PROGRAM DESCRIPTION I

Program Title REVERSI

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Program Description, Equations, Variables This program allows the user to play a game of Reversi against an HP-41C. The present program includes all features required: plays quite well and will easily defeat a beginner, so it provides a challenging level for everyone. The program itself runs the same with or without a printer, but if one is present, it will print the board.

```
YOU PLAY 57
FLIP 2 PCES

   1 2 3 4 5 6 7 8
1  - - - - - - - -
2  - - - - - - - -
3  O O O - - - - -
4  - - O O O - - -
5  - - O ▒ ▒ ▒ ▒ -
6  - - O O O ▒ ▒ O
7  - - - - O ▒ ▒ -
8  - - - - - O ▒ O
```

The program is also autonomous: no data cards required, no card reader required.

It is also quite fast for such a complex game: the HP-41C performs some 30 moves (whole game) in 25 minutes. Besides, the running speed increases as the game goes on.

You can select who makes the first move, and the type of opening: either diagonal or parallel. Also, you may select to print the board after every new position, or only after HP moves (so saving paper and time). The machine recognizes and rejects illegal moves. Can play a single move for you against itself. Even a whole game against itself if you want (imagine, the HP-41C playing both black and white at the same time!)

Though you are supposed to know the rules of the game, a brief explanation will be given, for the sake of completeness. Here is a brief outline of the rules:

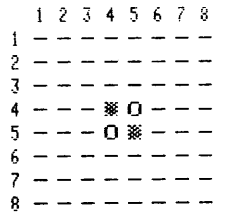
Necessary Accessories 3 single-density memory modules (or a quad module).

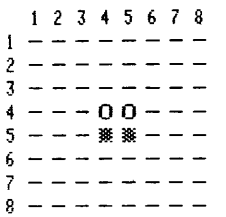
Operating Limits and Warnings Your move must be of the form xy, with both x and y ranging from 1 to 8, limits included, and the two exceptions to this rule being Ø (no move) and -1 (HP plays for you). Any negative number may be used instead of -1, if desired. The game generally ends when the board is full of pieces, but it may also end if no player can make a legal move. In that unlikely case, the counting of the pieces is not automatically performed. You must do it by yourself.

Reference(s) New Mathematical Diversions, by Martin Gardner. Includes the rules of Reversi, and some other curiosities. You can also have a look at the Games Pac for the HP-85 computer, which includes a program to play Reversi (not related to this program in any way, to be sure!!!)

Reversi is played on an 8x8 board. There are two standard openings (see illustrations):

-diagonal opening (left)
-parallel opening (right)



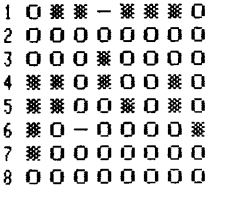


One of the players plays the white pieces (represented by the O), the other the black ones (represented by the checkerboard character).

To make a move, the player places one of his pieces in an empty location (represented by a dash) taking into account that:

-it must be adjacent to a piece of the other player.
-at least one enemy piece must be enclosed between the just placed piece and another piece of the same color.

This is, any number of pieces enclosed between the played piece and any other of the same color are flipped: they become of the capturer's color. No empty locations can be enclosed, only full rows of enemy pieces can be flipped. The row can be placed in any direction: horizontal, vertical or diagonal. If more than one row is enclosed at the same time, all are flipped. You can capture only when putting a piece on the board: enemy pieces which are left enclosed by yours because of other factors are not captured, of course.



Some example should make it clear. Look at the diagonal opening. If black plays to 64 (6 vertical, 4 horizontal), then the white piece at 54 is between the 2 black pieces at 44 and 64 (just played), so it's flipped: the white piece at 54 becomes black. (By the way, you play black, HP plays white).

Now, look at the illustration at the left of these lines: if white plays at 14, the black pieces at 12 and 13 are enclosed between the just played piece at 14 and the white piece at 11, so they would be flipped. Simultaneously, the black pieces at 15, 16 and 17 are between the just played piece at 14 and the white piece at 18, so they would be flipped, too.

