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DECUS NO.	8-359
TITLE	HI-Q GAME PLAYING PROGRAM
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COMPANY	General Radio Company Concord, Massachusetts
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SOURCE LANGUAGE	General Radio's PDP-8/1130 Assembly (Similar to PAL III)

HI-Q GAME PLAYING PROGRAM

DECUS Program Library Write-up DECUS NO. 8-359

HI-Q is a game played with pegs on a cross-shaped board. The board contains 33 holes, symmetrically arranged. Initially, all holes except the one in the center contain removable pegs.

A move is made by "jumping" a peg over an adjacent peg into a vacant hole, then removing the peg which was jumped. A move can be made only when two pegs and a hole lie in a vertical or horizontal line. A game consists of a series of moves, starting from the initial configuration of the board, and ending when no more moves can be made. A complete, winning game results in only one peg remaining, in the center position.

This program employs the PDP-8 to find winning-game solutions to HI-Q by an exhaustive search method. At each move, a "tree" is formed of all possible moves, and the first move found is made. Whenever a situation exists where no further moves can be made, the program backs up one step along the tree and makes the next move. Any winning solution is printed as a series of 32 board images. Other printouts are available by means of the SWITCH REGISTER setting.

Program operation

The program begins at location 200. The switch functions available are:

0	print all 32-move games (if off, print only those with peg in center hole)
1	print all games
2	print octal move counts for all games
10	print only serial number for each printed game (if off, print serial number and board images)
11	halt at end of current game

The program itself occupies locations 0-740. The table of moves, list of current moves, and 32 HI-Q boards occupy the remainder of memory, starting at 1000. The program contains a copy of the initial HI-Q board, with others generated at each move.

Internally, a HI-Q board occupies $(100)_8$ locations, stored as an 8 x 8 array. A particular location on a board is defined by its X and Y coordinates, each of which may be in the range 0 to 6. The coordinates of the board positions are interpreted as follows:

```
X  0  1  2  3  4  5  6
Y
0        *  *  *
1        *  *  *
2  *  *  *  *  *  *  *
3  *  *  *  +  *  *  *
4  *  *  *  *  *  *  *
5        *  *  *
6        *  *  *
```

The asterisks denote positions which initially contain a peg; the plus sign represents the initial empty hole. While a 7 x 7 array would suffice to store a board, the use of an 8 x 8 array makes interpretation of stored coordinates easier, as the X and Y coordinates are represented by individual octal digits.

Each array location contains a 1 if a peg is present at the corresponding board location, a 0 if a hole is present, or a -1 if the corresponding location is off the board (e.g. (X,Y)=(0,1) or (3,7)). The contents of the array are updated whenever a move is made.

The program starts at BEGIN (200). The current move indicator NMOVE is set to 1, the autoindex AXMOV is set to the beginning of free space to build the table of possible moves, and the game counter is set to 1.

SCAN begins the code to examine each location of the current board and build a table of possible moves. For each position, a check is made that that position contains a peg, then a check is made in each of the four possible directions to determine if a move is possible. When a possible move (the adjacent hole contains a peg and the next hole is empty) is found, an entry is made in the move table. This entry contains the Y and X coordinates of the peg which will move in the first two octal digits, and the Y and X coordinates of the location to which it will jump in the last two digits. After all board locations have been scanned for possible moves, a zero is stored in the move table to separate this move table from the one which will be built at the next level.

CHEQUE picks up the current-level move table pointer (MOVTBL contains a pointer to the current move at each level) and branches to EMPTY of no more moves remain to be made. Otherwise, NMOVE is incremented to indicate the number of the next move to be made, and the current board is copied into the next higher board location. The coordinates contained in the move-table entry are used, together with the address of the newly-created board, to "move" the selected peg and remove the peg which was jumped.

NMOVE is examined to determine whether 32 moves have now been made. If not, a branch is made to SCAN to generate the move table for the newly-created board. If so, the board may be printed, depending on the location of the final peg and the output print option selected.

EMPTY is reached when the move table at a particular level is empty. Depending on the options selected, the number of moves made or the current series of boards may be printed. Switch 11 is examined to determine whether the program should halt.

NMOVE is then decremented so that the program may back up one level. The NMOVEth entry in MOVTBL is found, and this is the address of the last move made at level NMOVE. This address is used to initialize a search for the end of the level NMOVE move table, which is in turn used to reset AXMOV to build the new move tables for succeeding levels. The pointer in MOVTBL is incremented to point to the next available move, and the game counter is incremented. A branch is then made to CHEQUE, and the process continues.

