various movement

keys will control the spaceship. You must stop the sideways motion and slow the downward motion for a landing. If you take too long and run out of fuel, the Q light comes on and the spaceship will fall to the surface. The spaceship can move through the sides of the screen but a crash will be drawn if it moves out the top. Whether you make it or crash, pushing the Input will reset the game for another try. To change the difficulty of the landing, the fuel count at loacation 0448 or the down movement at location 047F can be changed. Although a score counter is not in the program, you could try and see the minimum amount of fuel you use to land the spaceship.

Going Further

This program can be moved to any other pages of memory by simply changing the high order bytes at initialization. I used the input/movement subroutine for ease of understanding the program. If an additional register is needed, the subroutine can be easily incorporated into the main program. You can draw your own spacecraft of one to five bytes or adjust the display count and display location resets for a spaceship of any size. There should be sufficient room remaining in the two program pages to accomodate various modifications.

This program adds another dimension to video animatiom. I would like to hear from anyone who has ideas on modifying this program or using the above technique to animate other programs.

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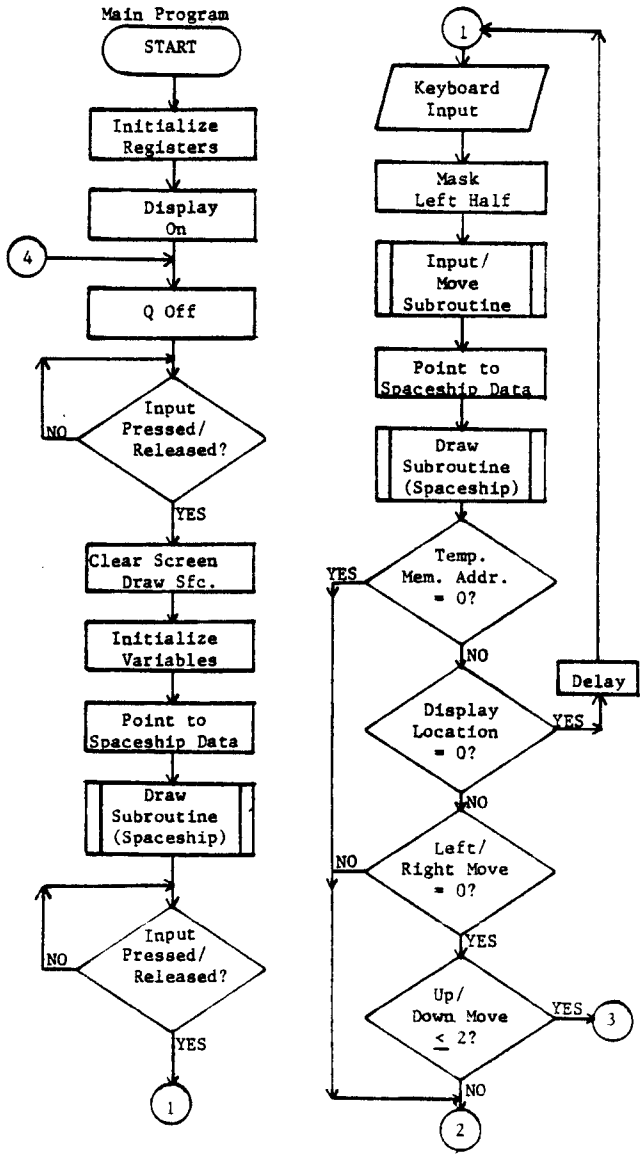
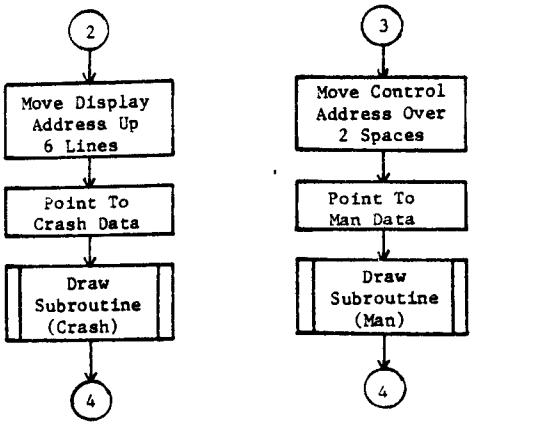
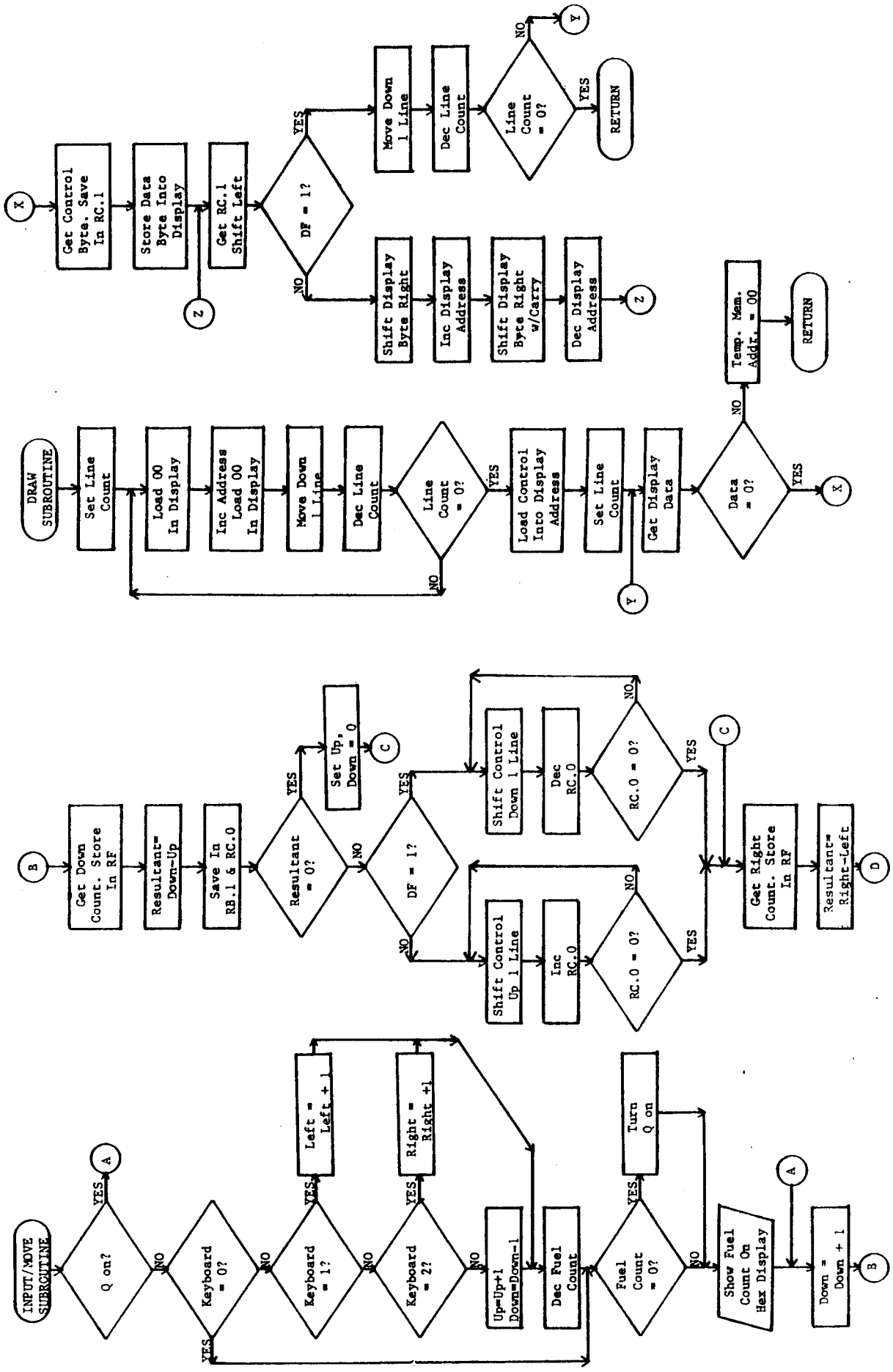
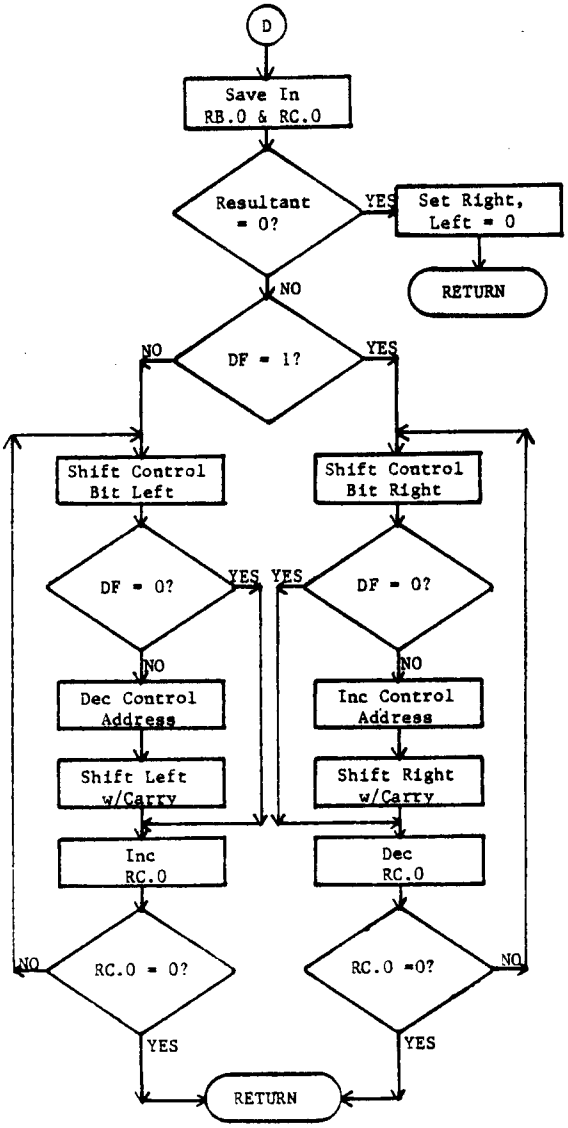