On the other hand, in the same board position, if black plays at 63, it would flip the white pieces at 62, 53, 43, 33, 23, 64, 65, 66, and 67, because there is another black piece at the end of each row of white pieces, and none of the rows contain empty locations between pieces.

PROGRAM CHARACTERISTICS

The program is exactly 672 bytes (96 registers) long, so it exactly fits onto 3 magnetic cards. The program is optimized for running speed: each location on the board is stored into a single data register, so a minimum SIZE 117 is required. This makes it necessary to have at least 3 single-density memory modules attached, in order to run the program, leaving a port free to plug in the card reader or the printer.

Registers are used as follows: R00 through R07 are scratch. R08 through R15 contain the directions array, necessary to scan each row. R16 through R27 store an array of constants used by the strategic part of the program to compute each move. R17 through R116 store the 8x8 board, including edges (thus being actually a 10x10 board). As you may see, the constants array and the board overlap, so saving 11 registers. This is possible because the edges may be any number except +1 or -1, and none of the constants have those values. White (HP's) pieces are stored as +1, black (yours) ones as -1, and empty locations are Ø. The edges are typically Ø, but can be any number except +1 or -1.

The program uses flags 1, 2, 3, 4, and 5. If flag 3 is set, your move is being tested for legality, or HP is playing your pieces against its own. If flag 4 is set, a given number is not yet considered legal. If flag 1 is set, HP plays your pieces for you. If flag 2 is set and the printer is present, the board will not be printed after your moves (except, of course, if you make the last move). If flag 2 is clear, the board is printed after every move. All flags are controlled by the program, except flag 2, which is user-dependent: you may set or clear it from the keyboard as often as you like. Flag 5 is set before a sequence of board positions is tested. If the flag is set at the end of the sequence, none of the positions tested are valid.

Remember that the program is printer-compatible: if you do not use a printer, it runs the same, except that the board is not printed, of course.

TIPS AND REMARKS

Here are a few typical running times. These times are just the time needed to compute HP moves. They do include time required to print the board, but, of course they do not include the time required for you to think out your own move.

-an average game : 30 HP moves

-without printer	: 25 minutes
-printer, SF 02 (1 board)	: 60 minutes
-printer, CF 02 (2 id.)	: 75 minutes

As you may see from these figures, the printer slows down significantly the execution speed, but the convenience of the automatic handling of the board, and the fact that an actual board is not needed at all, together with the game being recorded on the paper tape, make it worth the price.

Remember also that execution gets faster as the program progresses, from some 70 seconds for a move near the beginning of the game, to a few seconds for a move near the end of the game. This is possible because HP keeps track of already occupied locations, and once a group of 5 locations is tested to be occupied, they are not tested any more, speeding up the search algorithm quite a lot when the game is close to its termination.

No moves are random, so the same game is played if you make exactly the same moves. This feature is useful: if you made a mistake that allowed HP to win, you can repeat that game once more, this time avoiding the error, to see who wins now. As you'll see, the level of play is quite good for such a tiny program running under the speed limitations of the HP-41C. Any improvements to the playing logic are welcome, however.

There are several ways of making room for improvements, or to fit the program into 2 RAMs (instead of 3). Possible shortcuts are:

1) Delete lines 68, 69, change LBL "REVERSI" to LBL "R", line 260 to "OK", and shorten other alpha comments. This saves 27 to 30 bytes at almost no cost.

2) If you have no printer, or do not want printing of the board, you can delete lines 6, 62, 195 through 251, 254 through 258 (limits always included) and change line 49 to 60 instead of 61. This modification saves 116 bytes.

3) You may use a data card: delete lines 7 through 30 (both included) and insert in their place:

```
07 16.027
08 RDTAX
```

This saves another 148 bytes, but a card reader is needed, and you must load a data card when the program asks for one. The data card contains the constants that the program stores (in lines 7 through 30) in their respective registers. See program listings.

