DECUS
PROGRAM LIBRARY

DECUS NO.	8-261
TITLE	QUBIC
AUTHOR	Tim Yeager
COMPANY	William Tennent High School Warminster, Pennsylvania
DATE	Submitted May 4, 1970
SOURCE LANGUAGE	PAL III

QUBIC

DECUS Program Library Write-up

DECUS No. 8-261

ABSTRACT

'QUBIC' PLAYS 3 DIMENSIONAL TIC-TAC-TOE ON AN ORDER-4 CUBE. THE PROGRAM IS CONVERSATIONAL AND USES THE TELETYPE FOR ALL I/O. MOVES ARE TYPED IN AS 3 COORDINATES, AND OUTPUTTED USING BOTH COORDINATES AND A TELETYPE PRINTOUT OF THE PLAYING BOARD. THE STRATEGIES EMPLOYED IN PLAYING THE GAME HAVE BEEN FOUND TO BE EXTREMELY GOOD, BUT THE PROGRAM CAN BE BEATEN.

REQUIREMENTS

A PDP-8, PDP-8/I, OR PDP-8/L WITH 4K OF MEMORY AND AN ASR-33 TELETYPE.

LOADING PROCEDURE

LOAD WITH THE STANDARD BINARY LOADER.

OPERATING PROCEDURE

TURN THE TELETYPE TO LINE, SET SR=0200, PRESS 'LOAD ADDRESS', THEN PRESS 'START'.

THE COMPUTER THEN TYPES A SIGN-ON MESSAGE AND ASKS A SERIES OF QUESTIONS. THE QUESTIONS AND THEIR MEANINGS ARE LISTED IN TABLE I.

TABLE I

TELETYPE OUTPUT	DESCRIPTION
DO YOU WANT AN EXPLANATION OF HOW TO PLAY ?	ANSWER 'YES' OR 'NO'. IF THE 'YES' OPTION IS SELECTED, A BRIEF DESCRIPTION OF THE GAME WILL BE TYPED.
BOARD PRINTOUT ?	ANSWER 'YES' OR 'NO'. IF THE 'YES' OPTION IS SELECTED, THE PLAYING BOARD WILL BE PRINTED OUT AFTER EVERY COMPUTER MOVE. IF 'NO' IS TYPED, THE BOARD WILL BE PRINTED ONLY AFTER A WIN OR LOSS. (SEE APPENDIX A.)
SHALL I GO FIRST ?	ANSWER 'YES' OR 'NO'. IF 'YES' IS TYPED, THE COMPUTER WILL MAKE THE FIRST MOVE, OTHERWISE, YOU WILL GO FIRST.

YOUR MOVE IS	INPUT YOUR MOVE AS 3 COORDINATES FROM 1 TO 4 INCLUSIVE. TYPE IN THE ORDER ROW, COLUMN, PLANE. (THE TOP ROW AND LEFTMOST COLUMN OF THE TOP PLANE WOULD BE TYPED 1,1,1.)
HOW ABOUT ANOTHER GAME ?	TYPED AFTER A WIN, LOSS, OR TIE. ANSWERING 'YES' WILL RESTART THE PROGRAM, AND TYPING 'NO' WILL HALT IT WITH PC=0200.

TYPING ERROR RECOVERY

TYPING ANSWERS OTHER THAN THOSE BEGINNING WITH 'Y' OR 'N' WILL CAUSE AN ERROR MESSAGE TO BE TYPED AND THE QUESTION ASKED AGAIN.

IF ANY CHARACTERS OTHER THAN 1 THROUGH 4 ARE TYPED FOR MOVE INPUT, OR IF THE SPECIFIED SQUARE IS ALREADY OCCUPIED, AN ILLEGAL MOVE MESSAGE WILL BE PRINTED AND THE MOVE ASKED FOR AGAIN.

TYPING A BACK ARROW (SHIFT/O) BEFORE TYPING THE LAST COORDINATE OF AN INPUTTED MOVE DELETES THAT MOVE AND ASKS FOR A NEW ONE.

OUTPUT

AFTER THE INPUT OF EVERY USER MOVE, THE COMPUTER DETERMINES ITS MOVE AND OUTPUTS IT BY TYPING 'I MOVE' FOLLOWED BY THREE COORDINATES OF THE SAME FORM AS THOSE USED ON INPUT. WHEN THE COMPUTER WINS, IT TYPES 'I WIN ON' FOLLOWED BY THE 3 COORDINATES OF EACH OF THE 4 SQUARES ON THE WINNING PATH. IF THE HUMAN OPPONENT WINS, THE COMPUTER TYPES 'YOU WIN ON' FOLLOWED BY A SET OF SIMILAR COORDINATES. A TIE SIMPLY CAUSES A MESSAGE INDICATING A TIE TO BE TYPED OUT. IN ALL CASES EXCEPT A TIE, THE PLAYING BOARD IS PRINTED OUT AFTER THE MESSAGE. (SEE APPENDIX A.)

CONTROL OPTIONS

WHENEVER THE PROGRAM IS IN AN INPUT WAITING LOOP, TYPING CERTAIN CONTROL CHARACTERS WILL CAUSE BRANCHING TO OTHER PARTS OF THE PROGRAM. THESE CHARACTERS ARE LISTED IN TABLE II.

TABLE II

CHARACTER	PROGRAM ACTION
CONTROL/N	INTERRUPTS THE CURRENT GAME AND STARTS A NEW ONE.

CONTROL/S — TYPES THE SIGN-OFF MESSAGE AND HALTS THE COMPUTER WITH PC=0200.

THE GAME OF ORDER-4 3D TIC-TAC-TOE

THREE DIMENSIONAL TIC-TAC-TOE IS SIMILAR TO THE MORE FAMILIAR PLANAR TIC-TAC-TOE. THE OBJECT STILL IS TO GET 4 IN A ROW, BUT A CUBE PROVIDES MANY ADDED COMPLEXITIES AND WINNING PATHS. IN ADDITION TO STANDARD PLANAR CONFIGURATIONS IN ANY OF THE HORIZONTAL OR VERTICAL PLANES, DIAGONALS CAN BE MADE FROM OPPOSITE CORNERS OF THE CUBE. HENCE A COMPLEX THREE DIMENSIONAL NETWORK OF SQUARES MAKES THE TRIVIAL GAME OF TIC-TAC-TOE RATHER CHALLENGING.

THE ALGORITHM USED TO COMPUTE MOVES IN THIS PROGRAM WAS DEVELOPED BY ROBERT K. LOUDEN IN HIS BOOK, "PROGRAMMING THE IBM 1130 AND 1800." A BRIEF SUMMARY OF THIS ALGORITHM FOLLOWS.

IN MEMORY, THE PLAYING BOARD IS REPRESENTED BY A 64-LOCATION ARRAY. THE FOLLOWING CONVENTIONS ARE USED TO INDICATE THE STATUS OF EACH SQUARE: 0 SIGNIFIES AN EMPTY SQUARE, 1 INDICATES OCCUPATION BY THE HUMAN OPPONENT, AND 5 MEANS THE SQUARE IS OCCUPIED BY THE COMPUTER. THIS SYSTEM ALLOWS US TO DETERMINE STRATEGIC INFORMATION BY SUMMING UP THE 76 POSSIBLE WINNING PATHS: A SUM OF 3 INDICATES THE OPPOSITION HAS THREE IN A ROW AND MUST BE BLOCKED, A SUM OF 15 SHOWS THE COMPUTER HAS THREE IN A ROW AND WILL WIN ON THE NEXT MOVE, AND SO FORTH. A SYSTEM INVOLVING 3 WANTED SUM VALUES, LABELED TEST1, TEST2, AND TEST3, WHICH INCORPORATES THE MOST IMPORTANT STRATEGIC SITUATIONS, MAY BE SUMMARIZED AS FOLLOWS:

> FIND A BLANK SQUARE M1 ON A ROW WITH A SUM OF TEST1, SUCH THAT M1 IS ALSO ON A ROW OF SUM TEST2, WHICH CONTAINS A BLANK SQUARE M2 WHICH ALSO LIES ON A ROW OF SUM TEST3.