Operation

Normal operation of this program consists of setting the program counter to 0200 with LOAD ADDR, selecting the desired switch options, and pressing START. A typical printout is included. This printout represents the first solution found by the program, and includes the serial number (in octal) and the 32 boards generated. In the printout, an asterisk (*) represents a peg, while a plus (+) represents an empty hole.

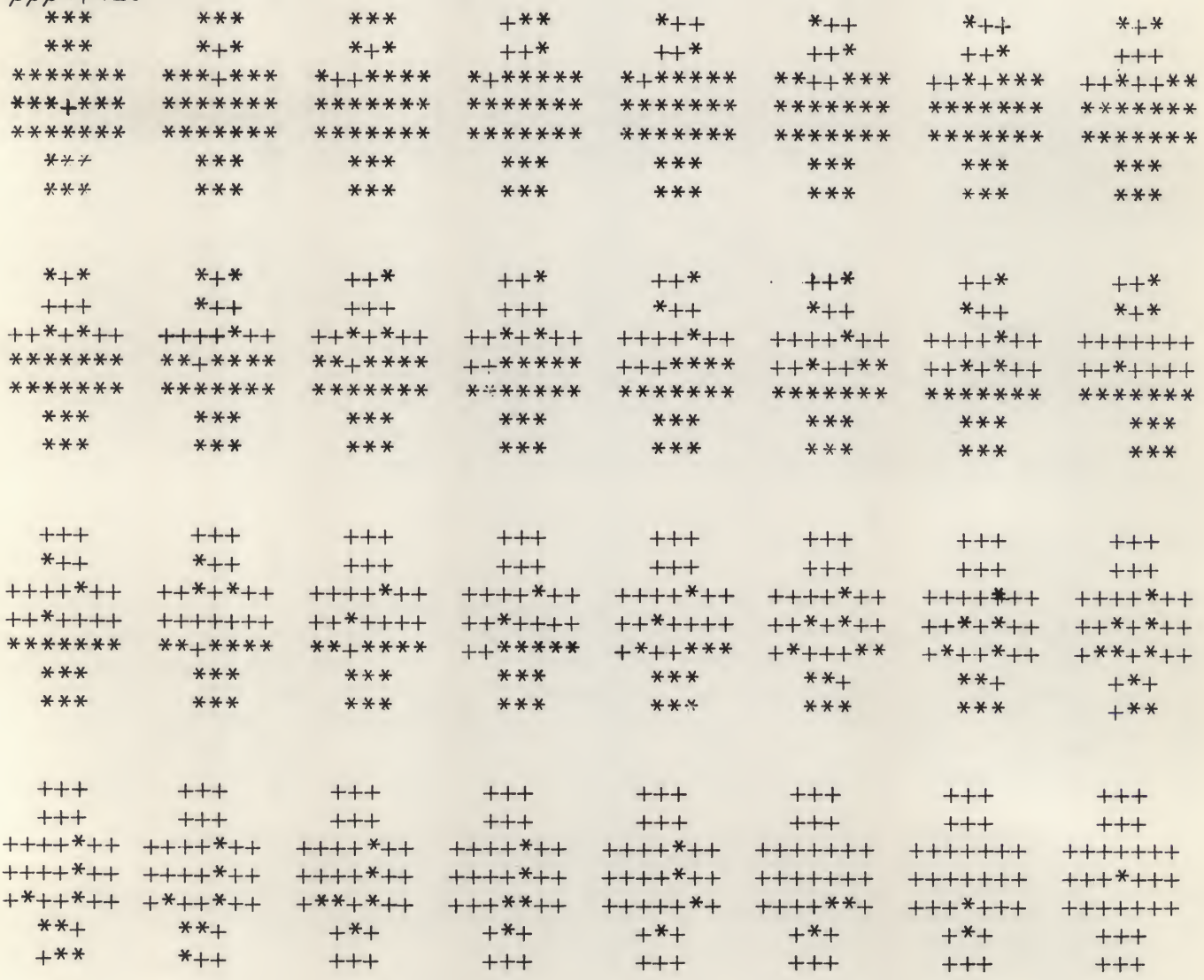
Because the program backs up and tries again from the last successful move made, it takes a very long time for the moves made in the early part of the game to change. The program can be made to try a new move earlier than it ordinarily would with the following procedure:

1. use switch 11 to halt at the end of current game
2. using DEPOSIT, set location NMOVE to the level at which the new move is to be made
3. reset the switches and restart at location 0513.