Remember that, although the game normally ends when the board is full of pieces, it may end if no player can make a legal move (or if a player loses all his/its pieces). In these cases, the automatic counting of the pieces to decide the winner is not performed: you'll have to do it manually.

```
                SF 02
          XEQ "REVERSI"
DIAG ?
                    RUN
```

SAMPLE GAME: Load the program, SIZE 117, and press the following:
SF 02 (selects one board only)

XEQ "REVERSI" : see printout at the left.

- the display asks you whether you want to play DIAGonal opening: you agree by pressing R/S

```
  1 2 3 4 5 6 7 8
1 - - - - - - - -
2 - - - - - - - -
3 - - - - - - - -
4 - - - ▒ O - - -
5 - - - O ▒ - - -
6 - - - - - - - -
7 - - - - - - - -
8 - - - - - - - -
```

- the board is printed now reflecting the diagonal opening that you have selected. This is the initial position. You are playing black (checkerboard characters) and HP plays white (the O's).

(if you are not using a printer, you need an actual 8x8 board, and a set of 64 reversible pieces, one side white, the other black. Dispose them as in the printout, and always actualize the board after your moves and after HP moves).

```
HP 1ST ?
N                   RUN
MOVE ?
                 64 RUN
YOU PLAY 64
FLIP 1 PCES
I PLAY 63
FLIP 1 PCES
```

- the machine prompts you whether it makes the first move
- enter an N and press R/S (N stands for NO): you move first
- the machine then prompts for your move
- enter 64, then R/S (you put a piece at 6 vertical, 4 horizontal)
- the machine tests your move, finds it legal, and acknowledges the move, displaying also the number of flipped pieces
- then computes its move, displays it, the number of pieces it flips, and prints the board

(the board was not printed after your move because we set flag 02)

```
  1 2 3 4 5 6 7 8
1 - - - - - - - -
2 - - - - - - - -
3 - - - - - - - -
4 - - - ▒ O - - -
5 - - - O ▒ - - -
6 - - O ▒ - - - -
7 - - - - - - - -
8 - - - - - - - -
```

the board reflects the position after the moves. Your move at 64 flipped the white piece at 54, which became black, but then the machine moved to 63 flipping that same piece once more to white. This is so because by playing at 63 the piece at 54 is enclosed between both white pieces at 63 and 45

... the game continues ... (You:53, HP:65) then, we decide to have a printing of both boards, so we clear flag 02, and enter 76, R/S as our move: (the flag is cleared using the keyboard sequence CF 02). The machine acknowledges your move, and, since flag 02 is cleared, prints the board reflecting your move.

```
MOVE ?
                        CF 02
                    76      RUN
YOU PLAY 76
FLIP 1 PCES

  1 2 3 4 5 6 7 8
1 - - - - - - - -
2 - - - - - - - -
3 - - - - - - - -
4 - - - ▒ O - - -
5 - - ▒ ▒ O - - -
6 - - O O ▒ - - -
7 - - - - - ▒ - -
8 - - - - - - - -
```

The board is printed. Your move at 76 just flipped the white piece at 65, which became black. You must be aware that this printout is not a direct continuation of the previous one, since we took the game up two moves later.

The machine plays to 66, so flipping once more the piece at 65. As you may see, unlike other games, such as chess or checkers, pieces never move from where they are left, but merely change sides any number of times. Of course, the object of the game is to have the maximum number of pieces on the board when the game ends.

The board is printed now, showing the effects of the machine move on the position.

```
I PLAY 66
FLIP 1 PCES

  1 2 3 4 5 6 7 8
1 - - - - - - - -
2 - - - - - - - -
3 - - - - - - - -
4 - - - ▒ O - - -
5 - - ▒ ▒ O - - -
6 - - O O O O - -
7 - - - - - ▒ - -
8 - - - - - - - -
```

```
  1 2 3 4 5 6 7 8
1 O ▒ ▒ ▒ ▒ ▒ ▒ O
2 O ▒ ▒ ▒ ▒ ▒ ▒ -
3 O O O ▒ O O ▒ O
4 ▒ ▒ O O O ▒ ▒ O
5 ▒ ▒ O O O O ▒ O
6 ▒ O O O O O O O
7 ▒ O O O O O O O
8 O O O O O O O O

MOVE ?
                -1    RUN
NO MOVE
I PLAY 28
FLIP 8 PCES

  1 2 3 4 5 6 7 8
1 O ▒ ▒ ▒ ▒ ▒ ▒ O
2 O O O O O O O O
3 O O O ▒ O O O O
4 ▒ ▒ O O O O ▒ O
5 ▒ ▒ O O O O ▒ O
6 ▒ O O O O O O O
7 ▒ O O O O O O O
8 O O O O O O O O

GAME IS OVER

HP: 49, YOU: 15

I WON
```