M1 IS THE BEST MOVE, AND M2 IS AN ALTERNATE. OFTEN ALL THREE TEST NUMBERS ARE NOT NEEDED TO ESTABLISH A SITUATION; HERE, A POSITIVE VALUE FOR ATEST NUMBER TERMINATES THE SEARCH. THIS ALGORITHM REQUIRES AN ARRAY CONTAINING THE VARIOUS SETS OF TEST NUMBERS IN ORDER OF IMPORTANCE, A 64-LOCATION MOVE ARRAY, A 76 LOCATION SUM ARRAY TO STORE THE SUMS OF EACH OF THE WINNING PATHS, AND A 76*4 OR 304 LOCATION ROW ARRAY TO HOLD THE SUBSCRIPTS OF THE 4 SQUARES ON EACH WINNING PATH.

THE MAIN PROGRAM INPUTS MOVES AND CALLS A SUBROUTINE, REFERRED TO AS 'STRAT', TO DETERMINE THE COMPUTER'S MOVE ACCORDING TO THE GIVEN ALGORITHM. IF NONE OF THE TEST SITUATIONS ARE FOUND, AS IS OFTEN THE CASE EARLY IN THE GAME, A MOVE IS TAKEN FROM THE WAITING LIST, AN ARRAY CONTAINING THE SUBSCRIPTS OF SEVERAL OF THE MOST IMPORTANT SQUARES. RUNNING OUT OF WAITING MOVES RESULTS IN A TIE. IF A WIN OR LOSS IS DETECTED, M1 IS A SUBSCRIPT TO THE ROW ARRAY, WHICH ALLOWS THE PROGRAM TO GET THE SUBSCRIPTS OF THE 4 SQUARES ON THE WINNING ROW.

FOR A MORE DETAILED DESCRIPTION OF THE ALGORITHM, PLEASE SEE

REFERENCE 1.

THE MAIN PROGRAM CALLS SEVERAL SUBROUTINES TO DO A MAJOR PORTION OF THE WORK. SUBROUTINES ARE LISTED IN TABLE III.

TABLE III

SUBROUTINE POINTER OR CALL	DESCRIPTION
MESAGE	PRINTS OUT TEXT INFORMATION PACKED TWO CHARACTERS TO THE WORD. THE LOCATION FOLLOWING THE CALL CONTAINS THE STARTING ADDRESS OF THE TEXT BLOCK. THE STRING IS TERMINATED BY A 00, AND THE ROUTINE USES THE CODES 43 AND 45 FOR CR AND LF.
YESNO	READS CHARACTERS FROM THE KEY-BOARD UNTIL A CR IS TYPED. IF THE FIRST CHARACTER TYPED IS A 'Y', RETURN TO CALL+2, IF AN 'N', RETURN TO CALL+1, AND IF NEITHER, TYPE AN ERROR MESSAGE AND ASK THE QUESTION AGAIN.
CODE	CHANGE ROW, COLUMN, PLANE COORDINATES TO 1-64 ROW ARRAY SUBSCRIPTS. LEAVE THE RESULT IN THE AC.
CONVRT	CONVERT 1-64 SUBSCRIPT IN THE AC TO ROW, COLUMN, PLANE COORDINATES. LEAVE THE RESULT IN 'ROW', 'COLUMN', AND 'PLANE'.
STRAT	DETERMINE THE COMPUTER'S MOVE. LEAVE AS A MOVE ARRAY SUBSCRIPT IN 'M1'. IF A WIN OR LOSS IS DETECTED, M1 IS A ROW SUBSCRIPT.
BOARD	PRINTS PLAYING BOARD (SEE APPENDIX A.)
'NEW INSTRUCTION' CALLS	
TESTAC	SKIP IF 260<AC<265.
READC	SINGLE CHARACTER READ FROM KEYBOARD INTO AC.
PRINTC	SINGLE CHARACTER PRINT AND CLEAR

PROGRAM DESCRIPTION

PAGE ZERO LOCATIONS	USE
10-17	AUTO-INDEX POINTERS.
20-37	NUMERICAL CONSTANTS.
40-45	STORAGE FOR THE 3 COORDINATES, THE CODED SUBSCRIPT OF THE MOVE ARRAY ('NEXT'), A TEMPORARY STORAGE LOCATION, AND A FLAG TO RECORD BOARD PRINTOUT STATUS.
46-54	VARIABLES USED BY 'STRAT'.
55-56	WAIT LIST CONTROLLERS.
57-66	COUNTERS FOR SUBROUTINE 'STRAT'.
67-73	CONSTANTS FOR POINTER INITIALIZATION.
74-101	POINTERS TO SUBROUTINES (REGULAR CALL).
102-104	POINTERS TO SUBROUTINES ('NEW INSTRUCTION' CALL).
105-110	MISCELLANEOUS POINTERS.
175-177	RUN TERMINATION.
MAIN PROGRAM	
200-214	PRINT OUT SIGN-ON, ASK INITIAL QUESTIONS, AND SET UP 'FLAG' FOR BOARD PRINTOUT.
215-234	SET UP WAIT LIST CONTROLS AND CLEAR OUT MOVE ARRAY.
235-250	READ IN USER'S MOVE AND STORE IN 'ROW', 'COLUMN', AND 'PLANE'.
251-302	CHECK MOVE FOR LEGALITY, AND STORE A 1 IN THE INDICATED MOVE ARRAY LOCATION.

303-321	CALL 'STRAT', CHECK IF A SITUATION WAS FOUND, AND IF NOT, SELECT A WAITING MOVE.
322-324	PRINT TIE GAME MESSAGE.
325-334	TEST FOR WIN OR LOSS.
335-351	PUT A 5 IN THE COMPUTER'S MOVE LOCATION, PRINT THE MOVE, AND, IF FLAG=0, PRINT THE BOARD.
352-354	PRINT ILLEGAL MOVE MESSAGE.
355-357	PRINT WIN MESSAGE.
360-361	PRINT LOSS MESSAGE.
362-365	PRINT WINNING ROW AND BOARD.
400-405	ASK ABOUT ANOTHER GAME.
406-413	ONE-CHARACTER PRINT.
414-443	ONE-CHARACTER READ AND TEST FOR CONTROL CHARACTERS.
444-455	'TESTAC' ROUTINE.
456-470	CHANGE ROW, COLUMN, PLANE TO MOVE SUBSCRIPT.
471-536	CONVERT SUBSCRIPT (1-64) TO ROW, COLUMN, PLANE.
537-572	INITALIZE 'STRAT', SUM UP ALL WINNING PATHS.
600-770	STRAT'S 8 NESTED LOOPS.
777-1023	PROCESS RETURNS FROM 'STRAT'.
1024-1111	BOARD PRINTOUT ROUTINE.
1200-1253	MESSAGE PRINTOUT ROUTINE (FROM DIGITAL-8-18-U-SYM).
1254-1306	ANSWER PROCESSING ROUTINE.

1307-1327	PRINT OUT COORDINATES OF WINNING ROW AND SET THE MOVE ARRAY LOCATIONS FOR THAT ROW = -1 AS A FLAG FOR THE BOARD PRINT-OUT ROUTINE.
1330-1427	MOVE ARRAY.
1430-1543	SUM ARRAY.
1544-1567	WAIT LIST.
1570-2247	ROW ARRAY.
2250-2316	TEST ARRAY.
2317-3143	TEXT MESSAGES. (NOTE: THIS SEGMENT WAS CODED INTO OCTAL BY A SMALL EDITING ROUTINE.)

REFERENCES

1. LOUDEN, ROBERT K., "PROGRAMMING THE IBM 1130 AND 1800," PRENTICE HALL, 1967

APPENDIX A - BOARD PRINTOUT

AT THE END OF EVERY GAME AND, IF DESIRED, AFTER EVERY MOVE MADE BY THE COMPUTER, THE PLAYING CUBE IS PRINTED ON THE TELETYPE. THE 3 DIMENSIONAL BOARD IS DISPLAYED BY PRINTING ITS FOUR HORIZONTAL PLANES IN THE ORDER OF TOPMOST TO BOTTOM. EACH PLANE IS PRINTED WITH ROW 1, COLUMN 1 AT THE UPPER LEFT-HAND CORNER. BLANK SQUARES ARE OBVIOUSLY NOT OCCUPIED, AN 'O', SIGNIFIES OCCUPATION BY THE HUMAN OPPONENT, AN 'X' INDICATES OCCUPATION BY THE COMPUTER, AND A '*' IS A SQUARE ON THE WINNING ROW AT THE END OF A GAME. THE 'BOARD PRINTOUT' OPTION IS PROVIDED TO AVOID THE LONG PRINTOUT CYCLE AFTER EVERY EXCHANGE OF MOVES, BUT SUPPRESSING THIS ACTION NECESSITATES RECORDING MOVES WITH SOME OTHER VISUAL AID. MOVES MAY BE RECORDED ON A COMMERCIAL THREE DIMENSIONAL TOY BOARD OR ON A GRID SIMILAR TO THE ONE USED IN THE BOARD PRINTOUT PREPARED AND DUPLICATED BEFOREHAND.