Register Assignments

R0= DMA	R9= Draw Subroutine
R1= Interrupt	RA.0=Control Bit
R2= Stack	RA.1=Keyboard Input
R3= Main	RB.0=Left/right Count
R4= Display Page	RB.1=Up/down Count
R5= Control Location	RC= Variable Counter
R6= Fuel Count	RD= Left/right Movement
R7= Unused	RE= Up/down Movement
R8= Input/move Subroutine	RF= Temporary Storage




INPUT/MOVE SUBROUTINE
Q on?
YES
NO
A
Keyboard = 0?
Keyboard = 1?
Keyboard = 2?
Left = Left + 1
Right = Right +1
Up=Up+1 Down=Down-1
Dec Fuel Count
Fuel Count = 0?
Turn Q on
Show Fuel Count On Hex Display
Down = Down + 1
B
Get Down Count. Store In RF
Resultant= Down-Up
Save In RB.1 & RC.0
Resultant = 0?
Set Up, Down = 0
C
DF = 1?
Shift Control Down 1 Line
Dec RC.0
RC.0 = 0?
Shift Control Up 1 Line
Inc RC.0
Get Right Count. Store In RF
Resultant= Right-Left
D
DRAW SUBROUTINE
Set Line Count
Load 00 In Display
Inc Address Load 00 In Display
Move Down 1 Line
Dec Line Count
Line Count = 0?
Load Control Into Display Address
Get Display Data
Data = 0?
Temp. Mem. Addr. = 00
RETURN
X
Y
Z
Get Control Byte. Save In RC.1
Store Data Byte Into Display
Get RC.1 Shift Left
Shift Display Byte Right
Inc Display Address
Shift Display Byte Right w/Carry
Dec Display Address