SAMPLE GAME CONTINUED: In the printout at the left, a typical game ends.

HP has just moved. Then you are prompted for your move. In the position shown, there is just one empty location left. But you cannot place a piece there, because no white pieces would result enclosed between your piece and another of your pieces. So you have no legal move. However, if you are a beginner, you may be unsure about it, so you decide to have the machine select your move (if any) for you:

Enter -1, R/S. HP begins to search for a suitable move for you. But as expected, finds none, displays (and beeps; you may have noticed by now that most messages are beeped as well as displayed and printed) NO MOVE, then proceeds to search for its move. Finally, after a few seconds, it moves to 28 (where else?!) and, while doing so, flips no less than 8 of your pieces: those located at 22, 23, 24, 25, 26, 27, 37, and 46.

The board is printed for the last time. Then the machine realizes that the game has ended, displays GAME IS OVER, and counts both black and white pieces on the board, to decide the winner. This time, it displays HP: 49, YOU: 15, meaning there are 49 white pieces on the board, while you have only 15 of your pieces remaining. Obviously, HP has won, so it displays a final I WON message. Once this message is on the display, there is only one possibility left for you: TRY AGAIN.

TEST GAME: If desired, test that your program is correctly loaded by executing the following game.

Diagonal opening, HP first. Only the moves are shown (no flip pieces)

YOU	HP	YOU	HP	YOU	HP	YOU	HP	YOU	HP
--	65	42	68	57	85	25	16	38	48
46	33	75	36	83	58	26	52	78	82
64	63	35	84	76	41	32	47	71	87
43	66	86	51	61	34	23	14	12	11
72	53	31	56	62	74	15	73	0	21
67	81	27	18	24	13	17	37	77	88
								22	28

FINAL SCORE: 17 47, so HP WON

NOTE: If you play with a printer (and set it to NORM, as recommended), you'll have each machine move printed, as well as displayed. However, if you play without a printer, and you happen to miss the I PLAY xy display, do not worry. Simply use backarrow to clear the MOVE ? display, and the last HP's move will be in the display, in the form xy. (Use backarrow just once. Using it twice or more consecutively would also clear the xy move! You can also simply turn alpha on and off to clear the MOVE ? prompt from the display.)

USER INSTRUCTIONS

SIZE: (HP-41C) 117

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
1	Load the program. You play black. HP white.			
2	If you want to use the printer, plug it in now and set NORM position.			
3	If a printer is used and you want to suppress board printing after your moves, press: the board will now be printed just after HP moves. This can be done at any time.		SF 02	Flag 2 annunc. on
or 3	To print the board each time, press:		CF 02	Flag 2 annunc. off
4	Make sure you have at least SIZE 117.			
5	Begin the game, press:		XEQ "REVERSI"	DIAG?
6	If you want to play diagonal opening:		R/S	HP 1ST?
or 6	If you want to play parallel opening:	N	R/S	HP 1ST?
7	If you want HP to make the first move:		R/S	I MOVE
or 7	If you want to make the first move:	N	R/S	MOVE?
8	IF IT IS YOUR TURN (MOVE? on the display)			
	Enter your move: (x=vertical, y=horizontal) (Your move is tested for legality. If it is found to be illegal, you'll be prompted once more for your move with MOVE?. Go to Step 9, then)	xy	R/S	YOU PLAY xy FLIP p PCES or ILLEGAL MOVE?
or 9	You have no legal move: enter: and HP proceeds to compute its move.	Ø	R/S	
or 9	You want the machine to play your pieces against its own in this turn: enter: and HP computes your move, displays: and then automatically computes its own move. NO MOVE is displayed if the machine finds no legal move for your pieces. If you want a whole machine/machine game, always enter -1 as your move.	-1	R/S	YOU PLAY xy FLIP p PCES or NO MOVE
10	IF HP MOVES it will think about its move for a while, then display: xy is the location where HP puts its piece and p is the number of your pieces flipped. NO MOVE is displayed if no legal move is possible for HP. You then have the turn once more:			I PLAY xy FLIP p PCES or NO MOVE
	Go to Step 8			MOVE?
	(If you play without a printer, remember to actualize the board after HP moves: put a white piece where indicated, then flip your captured pieces.)			