APPENDIX B - SAMPLE GAME

```
THIS IS QUBIC, 3D TIC-TAC-TOE

DO YOU WANT AN EXPLANATION OF HOW TO PLAY ? YES

THIS PROGRAM PLAYS TIC-TAC-TOE ON A 4 BY 4 BY 4 CUBE.
THE OBJECT IS TO GET 4 SQUARES IN A ROW, EITHER VERTICALLY,
DIAGONALLY OR HORIZONTALLY THROUGH THE CUBE. INPUT MOVES AS ROW,
COLUMN, PLANE. IF YOU DO NOT WANT THE BOARD PRINTED OUT AT EVERY STEP,
ANSWER 'NO' TO THE QUESTION 'BOARD PRINTOUT ?'. OTHERWISE,
THE BOARD IS PRINTED WITH YOU AS 'O', THE COMPUTER
AS 'X', AND THE WINNING ROW AS '*' .


BOARD PRINTOUT ? NO

SHALL I GO FIRST ? FLICK LIVES

PLEASE ANSWER 'YES' OR 'NO'.

SHALL I GO FIRST ? NO

YOUR MOVE IS 9,9,9

THAT MOVE IS ILLEGAL. TRY AGAIN.


YOUR MOVE IS P,Q,←

YOUR MOVE IS 2,2,2

I MOVE 3,3,3

YOUR MOVE IS 3,3,2

I MOVE 3,2,2

YOUR MOVE IS 3,1,1

I MOVE 2,3,3

YOUR MOVE IS 1,3,3

I MOVE 2,2,3

YOUR MOVE IS 1,1,3

I MOVE 1,1,2
```

```
YOUR MOVE IS 3,4,4
I MOVE 2,3,2
YOUR MOVE IS 1,4,2
I MOVE 1,4,3
YOUR MOVE IS 2,←
YOUR MOVE IS 3,2,3
I MOVE 3,1,4
YOUR MOVE IS 2,3,4
I MOVE 4,1,4
YOUR MOVE IS 2,1,4
I MOVE 2,4,4
YOUR MOVE IS 3,1,3
I MOVE 2,1,3
YOUR MOVE IS 2,4,3
I MOVE 4,1,1
```

```
YOUR MOVE IS 1,1,4

I WIN ON 3,2,2 2,3,3 1,4,4 4,1,1

.................
.   .   .   .   .
.................
.   .   .   .   .
.................
. 0 .   .   .   .
.................
. * .   .   .   .
.................

.................
. X .   .   . 0 .
.................
.   . 0 . X .   .
.................
.   . * . 0 .   .
.................
.   .   .   .   .
.................

.................
. 0 .   . 0 . X .
.................
. X . X . * . 0 .
.................
. 0 . 0 . X .   .
.................
.   .   .   .   .
.................

.................
. 0 .   .   . * .
.................
. 0 .   . 0 . X .
.................
. X .   .   . 0 .
.................
. X .   .   .   .
.................

HOW ABOUT ANOTHER GAME ? NO THANKS!

THANK YOU FOR AN ENJOYABLE GAME.
```