It may also be interesting to play the game with a different initial board configuration. This may be modified in core before starting the program. If this is done, it may be desirable either to alter the test for the desired final board configuration (now made at 464), or to operate the program so that it prints all one-peg games (switch 0 on).

The following is the first solution found by the HI-Q program.

ØØØ47426



```
                / SWITCH FUNCTIONS...
                /    0  PRINT ALL ONE-PEG GAMES
                /    1  PRINT ALL GAMES
                /    2  PRINT (OCTAL) MOVE COUNTS FOR ALL GAMES
                /   10  PRINT ONLY GAME NUMBER, NOT BOARDS
                /   11  HALT AT END OF CURRENT GAME

0010                    *10
0010  0000      AXMOV   0               STORE POINTER FOR MOVE TABLE
0011  0000      AXOCT   0

0020                    *20
0020  0740      PBOARD  BOARD-100
0021  1040      PBRD2   BOARD
0022  0000      NMOVE   0               MOVE COUNTER
0023  0777      PMOVTBL MOVTBL-1        POINTER TO MOVE TABLE POINTERS
0024  5037      PFREESP FREESP-1
0025  0000      CURMOV  0               POINTER TO CURRENT ENTRY IN MOVTBL
0026  0000      X       0               CURRENT X
0027  0000      Y       0               Y
0030  0000      THIS    0
0031  0000      POINT   0

0032  0000      ENTER   0               PUT ENTRY IN MOVE TABLE
0033  1027              TAD Y           PACK CURRENT Y
0034  4046              JMS R3L
0035  1026              TAD X           CURRENT X
0036  4046              JMS R3L
0037  1027              TAD Y           CURRENT Y AGAIN
0040  4046              JMS R3L
0041  1026              TAD X           CURRENT X AGAIN
0042  1432              TAD I ENTER     DISPLACEMENT
0043  3410              DCA I AXMOV     STORE
0044  2032              ISZ ENTER
0045  5432              JMP I ENTER

0046  0000      R3L     0               ROTATE 3 LEFT
0047  7106              CLL RTL
0050  7004              RAL
0051  5446              JMP I R3L

0052  0000      TYPE    0
0053  6046              TLS
0054  6041              TSF
0055  5054              JMP .-1
0056  5452              JMP I TYPE

0057  0000      CRLF    0
0060  7200              CLA
0061  1067              TAD C215
0062  4052              JMS TYPE
0063  1070              TAD M3
0064  4052              JMS TYPE
0065  7200              CLA
0066  5457              JMP I CRLF
0067  0215      C215    215
0070  7775      M3      -3
```

```
0071  0000     SWITCH  0                READ SWITCH REGISTER AND MASK
0072  7604             CLA OSR
0073  0471             AND I SWITCH
0074  2071             ISZ SWITCH
0075  5471             JMP I SWITCH

0076  0000     OCTAL   0
0077  7104             CLL RAL
0100  3117             DCA OCT1
0101  1121             TAD OCM4
0102  3120             DCA OCT2
0103  1117     OCT0    TAD OCT1
0104  7006             RTL
0105  7004             RAL
0106  3117             DCA OCT1
0107  1117             TAD OCT1
0110  0122             AND OCT7
0111  1123             TAD OCT260
0112  4052             JMS TYPE
0113  7200             CLA
0114  2120             ISZ OCT2
0115  5103             JMP OCT0
0116  5476             JMP I OCTAL
0117  0000     OCT1    0
0120  0000     OCT2    0
0121  7774     OCM4    -4
0122  0007     OCT7    7
0123  0260     OCT260  260

0124  0000     XINIT   0                INITIALIZE GAME COUNTER
0125  7200             CLA
0126  1134             TAD XM10
0127  3133             DCA XCOUNT
0130  1135             TAD PXBUF
0131  3011             DCA AXOCT
0132  5524             JMP I XINIT
0133  0000     XCOUNT  0
0134  7766     XM10    -10.
0135  0135     PXBUF   XBUF-1
0136           XBUF    BSS 10.
```

```
0200                    *200
                /********* BEGIN HERE TO START FROM FIRST POSSIBLE GAME
0200  7201     BEGIN    CLA IAC          SET MOVE=1
0201  3022              DCA NMOVE
0202  1024              TAD PFREESP      SETT UP STORE POINTER TO FREE AREA
0203  3010              DCA AXMOV
0204  4124              JMS XINIT        SET GAME COUNT TO 1
0205  3411              DCA I AXOCT
0206  2133              ISZ XCOUNT
0207  5205              JMP .-2
0210  2147              ISZ XBUF+9.

0211  1022     SCAN     TAD NMOVE        SCAN CURRENT BOARD AND BUILD MOVE TABI
0212  1023              TAD PMOVTBL
0213  3025              DCA CURMOV
0214  1010              TAD AXMOV        NEXT FRREE SPACE
0215  7001              IAC
0216  3425              DCA I CURMOV
0217  7326              P2AC             SET Y,X TO 0,2
0220  3026              DCA X
0221  3027              DCA Y