Main Program

```
Loc.  Code    Mnem.     Comments
0400  F8 04    LDI     SET UPPER
0402  B1 B2    PHI      REGISTERS
0404     B3    PHI
0405  F8 05    LDI
0407  B8 B9    PHI
0409     BF    PHI
040A  F8 06    LDI     SET DISPLAY
040C  B4 B5    PHI      PAGE
040E  F8 D0    LDI     SET INTERRUPT
0410     A1    PLO      COUNTER
0411  F8 F0    LDI     SET INTERRUPT
0413     A2    PLO      STACK
0414  F8 01    LDI     SET INPUT/MOVE
0416     A8    PLO      SUBROUTINE
0417  F8 81    LDI     SET DRAW
0419     A9    PLO      SUBROUTINE
041A  F8 1E    LDI     SET MAIN
041B     A3    PLO      PROGRAM
041D  D3       SEP     SET P
041E  E2       SEX     SET X
041F  69       INP     DISPLAY ON
0420  7A       REQ     RESET Q
0421  3F 21    BN4     WAIT FOR INPUT PRESSED
0423  37 23    B4      WAIT FOR INP. RELEASED
0425  E4       SEX     SET X
0426  F8 FF    LDI     CLEAR DISPLAY
0428     A4    PLO      PAGE
```

```
Loc.  Code    Mnem.     Comments
0429  F8 00    LDI
042B     73    STXD
042C  84       GLO
042D  3A 29    BNZ
042F  F8 FF    LDI     DRAW LINE
0431     A4    PLO      ALONG
0432  F8 FF    LDI      BOTTOM
0434     73    STXD
0435  84       GLO
0436  FF F8    SMI
0438  33 32    BDF
043A  F8 00    LDI     SET DISPLAY/CONTROL
043C  A4 A5    PLO      ADDRESSES
043E  AE AD    PLO     SET UP/LEFT/DOWN
0440     BE    PHI      =0
0441  F8 04    LDI     SET RIGHT MOVEMENT
0443     BD    PHI      =4
0444  F8 80    LDI     SET CONTROL
0446     AA    PLO      BIT
0447  F8 20    LDI     SET FUEL
0449     A6    PLO      COUNT
044A  F8 F0    LDI     POINT TO SPACESHIP
044C     AF    PLO      DATA
044D  D9       SEP     GO TO DRAW SUBROUTINE
044E  3F 4E    BN4     WAIT FOR INPUT PRESSED
0450  37 50    B4      WAIT FOR INPUT RELEASE
0452  85       GLO     PUT CONTROL ADDRESS
0453  A4       PLO      INTO DISPLAY ADDRESS
0454  E2       SEX     SET X
0455  6C       INP4    READ KEYBOARD
0456  FA 0F    ANI     MASK LEFT HALF
0458  BA       PHI      OF BYTE
0459  D8       SEP     GO TO INPUT SUBROUTINE
045A  30 70    BR

0470  F8 F0    LDI     POINT TO SPACESHIP
0472     AF    PLO      DATA
0473  D9       SEP     GO TO DRAW SUBROUTINE
0474  8F       GLO     GET ADDRESS VALUE
0475  32 84    BZ      BRANCH IF ZERO
0477  04       LDN     GET DISPLAY BYTE
0478  32 96    BZ      BR. NOT OCCUPIED
047A  8B       GLO     GET LEFT/RIGHT MOVE.
047B  3A 84    BNZ     BRANCH NOT ZERO
047D  9B       GHI     GET UP/DOWN MOVE.
047E  FF 02    SMI     SUBTRACT 2
0480  32 8F    BZ      BRANCH IF ZERO
0482  3B 8F    BNF     BR. IF NEGATIVE
0484  F8 FA    LDI     POINT TO CRASH
0486     AF    PLO      DATA
0487  84       GLO     GET DISPLAY ADDRESS
0488  FF 28    SMI     MOVE UP 6 LINES
048A  A4 A5    PLO      SAVE LOCATION
048C  D9       SEP     DRAW CRASH
048D  30 20    BR      BRANCH TO RESET
048F  15 15    INC     MOVE CONTROL ADDR.
0491  85       GLO     GET CONTROL ADDR.
0492  A4       PLO     PUT INTO DISPLAY ADDR.
0493  D9       SEP     DRAW MAN
0494  30 20    BR      BRANCH TO RESET
0496  F8 30    LDI     DELAY
0498     BC    PHI
0499  2C       DEC
049A  9C       GHI
049B  3A 99    BNZ
049D  30 52    BR      BR. TO CONTINUE
```

Input/Move Subroutine

```
Loc.  Code    Mnem.     Comments
0500  D3       SEP     RETURN
0501  EF       SEX     SET X
0502  F8 FF    LDI     POINT TO TEMP.
0504     AF    PLO      MEM. STORAGE
0505  31 29    BQ      BRANCH Q ON
0507  9A       GHI     GET KEYBOARD VALUE
0508  32 22    BZ      BRANCH IF ZERO
050A  FB 01    XRI     CHECK IF = 1
050C  32 1A    BZ       IF SO, BRANCH
050E  9A       GHI     GET KEYBOARD VALUE
050F  FB 02    XRI     CHECK IF = 2
0511  32 1D    BZ       IF SO, BRANCH
0513  1E       INC     INC UP MOVE COUNT
0514  9E       GHI     GET DOWN MOVE COUNT
```

```
Loc.  Code   Mnem.     Comments
0515  FF 01  SMI      SUBRACT 1
0517  BE     PHI      AND SAVE
0518  30 21  BR       BRANCH
051A  1D     INC      INC LEFT MOVE COUNT
051B  30 21  BR       BRANCH
051D  9D     GHI      GET RT. MOVE COUNT
051E  FC 01  ADI      ADD 1
0520  BD     PHI      AND SAVE
0521  26     DEC      DEC FUEL COUNT
0522  86     GLO      GET FUEL COUNT
0523  3A 26  BNZ      BRANCH NOT ZERO
0525  7B     SEQ      TURN Q ON
0526  5F     STR      STORE FUEL COUNT
0527  64     OUT4     DISPLAY FUEL COUNT
0528  2F     DEC      DEC TEMP. MEM. LOC.
0529  9E     GHI      GET DOWN MOVEMENT
052A  FC 01  ADI      ADD 1 FOR GRAV.
052C  BE     PHI      AND SAVE
052D  9E     GHI      GET DOWN MOVEMENT
052E  5F     STR      STORE IN TEMP. MEM.
052F  8E     GLO      GET UP MOVEMENT
0530  F5     SD       SUBTRACT FROM DOWN
0531  AC     PLO      SAVE IN COUNTER
0532  BB     PHI      AND RESULTANT
0533  3A 39  BNZ      BRANCH NOT ZERO
0535  AE     PLO      OR SET UP/DOWN
0536  BE     PHI      TO ZERO
0537  30 4D  BR       BRANCH
0539  33 45  BDF      BRANCH IF POSITIVE
053B  85     GLO      GET CONTROL ADDRESS
053C  FF 08  SMI      MOVE UP ONE LINE
053E  A5     PLO      AND SAVE
053F  1C     INC      INC UP COUNT
0540  8C     GLO      GET UP COUNT
0541  3A 3B  BNZ      BR. BACK IF NOT ZERO
0543  30 4D  BR       BRANCH
0545  85     GLO      GET CONTROL ADDRESS
0546  FC 08  ADI      MOVE DOWN ONE LINE
0548  A5     PLO      AND SAVE
0549  2C     DEC      DEC DOWN COUNT
054A  8C     GLO      GET DOWN COUNT
054B  3A 45  BNZ      BR. BACK IF NOT ZERO
054D  9D     GHI      GET RIGHT MOVEMENT
054E  5F     STR      STORE IN TEMP. MEM.
054F  8D     GLO      GET LEFT MOVEMENT
0550  F5     SD       SUBRACT FROM RIGHT
0551  AC     PLO      SAVE IN COUNTER
0552  AB     PLO      AND RESULTANT
0553  3A 59  BNZ      BRANCH NOT ZERO
0555  AD     PLO      OR SET LEFT/RIGHT
0556  BD     PHI      TO ZERO
0557  30 00  BR       BRANCH TO RETURN
0559  33 68  BDF      BRANCH IF POSITIVE
055B  8A     GLO      GET CONTROL BYTE
055C  FE     SHL      SHIFT LEFT
055D  3B 61  BNF      BRANCH DF=0
055F  25     DEC      DEC CONTROL ADDRESS
0560  7E     SHLC     SHIFT LEFT W/CARRY
0561  AA     PLO      SAVE CONTROL BYTE
0562  1C     INC      INC COUNTER
0563  8C     GLO      GET COUNTER
0564  3A 5B  BNZ      BRANCH NOT ZERO
0566  30 00  BR       BRANCH TO RETURN
0568  8A     GLO      GET CONTROL BYTE
0569  F6     SHR      SHIFT RIGHT
056A  3B 6E  BNF      BRANCH DF = 0
056C  15     INC      INC CONTROL ADDRESS
056D  76     SHRC     SHIFT RT. W/CARRY
056E  AA     PLO      SAVE CONTROL BYTE
056F  2C     DEC      DEC COUNTER
0570  8C     GLO      GET COUNTER
0571  3A 68  BNZ      BRANCH COUNT NOT ZERO
0573  30 00  BR       BRANCH TO RETURN
```