APPENDIX C - PROGRAM LISTING

```
                /3D TIC-TAC-TOE, BY TIM YEAGER ***

                /PAGE 0

                /INDEX REGISTERS

                *10
0010    0000    XR1,    0
0011    0000    XR2,    0
0012    0000    XR3,    0
0013    0000    XR4,    0
0014    0000    XR5,    0
0015    0000    XR6,    0
0016    0000    XR7,    0
0017    0000    XR8,    0

                /NUMERICAL CONSTANTS

0020    7777    MINUS1, -1
0021    7775    MINUS3, -3
0022    7774    M4,     -4
0023    7773    M5,     -5
0024    7754    M20,    -24
0025    7763    M13,    -15
0026    7664    M76,    -114
0027    7700    M64,    -100
0030    7520    M260,   -260
0031    7563    MCR,    -215
0032    0005    P5,     5
0033    0114    P76,    114
0034    0261    K261,   261
0035    0212    LF,     212
0036    0240    SPACE,  240
0037    0254    COMMA,  254

                /VARIABLE STORAGE

0040    0000    ROW,    0
0041    0000    COLUMN, 0
0042    0000    PLANE,  0
0043    0000    NEXT,   0
0044    0000    SAVE,   0
0045    0000    FLAG,   0

                /USED BY 'STRAT'
0046    0000    XSUM,   0
0047    0000    TEST1,  0
0050    0000    TEST2,  0
0051    0000    TEST3,  0
0052    0000    M1,     0
```

```
0053  0000  M2,      0
0054  0000  M3,      0
0055  0000  WAITP,   0
0056  0000  WAITCT,  0

0057  0000  COUNT1,  0
0060  0000  COUNT2,  0
0061  0000  COUNT3,  0
0062  0000  COUNT4,  0
0063  0000  COUNT5,  0
0064  0000  COUNT6,  0
0065  0000  COUNT7,  0
0066  0000  COUNT8,  0

            /ADDRESS INITIALIZATION ***

0067  1327  MOVEP,   MOVE-1
0070  1544  WAITL,   WAITLST
0071  1427  SUMP,    SUM-1
0072  1567  ROWP,    ROWLST-1
0073  2247  TESTP,   TEST-1

            /SUBROUTINE POINTERS

0074  1254  YESNO,   XYESNO
0075  1200  MESAGE,  PRNTXT
0076  0471  CONVRT,  XCNVRT
0077  0456  CODE,    XCODE
0100  1024  BOARD,   CUBE
0101  0537  STRAT,   STRTG


0102  0444  TESTAC=JMS I .  ; XTSTAC

0103  0414   READC=JMS I .  ; XREADC

0104  0406  PRINTC=JMS I .  ; XPRNTC

            /GENERAL POINTERS

0105  0400  ENDGAM,  TRYAGN
0106  1002  RETRN1,  RTRN01
0107  1012  RETRN2,  RTRN02
0110  1014  RETRN3,  RTRN03

                        *175

0175  4475  STPROG,  JMS I MESAGE
0176  3076           TEXT16
0177  7402           HLT

            PAUSE
```

```
                /MAIN PROGRAM ***

0200   6032             KCC
0201   6046             TLS
0202   4475             JMS I MESAGE
0203   2317             TEXT01
0204   4474             JMS I YESNO
0205   5210             JMP .+3
0206   4475             JMS I MESAGE
0207   2367             TEXT03
0210   4475             JMS I MESAGE
0211   3131             TEXT17
0212   4474             JMS I YESNO
0213   7040             CMA
0214   3045             DCA FLAG

0215   1070  SETUP,     TAD WAITL
0216   3055             DCA WAITP
0217   1024             TAD M20
0220   3056             DCA WAITCT
0221   1027             TAD M64
0222   3057             DCA COUNT1
0223   1067             TAD MOVEP
0224   3010             DCA XR1
0225   3410             DCA I XR1
0226   2057             ISZ COUNT1
0227   5225             JMP .-2

0230   4475             JMS I MESAGE
0231   2704             TEXT04
0232   4474             JMS I YESNO
0233   7410             SKP
0234   5303             JMP DECIDE

                /GET OPPONENT'S MOVE

0235   4475  GETMV,     JMS I MESAGE
0236   2720             TEXT05
0237   4503             READC
0240   3040             DCA ROW
0241   1037             TAD COMMA
0242   4504             PRINTC
0243   4503             READC
0244   3041             DCA COLUMN
0245   1037             TAD COMMA
0246   4504             PRINTC
0247   4503             READC
0250   3042             DCA PLANE

                /CHECK FOR LEGALITY
```



```
0251   1040             TAD ROW
0252   4502             TESTAC
```

```
0253   5352            JMP ILLEGL
0254   1041            TAD COLUMN
0255   4502            TESTAC
0256   5352            JMP ILLEGL
0257   1042            TAD PLANE
0260   4502            TESTAC
0261   5352            JMP ILLEGL
0262   1040            TAD ROW
0263   1030            TAD M260
0264   3040            DCA ROW
0265   1041            TAD COLUMN
0266   1030            TAD M260
0267   3041            DCA COLUMN
0270   1042            TAD PLANE
0271   1030            TAD M260
0272   3042            DCA PLANE
0273   4477            JMS I CODE
0274   1067            TAD MOVEP
0275   3043            DCA NEXT
0276   1443            TAD I NEXT
0277   7640            SZA CLA
0300   5352            JMP ILLEGL
0301   7001            IAC
0302   3443            DCA I NEXT

               /MAKE COMPUTER'S MOVE

0303   4501  DECIDE,  JMS I STRAT
0304   1052            TAD M1
0305   7640            SZA CLA
0306   5325            JMP SITFND
0307   1455            TAD I WAITP
0310   3052            DCA M1
0311   1052            TAD M1
0312   1067            TAD MOVEP
0313   3044            DCA SAVE
0314   1444            TAD I SAVE
0315   7650            SNA CLA
0316   5340            JMP COMOVE
0317   2055            ISZ WAITP
0320   2056            ISZ WAITCT
0321   5307            JMP .-12

               /TIE GAME ***

0322   4475            JMS I MESAGE
0323   2763            TEXT08
0324   5505            JMP I ENDGAM

               /TEST FOR WIN OR LOSE

0325   7240  SITFND,  CLA CMA
0326   1054            TAD M3
0327   7650            SNA CLA
```

```
0330   5360            JMP WELOSE
0331   7344            CLA CLL CMA RAL
0332   1054            TAD M3
0333   7650            SNA CLA
0334   5355            JMP WEWON

                /NORMAL MOVE ***

0335   1067            TAD MOVEP
0336   1052            TAD M1
0337   3044            DCA SAVE
0340   1032  COMOVE,    TAD P5
0341   3444            DCA I SAVE
0342   4475            JMS I MESAGE
0343   2755            TEXT07
0344   1052            TAD M1
0345   4476            JMS I CONVRT
0346   1045            TAD FLAG
0347   7700            SMA CLA
0350   4500            JMS I BOARD
0351   5235            JMP GETMV
0352   4475  ILLEGL,    JMS I MESAGE
0353   2731            TEXT06
0354   5235            JMP GETMV

0355   4475  WEWON,     JMS I MESAGE
0356   3010            TEXT10
0357   5362            JMP .+3

0360   4475  WELOSE,    JMS I MESAGE
0361   3000            TEXT09

                /PRINT OUT WINNING ROW
0362   4765            JMS I WINROW
0363   4500            JMS I BOARD
0364   5505            JMP I ENDGAME
0365   1307  WINROW,    XWNROW

                        *400
0400   4475  TRYAGN,    JMS I MESAGE
0401   3017            TEXT11
0402   4474            JMS I YESNO
0403   5175            JMP STPROG
0404   5605            JMP I .+1
0405   0215            SETUP
```

```
                    PAUSE
                /SUBROUTINES (I)

0406   0000  XPRNTC, 0
0407   6041         TSF
0410   5207         JMP .-1
0411   6046         TLS
0412   7200         CLA
0413   5606         JMP I XPRNTC

0414   0000  XREADC, 0
0415   6031         KSF
0416   5215         JMP .-1
0417   6036         KRB
0420   6046         TLS
0421   3044         DCA SAVE
0422   1044         TAD SAVE
0423   1240         TAD MNCODE
0424   7650         SNA CLA
0425   5505         JMP I ENDGAME
0426   1044         TAD SAVE
0427   1241         TAD MARROW
0430   7650         SNA CLA
0431   5643         JMP I LASTMV
0432   1044         TAD SAVE
0433   1242         TAD MSCODE
0434   7650         SNA CLA
0435   5175         JMP STPROG
0436   1044         TAD SAVE
0437   5614         JMP I XREADC
0440   7562  MNCODE, -216
0441   7441  MARROW, -337
0442   7555  MSCODE, -223
0443   0235  LASTMV, GETMV

                    /SKIP IF 260<AC<265

0444   0000  XTSTAC, 0
0445   1030         TAD M260
0446   7550         SPA SNA
0447   5254         JMP XRTRN
0450   1023         TAD M5
0451   7700         SMA CLA
0452   5254         JMP XRTRN
0453   2244         ISZ XTSTAC
0454   7200  XRTRN,  CLA
0455   5644         JMP I XTSTAC

                    /CHANGE ROW, COLUMN, PLANE TO 1-64

0456   0000  XCODE,  0
0457   7240         CLA CMA
0460   1042         TAD PLANE
```

420 JMP 573 5373

```
0461   7106           CLL RTL
0462   3044           DCA SAVE
0463   7240           CLA CMA
0464   1041           TAD COLUMN
0465   1044           TAD SAVE
0466   7106           CLL RTL
0467   1040           TAD ROW
0470   5656           JMP I XCODE

                      /CONVERT MOVE CODE TO ROW,COLUMN,PLANE

0471   0000  XCNVRT,   0
0472   1020           TAD MINUS1
0473   3044           DCA SAVE
0474   1044           TAD SAVE
0475   7110           CLL RAR
0476   7110           CLL RAR
0477   7110           CLL RAR
0500   7110           CLL RAR
0501   3042           DCA PLANE
0502   1042           TAD PLANE
0503   7106           CLL RTL
0504   7006           RTL
0505   7041           CIA
0506   1044           TAD SAVE
0507   7110           CLL RAR
0510   7110           CLL RAR
0511   3041           DCA COLUMN
0512   1042           TAD PLANE
0513   7106           CLL RTL
0514   1041           TAD COLUMN
0515   7006           RTL
0516   7041           CIA
0517   1044           TAD SAVE
0520   3040           DCA ROW
0521   1040           TAD ROW
0522   1034           TAD K261
0523   4504           PRINTC
0524   1037           TAD COMMA
0525   4504           PRINTC
0526   1041           TAD COLUMN
0527   1034           TAD K261
0530   4504           PRINTC
0531   1037           TAD COMMA
0532   4504           PRINTC
0533   1042           TAD PLANE
0534   1034           TAD K261
0535   4504           PRINTC
0536   5671           JMP I XCNVRT

       PAUSE

                      /SUBROUTINE STRAT
```

```
0537  0000  STRTG,  0
0540  1071          TAD SUMP
0541  3010          DCA XR1
0542  1072          TAD ROWP
0543  3011          DCA XR2
0544  1026          TAD M76
0545  3057          DCA COUNT1
0546  3046  SUMLOP, DCA XSUM
0547  1022          TAD M4
0550  3060          DCA COUNT2
0551  1411          TAD I XR2
0552  3044          DCA SAVE
0553  1046          TAD XSUM
0554  1444          TAD I SAVE
0555  3046          DCA XSUM
0556  2060          ISZ COUNT2
0557  5351          JMP .-6
0560  1046          TAD XSUM
0561  3410          DCA I XR1
0562  2057          ISZ COUNT1
0563  5346          JMP SUMLOP

                    /SET UP OUTSIDE LOOP COUNTR
0564  1025          TAD M13
0565  3057          DCA COUNT1
0566  1073          TAD TESTP
0567  3010          DCA XR1
0570  3054          DCA M3
0571  5772          JMP I .+1
0572  0600          SCAN01

                    /NESTED LOOPS

                    *600

0600  2054  SCAN01, ISZ M3
0601  1410          TAD I XR1
0602  3047          DCA TEST1
0603  1410          TAD I XR1
0604  3050          DCA TEST2
0605  1410          TAD I XR1
0606  3051          DCA TEST3

                    /SKIP IF TEST NO. > 0
0607  1047          TAD TEST1
0610  7740          SMA SZA CLA
0611  5366          JMP DONE01

                    /FIND A ROW WITH A SUM OF TEST1

0612  1071          TAD SUMP
0613  3011          DCA XR2
0614  1026          TAD M76
```