0222  1022     SCN00    TAD NMOVE        COMPUTE ADDR OF THIS BOARD
0223  4046              JMS R3L
0224  1027              TAD Y
0225  4046              JMS R3L
0226  1026              TAD X
0227  1020              TAD PBOARD
0230  3030              DCA THIS         ADDR OF CURRENT CONSIDERED POINT

0231  1430              TAD I THIS       CHECK FOR PEG PRESENT
0232  7750              SPA SNA CLA
0233  5340              JMP SCN10        NO

0234  1026              TAD X            CHECK X LE 4
0235  1356              TAD M4
0236  7740              SMA SZA CLA
0237  5254              JMP SCN02        NO

0240  1030              TAD THIS         CHECK N(Y,X+1) G 0
0241  7001              IAC
0242  3357              DCA TEM
0243  1757              TAD I TEM
0244  7750              SPA SNA CLA
0245  5254              JMP SCN02        NO

0246  2357              ISZ TEM          CHECK N(Y,X+2) ZERO
0247  1757              TAD I TEM
0250  7640              SZA CLA
0251  5254              JMP SCN02        NO
0252  4032              JMS ENTER        YES, STORE POINT IN TABLE
0253  0002              2
```

```
0254  1027     SCN02   TAD Y           IS Y LE 4
0255  1356             TAD M4
0256  7740             SMA SZA CLA
0257  5276             JMP SCN04       NO

0260  1030             TAD THIS        CHECK N(Y+1,X) POS
0261  1360             TAD C10
0262  3357             DCA TEM
0263  1757             TAD I TEM
0264  7750             SPA SNA CLA
0265  5276             JMP SCN04       NO

0266  1357             TAD TEM         CHECK N(Y+2,X) EMPTY
0267  1360             TAD C10
0270  3357             DCA TEM
0271  1757             TAD I TEM
0272  7640             SZA CLA
0273  5276             JMP SCN04       NO
0274  4032             JMS ENTER       YES, STORE POINT
0275  0020               20

0276  7344     SCN04   M2AC            CHECK X GE 2
0277  1026             TAD X
0300  7710             SPA CLA
0301  5316             JMP SCN06       NO

0302  7344             M2AC
0303  1030             TAD THIS
0304  3357             DCA TEM
0305  1757             TAD I TEM
0306  7640             SZA CLA
0307  5316             JMP SCN06       NO

0310  2357             ISZ TEM         CHECK N(Y,X-1) POSITIVE
0311  1757             TAD I TEM
0312  7750             SPA SNA CLA
0313  5316             JMP SCN06
0314  4032             JMS ENTER
0315  7776               -2
```

```
0316  7344    SCN06   M2AC            CHECK Y GE 2
0317  1027            TAD Y
0320  7710            SPA CLA
0321  5340            JMP SCN10

0322  1030            TAD THIS        N(Y-1,X) POS
0323  1361            TAD M10
0324  3357            DCA TEM
0325  1757            TAD I TEM
0326  7750            SPA SNA CLA
0327  5340            JMP SCN10       NO

0330  1357            TAD TEM         N(Y-2,X) ZERO
0331  1361            TAD M10
0332  3357            DCA TEM
0333  1757            TAD I TEM
0334  7640            SZA CLA
0335  5340            JMP SCN10
0336  4032            JMS ENTER
0337  7760              -20

0340  2026    SCN10   ISZ X           NEXT X VALUE
0341  1026            TAD X           X GE 7
0342  1362            TAD M7
0343  7710            SPA CLA         SKIP IF SO
0344  5222            JMP SCN00       NO, SCAN NEXT POINT
0345  3026            DCA X           RESET X TO 0
0346  2027            ISZ Y           NEXT Y
0347  1027            TAD Y           CHECK
0350  1362            TAD M7          GE 7
0351  7710            SPA CLA         SKIP IF SO
0352  5222            JMP SCN00       NO
0353  3410            DCA I AXMOV     STORE END-OF-MOVE CHAR AND END SCAN
0354  5755            JMP I .+1
0355  0400              CHEQUE

0356  7774    M4      -4
0357  0000    TEM     0
0360  0010    C10     10
0361  7770    M10     -10
0362  7771    M7      -7
```

```
0400                    *400
0400  1425    CHEQUE    TAD I CURMOV      CONTENTS OF CURRENT MOVE POINTER
0401  3031              DCA POINT         POINTS TO CURRENT ENTRY
0402  1431              TAD I POINT       MORE MOVES REMAINING
0403  7650              SNA CLA
0404  5272              JMP EMPTY         NO

0405  1022              TAD NMOVE         COMPUTE ADDR OF THIS BOARD
0406  4046              JMS R3L
0407  4046              JMS R3L
0410  1020              TAD PBOARD
0411  3347              DCA TEM1

0412  2022              ISZ NMOVE         INCR MOVES AND COMPUTE ADDR OF NEXT B
0413  1022              TAD NMOVE
0414  4046              JMS R3L
0415  4046              JMS R3L
0416  1020              TAD PBOARD
0417  3350              DCA TEM2

0420  1353              TAD M100          SET UP WORD COUNT
0421  3351              DCA TEM3
