

Program Description I

Program Title JACK OF EAGLES (GAME)

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Program Description, Equations, Variables A guessing game. On each move the human enters a positive or negative number: the machine has already analysed the human's previous moves and anticipated his choice. If correct, the machine score goes up: if wrong, human score goes up. The number of plays can be set by the user. The game limit, if the human does not specify one, is 7: the maximum is 9. The program has some learning ability.

THEORY: See sheets labelled "Jack of Eagles: Theory"

Operating Limits and Warnings

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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00727D Program Description II

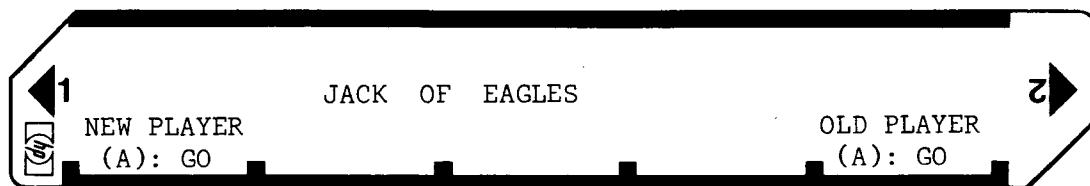
Sample Problem(s) Try to win

SOLUTION

KEYSTROKE	COMMENT	OUTPUT	COMMENT
LOAD SIDES 1 and 2 OF PROGRAM CARD			
A	Initialise	7.0 ***	Game limit
CHS, R/S	Select a negative number	-1.-01 ***	Machine selects -1. I lose
		0.1 ***	My score 0; machine's 1
CHS, R/S	Negative again	1.-01 ***	Machine selects 1. I win
		1.1 ***	Both scores are 1
R/S	Positive	1.+01 ***	Machine selects 1. I lose
		1.2 ***	
R/S	Positive	1.+01 ***	I lose again
		1.3 ***	
CHS, R/S	Will it get the sequence?	-1.-01 ***	Yes! I lose again
		1.4 ***	
R/S	Break the sequence	-1.+01 ***	I win
		2.4 ***	
CHS, R/S	Break again	-1.-01 ***	!! I lose
		2.5 ***	
CHS, R/S	Break new sequence	-1.-01 ***	!! Oh dear
		2.6 ***	Only 1 chance left
CHS, R/S	Never had 3 same signs	-1.-01 ***	!!

Display reads 0-BLISS (inverted). Machine has won.

5, A Another game 5.0 *** Game limit is 5
 ETC.



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	LOAD SIDES 1 and 2 OF PROGRAM CARD			
2	START Do ONE of 2a or 2b			
2a	For game limit of 7		A	7.000 *
2b	For any other goal-score, A: Set A*	A	A	A *
3	MAKE MOVE Do ONE of 3a or 3b			
3a	To select a positive number		R/S	M.H *
3b	To select a negative number		CHS	R/S
	M is machine's guess ($\pm 1.$), H is human's Selection (± 01). If M=H, human has been outguessed. If human selected a positive (negative) number, H = +01 (-01)			M.H *
4	MACHINE MAKES NEW GUESS			SH.SM *
	After the analysis of the human's previous moves, the scores are printed (SH is human's score, SM is the machine's).			
5	CONTINUE			
	Return to 3 until SH or SM = A			
	A message is displayed. Invert and read.			MESSAGE
6	FOR NEW GAME, SAME PLAYER			
	Do ONE of 6a, 6b			
	For goal-score of 7		E	7.000 *
	For any other goal-score. Set A*	A	E	A *
	Go to 3			
7	FOR NEW GAME, NEW PLAYER			
	Go to 2			
*	If A > 9, the word "Error" is displayed. Press and return to 2 or 7		CLR	
	NOTE: TO CHEAT ON ANY MOVE (STEP 3)			
	Instead of 3a or 3b		RCL	B
	This choice must win on the current play		CHS	R/S