573 2006 SNA 7450
574 JMP 415 5215
575 TLS 6046
576 JMP 421 5221

```
0615  3060            DCA  COUNT2

0616  1411  SCAN02,   TAD  I XR2
0617  1047            TAD  TEST1
0620  7640            SZA  CLA
0621  5364            JMP  DONE02
0622  7344            CLA  CLL CMA RAL
0623  1054            TAD  M3
0624  7750            SPA  SNA CLA
0625  5506            JMP  I RETRN1

                /FIND A BLANK SQUARE M1 ON THE ROW WITH SUM OF TEST1

0626  1033            TAD  P76
0627  1060            TAD  COUNT2
0630  7106            CLL  RTL
0631  1072            TAD  ROWP
0632  3012            DCA  XR3
0633  1022            TAD  M4
0634  3061            DCA  COUNT3

0635  1412  SCAN03,   TAD  I XR3
0636  3052            DCA  M1
0637  1452            TAD  I M1
0640  7640            SZA  CLA
0641  5362            JMP  DONE03
0642  1050            TAD  TEST2
0643  7740            SMA  SZA CLA
0644  5507            JMP  I RETRN2

                /FIND A ROW WITH A SUM OF TEST2

0645  1071            TAD  SUMP
0646  3013            DCA  XR4
0647  1026            TAD  M76
0650  3062            DCA  COUNT4

0651  1413  SCAN04,   TAD  I XR4
0652  1050            TAD  TEST2
0653  7640            SZA  CLA
0654  5360            JMP  DONE04
0655  1011            TAD  XR2
0656  7041            CIA
0657  1013            TAD  XR4
0660  7650            SNA  CLA
0661  5360            JMP  DONE04

                /FIND THE BLANK SQUARE M1 ON ROW WITH SUM=TEST2

0662  1033            TAD  P76
0663  1062            TAD  COUNT4
0664  7106            CLL  RTL
0665  1072            TAD  ROWP
0666  3014            DCA  XR5
```

```
0667  1014           TAD XR5
0670  3015           DCA XR6
0671  1022           TAD M4
0672  3063           DCA COUNT5

0673  1414  SCAN05,  TAD I XR5
0674  7041           CIA
0675  1052           TAD M1
0676  7640           SZA CLA
0677  5356           JMP DONE05
0700  1051           TAD TEST3
0701  7740           SMA SZA CLA
0702  5507           JMP I RETRN2

                /FIND ANY BLANK SQUARE M2 ON ROW WITH SUM=TEST2

0703  1022           TAD M4
0704  3064           DCA COUNT6

0705  1415  SCAN06,  TAD I XR6
0706  3053           DCA M2
0707  1453           TAD I M2
0710  7640           SZA CLA
0711  5354           JMP DONE06

                /FIND A ROW WHOSE SUM = TEST3

0712  1071           TAD SUMP
0713  3016           DCA XR7
0714  1026           TAD M76
0715  3065           DCA COUNT7

0716  1416  SCAN07,  TAD I XR7
0717  1051           TAD TEST3
0720  7640           SZA CLA
0721  5352           JMP DONE07
                /TEST IF SAME ROW AS FOR TEST1, TEST2
0722  1016           TAD XR7
0723  7041           CIA
0724  1011           TAD XR2
0725  7650           SNA CLA
0726  5352           JMP DONE07
0727  1016           TAD XR7
0730  7041           CIA
0731  1013           TAD XR4
0732  7650           SNA CLA
0733  5352           JMP DONE07

                /FIND THE BLANK SQUARE M2 ON THE ROW WITH SUM = TEST3

0734  1033           TAD P76
0735  1065           TAD COUNT7
0736  7106           CLL RTL
0737  1072           TAD ROWP
```

```
0740   3017            DCA XR8
0741   1022            TAD M4
0742   3066            DCA COUNT8

0743   1417  SCAN08,   TAD I XR8
0744   7041            CIA
0745   1053            TAD M2
0746   7650            SNA CLA
0747   5510            JMP I RETRN3

                /LOOP ENDS ***

0750   2066  DONE08,   ISZ COUNT8
0751   5343            JMP SCAN08

0752   2065  DONE07,   ISZ COUNT7
0753   5316            JMP SCAN07

0754   2064  DONE06,   ISZ COUNT6
0755   5305            JMP SCAN06

0756   2063  DONE05,   ISZ COUNT5
0757   5273            JMP SCAN05

0760   2062  DONE04,   ISZ COUNT4
0761   5251            JMP SCAN04

0762   2061  DONE03,   ISZ COUNT3
0763   5235            JMP SCAN03

0764   2060  DONE02,   ISZ COUNT2
0765   5216            JMP SCAN02

0766   2057  DONE01,   ISZ COUNT1
0767   5200            JMP SCAN01

0770   5377            JMP ENDPAGE

                *777

0777   3052  ENDPAGE,  DCA M1
1000   3053            DCA M2
1001   5220            JMP RTURN

                /RETURNS FROM STRAT ***

                /WIN OR LOSE - M1 A ROW SUBSCRPT ***

1002   1033  RTRN01,   TAD P76
1003   1060            TAD COUNT2
1004   7106            CLL RTL
1005   1072            TAD ROWP
1006   7001            IAC
1007   3052            DCA M1
```

```
1010   3053            DCA M2
1011   5220            JMP RTURN
1012   7300  RTRN02,   CLA CLL
1013   3053            DCA M2
1014   1067  RTRN03,   TAD MOVEP
1015   7041            CIA
1016   1052            TAD M1
1017   3052            DCA M1
1020   1623  RTURN,    TAD I STRTPT
1021   3044            DCA SAVE
1022   5444            JMP I SAVE
1023   0537  STRTPT,   STRTG
```

```
                PAUSE
                /SUBROUTINE BOARD *** PRINT-OUT OF BOARD

1024    0000    CUBE,   0
1025    1035            TAD LF
1026    4504            PRINTC
1027    1022            TAD M4
1030    3057            DCA COUNT1
1031    7201            CLA IAC
1032    3042            DCA PLANE

1033    4475    PLNLOP, JMS I MESAGE
1034    3057            TEXT13
1035    1022            TAD M4
1036    3060            DCA COUNT2
1037    7201            CLA IAC
1040    3040            DCA ROW

1041    4475    ROWLOP, JMS I MESAGE
1042    3072            TEXT14
1043    1022            TAD M4
1044    3061            DCA COUNT3
1045    7201            CLA IAC
1046    3041            DCA COLUMN

1047    4477    COLOOP, JMS I CODE
1050    1067            TAD MOVEP
1051    3044            DCA SAVE
1052    1444            TAD I SAVE
1053    7450            SNA
1054    5264            JMP PRTSPC
1055    7510            SPA
1056    5304            JMP STAR
1057    1023            TAD M5
1060    7650            SNA CLA
1061    1307            TAD XCDE
1062    1310            TAD OCODE
1063    7410            SKP
1064    1036    PRTSPC, TAD SPACE
1065    4504            PRINTC
1066    4475            JMS I MESAGE
1067    3074            TEXT15
1070    2041            ISZ COLUMN
1071    2061            ISZ COUNT3
1072    5247            JMP COLOOP
1073    4475            JMS I MESAGE
1074    3057            TEXT13
1075    2040            ISZ ROW
1076    2060            ISZ COUNT2
1077    5241            JMP ROWLOP
1100    2042            ISZ PLANE
1101    2057            ISZ COUNT1
1102    5233            JMP PLNLOP
```

```
1103  5624            JMP I CUBE

1104  7200  STAR,     CLA
1105  1311            TAD CSTAR
1106  5265            JMP PRTSPC+1

1107  0011  XCDE,     11
1110  0317  OCODE,    317
1111  0252  CSTAR,    252

              /MESSAGE PRINT OUT ***

              *1200

1200  0000  PRNTXT,   0
1201  7240            CLA CMA
1202  1600            TAD I PRNTXT
1203  3010            DCA 10
1204  2200            ISZ PRNTXT
1205  1410            TAD I 10
1206  3217            DCA MSRGHT
1207  1217            TAD MSRGHT
1210  7012            RTR
1211  7012            RTR
1212  7012            RTR
1213  4220            JMS TYPECH
1214  1217            TAD MSRGHT
1215  4220            JMS TYPECH
1216  5205            JMP PRNTXT+5
1217  0000  MSRGHT,   0

1220  0000  TYPECH,   0
1221  0247            AND MASK77
1222  7450            SNA
1223  5600            JMP I PRNTXT
1224  1250            TAD M40
1225  7500            SMA
1226  5231            JMP .+3
1227  1251            TAD C340
1230  5244            JMP MTP
1231  1021            TAD MINUS3
1232  7440            SZA
1233  5236            JMP .+3
1234  1035            TAD LF
1235  5244            JMP MTP
1236  1252            TAD XM2
1237  7440            SZA
1240  5243            JMP .+3
1241  1246            TAD CR
1242  5244            JMP MTP
1243  1253            TAD C245
1244  4504  MTP,      PRINTC
1245  5620            JMP I TYPECH
```

```
1246  0215  CR,       215
1247  0077  MASK77,   77
1250  7740  M40,      -40
1251  0340  C340,     340
1252  7776  XM2,      -2
1253  0245  C245,     245

                /SUBROUTINE YESNO ***

1254  0000  XYESNO,   0
1255  4503            READC
1256  1305            TAD MYES
1257  7450            SNA
1260  5276            JMP YES
1261  1306            TAD MNO
1262  7650            SNA CLA
1263  5277            JMP NO
1264  4503            READC
1265  1031            TAD MCR
1266  7640            SZA CLA
1267  5264            JMP .-3
1270  4475            JMS I MESAGE
1271  3036            TEXT12
1272  1254            TAD XYESNO
1273  1021            TAD MINUS3
1274  3254            DCA XYESNO
1275  5654            JMP I XYESNO
1276  2254  YES,      ISZ XYESNO
1277  7200  NO,       CLA
1300  4503            READC
1301  1031            TAD MCR
1302  7640            SZA CLA
1303  5300            JMP NO+1
1304  5654            JMP I XYESNO

1305  7447  MYES,     -331
1306  0013  MNO,      331-316

1307  0000  XWNROW,   0
1310  1022            TAD M4
1311  3057            DCA COUNT1
1312  1452  WINRW,    TAD I M1
1313  3044            DCA SAVE
1314  7240            CLA CMA
1315  3444            DCA I SAVE
1316  1067            TAD MOVEP
1317  7041            CIA
1320  1044            TAD SAVE
1321  4476            JMS I CONVRT
1322  1036            TAD SPACE
1323  4504            PRINTC
1324  2052            ISZ M1
1325  2057            ISZ COUNT1
1326  5312            JMP WINRW
```

```
1327  5707            JMP I XWNROW

                MOVE=.
                   M=.-1

                *.+100

                 SUM=.

                *.+114

                WAITLST=.

                DECIMAL

                /WAIT LIST:

1544  0026
1545  0053
1546  0027
1547  0052
1550  0032
1551  0047
1552  0033
1553  0046
1554  0001
1555  0100     22;   43;   23;   42;   26;   39;   27;   38;    1;   64
1556  0015
1557  0064
1560  0004
1561  0075
1562  0020
1563  0061
1564  0026
1565  0053
1566  0027
1567  0052     13;   52;    4;   61;   16;   49;   22;   43;   23;   42

                PAUSE

                ROWLST=.

                /ROW ARRAY:

1570  1355
1571  1402
1572  1427
1573  1330     22+M;   43+M;   64+M;    1+M
1574  1356
1575  1401
1576  1424
```