0422  1747              TAD I TEM1        MOVE
0423  3750              DCA I TEM2
0424  2347              ISZ TEM1
0425  2350              ISZ TEM2
0426  2351              ISZ TEM3          COUNT
0427  5222              JMP .-5

0430  1431              TAD I POINT       GET CURRENT MOVE
0431  7112              CLL RTR           FROM
0432  7012              RTR
0433  7012              RTR
0434  0354              AND C77
0435  1347              TAD TEM1          ADDR OF CURRENT ARRAY
0436  3350              DCA TEM2
0437  3750              DCA I TEM2        REMOVE THE PEG

0440  1431              TAD I POINT
0441  0354              AND C77           TO
0442  1347              TAD TEM1
0443  3351              DCA TEM3
0444  7001              IAC               PUT A PEG THERE
0445  3751              DCA I TEM3

0446  7100              CLL               REMOVE JUMPED PAG
0447  1350              TAD TEM2
0450  1351              TAD TEM3
0451  7010              RAR
0452  3351              DCA TEM3
0453  3751              DCA I TEM3
```

```
0454  1022            TAD NMOVE       32 MOVES MADE
0455  1352            TAD M32D
0456  7640            SZA CLA         SKIP IF SO, OTHERWISE
0457  5755            JMP I SCANP     GO MAKE NEXT MOVE

0460  4071            JMS SWITCH      SHOULD ALL ONE-PEG GAMES BE PRINTED
0461  4000              4000
0462  7640            SZA CLA         SKIP IF NOT
0463  5267            JMP .+4         BRANCH IF SO

0464  1760            TAD I LMOVP     LAST MOVE CORRECT
0465  7650            SNA CLA
0466  5272            JMP EMPTY       NO

0467  1022            TAD NMOVE       PRINT
0470  4756            JMS I OUTBDP
0471  5307            JMP EMPTY2      PROCEED TO NEXT GAME

0472  4071  EMPTY     JMS SWITCH      END OF GAME..SHOULD NMOVE BE PRINTED
0473  1000              1000
0474  7650            SNA CLA         SKIP IF SO
0475  5301            JMP .+4         BRANCH IF NOT
0476  1022            TAD NMOVE
0477  4076            JMS OCTAL
0500  4057            JMS CRLF

0501  4071            JMS SWITCH      SHOULD ALL GAMES BE PRINTED
0502  2000              2000
0503  7650            SNA CLA         SKIP IF SO
0504  5307            JMP .+3         BRANCH IF NOT
0505  1022            TAD NMOVE       PRINT
0506  4756            JMS I OUTBDP

0507  4071  EMPTY2    JMS SWITCH      HALT AT END OF GAME
0510  0001              0001
0511  7640            SZA CLA         SKIP IF NO
0512  7402            HLT             YES

                  /********** BEGIN HERE TO RESTART AFTER HALT
0513  7240                STA         DECREMENT MOVE COUNTER
0514  1022                TAD NMOVE
0515  7450                SNA         ZERO
0516  5345                JMP QUIT    YES, ALL GAMES PLAYED
0517  3022                DCA NMOVE
0520  1022                TAD NMOVE   COMPUTE ADDR OF MOVE TABLE ENTRIES
0521  1023                TAD PMOVTBL
0522  3025                DCA CURMOV
0523  7240                STA         RESET THE STORE POINTER
0524  1425                TAD I CURMOV
0525  3010                DCA AXMOV
0526  1410                TAD I AXMOV
0527  7640                SZA CLA     FIND END
0530  5326                JMP .-2
0531  2425                ISZ I CURMOV NEXT MOVE IN TABLE
```

```
0532  4124          JMS XINIT       INCR GAME COUNT
0533  1357          TAD PXBUF2      END OF BUFFER
0534  3347  INCR    DCA TEM1
0535  2747          ISZ I TEM1
0536  5200          JMP CHEQUE      JUMP IF NO CARRY
0537  2133          ISZ XCOUNT      CONT CARRIES
0540  7410          SKP
0541  5200          JMP CHEQUE      OVERFLOW
0542  7240          STA             MOVE TO NEXT WORD
0543  1347          TAD TEM1
0544  5334          JMP INCR

0545  7402  QUIT    HLT
0546  5345          JMP .-1

0547  0000  TEM1    0
0550  0000  TEM2    0
0551  0000  TEM3    0
0552  7740  M32D    -32.
0553  7700  M100    -100
0554  0077  C77     77
0555  0211  SCANP   SCAN
0556  0600  OUTBDP  OUTBRD
0557  0147  PXBUF2  XBUF+9.          LAST COUNT ENTRY
0560  4773  LMOVP   31.*100+BOARD+33   ADDR OF CENTER HOLE OF LAST BOARD
```

```
                / SUBROUTINE TO OUTPUT CURRENT SERIES OF BOARDS
0600                    *600
0600  0000      OUTBRD  0
0601  3312              DCA OUTN
0602  4124              JMS XINIT         OUTPUT GAME NUMBER
0603  1411              TAD I AXOCT
0604  7440              SZA               DON'T PRINT ZERO WORDS
0605  5210              JMP .+3
0606  2133              ISZ XCOUNT
0607  5203              JMP .-4           GET NEXT WORD
0610  4076              JMS OCTAL         PRINT NONZERO
0611  2133              ISZ XCOUNT        COUNT
0612  7410              SKP
