

Program Title CHESS - THE EIGHT QUEENS PROBLEM
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Program Description, Equations, Variables It is possible to place eight queens on a chessboard in such a way that no queen attacks another. In fact, there are 92 ways that this can be done. However, there are twelve distinct solutions, the other 80 can be derived by rotating and/or reflecting the twelve distinct solutions. This program will find all twelve distinct solutions. On an HP-97 they will be listed. The solutions are also stored in the data registers for easy retrieval, even on the HP-67. They will be in R10 through R21 (R50-R59, RA and RB).

The method used is a sequential search. Working a row at a time, a queen is placed on the first square, and checks are made down, down and left, and down and right, to see whether it attacks
(next page, please)

Necessary Accessories None required

Operating Limits and Warnings The program requires about eight hours to find all twelve solutions.

Reference(s) Winslow, David "Eight Queen Problem" PPC Journal V6N1P22-23.

PPC Journal is the newsletter of the PPC, an independent HP users' group.

Information can be obtained from: Richard Nelson; 2541 W. Camden Pl.; Santa Ana, Calif. 92704.

This program has been verified only with respect to the numerical example given in Program Description II. User accepts and uses this program material AT HIS OWN RISK, in reliance solely upon his own inspection of the program material and without reliance upon any representation or description concerning the program material.

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(CONTINUATION PAGE)

a queen placed previously. If not, the search goes to the next row up, until all eight rows are done. If an attack is found, the queen is moved one square to the left. If it cannot be moved left, the procedure backs down one row.

When a possible solution is found, it is checked against a list of previously found distinct solutions. Also, its seven rotations and mirror-images are also checked. If no match is found, it is added to the list, and the search continues until twelve solutions are found.

Each solution is given as an eight-digit number $n_1 n_2 n_3 n_4 n_5 n_6 n_7 n_8$.

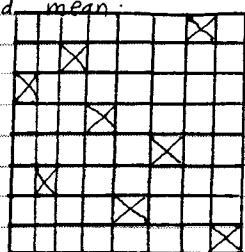
n_i means a queen on the n_i^{th} square of the i^{th} row.

The sequence 73146258

1st row, 7th square
2nd row, 3rd square
3rd row, 1st square
4th row, 4th square
5th row, 6th square
6th row, 2nd square
7th row, 5th square
8th row, 8th square

would mean:

OR



NOTE:

This is not a solution; you didn't expect me to give you one, did you?

About one hour is required for the first solution, the entire list requires about eight hours.

If you do not have the time (or patience) for a complete list at one sitting, the following procedure may be used:

- (1) Stop the program when a solution (not solution number) is being printed.
- (2) Record a data card. (Press W/DATA and feed in both sides of a blank card)

To continue:

- (3) Load program (both sides).
- (4) Load data card from step 2 (both sides).
- (5) Press GSB \emptyset .

SOLUTION:

Input	Function	Display	Comments
	A		Begin execution
		Solution number *** Solution ***	} This is repeated for twelve solutions.
	E	Solution 1 ...	Optional: List solutions
		Solution 12	12 solutions followed by 4 additional numbers
			or Review solutions
	PZS		
	RCL n	Solution # n+1	for $0 \leq n \leq 9$
	RCL A	Solution # 11	
	RCL B	Solution # 12	

Diagram of a tape with the text "EIGHT QUEENS PROBLEM" and "START" followed by a series of markers and "LIST".

[illegible]

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBLA	21 11	START	057	ST09	35 09	
002	CLRG	16-53		058	*LBL8	21 08	
003	8	08		059	DSZI	16 25 46	Decrement skip on non-zero
004	ST01	35 01		060	X<0?	16-45	(X is always ≥ 0)
005	EEX	-23	EEX is faster than 1.	061	GT06	22 06	
006	ST00	35 00		062	EEX	-23	
007	EEX	-23		063	ST-9	35-45 09	
008	1	01		064	RCL9	36 09	
009	ST0E	35 15		065	X=0?	16-43	
010	SPC	16-11		066	GT06	22 06	
011	*LBL1	21 01		067	RCLi	36 45	
012	EEX	-23		068	X#Y?	16-32	
013	ST+0	35-55 00		069	GT08	22 08	
014	8	08		070	*LBL5	21 05	
015	ST09	35 09		071	CF0	16 22 00	
016	RCL0	36 00		072	GT07	22 07	
017	9	09		073	*LBL6	21 06	
018	X=Y?	16-33	Feasible solution?	074	SF0	16 21 00	
019	GT0D	22 14	Yes, check distinctiveness.	075	*LBL7	21 07	
020	*LBL2	21 02	No, keep trying.	076	RCLD	36 14	
021	RCL0	36 00		077	ST09	35 09	
022	ST0I	35 46		078	F0?	16 23 00	
023	RCL9	36 09		079	GT05	22 05	
024	ST0D	35 14		080	*LBL9	21 09	
025	*LBL3	21 03		081	EEX	-23	
026	DSZI	16 25 46		082	ST-9	35-45 09	
027	GT05	22 05		083	RCL9	36 09	
028	RCL0	36 00		084	X#0?	16-42	
029	ST0I	35 46		085	GT02	22 02	
030	RCL9	36 09		086	*LBL0	21 00	Entry point for next solution.
031	ST0D	35 14		087	EEX	-23	
032	*LBL4	21 04		088	ST-0	35-45 00	
033	DSZI	16 25 46		089	RCL0	36 00	
034	GT06	22 06		090	ST0I	35 46	
035	GT07	22 07		091	RCLi	36 45	
036	*LBL5	21 05		092	ST09	35 09	
037	RCLi	36 45		093	ST-i	35-45 45	
038	RCL9	36 09		094	GT09	22 09	
039	X#Y?	16-32		095	*LBL5	21 05	
040	GT03	22 03		096	RCL0	36 00	
041	GT05	22 05		097	ST0I	35 46	
042	*LBL6	21 06		098	RCL9	36 09	
043	EEX	-23		099	ST+i	35-55 45	
044	ST+9	35-55 09		100	GT01	22 01	
045	9	09		101	*LBLD	21 14	
046	RCL9	36 09		102	8	08	
047	X=Y?	16-33		103	ST0I	35 46	A solution has been found.
048	GT07	22 07		104	CLX	-51	Check all rotations and reflections.
049	RCLi	36 45		105	*LBLa	21 16 11	
050	X#Y?	16-32		106	RCLi	36 46	
051	GT04	22 04		107	RCLi	36 45	
052	GT05	22 05		108	EEX	-23	
053	*LBL7	21 07		109	-	-45	
054	RCL0	36 00		110	10*	16 33	
055	ST0I	35 46		111	x	-35	
056	RCLD	36 14		112	+	-55	