USER INSTRUCTIONS

STEP	INSTRUCTIONS	INPUT	FUNCTION	DISPLAY
11	Once the last player makes the last move, you should see: where nn = number of white (HP) pieces on the board mm = number of black (you) pieces on the board Of course, the player with the most pieces at the end of the game wins the game. So, if HP has 24 pieces on the board and you have 40, you won. If HP has 40 and you 24, HP wins. But if both have 32 pieces, it is a tie and no winning message is displayed.			GAME IS OVER HP: nn, YOU: mm I WON or YOU WON

NOTES: If the printer is plugged in, everything that appears in the display is printed as well, and the resulting board position is printed after every legal move if Flag 02 is clear, and only after HP moves if it is set. After the last move, the board is printed also, regardless of the status of Flag 02.

You may set or clear Flag 02 using SF 02 and CF 02 respectively from the keyboard as often as you like. You may do it at any time during program execution, whenever the machine is at a halt.

If no player can make a legal move, or if one player loses all his pieces, the game is ended, but this is not recognized by the program, and the automatic counting of the pieces is not performed. Do it yourself, to determine the winner. The board, if not already printed, may be forced to be printed by the following series of keystrokes:

GTO .202
R/S

and halt the program just after the 8th row is printed, by pressing R/S. Once the board is printed, you can perform the counting.

The machine-plays-for-you feature is very useful. You can use it freely whenever you don't know what to play: let the machine play (honestly) your pieces, hoping its selection is a good one. Or, if you are unsure whether you have any legal move or not, let the machine play your pieces:

- if there is a legal move for you it will be found
- if no legal move at all, NO MOVE is displayed, and the machine now computes its own move.

This capability is especially useful for beginners; also, if you want the machine to play a whole game against itself, always enter -1 as your move, and you'll see HP in action as never before!

PROGRAM LISTING

☐ 67 ☐ 97 ☒ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
	01◆LBL "REV		
	ERSI"		
02	CLRG		Initialization
03	FIX 0		
04	CF 29		
05	CF 01		
06	CF 12		
07	.8188111		Store move
	883		constants
08	STO 16		
09	.8661683		
	138		
10	STO 17		
11	.1316636		
	633		
12	STO 18		
13	.3684855		
	158		
14	STO 19		
15	.4148141		
	564		
16	STO 20		
17	.6553564		
	346		
18	STO 21		
19	.3435747		
	552		
20	STO 22		
21	.5742472		
	425		
22	STO 23		
23	.7376626		
	732		
24	STO 24		
25	.3723268		
	287		
26	STO 25		
27	.7178212		
	812		
28	STO 26		
29	.1772772		
	227		
30	STO 27		
31	SIGN		1
32	STO 62		Initialize
33	STO 09		test constants
34	CHS		-1
35	STO 08		
36	STO 72		
37	9		
38	STO 15		
39	CHS		
40	STO 14		
41	+		
42	STO 11		
43	CHS		
44	STO 10		
45	11		
46	STO 13		
47	CHS		
48	STO 12		
49	61		
50	STO 07		
51	"DIAG ?"		Query for
52	CF 23		parallel or
53	AON		diagonal
54	PROMPT		opening
55	RCL 09		
56	RCL 08		
57	FS?C 23		
58	X<>Y		
59	STO 61		
60	X<>Y		
61	STO 71		
62	XEQ 06		Print board
63	"HP 1ST		"Who moves
	?"		first?" test
64	PROMPT		
65	AOFF		
66	FS?C 23		
67	GTO 00		
68	"I MOVE"		HP first
69	AVIEW		
70	SF 29		--First move
71◆LBL 14			of game
72	"I"		HP's move
73	CF 03		
74◆LBL 08			
75	16.027		
76	FS?C 29		First move of
77	21		game
78	STO 05		
79◆LBL 11			
80	RCL IND		Recall constant
	05		
81	X=0?		Constant exhausted?