Draw Subroutine

```
Loc.  Code   Mnem.     Comments
0580  D3     SEP      RETURN
0581  F8 05  LDI      SET LINE
0583     AC  PLO       COUNT
0584  F8 00  LDI      CLEAR OLD
0586  54     STR       SPACESHIP
0587  14     INC
0588  54     STR
0589  84     GLO
058A  FC 07  ADI
058C  A4     PLO
058D  2C     DEC
058E  8C     GLO
058F  3A 84  BNZ
0591  85     GLO      GET CONTROL ADDRESS
0592  A4     PLO      PUT INTO DISPLAY ADDR.
0593  F8 05  LDI      SET LINE
0595     AC  PLO       COUNT
0596  04     LDN      GET DISPLAY BYTE
0597  3A B6  BNZ      BRANCH IF OCCUPIED
0599  8A     GLO      GET CONTROL BIT
059A  BC     PHI      STORE IN TEMP. COUNTER
059B  4F     LDA      GET DATA BYTE
059C  54     STR      STORE IN DISPLAY
059D  9C     GHI      GET CONTROL BIT
059E  FE     SHL      SHIFT LEFT
059F  BC     PHI       SAVE
05A0  33 AC  BDF      BRANCH IF DF = 1
05A2  04     LDN      GET DISPLAY BYTE
05A3  F6     SHR       SHIFT RIGHT
05A4  54     STR       STORE
05A5  14     INC      INC DISPLAY LOCATION
05A6  04     LDN      GET DISPLAY BYTE
05A7  76     SHRC      SHIFT RIGHT W/CARRY
05A8  54     STR       STORE
05A9  24     DEC      RESET DISPLAY LOC.
05AA  30 9D  BR       BRANCH
05AC  84     GLO      GET DISPLAY ADDRESS
05AD  FC 08  ADI       MOVE DOWN ONE
05AF  A4     PLO       LINE
05B0  2C     DEC      DEC LINE COUNT
05B1  8C     GLO      GET LINE COUNT
05B2  3A 96  BNZ       BRANCH NOT ZERO
05B4  30 80  BR       BRANCH TO RETURN
05B6  F8 00  LDI      SET TEMP. MEM. ADDR.
05B8     AF  PLO       TO ZERO
05B9  30 80  BR       BRANCH TO RETURN
```

Display Subroutine

```
Loc.  Code   Mnem.     Comments
04CE  72     LDXA     INTERRUPT
04CF  70     RET       RETURN
04D0  22     DEC
04D1  78     SAV
04D2  22     DEC
04D3  52     STR
04D4  C4 C4  NOP      NOPs FOR
04D6     C4  NOP       SYNC.
04D7  F8 06  LDI      SET DMA
04D9     B0  PHI       POINTER
04DA  F8 00  LDI
04DC     A0  PLO
04DD  80     GLO      INTERRUPT
04DE  E2     SEX       ROUTINE
04DF  E2     SEX
04E0  20     DEC
04E1  A0     PLO
04E2  E2     SEX
04E3  20     DEC
04E4  A0     PLO
04E5  E2     SEX
04E6  20     DEC
04E7  A0     PLO
04E8  3C DD  BN1      BR. TO INTERRUPT
04EA  30 CE  BR       BRANCH TO RETURN
04EC  00 00           STACK AREA
04EE  00 00
04F0  00
```

```
Data
05F0  18   SPACESHIP
05F1  3C
05F2  FF
05F3  24
05F4  42
05F5  04   MAN
05F6  1F
05F7  04
05F8  0A
05F9  11
05FA  24   CRASH
05FB  81
05FC  24
05FD  42
05FE  18
05FF  xx   TEMP. STORAGE
```

Q*BUG

In a previous column, we added some new commands and shortened some other command names. Four of the shortened commands require a letter designator after the command word to establish the physical means of data input or output. These commands are:

LOAD (X)	X = Required letter designator
SAVE (X)	C = Cassette I/O
D/L (X)	F = Floppy Disk I/O
D/S (X)	S = Stringy Floppy I/O

If you are not fortunate enough to have a Stringy Floppy and/or Floppy Disk I/O device interfaced to your computer, how would you like to eliminate the typing of the letter designator? If you use only a cassette for data I/O, the use of a letter designator is redundant and a simple fix will do away with it.

First, a little background on what Super does when you type commands such as "LOAD C". In processing an inputted command, Super puts the command, byte by byte, into the line buffer area on work page 3500. The buffer area is location 3500 thru 355F. Thus, "LOAD C", in the direct execution mode, would appear in the line buffer as:

Location	Code
3500	4C (L)
3501	4F (O)
3502	41 (A)
3503	44 (D)
3504	20 (Space)
3505	43 (C)
3506	OD (c/r)

Super will then "read" the command word in the line buffer and search the command table for a matching word. If Super finds a match, it will "stuff" the token for the command into the first position in the intermediate line buffer area at location 35D0 on work page 3500. Super then examines the byte following the command word in the line buffer. In our illustration, this is a space (20) and Super will ignore this space. (This is one way OUR Basic saves space in memory. The TRS 80 and some other Basics write ALL spaces into their program memory.)

Super examines the next byte in the line buffer (43) and determines its acceptability as a valid ASCII letter. Since "43" is the ASCII letter "C", Super assigns a prefix designator of "D1" to the "43" and stuffs both bytes into the next positions in the intermediate line buffer.

"LOAD C" will now appear in the intermediate line buffer as:

Location	Code
35D0	98 (Token for LOAD)
35D1	D1 (Letter prefix)
35D2	43 (C)
35D3	0D (c/r)

After Super has loaded the command to the intermediate line buffer, it then examines the intermediate line buffer to determine what it should do. The first byte (token 98) "points" Super to the execution table location 0730. At this location, Super picks up the address of the actual "LOAD" machine language routine, which is 0E00, and goes to that location to perform the LOAD routine.

In all of the LOAD, SAVE, D/L, or D/S, routines, Super uses a subroutine at location 14FE to test for the presence of the "D1" after the token in the intermediate line buffer. If Super finds the "D1", it examines the the next byte. Depending on the letter found, Super will stuff either "32 06" (for C) or "F8 06" (for F or S) into locations 35A0 and 35A1 on work page 3500. These locations are the statement call address to which Super will branch later on in the LOAD or SAVE routines.

If Super does not find a D1 after the token in the intermediate line buffer, it will return an error mesage (#60). When LOAD is typed without the letter designator, the intermediate line buffer will look like this:

35D0	98
35D1	0D

To keep Super from returning an error message if we do not use a letter designator, we must bypass the test for the D1 in the subroutine at location 14FE.