0613  5216              JMP .+3
0614  1411              TAD I AXOCT
0615  5210              JMP .-5
0616  4057              JMS CRLF
0617  4071              JMS SWITCH        TEST 'PRINT OCTAL ONLY'
0620  0002                0002
0621  7640              SZA CLA
0622  5600              JMP I OUTBRD

0623  1021              TAD PBRD2
0624  3313              DCA OUTPTR
0625  1312      OUT00   TAD OUTN
0626  7750              SPA SNA CLA
0627  5600              JMP I OUTBRD
0630  1312              TAD OUTN
0631  1331              TAD OUTM8
0632  3312              DCA OUTN          DECREMENT NUMBER BY 8
0633  1312              TAD OUTN
0634  7500              SMA               IF MORE THAN 8 REMAIN
0635  7200              CLA               SET NUMBER TO 8
0636  1326              TAD C8
0637  7041              CMA IAC           NEGATE NUMBER
0640  3314              DCA OUTCNT        STORE IT
0641  1330      OUT02   TAD OUTM7
0642  3315              DCA OUTLCT
0643  1314      OUT03   TAD OUTCNT
0644  3316              DCA OUTEMP
0645  1313              TAD OUTPTR
0646  3317              DCA OTEMPT
0647  1330      OUT04   TAD OUTM7
0650  3320              DCA OUCHRC
0651  1717      OUT05   TAD I OTEMPT
0652  7540              SMA SZA
0653  1321              TAD STARCH        '0-1
0654  7450              SNA
0655  1322              TAD PLUSCH        '+
0656  7510              SPA
0657  1323              TAD BLNKCH        ' +1
0660  4052              JMS TYPE
0661  7200              CLA
0662  2317              ISZ OTEMPT
0663  2320              ISZ OUCHRC
0664  5251              JMP OUT05
0665  1324              TAD C240
0666  4052              JMS TYPE
```

```
0667  4052            JMS TYPE
0670  7200            CLA
0671  1317            TAD OTEMPT
0672  1325            TAD 64M7
0673  3317            DCA OTEMPT
0674  2316            ISZ OUTEMP      COUNT BOARDS
0675  5247            JMP OUT04
0676  1313            TAD OUTPTR      MOVE TO NEXT ROW
0677  1326            TAD C8
0700  3313            DCA OUTPTR
0701  4057            JMS CRLF
0702  2315            ISZ OUTLCT      COUNT LINES
0703  5243            JMP OUT03
0704  4057            JMS CRLF
0705  4057            JMS CRLF
0706  4057            JMS CRLF
0707  1313            TAD OUTPTR      MOVE UP TO NEXT 8 BOARDS
0710  1327            TAD C710
0711  5224            JMP OUT00-1

0712  0000    OUTN    0
0713  0000    OUTPTR  0
0714  0000    OUTCNT  0
0715  0000    OUTLCT  0
0716  0000    OUTEMP  0
0717  0000    OTEMPT  0
0720  0000    OUCHRC  0
0721  0251    STARCH  '*-1
0722  0253    PLUSCH  '+
0723  0241    BLNKCH  ' +1
0724  0240    C240    '
0725  0071    64M7    100-7
0726  0010    C8      8
0727  0710    C710    710             1000-7*10
0730  7771    OUTM7   -7
0731  7770    OUTM8   -8.
```

```
1000                    *1000
1000           MOVTBL   BSS 32.
1040   7777    BOARD    -1
1041   7777             -1
1042   0001             1
1043   0001             1
1044   0001             1
1045   7777             -1
1046   7777             -1
1047   7777             -1
1050   7777             -1
1051   7777             -1
1052   0001             1
1053   0001             1
1054   0001             1
1055   7777             -1
1056   7777             -1
1057   7777             -1
1060   0001             1
1061   0001             1
1062   0001             1
1063   0001             1
1064   0001             1
1065   0001             1
1066   0001             1
1067   7777             -1
1070   0001             1
1071   0001             1
1072   0001             1
1073   0000             0
1074   0001             1
1075   0001             1
1076   0001             1
1077   7777             -1
1100   0001             1
1101   0001             1
1102   0001             1
1103   0001             1
1104   0001             1
1105   0001             1
1106   0001             1
1107   7777             -1
1110   7777             -1
1111   7777             -1
1112   0001             1
1113   0001             1
1114   0001             1
1115   7777             -1
1116   7777             -1
1117   7777             -1
1120   7777             -1
1121   7777             -1
1122   0001             1
1123   0001             1
1124   0001             1
1125   7777             -1
1126   7777             -1
1127   7777             -1
```

```
1130  7777              -1
1131  7777              -1
1132  7777              -1
1133  7777              -1
1134  7777              -1
1135  7777              -1
1136  7777              -1
1137  7777              -1

1140                    BSS 31.*100
5040            FREESP  BSS 0
```