Program Listing I

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STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	XLELR	21 11		057	X	-35	
002	ROL6	36 06		058	SCI	-12	
003	CLR6	16-53		059	DSP6	-63 08	
004	P#3	16-51		060	PRTX	-14	
005	CLR6	16-53		061	FIX	-11	
006	ST06	35 06		062	DSP1	-63 01	
007	GT01	22 01		063	RCL6	36 12	
008	*LBL1	21 15		064	RCLA	36 11	
009	0	00		065	X	-35	
010	ST07	35 07		066	SF0	16 21 00	
011	ST08	35 08		067	X<0?	16-45	
012	ST09	35 09		068	CF0	16 22 00	
013	*LBL1	21 01		069	0	08	
014	R↓	-31		070	ST01	35 46	
015	7	07		071	F0?	16 23 00	
016	F3?	16 23 03		072	ISZ1	16 26 46	
017	X#Y	-41		073	ISZ1	16 26 45	
018	ABS	16 31		074	0	08	
019	ST07	35 07		075	ST08	35 12	
020	÷	-24		076	RCL8	36 08	
021	9	09		077	RCL7	36 07	
022	RCL7	36 07		078	X>Y?	16-34	
023	X>Y?	16-34		079	GT08	22 08	
024	SIN?	16 41		080	7	07	
025	1	01		081	7	07	
026	0	00		082	3	03	
027	ST08	35 15		083	4	04	
028	GT06	22 06		084	RTN	24	
029	*LBL6	21 00		085	*LBL8	21 08	
030	ST08	35 12		086	RCL9	36 09	
031	RCL8	36 08		087	X#Y	-41	
032	RCL9	36 09		088	X>Y?	16-34	
033	RCL6	36 15		089	GT08	22 08	
034	÷	-24		090	5	05	
035	+	-55		091	5	05	
036	X=0?	16-43		092	1	01	
037	RCL7	36 07		093	7	07	
038	PRTX	-14		094	8	08	
039	R/S	51		095	RTN	24	
040	CF3	16 22 03		096	*LBL6	21 08	
041	X=0?	16-43		097	RCLA	36 11	
042	1	01		098	RCL6	36 08	
043	GSBC	23 13		099	X#0?	16-42	
044	RCLA	36 11		100	GSBC	23 13	
045	X#Y	-41		101	X	-35	
046	ST0A	35 11		102	ST+2	35-55 02	
047	X	-35		103	RCLA	36 11	
048	4	04		104	RCL1	36 01	
049	ST01	35 46		105	X#0?	16-42	
050	R↓	-31		106	GSBC	23 13	
051	F0?	16 23 00		107	A	-35	
052	ISZ1	16 25 46		108	ST+5	35-55 05	
053	ST+1	35-55 45		109	F#3	16-51	
054	RCL8	36 12		110	RCL8	36 08	
055	RCL6	36 11		111	ST09	35 09	
056	10*	16 31		112	RCL7	36 07	

REGISTERS

0 G_E	1 G_S	2 S_E	3 a-b	4 d-c	5 S_S	6 RANDOM #	7 GAME LIMIT	8 HUMAN SCORE	9 MACHINE SCORE
S0	S1	S2	S3	S4 LAST TEN	S5 HUMAN PLAYS	S6	S7	S8	S9
A CURRENT HUMAN CHOICE	B FINAL GUESS	C Q	D P	E 10	I USED				

Program Listing II

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STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
113	ST08	35 08		169	RC0C	36 13	
114	RCL6	36 06		170	X ²	53	
115	ST07	35 07		171	X	-35	
116	RCL5	36 05		172	RCLB	36 12	
117	ST06	35 06		173	+	-55	
118	RCL4	36 04		174	ST08	35 12	
119	ST05	35 05		175	*LBL8	21 08	
120	RCL3	36 03		176	RCLD	36 14	
121	ST04	35 04		177	1	01	
122	RCL2	36 02		178	+	-55	
123	ST03	35 03		179	ST0D	35 14	
124	RCL1	36 01		180	9	09	
125	ST02	35 02		181	X>Y?	16-34	
126	RCL0	36 00		182	GT02	22 02	
127	ST01	35 01		183	P ¹⁸	16-51	
128	RCLA	36 11		184	RCLB	36 12	
129	ST00	35 00		185	ST00	35 00	
130	1	01		186	RCL4	36 04	
131	ST0D	35 14		187	F0?	16 23 00	
132	*LBL2	21 02		188	RCL3	36 03	
133	RCLD	36 14		189	RCLA	36 11	
134	ST0I	35 46		190	X	-35	
135	RCL1	36 45		191	ST01	35 01	
136	RCL0	36 00		192	RCL2	36 02	
137	X#Y?	16-32		193	RCL0	36 00	
138	GT08	22 06		194	X	-35	
139	1	01		195	X#0?	16-42	
140	ST0C	35 13		196	GT07	22 07	
141	*LBL3	21 03		197	RCL1	36 01	
142	RCLC	36 13		198	RCL5	36 05	
143	ST0I	35 46		199	X	-35	
144	RCL1	36 45		200	*LBL7	21 07	
145	X#I	16-41		201	ST08	35 12	
146	RCLD	36 14		202	*LBL6	21 06	
147	+	-55		203	RCLB	36 12	
148	X#I	16-41		204	X=0?	16-43	
149	RCL1	36 45		205	GSBB	23 12	
150	X#Y?	16-32		206	GSBC	23 13	
151	GT07	22 07		207	GT00	22 00	
152	RCLD	36 14		208	*LBLB	21 12	
153	RCLC	36 13		209	RCL6	36 06	
154	X=Y?	16-33		210	P ¹	16-24	
155	GT07	22 07		211	+	-55	
156	1	01		212	5	05	
157	+	-55		213	Y ²	31	
158	ST0C	35 13		214	FRC	16 44	
159	+	-55		215	ST06	35 06	
160	RCLC	36 15		216	.	-62	
161	X>Y?	16-34		217	5	05	
162	ST03	22 03		218	-	-45	
163	*LBL7	21 07		219	RTN	24	
164	RCLD	36 14		220	*LBL0	21 13	
165	1	01		221	ABS	16 31	
166	-	-45		222	LSTX	16-63	
167	ST0I	35 46		223	÷	-24	
168	RCL1	36 45		224	RTN	24	