This is the present routine at location 14FE with my homemade comments:

Location	Code	Comment
14FE	4B	Get byte AFTER token byte at 35D0
14FF	FB D1	Test for "D1" if yes, D will =0
1501	32 07	If D = 0, branch to 1507
1503	D4 09 FF	Error routine – do if D <> 0
1506	3C	Garbage byte – leftover assem–

		bler label?
1507	BA	Put D (00) in register BA.1
1508	4B	Get next byte at location 35D2
1509	FB 43	Test for "C" if yes, D will = 0
150B	3A 15	If not "C" branch to 1515
150D	F8 E1	Put E1 in D
150F	AA	Put D in register BA.0 - BA = 00E1
1510	0A	Get byte at location 00E1 - should be "32"
1511	DD 20	Put "32" in location 35A0 (3580 + 20)
1513	30 2B	Branch to 152B
1515	FB 05	Test for "F" (43 XOR 5 = 46(F))
1517	3A 21	If not "F" branch to 1521
1519	F8 E2	Put E2 in D
151B	AA	Put D in register BA.0 - BA now = 00E2
151C	0A	Get byte at location 00E2 (F8)
151D	DD 20	Put "F8" in location 35A0
151F	30 2B	Branch to 152B
1521	FB 15	Test for "S" (46 XOR 15 = 53(S))
1523	3A 03	If not S branch back to 1503 (error)
1525	F8 E3	Put E3 in D
1527	AA	Put D in register BA.0 - BA now = 00E3
1528	0A	Get byte at location 00E3 (F8)
1529	DD 20	Put in location 35A0
152B	F8 06	Put 06 in D
152D	DD 21	Put 06 in location 35A1 (If letter designator was "C", locations 359F thru 35A2 will now read "D4 32 06 D5". If "F" or "S", it would read "D4 F8 06 D5". Location 359F thru 35A2 is the call to the actual LOAD or SAVE routines. Location 3206 is the cassette I/O routines.)
152F	AF	Also put 06 in register RF.0
1530	0A	Get byte at location 00E1 for "C" or location 00E2 for "F" or location 00E3 for "S"
1531	BF	Put byte in register BF.1 - 32 for C or F8 for F or S
1532	0F	Get byte at location pointed to by register BF - 3206 for C, F806 for F or S
1533	FB C0	Test for C0 - location 3206 DOES contain C0 - location F806 may or may not contain C0
1535	CA 0C C2	If the byte is not C0, an error message "N/A" will be printed
1538	D5	Return to calling location

To bypass the part of this routine that checks for the D1 and letter is simply a matter of changing the first five byte at location 14FE to:

14FE F8 00 BA 30 0D

Now, Super will immediately stuff "32 06" into the call location and go right to work LOADing or SAVEing.

One word of caution, however, is in order. If you are running a program that was written WITH a letter designator, Super will treat this as an error and abort the program AFTER the D/L or D/S. It will perform the Data Save or Data Load correctly.

My advice is to review any programs that have DSAVE, D/S, DLOAD, or D/L, and remove the letter designator. One final change! Let's put a shorthand command for LOAD or SAVE in the command table. Make the following changes:

Location	Code
06EE	63
06EF	4C
06F0	CC
06F1	98
06F2	63
06F3	53
06F4	D3
06F5	97

Now, LOAD or LL will load a cassette, SAVE or SS will dump to a cassette.

Finally, make a new master Super program tape.

Keep a permanent record of the original routine at location 14FE. Should you ever wish to interface a Stringy Floppy or Floppy Disk, you will probably have to restore the routine to its original state.

Now, for ELF II owners, let's shrink the serial version of Super to a promable length of 12 1/4 K.

In a previous column, we eliminated the need for part of the initialization routines at location 1800 thru 183F and 3493 thru 34CC. We will now use these areas for the extra patch routines required by the ELF II Video Board. (Page 71 in the Super manual)

The first patch shown on page 71 is:

3300: C0 34 93

This is the terminal timing routine which we previously eliminated by putting "C0 31 48" at location 3300. This change will remain as is but will go in a different location.

The second patch on page 71 is:

3303: C0 34 F3

This is the Break routine at location 34F3. We will put this routine on page 3300 but at a different location, also.

The next patch is:

3306: C0 33 1C

This is a branch to an ELF II required output patch routine at location 331C as detailed on page 71 of the manual. This routine is performed BEFORE the output routine at location 3406. We will put this patch routine into the free area at location 1800 as follows:

1800: BF 12 12 12 02 FB 0F 3A
1808: 2B 72 A6 02 B6 9F D5 22
1810: 22 22 9F 73 DD 9B FF 41
1818: 3B 3D D4 2F F9 F8 01 DD
1820: 1B 12 02 D4 34 06 D5

Change the branches at locations 1807 and 1818 and the subroutine call at location 1823 as follows:

1807: 3A 0F
1818: 3B 21
1823: D4 33 16 D5

At location 3306, change the long branch to:

3306: C0 18 00

The last patch on page 71 is:

3309: D4 34 09
330C: D4 2E 3B (etc)

This is an input patch routine. The routine from location 330C thru 331B is performed AFTER the input routine at location 3409.

We will start this patch routine by putting a long branch to the remaining free area at location 1827 as follows:

3309: C0 18 27

Starting at location 1827, insert the following:

1827: D4 33 19 D4 2E 3B 73 DD 9B
1830: FF 40 3B 37 D4 2F F9 12
1838: 02 D5 C4 C4 C4 C4 C4 C4

This is the patch originally shown on page 71 for location 3309 thru 331B. I have already corrected the branches for you. The line length is set for 64 characters on the CRT screen so if you use a different length, make the appropiate changes to the bytes at locations 1817 and 1831.

Now, change location 3300 thru 3305 to:

3300: C0 33 0C C0 33 10

Put the CLS branch at 330C:

330C: D4 31 48 D5

Put the Break routine at location 3310:

3310: 3F 14 FF 00 D5

This finishes the relocation of the ELF II patches. Now, we must move the actual input, output, and delay routines, from page 3400 to page 3300. First, block move the input/output routine from location 3406 thru 3492 to location 3316 thru 33A2. When this is done, make the following branch changes:

3317: 63
331A: 35
3339: 38
333E: 40
3347: 4D
334C: 53
3350: 52
3357: 44
335F: 35
3362: 98
3369: 6D
3380: 83
338B: 7F
3390: 95
3394: 72

Next, block move the delay routine from location 34CD thru 34F2 to location 33A3 thru 33C8. Make the following branch changes:

33A9: A6
33AF: AC
33B4: C2
33BC: B9
33C1: B3
33C6: A3
33C8: AA

You might find, as I did, that this shifting of routines somehow messes up the terminal timing and you get a double echo of the typed character on your CRT. In my case, I simply changed the time constants on work page 0000 at locations 00E7 and 00E8. They changed from "80 55" to "00 55". This cleared up my problem but you may have to experiment with different values.

Now, if everything is working to your satisfaction, make a new master Super program tape.

LINE by LINE ASSEMBLER

by

Werner Cirsovius

This simple Assembler supports the development of machine written programs by translating mnemonic code into hexadecimal machine code. The length of this program is about 4.75k bytes, including string and array areas. The assembler is software protected, so any try to write out of the allocated Ram space will result in an error message and break.

NOTE:The available Ram for machine code is above the Basic program. To use the hole created by the 'DEFUS' statement, a short program for moving data into the hole must be written by the user.