SYMBOL TABLE

AXMOV	0010	PMOVTB	0023
AXOCT	0011	POINT	0031
BEGIN	0200	PXBUF	0135
BLNKCH	0723	PXBUF2	0557
BOARD	1040	QUIT	0545
CHEQUE	0400	R3L	0046
CRLF	0057	SCAN	0211
CURMOV	0025	SCANP	0555
C10	0360	SCN00	0222
C215	0067	SCN02	0254
C240	0724	SCN04	0276
C710	0727	SCN06	0316
C77	0554	SCN10	0340
C8	0726	STARCH	0721
EMPTY	0472	SWITCH	0071
EMPTY2	0507	TEM	0357
ENTER	0032	TEM1	0547
FREESP	5040	TEM2	0550
INCR	0534	TEM3	0551
LMOVP	0560	THIS	0030
MOVTBL	1000	TYPE	0052
M10	0361	X	0026
M100	0553	XBUF	0136
M3	0070	XCOUNT	0133
M32D	0552	XINIT	0124
M4	0356	XM10	0134
M7	0362	Y	0027
NMOVE	0022	64M7	0725
OCM4	0121		
OCTAL	0076		
OCT0	0103		
OCT1	0117		
OCT2	0120		
OCT260	0123		
OCT7	0122		
OTEMPT	0717		
OUCHRC	0720		
OUTBDP	0556		
OUTBRD	0600		
OUTCNT	0714		
OUTEMP	0716		
OUTLCT	0715		
OUTM7	0730		
OUTM8	0731		
OUTN	0712		
OUTPTR	0713		
OUT00	0625		
OUT02	0641		
OUT03	0643		
OUT04	0647		
OUT05	0651		
PBOARD	0020		
PBRD2	0021		
PFREES	0024		
PLUSCH	0722		