1577	1333	23+M;	42+M;	61+M;	4+M
1600	1361				
1601	1376				
1602	1413				
1603	1344	26+M;	39+M;	52+M;	13+M
1604	1362				
1605	1375				
1606	1410				
1607	1347	27+M;	38+M;	49+M;	16+M
1610	1355				
1611	1401				
1612	1425				
1613	1331	22+M;	42+M;	62+M;	2+M
1614	1356				
1615	1402				
1616	1426				
1617	1332	23+M;	43+M;	63+M;	3+M
1620	1356				
1621	1375				
1622	1414				
1623	1337	23+M;	38+M;	53+M;	8+M
1624	1362				
1625	1401				
1626	1420				
1627	1343	27+M;	42+M;	57+M;	12+M
1630	1361				
1631	1375				
1632	1411				
1633	1345	26+M;	38+M;	50+M;	14+M
1634	1362				
1635	1376				
1636	1412				
1637	1346	27+M;	39+M;	51+M;	15+M
1640	1355				
1641	1376				
1642	1417				
1643	1334	22+M;	39+M;	56+M;	5+M
1644	1361				
1645	1402				
1646	1423				
1647	1340	26+M;	43+M;	60+M;	9+M
1650	1355				
1651	1375				
1652	1415				
1653	1335	22+M;	38+M;	54+M;	6+M
1654	1356				
1655	1376				
1656	1416				
1657	1336	23+M;	39+M;	55+M;	7+M
1660	1361				
1661	1401				
1662	1421				
1663	1341	26+M;	42+M;	58+M;	10+M
1664	1362				

```
1665   1402
1666   1422
1667   1342     27+M;    43+M;    59+M;    11+M
1670   1355
1671   1356
1672   1357
1673   1354     22+M;    23+M;    24+M;    21+M
1674   1361
1675   1362
1676   1363
1677   1360     26+M;    27+M;    28+M;    25+M
1700   1355
1701   1361
1702   1365
1703   1351     22+M;    26+M;    30+M;    18+M
1704   1356
1705   1362
1706   1366
1707   1352     23+M;    27+M;    31+M;    19+M
1710   1355
1711   1362
1712   1367
1713   1350     22+M;    27+M;    32+M;    17+M
1714   1356
1715   1361
1716   1364
1717   1353     23+M;    26+M;    29+M;    20+M
1720   1375
1721   1376
1722   1377
1723   1374     38+M;    39+M;    40+M;    37+M
1724   1401
1725   1402
1726   1403
1727   1400     42+M;    43+M;    44+M;    41+M
1730   1375
1731   1401
1732   1405
1733   1371     38+M;    42+M;    46+M;    34+M
1734   1376
1735   1402
1736   1406
1737   1372     39+M;    43+M;    47+M;    35+M
1740   1375
1741   1402
1742   1407
1743   1370     38+M;    43+M;    48+M;    33+M
1744   1376
1745   1401
1746   1404
1747   1373     39+M;    42+M;    45+M;    36+M
1750   1424
1751   1330
1752   1354
```

```
1753   1400      61+M;     1+M;     21+M;     41+M
1754   1427
1755   1333
1756   1357
1757   1403      64+M;     4+M;     24+M;     44+M
1760   1410
1761   1333
1762   1352
1763   1371      49+M;     4+M;     19+M;     34+M
1764   1424
1765   1347
1766   1366
1767   1405      61+M;     16+M;    31+M;     46+M
1770   1410
1771   1344
1772   1360
1773   1374      49+M;     13+M;    25+M;     37+M
1774   1413
1775   1347
1776   1363
1777   1377      52+M;     16+M;    28+M;     40+M
2000   1413
2001   1330
2002   1351
2003   1372      52+M;     1+M;     18+M;     35+M
2004   1427
2005   1344
2006   1365
2007   1406      64+M;     13+M;    30+M;     47+M
2010   1410
2011   1330
2012   1350
2013   1370      49+M;     1+M;     17+M;     33+M
2014   1413
2015   1333
2016   1353
2017   1373      52+M;     4+M;     20+M;     36+M
2020   1424
2021   1344
2022   1364
2023   1404      61+M;     13+M;    29+M;     45+M
2024   1427
2025   1347
2026   1367
2027   1407      64+M;     16+M;    32+M;     48+M
2030   1333
2031   1330
2032   1331
2033   1332       4+M;     1+M;      2+M;      3+M
2034   1347
2035   1344
2036   1345
2037   1346      16+M;     13+M;    14+M;     15+M
2040   1344
```

```
2041   1330
2042   1334
2043   1340      13+M;     1+M;     5+M;     9+M
2044   1347
2045   1333
2046   1337
2047   1343      16+M;     4+M;     8+M;    12+M
2050   1347
2051   1330
2052   1335
2053   1342      16+M;     1+M;     6+M;    11+M
2054   1344
2055   1333
2056   1336
2057   1341      13+M;     4+M;     7+M;    10+M
2060   1413
2061   1410
2062   1411
2063   1412      52+M;    49+M;    50+M;    51+M
2064   1427
2065   1424
2066   1425
2067   1426      64+M;    61+M;    62+M;    63+M
2070   1424
2071   1410
2072   1414
2073   1420      61+M;    49+M;    53+M;    57+M
2074   1427
2075   1413
2076   1417
2077   1423      64+M;    52+M;    56+M;    60+M
2100   1427
2101   1410
2102   1415
2103   1422      64+M;    49+M;    54+M;    59+M
2104   1424
2105   1413
2106   1416
2107   1421      61+M;    52+M;    55+M;    58+M
2110   1351
2111   1371
2112   1411
2113   1331      18+M;    34+M;    50+M;     2+M
2114   1352
2115   1372
2116   1412
2117   1332      19+M;    35+M;    51+M;     3+M
2120   1354
2121   1374
2122   1414
2123   1334      21+M;    37+M;    53+M;     5+M
2124   1357
2125   1377
2126   1417
```

```
2127   1337     24+M;   40+M;   56+M;    8+M
2130   1360
2131   1400
2132   1420
2133   1340     25+M;   41+M;   57+M;    9+M
2134   1363
2135   1403
2136   1423
2137   1343     28+M;   44+M;   60+M;   12+M
2140   1365
2141   1405
2142   1425
2143   1345     30+M;   46+M;   62+M;   14+M
2144   1366
2145   1406
2146   1426
2147   1346     31+M;   47+M;   63+M;   15+M
2150   1335
2151   1336
2152   1337
2153   1334      6+M;    7+M;    8+M;    5+M
2154   1341
2155   1342
2156   1343
2157   1340     10+M;   11+M;   12+M;    9+M
2160   1335
2161   1341
2162   1345
2163   1331      6+M;   10+M;   14+M;    2+M
2164   1336
2165   1342
2166   1346
2167   1332      7+M;   11+M;   15+M;    3+M
2170   1351
2171   1352
2172   1353
2173   1350     18+M;   19+M;   20+M;   17+M
2174   1365
2175   1366
2176   1367
2177   1364     30+M;   31+M;   32+M;   29+M
2200   1354
2201   1360
2202   1364
2203   1350     21+M;   25+M;   29+M;   17+M
2204   1357
2205   1363
2206   1367
2207   1353     24+M;   28+M;   32+M;   20+M
2210   1371
2211   1372
2212   1373
2213   1370     34+M;   35+M;   36+M;   33+M
2214   1405
```

```
2215   1406
2216   1407
2217   1404     46+M;    47+M;    48+M;    45+M
2220   1374
2221   1400
2222   1404
2223   1370     37+M;    41+M;    45+M;    33+M
2224   1377
2225   1403
2226   1407
2227   1373     40+M;    44+M;    48+M;    36+M
2230   1415
2231   1416
2232   1417
2233   1414     54+M;    55+M;    56+M;    53+M
2234   1421
2235   1422
2236   1423
2237   1420     58+M;    59+M;    60+M;    57+M
2240   1415
2241   1421
2242   1425
2243   1411     54+M;    58+M;    62+M;    50+M
2244   1416
2245   1422
2246   1426
2247   1412     55+M;    59+M;    63+M;    51+M

               TEST=.

               /TEST ARRAY:

2250   7774
2251   0001
2252   0001      -4;      1;      1
2253   7761
2254   0001
2255   0001     -15;      1;      1
2256   7775
2257   0001
2260   0001      -3;      1;      1
2261   7766
2262   7766
2263   0001     -10;    -10;      1
2264   7766
2265   7773
2266   7766     -10;     -5;    -10
2267   7776
2270   7776
2271   0001      -2;     -2;      1
2272   7776
2273   7777
2274   7776      -2;     -1;     -2
```

```
2275   7776
2276   7777
2277   7777      -2;   -1;   -1
2300   7776
2301   0000
2302   7776      -2;    0;   -2
2303   7773
2304   7773
2305   7766      -5;   -5;  -10
2306   7773
2307   7773
2310   7773      -5;   -5;   -5
2311   7773
2312   0000
2313   7766      -5;    0;  -10
2314   7773
2315   0000
2316   7773      -5;    0;   -5

               OCTAL

               PAUSE

               /TEXT MESSAGES ***

2317   4543   TEXT01, 4543
2320   2410   2410
2321   1123   1123
2322   4011   4011
2323   2340   2340
2324   2125   2125
2325   0211   0211
2326   0354   0354
2327   4063   4063
2330   0440   0440
2331   2411   2411
2332   0355   0355
2333   2401   2401
2334   0355   0355
2335   2417   2417
2336   0545   0545
2337   4343   4343
2340   0417   0417
2341   4031   4031
2342   1725   1725
2343   4027   4027
2344   0116   0116
2345   2440   2440
2346   0116   0116
2347   4005   4005
2350   3020   3020
2351   1401   1401
2352   1601   1601
2353   2411   2411
```

```
2354   1716   1716
2355   4017   4017
2356   0640   0640
2357   1017   1017
2360   2740   2740
2361   2417   2417
2362   4020   4020
2363   1401   1401
2364   3140   3140
2365   7740   7740
2366   0000   0000

2367   4543   TEXT03, 4543
2370   4324   4324
2371   1011   1011
2372   2340   2340
2373   2022   2022
2374   1707   1707
2375   2201   2201
2376   1540   1540
2377   2014   2014
2400   0131   0131
2401   2340   2340
2402   2411   2411
2403   0355   0355
2404   2401   2401
2405   0355   0355
2406   2417   2417
2407   0540   0540
2410   1716   1716
2411   4001   4001
2412   4064   4064
2413   4002   4002
2414   3140   3140
2415   6440   6440
2416   0231   0231
2417   4064   4064
2420   4003   4003
2421   2502   2502
2422   0556   0556
2423   4543   4543
2424   2410   2410
2425   0540   0540
2426   1702   1702
2427   1205   1205
2430   0324   0324
2431   4011   4011
2432   2340   2340
2433   2417   2417
2434   4007   4007
2435   0524   0524
2436   4064   4064
2437   4023   4023
2440   2125   2125
```