This assembler supports:
- -all standard RCA mnemonics
- -two Standard Call and Return Technique mnemonics
- -three pseudo opcodes
- -decimal, hexadecimal and character operands (but no labels)
- -multiple mnemonics per line separated by a blank

OPERANDS

Operands may be decimal, hexadecimal or characters. If the pseudo opcode DC' (Define constant) is used, string operands are legal, too. While decimal operands need no prefix, the hexadecimal operands use the hash sign (#) and the characters/strings the dollar ($) sign.

Examples: 10 Decimal 10
#10 Hex 10 (Decimal 16)
$A Character 'A' (Hex 41, decimal 65)

MNEMONICS

All available mnemonics are stored in a data field (Lines 2000-2990). Each mnemonic uses three data statements:

- -Statement 1 : Mnemonic string
- -Statement 2 : Line for executing the type of mnemonic
- -Statement 3 : Hexadecimal Opcode

The last statement in the data list is the asterisk (*), indicating the end of the list. If the asterisk is found, the assembler prints:

'UNKNOWN MNEMONIC'

Description of the various modes.

MODE 1: Opcode with no operand (Line 300)

Format : /Mnemonic/

Examples: IDL NOP

Code generated: 00 C4

MODE 2: Opcode with Register operand (Line 200)

Format : /Mnemonic//(Prefix) Operand/With operand in range 0..15 (decimal) or 0..F (hex)

Examples: SEX 2 SEP #A

Code generated: E2 DA

MODE 3: Opcode with immediate operand (Line 400)

Format : /Mnemonic/ /(Prefix) Operand/ With operand in range 0...255

Examples: LDI 16 ADI #FE ORI $0

Code generated: F8 10 FC FE F9 30

MODE 4 : Opcode with 8 bit pointer (Branches) (Line 600)

Format : /Mnemonic/ /Operand/The operand is always in hex notation and needs no prefix

Examples: BR 10 BN4 D0 BGE 0

Code generated: 30 10 3F D0 33 00

MODE 5 : Opcode with 16 bit address (Long Branches) (Line 700)

Foramat : /Mnemonic/ /Operand/ The operand is always in hex notation as in mode 4

Examples: LBR 13 LBNF F000

Code generated: C0 00 13 CB F0 00

MODE 6 : Opcode with I/O operand (Line 500)

Format : /Mnemonic//(Prefix) Operand/
With operand in range 1..7

Examples: OUT 4 INP #7

Code generated: 64 6F

MODE 7 : Pseudo opcode 'ORG', set origin (Line 800)

Format : ORG /Operand/
With operand always in hex notation

Examples: ORG 100 ORG F000

Sets PC to : 0100 F000

MODE 8 : Pseudo opcode 'END', end of assembler (Line 900)

Format : END, prints the message'END ON XXXX' and enters Basic

MODE 9 : Pseudo opcode 'DC' , define constant (Line 1900)

Format : DC /(Prefic) Operand/

If the operand is decimal (no prefix) and hexadecimal (prefix #), the numbers must be in the range 0..65535 (0000..FFFF). If the operand is less than 256, only 8 bits will be set up as constant, otherwise 16 bits are used. If the operand is a string (prefix $) up to 32 characters in that string are legal.

Exampls: DC 200 DC #10 DC 256 DC #1000 DC $ ABC

Constant generated: C8 10 0100 100020 41 42 43

ERROR MESSAGES

Whenever an error is detected, the assembler prints an error message followed by the mnemonic line with a question mark behind the error string portion.

'UNKNOWN MNEMONIC ERROR'	If a mnemonic is not found in the list
'MISSING OPERAND ERROR'	If the assembler finds no operand
'OPCODE ERROR'	If the mnemonic 'LDN 0' is found (Generating code 00 which is used for mnemonic 'IDL')
'OPERAND ERROR'	If the register or I/O operands are out of range
'STRING ERROR'	If there are more than 32 characters in the string of a 'DC' opcode
'ERROR'	If an error in the operand field is detected. That is -if a (hexa)decimal number is out of range -if a digit is not 0..9 or A..F
'ADDRESS VIOLATION'	If the memory address is within the protected area. The assembler responds with 'ORG ' and enters the 'ORG' sequence
'MEMORY FULL'	If no more memory is available. This message results in an end of the assembler

MEMORY SPACE

As found in the Super Basic manuals, the following pages are stored in the workspace (Note that in the listing this is page 01, see lines 20 and 50. It will be page 2F in V3.0 and page 35 in V5.0).

XX99 Page for end of string variables

XXBB Stack page

These pages will be loaded and referred to as start-and-end-address.

Assume end of string variables is page '31' and the stack page '4F'.

The assembler prints at the beginning:

'FIRST ADDRESS AVAILABLE 3300'
' LAST ADDRESS AVAILABLE 4DFF'

To be sure no dynamic assignment of memory areas will crash the program, there are some free pages.

TABLE OF VARIABLES

A	Holds first available memory address
B	Length of hex string (2 for byte, 4 for 16 bits)
C	End flag of substring (1 if no end, 0 if end of string)
D	Length of decimal string (3 for byte, 5 for 16 bits)
E	Holds last available memory address
F	Range flag (0 if character 0..9,A..F, 1 otherwise)
H	Work variable

I,J	For .. Next loop variables
L	Length of substring or executing mode line number
M	Current memory address
N	Current string pointer for line string
O	Opcode and operand counter
T	Work variable holds divisor for hex printing (Line 1200)
U	String pointer for string in 'DC' opcode
V	Nibble counter (2 if 8 bits, 4 if 16 bits)
X	Operand
Y,Z	Work variables
C($)	Substring, holding mnemonic or operand
H($)	Mnemonic from data list
O($)	Constant text for error routine
T($)	Mnemonic and operand input string
X($)	Token string (Holds prefix # or $)
O(32)	Array for opcode/operand/constant

SAMPLEPROGRAM

In some applications it's useful to work with the Gray-code. To work with Gray-coded information, a converter must be used.

The conversion of Binary to Gray is easy:

-Load Accu with binary word

-Shift accu right one bit

-Exor accu with original binary word

-Store content of accu as Gray code

The conversion of Gray code to Binary is similar, but uses the above routine M-times, where M depends on the number of bits (N) in the following way:

$$N \leq 2^X \qquad m=2^X-1$$

The assembler program consists of two parts: (Note the start address of hex '1600', this may differ from normal Super Basic versions)

Part 1 : 1600-1613 Calculate the number of loops (M) depending on the number of bits (N) in Lo register 8. The calculation starts with $x=1,2^X=2$. If the comparision $N-2^X$ is less or equal 0, the result is 2^X-1

Part 2 : 1620-1626 Perform the conversion (One loop)

Registers used : Reg 2 as stack pointer
Reg 8 as parameter register

The end of both parts is a SEP 5 (RTS) instruction.

```
SAMPLE RUN OF ASSEMBLER


(SUBROUTINES FOR GRAY CODE CONVERSION)

FIRST ADDRESS AVAILABLE @1600
 LAST ADDRESS AVAILABLE @2DFF
ENTER MNEMONIC

1600:LDI 2 STR 2 GLO 8 SM
1600 F8 02
1602 52
1603 88
1604 F7
1605:BL 0E BZ 0E LDN 2 SHL STR 2 BR 03
1605 3B 0E
1607 32 0E
1609 02
160A FE
160B 52
160C 30 03
160E:LDN 2 SMI 1 PLO 8 RTS
160E 02
160F FF 01
1611 A8
1612 D5
1613:ORG 1620 GLO 8 STR 2 SHR XOR PLO 8 RTS
1620 88
1621 52
1622 F6
1623 F3
1624 A8
1625 D5
1626:END
```

SAMPLE PROGRAM IN BASIC

This short program is the main program for the conversion of Gray code to Binary code and vice versa.