NO ERRORS IN ABOVE ASSEMBLY

REFERENCES TO DEFINED SYMBOLS

SYMBOL	VALUE	REFERENCES									
AXMOV	0010	0043	0203	0214	0353	0525	0526				
AXOCT	0011	0131	0205	0603	0614						
BEGIN	0200										
BLNKCH	0723	0657									
BOARD	1040	0020	0021	0560							
CHEQUE	0400	0355	0536	0541							
CRLF	0057	0066	0500	0616	0701	0704	0705	0706			
CURMOV	0025	0213	0216	0400	0522	0524	0531				
C10	0360	0261	0267								
C215	0067	0061									
C240	0724	0665									
C710	0727	0710									
C77	0554	0434	0441								
C8	0726	0636	0677								
EMPTY	0472	0404	0466								
EMPTY2	0507	0471									
ENTER	0032	0042	0044	0045	0252	0274	0314	0336			
FREESP	5040	0024									
INCR	0534	0544									
LMOVP	0560	0464									
MOVTBL	1000	0023									
M10	0361	0323	0331								
M100	0553	0420									
M3	0070	0063									
M32D	0552	0455									
M4	0356	0235	0255								
M7	0362	0342	0350								
NMOVE	0022	0201	0211	0222	0405	0412	0413	0454	0467	0476	0505
		0514	0517	0520							
OCM4	0121	0101									
OCTAL	0076	0116	0477	0610							
OCT0	0103	0115									
OCT1	0117	0100	0103	0106	0107						
OCT2	0120	0102	0114								
OCT260	0123	0111									
OCT7	0122	0110									
OTEMPT	0717	0646	0651	0662	0671	0673					
OUCHRC	0720	0650	0663								
OUTBDP	0556	0470	0506								
OUTBRD	0600	0556	0622	0627							
OUTCNT	0714	0640	0643								
OUTEMP	0716	0644	0674								
OUTLCT	0715	0642	0702								
OUTM7	0730	0641	0647								
OUTM8	0731	0631									
OUTN	0712	0601	0625	0630	0632	0633					
OUTPTR	0713	0624	0645	0676	0700	0707					
OUT00	0625	0711									
OUT02	0641										
OUT03	0643	0703									
OUT04	0647	0675									
OUT05	0651	0664									
PBOARD	0020	0227	0410	0416							
PBRD2	0021	0623									
PFREES	0024	0202									

PLUSCH	0722	0655								
PMOVTB	0023	0212	0521							
POINT	0031	0401	0402	0430	0440					
PXBUF	0135	0130								
PXBUF2	0557	0533								
QUIT	0545	0516								
R3L	0046	0034	0036	0040	0051	0223	0225	0406	0407	0414	0415
SCAN	0211	0555								
SCANP	0555	0457								
SCN00	0222	0344	0352							
SCN02	0254	0237	0245	0251						
SCN04	0276	0257	0265	0273						
SCN06	0316	0301	0307	0313						
SCN10	0340	0233	0321	0327	0335					
STARCH	0721	0653								
SWITCH	0071	0073	0074	0075	0460	0472	0501	0507	0617	
TEM	0357	0242	0243	0246	0247	0262	0263	0266	0270	0271	0304
		0305	0310	0311	0324	0325	0330	0332	0333		
TEM1	0547	0411	0422	0424	0435	0442	0534	0535	0543		
TEM2	0550	0417	0423	0425	0436	0437	0447				
TEM3	0551	0421	0426	0443	0445	0450	0452	0453			
THIS	0030	0230	0231	0240	0260	0303	0322				
TYPE	0052	0056	0062	0064	0112	0660	0666	0667			
X	0026	0035	0041	0220	0226	0234	0277	0340	0341	0345	
XBUF	0136	0135	0210	0557							
XCOUNT	0133	0127	0206	0537	0606	0611					
XINIT	0124	0132	0204	0532	0602						
XM10	0134	0126									
Y	0027	0033	0037	0221	0224	0254	0317	0346	0347		
64M7	0725	0672									