REGISTERS

0 USED	1 Row ₁	2 Row ₂	3 Row ₃	4 Row ₄	5 Row ₅	6 Row ₆	7 Row ₇	8 Row ₈	9 USED
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
← SOLUTIONS →				→					
A ← SOLUTIONS → B				C		D USED		E SOLUTION COUNTER	
								I INDIRECT	

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
113	DSZI	16 25 46		169	+	-55	
114	GTQa	22 16 11		170	DSZI	16 25 46	
115	GSBB	23 12		171	GTQd	22 16 14	
116	F2?	16 23 02		172	GSBB	23 12	
117	GT00	22 00		173	F2?	16 23 02	
118	GSBe	23 16 15		174	GT00	22 00	
119	F2?	16 23 02		175	GSBe	23 16 15	
120	GT00	22 00		176	F2?	16 23 02	
121	8	00		177	GT00	22 00	
122	STOI	35 46		178	RCLE	36 15	A distinct solution
123	CLX	-51		179	STOI	35 46	has been found.
124	*LBLb	21 16 12		180	EEX	-23	Increment solution counter.
125	RCLI	36 46		181	+	-55	
126	8	00		182	STOE	35 15	
127	RCLi	36 45		183	EEX	-23	
128	-	-45		184	1	01	
129	10 ^x	16 33		185	-	-45	
130	x	-35		186	PRTX	-14	Solution number.
131	+	-55		187	RCL9	36 09	
132	DSZI	16 25 46		188	STOI	35 45	Solution.
133	GTOb	22 16 12		189	PRTX	-14	
134	GSBB	23 12		190	CLX	-51	
135	F2?	16 23 02		191	1	01	
136	GT00	22 00		192	2	02	
137	GSBe	23 16 15		193	SPC	16-11	
138	F2?	16 23 02		194	X#Y?	16-32	Last distinct solution?
139	GT00	22 00		195	GT00	22 00	No, go to search program.
140	8	00		196	RTN	24	Yes, stop.
141	STOI	35 46		197	*LBLc	21 16 15	Derive reflection
142	CLX	-51		198	EEX	-23	
143	*LBLc	21 16 13		199	8	00	
144	RCLi	36 45		200	RCL9	36 09	
145	RCLI	36 46		201	-	-45	
146	EEX	-23		202	EEX	-23	
147	-	-45		203	-	-45	
148	10 ^x	16 33		204	*LBLB	21 12	Check for
149	x	-35		205	STO9	35 09	distinctiveness
150	+	-55		206	9	09	
151	DSZI	16 25 46		207	STOI	35 46	
152	GT0c	22 16 13		208	*LBLC	21 13	
153	GSBB	23 12		209	ISZI	16 26 46	
154	F2?	16 23 02		210	RCLI	36 46	
155	GT00	22 00		211	RCLE	36 15	
156	GSBe	23 16 15		212	X=Y?	16-33	
157	F2?	16 23 02		213	RTN	24	
158	GT00	22 00		214	RCL9	36 09	
159	8	00		215	RCLi	36 45	
160	STOI	35 46		216	X#Y?	16-32	
161	CLX	-51		217	GT0C	22 13	
162	*LBLd	21 16 14		218	SF2	16 21 02	
163	RCLi	36 45		219	RTN	24	
164	8	00		220	*LBLE	21 15	LIST Solutions
165	RCLI	36 46		221	P+S	16-51	
166	-	-45		222	PREG	16-13	
167	10 ^x	16 33		223	P+S	16-51	
168	x	-35		224	RTN	24	

LABELS					FLAGS	SET STATUS			
A START	B Distinctiveness check	C used	D Rotate and Reflect	E LIST	0 USED	FLAGS		TRIG	DISP
a used	b used	c used	d used	e Reflect	1	ON OFF		DEG <input checked="" type="checkbox"/>	FIX <input checked="" type="checkbox"/>
0 Next solution	1 used	2 used	3 used	4 used	2 USED	0 <input type="checkbox"/> <input checked="" type="checkbox"/>	GRAD <input type="checkbox"/>	SCI <input type="checkbox"/>	
5 used	6 used	7 used	8 used	9 used	3	1 <input type="checkbox"/> <input checked="" type="checkbox"/>	RAD <input type="checkbox"/>	ENG <input type="checkbox"/>	
						2 <input type="checkbox"/> <input checked="" type="checkbox"/>		n <u>0</u>	
						3 <input type="checkbox"/> <input checked="" type="checkbox"/>			