After initialization, the program asks for the mode. The user may select one of the four available modes with the following keys:

B Define number of bits to be converted. Basic calls the routine part 1 (Line 30) and prints:

'N BITS NEED M RUNS'

G Convert Gray to Binary

D Convert Binary to Gray

Both conversion modes print after execution:
'CONVERTED FROM X TO Y'

E End of program

```
10 DEFINT Z
20 INPUT "BITS TO BE CONVERTED" B
30 M=USR(@1600,B,O)
40 PRINT B;" BITS NEED " ;M;" RUNS"
50 INPUT "MODE" M$
60 IF MID$(M$,1,1)="G"  GOTO 110
70 IF MID$(M$,1,1)="D"  GOTO 120
80 IF MID$(M$,1,1)="B"  GOTO 20
90 IF MID$(M$,1,1)="E"  GOTO 200
100 GOTO 50
110 L=M: GOTO 130
120 L=1
130 INPUT "WORD" W:H=W
140 FOR I=1 TO L:W=USR(@1620,W,O): NEXT
150 PRINT "CONVERTED FROM " ;H;" TO " ;W
160 GOTO 50
200 DEFINT
```

```
BITS TO BE CONVERTED?8
8 BITS NEED 7 RUNS
MODE?B
BITS TO BE CONVERTED?4
4 BITS NEED 3 RUNS
MODE?G
WORD?6
CONVERTED FROM 6 TO 4
MODE?D
WORD?4
CONVERTED FROM 4 TO 6
MODE?B
BITS TO BE CONVERTED?8
8 BITS NEED 7 RUNS
MODE?G
WORD?100
CONVERTED FROM 100 TO 71
MODE?D
WORD?71
CONVERTED FROM 71 TO 100
MODE?E
```

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```
5 REM LINE BY LINE ASSEMBLER
6 REM FOR THE COSMAC CDP 1802
7 REM BY W.CIRSOVIUS,JUNE 81
10 DEFINT Z: DIM O(32): CLS: PRINT : PRINT
15 O$="OPERAND"
19 H=2
20 A=(PEEK(@0199)+H)*256:M=A
30 C$=" ADDRESS AVAILABLE @"
40 PRINT "FIRST";C$;: GOSUB 1200: PRINT
50 E=(PEEK(@018B)-1)*256-1:M=E
60 PRINT " LAST";C$;: GOSUB 1200: PRINT
70 PRINT "ENTER MNEMONIC": PRINT :M=A
75 REM **MAIN LOOP**
80 GOSUB 1200: INPUT ";"T$:N=1
90 GOSUB 1100: RESTORE
100 READ H$: IF H$="*" PRINT "UNKNOWN MNEMONIC";: GOTO 1000
110 READ L,O(1): IF H$=C$ GOTO L
130 GOTO 100
200 REM **REGISTER OPERAND**
210 IF C=0 GOTO 999
220 GOSUB 1300: IF X>15 PRINT O$;: GOTO 1000
240 O(1)=O(1)+X: IF O(1)=0 PRINT "OPCODE";: GOTO 1000
300 REM **NO OPERAND**
305 O=1
320 IF M<A PRINT "ADDRESS VIOLATION": INPUT "ORG @"T$:N=1: GOTO 820
330 IF M>E PRINT "MEMORY FULL": GOTO 920
335 IF M+O>E+1 GOTO 330
336 GOSUB 1200: PRINT " ";
340 FOR I=1 TO O: POKE(M,O(I));:H=M+1
350 M=O(I): GOSUB 1206: PRINT " ";
360 M=H: NEXT : PRINT
380 IF C<>0 GOTO 90
390 GOTO 80
400 REM **IMMEDIATE OPERAND**
410 IF C=0 GOTO 999
420 GOSUB 1300
430 O(2)=X:O=2: GOTO 320
500 REM **I/O CODE**
510 IF C=0 GOTO 999
520 GOSUB 1300: IF X=0 GOTO 550
540 IF X<8 GOTO 240
550 PRINT O$;: GOTO 1000
600 REM **BRANCH**
610 B=2: GOTO 720
700 REM **LONG BRANCH**
710 B=4
720 IF C=0 GOTO 999
730 GOSUB 1100: GOSUB 1420: IF B=2 GOTO 430
750 O(2)=X/256:O(3)=X-O(2)*256:O=3: GOTO 320
800 REM **ORIGIN**
810 IF C=0 GOTO 999
820 B=4: GOSUB 1100: GOSUB 1420:M=X: GOTO 380
900 REM **END**
910 PRINT : PRINT : PRINT "END ON @";: GOSUB 1200: PRINT
920 DEFINT
930 END
998 REM **ERROR HANDLER**
999 PRINT "MISSING OPERAND";
1000 PRINT " ERROR": PRINT
1020 FOR I=1 TO N-1: PRINT MID$(T$,I,1);: NEXT
1030 PRINT "?";: IF N=LEN(T$) GOTO 1050
1040 FOR I=N TO LEN(T$): PRINT MID$(T$,I,1);: NEXT
1050 PRINT : GOTO 80
```