2441	0122	0122
2442	0523	0523
2443	4011	4011
2444	1640	1640
2445	0140	0140
2446	2217	2217
2447	2754	2754
2450	4005	4005
2451	1124	1124
2452	1005	1005
2453	2240	2240
2454	2605	2605
2455	2224	2224
2456	1103	1103
2457	0114	0114
2460	1431	1431
2461	5445	5445
2462	4304	4304
2463	1101	1101
2464	0717	0717
2465	1601	1601
2466	1414	1414
2467	3140	3140
2470	1722	1722
2471	4010	4010
2472	1722	1722
2473	1132	1132
2474	1716	1716
2475	2401	2401
2476	1414	1414
2477	3140	3140
2500	2410	2410
2501	2217	2217
2502	2507	2507
2503	1040	1040
2504	2410	2410
2505	0540	0540
2506	0325	0325
2507	0205	0205
2510	5640	5640
2511	1116	1116
2512	2025	2025
2513	2440	2440
2514	1517	1517
2515	2605	2605
2516	2340	2340
2517	0123	0123
2520	4022	4022
2521	1727	1727
2522	5445	5445
2523	4303	4303
2524	1714	1714
2525	2515	2515
2526	1654	1654

```
2527   4020   4020
2530   1401   1401
2531   1605   1605
2532   5640   5640
2533   1106   1106
2534   4031   4031
2535   1725   1725
2536   4004   4004
2537   1740   1740
2540   1617   1617
2541   2440   2440
2542   2701   2701
2543   1624   1624
2544   4024   4024
2545   1005   1005
2546   4002   4002
2547   1701   1701
2550   2204   2204
2551   4020   4020
2552   2211   2211
2553   1624   1624
2554   0504   0504
2555   4017   4017
2556   2524   2524
2557   4001   4001
2560   2440   2440
2561   0526   0526
2562   0522   0522
2563   3140   3140
2564   2324   2324
2565   0520   0520
2566   5445   5445
2567   4301   4301
2570   1623   1623
2571   2705   2705
2572   2240   2240
2573   4716   4716
2574   1747   1747
2575   4024   4024
2576   1740   1740
2577   2410   2410
2600   0540   0540
2601   2125   2125
2602   0523   0523
2603   2411   2411
2604   1716   1716
2605   4047   4047
2606   0217   0217
2607   0122   0122
2610   0440   0440
2611   2022   2022
2612   1116   1116
2613   2417   2417
2614   2524   2524
```