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

PROGRAM LISTING

☐ 67 ☐ 97 ☒ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
	82 GTO 05		Get new constant
	83 SF 05		
	84◆LBL 13		
	85 RCL 10		10
	86 X↑2		
	87 *		
	88 STO 06		
	89 INT		
	90 XEQ 12		Test position
	91 FC?C 04		Invalid move?
	92 GTO 00		
	93 RCL 06		
	94 FRC		
	95 X≠0?		If constant not exhausted, recycle
	96 GTO 13		
	97 FS? 05		All squares tested full? Null constant
	98 STO IND 05		
	99◆LBL 05		
	100 ISG 05		Next constant
	101 GTO 11		
	102 "NO MOVE "		All tested moves failed
	103 AVIEW		
	104 TONE 9		
	105 PSE		
	106◆LBL 00		Your move
	107 FS?C 01		
	108 GTO 14		
	109 "MOVE ?"		
	110 PROMPT		
	111 X=0?		No move?
	112 GTO 14		Go to HP's move
	113 SF 03		
	114 "YOU"		Your move
	115 X<0?		
	116 SF 01		
	117 X<0?		HP move for you
	118 GTO 08		
	119 XEQ 12		Test position
	120 FC?C 04		Legal move?
	121 GTO 14		
	122 "ILLEGAL "		
	123 AVIEW		
	124 TONE 9		
	125 GTO 00		
	126◆LBL 12		
	127 SF 04		Occupied square flag
	128 17		
	129 +		
	130 STO 00		
	131 RCL IND 00		
	132 X≠0?		Square occupied?
	133 RTN		Return
	134 CF 05		Empty square
	135 STO 01		Initialize empty square test
	136 8.015		
	137 STO 02		
	138 RCL 09		
	139 FC? 03		
	140 CHS		
	141 STO 04		
	142◆LBL 01		
	143 RCL 00		Is there a flippable neighbor piece?
	144 RCL IND 02		
	145 +		
	146 STO 03		
	147 RCL IND X		
	148 RCL 04		Neighbor not flippable
	149 X≠Y?		
	150 GTO 12		
	151◆LBL 03		Test the rest of the pieces in the row
	152 LASTX		
	153 ST+ 03		
	154 RCL IND 03		
	155 RCL 04		
	156 X=Y?		
	157 GTO 03		
	158 CHS		
	159 X≠Y?		Space?
	160 GTO 12		Next direction
	161 STO IND 00		
	162◆LBL 04		Flip pieces
	163 LASTX		
	164 ST- 03		
	165 RCL 00		
	166 RCL 03		
	167 X=Y?		
	168 GTO 12		
	169 RCL 08		