LABELS

LABELS					FLAGS	SET STATUS		
A NEW PLAYER GO	B RANDOM # GENERATOR	C GET ±1	D	E OLD PLAYER GO	OFF FOR BAD CHOICE	FLAGS	TRIG	DISP
a	b	c	d	e	1	ON OFF		
0 JUMP	1 JUMP	2 LOOP	3 LOOP	4	2	0 <input type="checkbox"/> <input checked="" type="checkbox"/>	DEG <input type="checkbox"/>	FIX <input type="checkbox"/>
5	6 JUMP	7 JUMP	8 JUMP	9	3 GAME LIMIT INPUT?	1 <input type="checkbox"/> <input checked="" type="checkbox"/>	GRAD <input type="checkbox"/>	SCI <input type="checkbox"/>
					3	2 <input type="checkbox"/> <input checked="" type="checkbox"/>	RAD <input type="checkbox"/>	ENG <input type="checkbox"/>
					4	3 <input type="checkbox"/> <input checked="" type="checkbox"/>	n <input type="checkbox"/>	0 <input type="checkbox"/>

JACK OF EAGLES: THEORY

*** WARNING! READING THIS MAY SPOIL
YOUR ENJOYMENT OF THIS GAME.
READ ONLY TO UNDERSTAND THE
PROGRAM

The human's choice is converted to -1 if it was negative, and to 1 if it was positive. His most likely next choice is then determined by an analysis of his previous moves and by his "psychology" which the machine attempts to learn during the game. The analysis is based on (a) a "Sequence Extrapolator", described below, which analyses the last 10 human choices and finds all completed and uncompleted patterns of 1 through 5 digits, extrapolates these patterns one digit on, and takes, in effect, a weighted mean of these extrapolations: and on (b) whether the human switches, or keeps to, his last choice on a win/loss: this is the "Switch/Keep Algorithm", also described below. The "psychology" is deduced by keeping track of the success/failure of these analysis schemes - a positive value means more success than failure for the particular scheme. Call these "success scores" S_E for the extrapolator and S_S for the switch/keep algorithm.

The final guess is formed as follows.

1. Use the Sequence Extrapolator to get a guess G_E
2. Use the Switch/Keep Algorithm to get a guess G_S
3. Then 3a If $G_E \cdot S_E \neq 0$, the guess is $G_E \cdot S_E = G$
3b If $G_E \cdot S_E = 0$ and $G_S \cdot S_S \neq 0$, the guess is $G_S \cdot S_S = G$
3c If $G_E \cdot S_E = G_S \cdot S_S = 0$, the guess is random = G
4. Only the sign of the guess is of importance, so the final guess is $G/|G|$

Switch/Keep Algorithm

Let a be the number of times the human keeps his choice when that choice won

"	b	"	"	"	"	"	"	switches	"	"	"	"	"	"
"	c	"	"	"	"	"	"		"	"	"	"	"	lost
"	d	"	"	"	"	"	"	keeps	"	"	"	"	"	"

Then if the last choice won, the guess is $G_S = D_0 (a-b)$

" " " " lost, " " " " $G_S = D_0 (d-c)$

Sequence Extrapolator Algorithm

Let P be a scan of the last 10 moves, and let Q be the length of any pattern found. Call the current human choice D_0 , the penultimate one D_1 , etc. The algorithm is:

- a. Set $G_e = 0$
- b. Set $P = 1$
- c. Extract D_P
- d. If $D_0 \neq D_P$, go to n
- e. Set $Q = 1$
- f. Extract D_Q
- g. Extract D_{P+Q}
- h. If $D_Q \neq D_{P+Q}$, go to 1
- i. If $Q = P$, go to 1
- j. $Q = Q + 1$
- k. If $(P + Q) < 10$, go to f
- l. $G = Q^2 \cdot D_{P-1} \leftarrow$
- m. $G_e = G_e + G$
- n. $P = P + 1 \leftarrow$
- o. If $P < N - 1$, go to c
- p. G_e is the guess. (But see step 4 above).

No pattern starting at P exists
Find length of pattern starting at P

The pattern ends
(The pattern cannot be longer than P digits)
Increase the length-of-pattern search
Only the last 10 choices are scanned
 G is the current extrapolated guess ($G = \pm 1$),
weighted for the length of the pattern found (Q).
Increase choice scan
Continue scan of last 10 choices