2615	4077	4077
2616	4756	4756
2617	4017	4017
2620	2410	2410
2621	0522	0522
2622	2711	2711
2623	2305	2305
2624	5445	5445
2625	4324	4324
2626	1005	1005
2627	4002	4002
2630	1701	1701
2631	2204	2204
2632	4011	4011
2633	2340	2340
2634	2022	2022
2635	1116	1116
2636	2405	2405
2637	0440	0440
2640	2711	2711
2641	2410	2410
2642	4031	4031
2643	1725	1725
2644	4001	4001
2645	2340	2340
2646	4717	4717
2647	4754	4754
2650	4024	4024
2651	1005	1005
2652	4003	4003
2653	1715	1715
2654	2025	2025
2655	2405	2405
2656	2245	2245
2657	4301	4301
2660	2340	2340
2661	4730	4730
2662	4754	4754
2663	4001	4001
2664	1604	1604
2665	4024	4024
2666	1005	1005
2667	4027	4027
2670	1116	1116
2671	1611	1611
2672	1607	1607
2673	4022	4022
2674	1727	1727
2675	4001	4001
2676	2340	2340
2677	4752	4752
2700	4740	4740
2701	5645	5645
2702	4343	4343

```
2703   4300   4300

2704   4543   TEXT04, 4543
2705   4323   4323
2706   1001   1001
2707   1414   1414
2710   4011   4011
2711   4007   4007
2712   1740   1740
2713   0611   0611
2714   2223   2223
2715   2440   2440
2716   7740   7740
2717   0000   0000

2720   4543   TEXT05, 4543
2721   4331   4331
2722   1725   1725
2723   2240   2240
2724   1517   1517
2725   2605   2605
2726   4011   4011
2727   2340   2340
2730   0000   0000

2731   4543   TEXT06, 4543
2732   4324   4324
2733   1001   1001
2734   2440   2440
2735   1517   1517
2736   2605   2605
2737   4011   4011
2740   2340   2340
2741   1114   1114
2742   1405   1405
2743   0701   0701
2744   1456   1456
2745   4024   4024
2746   2231   2231
2747   4001   4001
2750   0701   0701
2751   1116   1116
2752   5645   5645
2753   4343   4343
2754   0000   0000

2755   4543   TEXT07, 4543
2756   4311   4311
2757   4015   4015
2760   1726   1726
2761   0540   0540
2762   0000   0000

2763   4543   TEXT08, 4543
```

```
2764   4314   4314
2765   0524   0524
2766   4723   4723
2767   4003   4003
2770   0114   0114
2771   1440   1440
2772   2410   2410
2773   1123   1123
2774   4001   4001
2775   4024   4024
2776   1105   1105
2777   5600   5600

3000   4543   TEXT09, 4543
3001   4331   4331
3002   1725   1725
3003   4027   4027
3004   1116   1116
3005   4017   4017
3006   1640   1640
3007   0000   0000

3010   4543   TEXT10, 4543
3011   4311   4311
3012   4027   4027
3013   1116   1116
3014   4017   4017
3015   1640   1640
3016   0000   0000

3017   4543   TEXT11, 4543
3020   4310   4310
3021   1727   1727
3022   4001   4001
3023   0217   0217
3024   2524   2524
3025   4001   4001
3026   1617   1617
3027   2410   2410
3030   0522   0522
3031   4007   4007
3032   0115   0115
3033   0540   0540
3034   7740   7740
3035   0000   0000

3036   4543   TEXT12, 4543
3037   4320   4320
3040   1405   1405
3041   0123   0123
3042   0540   0540
3043   0116   0116
3044   2327   2327
3045   0522   0522
```

```
3046   4047   4047
3047   3105   3105
3050   2347   2347
3051   4017   4017
3052   2240   2240
3053   4716   4716
3054   1747   1747
3055   5645   5645
3056   4300   4300

3057   4543   TEXT13, 4543
3060   5656   5656
3061   5656   5656
3062   5656   5656
3063   5656   5656
3064   5656   5656
3065   5656   5656
3066   5656   5656
3067   5656   5656
3070   5645   5645
3071   4300   4300

3072   5640   TEXT14, 5640
3073   0000   0000

3074   4056   TEXT15, 4056
3075   4000   4000

3076   4543   TEXT16, 4543
3077   4324   4324
3100   1001   1001
3101   1613   1613
3102   4031   4031
3103   1725   1725
3104   4006   4006
3105   1722   1722
3106   4001   4001
3107   1640   1640
3110   0516   0516
3111   1217   1217
3112   3101   3101
3113   0214   0214
3114   0540   0540
3115   0701   0701
3116   1505   1505
3117   5645   5645
3120   4343   4343
3121   4343   4343
3122   4343   4343
3123   4343   4343
3124   4343   4343
3125   4343   4343
3126   4343   4343
3127   4343   4343
```

```
3130   0000   0000

3131   4543   TEXT17, 4543
3132   4302   4302
3133   1701   1701
3134   2204   2204
3135   4020   4020
3136   2211   2211
3137   1624   1624
3140   1725   1725
3141   2440   2440
3142   7740   7740
3143   0000   0000
```

```
BOARD    0100
CODE     0077
COLOOP   1047
COLUMN   0041
COMMA    0037
COMOVE   0340
CONVRT   0076
COUNT1   0057
COUNT2   0060
COUNT3   0061
COUNT4   0062
COUNT5   0063
COUNT6   0064
COUNT7   0065
COUNT8   0066
CR       1246
CSTAR    1111
CUBE     1024
C245     1253
C340     1251
DECIDE   0303
DONE01   0766
DONE02   0764
DONE03   0762
DONE04   0760
DONE05   0756
DONE06   0754
DONE07   0752
DONE08   0750
ENDGAM   0105
ENDPAG   0777
FLAG     0045
GETMV    0235
ILLEGL   0352
K261     0034
LASTMV   0443
LF       0035
M        1327
```

```
MARROW  0441
MASK77  1247
MCR     0031
MESAGE  0075
MINUS1  0020
MINUS3  0021
MNCODE  0440
MNO     1306
MOVE    1330
MOVEP   0067
MSCODE  0442
MSRGHT  1217
MTP     1244
MYES    1305
M1      0052
M13     0025
M2      0053
M20     0024
M260    0030
M3      0054
M4      0022
M40     1250
M5      0023
M64     0027
M76     0026
NEXT    0043
NO      1277
OCODE   1110
PLANE   0042
PLNLOP  1033
PRINTC  4504
PRNTXT  1200
PRTSPC  1064
P5      0032
P76     0033
READC   4503
RETRN1  0106
RETRN2  0107
RETRN3  0110
ROW     0040
ROWLOP  1041
ROWLST  1570
ROWP    0072
RTRN01  1002
RTRN02  1012
RTRN03  1014
RTURN   1020
SAVE    0044
SCAN01  0600
SCAN02  0616
SCAN03  0635
SCAN04  0651
SCAN05  0673
SCAN06  0705
```

```
SCAN07   0716
SCAN08   0743
SETUP    0215
SITFND   0325
SPACE    0036
STAR     1104
STPROG   0175
STRAT    0101
STRTG    0537
STRTPT   1023
SUM      1430
SUMLOP   0546
SUMP     0071
TEST     2250
TESTAC   4502
TESTP    0073
TEST1    0047
TEST2    0050
TEST3    0051
TEXT01   2317
TEXT03   2367
TEXT04   2704
TEXT05   2720
TEXT06   2731
TEXT07   2755
TEXT08   2763
TEXT09   3000
TEXT10   3010
TEXT11   3017
TEXT12   3036
TEXT13   3057
TEXT14   3072
TEXT15   3074
TEXT16   3076
TEXT17   3131
TRYAGN   0400
TYPECH   1220
WAITCT   0056
WAITL    0070
WAITLS   1544
WAITP    0055
WELOSE   0360
WEWON    0355
WINROW   0365
WINRW    1312
XCDE     1107
XCNVRT   0471
XCODE    0456
XM2      1252
XPRNTC   0406
XREADC   0414
XRTRN    0454
XR1      0010
XR2      0011
```

```
XR3       0012
XR4       0013
XR5       0014
XR6       0015
XR7       0016
XR8       0017
XSUM      0046
XTSTAC    0444
XWNROW    1307
XYESNO    1254
YES       1276
YESNO     0074
```