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

PROGRAM LISTING

☐ 67 ☐ 97 ☒ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
170	ST* IND Y		
171	ST- 01		
172	GTO 04		
173	◆LBL 12		
174	ISG 02		Increment flip
175	GTO 01		test counter
176	RCL 01		
177	X=0?		No valid flips?
178	RTN		
179	CF 04		End test
180	"⊢ PLAY "		
181	RCL 00		Display move
182	17		
183	-		
184	ARCL X		
185	AVIEW		
186	FC? 01		
187	FC? 03		
188	BEEP		
189	PSE		
190	"FLIP "		
191	ARCL 01		
192	"⊢ PCES"		
193	AVIEW		
194	PSE		
195	FC? 02		Print board?
196	GTO 06		
197	FS? 03		HP's move?
198	GTO 12		
199	◆LBL 06		
200	FC? 55		If no printer,
201	GTO 12		skip printing
202	ADV		routine
203	31		
204	STO 00		
205	45		
206	STO 01		Initialization
207	79		for board
208	STO 02		printing
209	2.01		routine
210	STO 03		
211	8		
212	SKPCOL		
213	49.056		
214	STO 04		
215	◆LBL 02		
216	RCL 13		Print horizontal
217	SKPCOL		labels 1-8
218	X<>Y		
219	ACCHR		
220	ISG X		
221	GTO 02		
222	PRBUF		
223	28.035		
224	STO 05		
225	◆LBL 09		
226	RCL 04		Print playing
227	ACCHR		board row by
228	RCL 15		row
229	SKPCOL		
230	SF 12		
231	◆LBL 10		Accumulate row
232	RCL IND 05		characters for
233	RCL 09		printing
234	+		
235	RCL IND X		
236	ACCHR		
237	RCL 03		
238	SKPCOL		
239	ISG 05		
240	GTO 10		
241	PRBUF		
242	ST+ 05		
243	CF 12		
244	ISG 04		
245	GTO 09		
246	ADV		
247	FS? 03		
248	GTO 12		
249	ADV		
250	ADV		
251	◆LBL 12		Move counter
252	DSE 07		
253	RTN		
254	FC? 02		
255	GTO 12		
256	FS?C 03		
257	XEQ 06		
258	◆LBL 12		
259	32		
260	"GAME IS OVER"		

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

PROGRAM LISTING

☐ 67 ☐ 97 ☒ 41C

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS
261	28.105		
262	AVIEW		
263	0		
264	◆LBL 07		Total scores
265	RCL IND Y		
266	+		
267	ISG Y		
268	GTO 07		
269	2		
270	/		
271	X<>Y		
272	RDN		
273	ST- Z		
274	+		
275	ADV		
276	"HP: "		Display scores
277	ARCL X		
278	"├, YOU: "		
279	ARCL Y		
280	AVIEW		
281	BEEP		
282	ADV		
283	PSE		
284	X=Y?		
285	STOP		
286	"I"		
287	X<Y?		
288	"YOU"		
289	"├ WON"		Who won?
290	PROMPT		
291	.END.		

STEP/ LINE	KEY ENTRY	KEY CODE (67/97 only)	COMMENTS

Note: Refer to "HP-41C OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for specific information on keystrokes. The Function Index is found at the very back of the Handbook. Refer to Appendix E in 67 or 97 "OWNER'S HANDBOOK AND PROGRAMMING GUIDE" for exact keystrokes.

REGISTERS, STATUS, FLAGS, ASSIGNMENTS

DATA REGISTERS

01 to 07	Scratch
08 to 15	Directions array
16 to 27	Constants array
17 to 116	Board

(Constants array and Board overlap)