```
1100 REM **GET SUBSTRING**
1110 FOR I=N TO LEN(T$)
1120 IF MID$(T$,I,1)=" " EXIT 1150
1130 NEXT :C=0
1140 C$=MID$(T$,N,I-N-C):N=I: RETURN
1150 C=1:I=I+1: GOTO 1140
1200 REM **PRINT HEX**
1205 V=4: GOTO 1210
1206 V=2
1210 X=M:T=16^(V-1): FOR J=1 TO V
1220 Y=X/T:Z=Y: IF Z>9Z=Z+7
1230 PRINT CHR$(Z+48);:X=X-Y*T:T=T/16: NEXT : RETURN
1300 REM **GET OPERAND**
1305 D=3:B=2
1310 GOSUB 1100:X$=MID$(C$,1,1):L=LEN(C$)
1320 IF X$="#" GOTO 1410
1330 IF X$="$" GOTO 1490
1335 REM **DECIMAL**
1340 IF L>D EXIT 1000
1350 X=0: FOR I=1 TO L
1360 D=ASC(MID$(C$,I,1)): GOSUB 1630
1370 IF F=1 EXIT 1395
1380 X=X*10+D-48: NEXT : RETURN
1395 EXIT 1000
1400 REM **HEX**
1410 C$=MID$(C$,2,LEN(C$))
1420 L=LEN(C$): IF L>B EXIT 1000
1430 X=0: FOR I=1 TO L
1440 D=ASC(MID$(C$,I,1)): GOSUB 1600
1450 IF F=1 EXIT 1395
1460 IF D>57D=D-7
1470 X=X*16+D-48: NEXT : RETURN
1490 REM **CHARACTER**
1500 X=ASC(MID$(C$,2,1)): RETURN
1600 REM **RANGE TEST**
1605 F=0: IF D>70F=1
1610 IF D<65 IF D>57F=1
1620 GOTO 1650
1630 F=0: IF D>57F=1
1650 IF D<48F=1
1660 RETURN
1900 REM **CONSTANT**
1910 IF C=0 GOTO 999
1915 O=LEN(T$)-N:U=N: IF O=0 GOTO 1925
1920 GOSUB 1100:X$=MID$(C$,1,1):L=LEN(C$): IF L>0 GOTO 1930
1925 PRINT "CONSTANT";: GOTO 1000
1930 IF X$="#"B=4: GOSUB 1410: GOTO 1960
1940 IF X$="$" GOTO 1980
1950 D=5: GOSUB 1340
1960 IF X<2560=1:O(1)=X: GOTO 320
1970 O=2:O(1)=X/256:O(2)=X-O(1)*256: GOTO 320
1980 IF O>32 PRINT "STRING";: GOTO 1000
1990 FOR I=1 TO O:O(I)=ASC(MID$(T$,U+I,1)): NEXT :C=0: GOTO 320
2000 REM **MNEMONIC DATA**
2010 DATA "IDL",300,#00,"NOP",300,#C4,"SEP",200,#D0,"SEX",200,#E0
2020 DATA "SEQ",300,#7B,"REQ",300,#7A,"SAV",300,#78,"MARK",300,#79
2030 DATA "RET",300,#70,"DIS",300,#71,"LDN",200,#00,"LDA",200,#40
2040 DATA "ORG",800,0,"END",900,0,"DC",1900,0
2050 DATA "LDXA",300,#72,"LDX",300,#F0,"LDI",400,#F8,"STR",200,#50
2060 DATA "STXD",300,#73,"INC",200,#10,"DEC",200,#20,"IRX",300,#60
2070 DATA "GLO",200,#80,"PLO",200,#A0,"GHI",200,#90,"PHI",200,#B0
2080 DATA "ORI",400,#F9,"OR",300,#F1,"XOR",300,#F3,"XRI",400,#FB
2090 DATA "AND",300,#F2,"ANI",400,#FA,"SHRC",300,#76,"SHR",300,#F6
2100 DATA "SHLC",300,#7E,"SHL",300,#FE,"ADD",300,#F4,"ADI",400,#FC
2110 DATA "ADCI",400,#7C,"ADC",300,#74,"SDBI",400,#7D,"SDB",300,#75
2120 DATA "SDI",400,#FD,"SD",300,#F5,"SMBI",400,#7F,"SMB",300,#77
2130 DATA "SMI",400,#FF,"SM",300,#F7,"BR",600,#30,"NBR",300,#38
2140 DATA "BZ",600,#32,"BNZ",600,#3A,"BDF",600,#33,"BNF",600,#3B
2150 DATA "BPZ",600,#33,"BGE",600,#33,"BM",600,#3B,"BL",600,#3B
2160 DATA "BQ",600,#31,"BNQ",600,#39,"B1",600,#34,"BN1",600,#3C
2170 DATA "B2",600,#35,"BN2",600,#3D,"B3",600,#36,"BN3",600,#3E
2180 DATA "B4",600,#37,"BN4",600,#3F,"LBR",700,#C0,"NLBR",300,#C8
2190 DATA "LBZ",700,#C2,"LBNZ",700,#CA,"LBDF",700,#C3,"LBNF",700,#CB
2200 DATA "LBQ",700,#C1,"LBNQ",700,#C9,"SKP",300,#38,"LSKP",300,#C8
2210 DATA "LSZ",300,#CE,"LSNZ",300,#C6,"LSDF",300,#CF,"LSNF",300,#C7
2220 DATA "LSQ",300,#CD,"LSNQ",300,#C5,"LSIE",300,#CC,"OUT",500,#60
2230 DATA "INP",500,#68
2240 DATA "CALL",700,#D4,"RTS",300,#D5
2990 DATA "*"
```

MEMORY TEST

by
Gary Gehlhoff

Occasionally I have felt that my ELF System was dropping a bit in memory somewhere along the line. To provide an initial check the following short program was written.

The "Memory Test" program puts the hexadecimal value FF into each memory location with each bit then being shifted into the DF register. DF is then tested for zero. If a zero occurs in DF, control is transferred to an error display (See Below). When all the bits of each memory location have been tested via DF, each memory location is then tested for zero. If all locations function properly, the Q L.E.D. will come on and the beginning address of the test will be displayed on the hex display.

If an error is found during testing, the Q L.E.D. will remain off while the high address of the memory location will be displayed on the hex display. Depressing and releasing the Input Button will show the low address of the memory location on the hex display.

Slight modifications to OP Codes in locations 0015, 002D, and 0032 will allow any section of memory to be tested.

It's interesting to note that there are 256 to the 256 power (which is beyond the range of any standard scientific calculator) possible bit combinations in one page of memory. Processing those combinations at the rate of 4,000,000 sec. (Elf clock frequency) would take 9.2 EE 62 years for your Elf to complete the task.

```
ADDR CODE          COMMENT
0010 90            R(0) 1 --> D
0011 B1 B2 B3      D --> R(1,2,3).1
0014 F8 50 A1      50 --> R(1).0  .0050 Start Test
0017 F8 4F A2      4F --> R(2).0
001A F8 08 A3      08 --> R(3).0
001D E1            X = 1
001E F8 FF         FF --> D
0020 51            D --> M(R(1))
0021 F0            M(R(X)) --> D
0022 F6            Shift Right --> DF
0023 51            D --> (M(R(1)))
0024 3B 42         If DF=0 Go To 42  Error Display
0026 23            R(3)-1
0027 83            R(3).0 --> D
0028 3A 21         If D ≠ 0
002A 11            R(1)+1
002B 91            R(1).1 --> D
002C FF 10         D - 10 --> D  High Ending Byte
002E 3A 1A         If D=0 Goto 1A
0030 81            R(1).0 --> D
0031 FF 00         D - 00 --> D Low Ending Byte
0033 3A 1A         If D=0 Goto 1A
0035 21            R(1)-1
0036 F0            M(R(X)) --> D
0037 3A 42         If D ≠ 0 Goto 42 Error Display
0039 91            R(1).1 --> D
003A 3A 35         If D ≠ 0 Goto 35
003C 81            R(1).0 --> D
003D FF 50         D - 50 --> D
003F 3A 35         If D ≠ 0 Goto 35
0041 7B            Q on
0042 91            R(1).1 --> D
0043 E2            X = 2
0044 52            D --> M(R(2))
0045 64            M(R(X)) --> Hex Display R(X)+1
0046 22            R(X)-1
0047 3F 47         Wait for "1" Depressed
0049 37 49         Wait for "1" Released
004B 81            R(1).0 --> D
004C 52            D --> M (R(2))
004D 64            M(R(X) --> Hex  R(X)+1
004E 00            Stop.
004F               Stack Location
```