STATUS

SIZE 117	TOT. REG. 213		USER MODE		
ENG	FIX	SCI	ON	OFF	XX
DEG	RAD	GRAD			

FLAGS

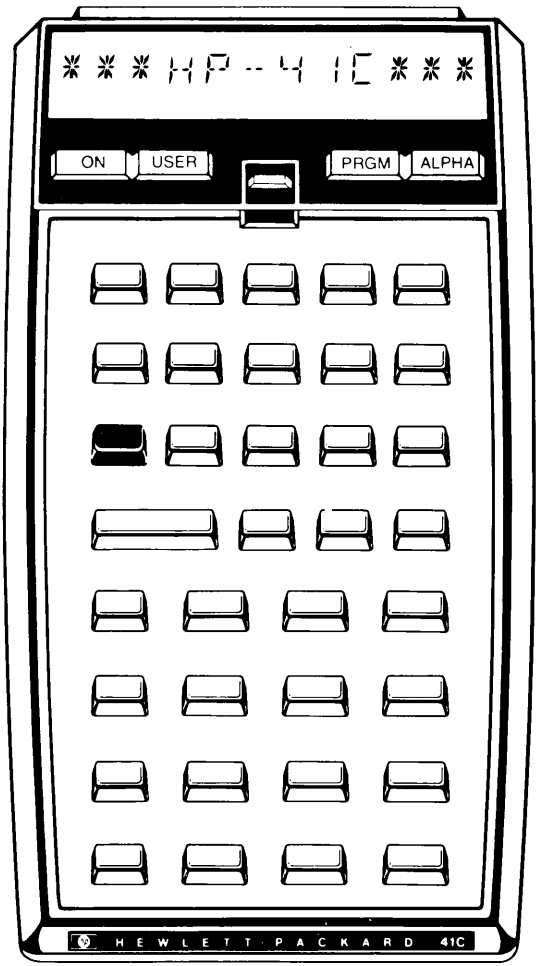
#	INIT S/C	SET INDICATES	CLEAR INDICATES
01		HP playing your pieces	
02		Only 1 board	Both boards
03		Move tested legal	
04		Move not yet legal	
05		Set before a sequence of board positions is tested. If the flag is set at the end of the sequence, none of the positions tested are valid.	
12		Double wide print	Single wide print
23		Alpha input	No alpha input
29		Decimal point Flag 29 is also set to indicate the first move of the game.	Suppress Decimal
55		Printer exists	No printer

ASSIGNMENTS

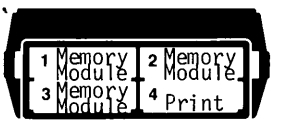
FUNCTION	KEY	FUNCTION	KEY

KEYBOARD CARD LABELING

KEYBOARD

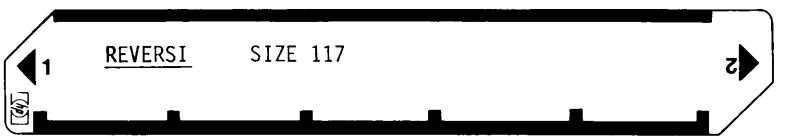


SYSTEM CONFIGURATION



(Printer is optional)

CARD



PROGRAM REGISTERS NEEDED: 96

ROW 1 (1 : 3)

ROW 2 (3 : 7)

ROW 3 (7 : 9)

ROW 4 (9 : 11)

ROW 5 (11 : 13)

ROW 6 (13 : 15)

ROW 7 (15 : 17)

ROW 8 (17 : 19)

ROW 9 (19 : 21)

ROW 10 (21 : 23)

ROW 11 (23 : 25)

ROW 12 (25 : 27)

ROW 13 (27 : 29)

ROW 14 (29 : 35)

ROW 15 (36 : 46)

ROW 16 (47 : 52)

ROW 17 (52 : 61)

ROW 18 (62 : 64)

ROW 19 (65 : 69)

ROW 20 (70 : 75)

ROW 21 (75 : 83)

ROW 22 (83 : 92)

ROW 23 (92 : 100)

ROW 24 (101 : 104)

ROW 25 (105 : 109)

ROW 26 (110 : 116)

ROW 27 (117 : 122)

ROW 28 (122 : 127)

ROW 29 (128 : 136)

ROW 30 (136 : 144)

ROW 31 (145 : 154)

ROW 32 (154 : 163)

ROW 33 (164 : 172)

ROW 34 (172 : 180)

ROW 35 (180 : 185)

OW 36 (186 : 191)

ROW 37 (191 : 196)

ROW 38 (196 : 203)

ROW 39 (204 : 211)

ROW 40 (212 : 217)

ROW 41 (218 : 223)

ROW 42 (223 : 231)

ROW 43 (232 : 239)

ROW 44 (240 : 246)

ROW 45 (247 : 255)

ROW 46 (255 : 260)

ROW 47 (260 : 261)

ROW 48 (261 : 269)

ROW 49 (270 : 277)

ROW 50 (277 : 280)

ROW 51 (281 : 289)

ROW 52 (289 : 291)