Program Description I

Program Title	JACK OF EAGLES (GAME)
Contributor's Name	Dick Jenssen
Address	Meteorology Department/Melbourne University
City	Parkville State Victoria Zip Code 3052 AUSTRALIA

Program Description, Equations, Variables

A guessing game.

On each move the human enters a positive or negative number (zero is treated as positive). The machine has anticipated this choice: if it is correct its score goes up by 1, if wrong the human's score goes up by 1. The first player whose score reaches the game limit (1 through 9) is the winner. The game limit is usually set by the machine to 7.

THEORY: See attached sheets.

TITLE: "Jack of Eagles" is a science fiction novel by James Blish concerned with psychic abilities: the program converts the machine into a mind reader.

Operating Limits and Warnings NONE.

Program Description 11

Sketch(es)

Sample Problem(s) CAN I WIN?

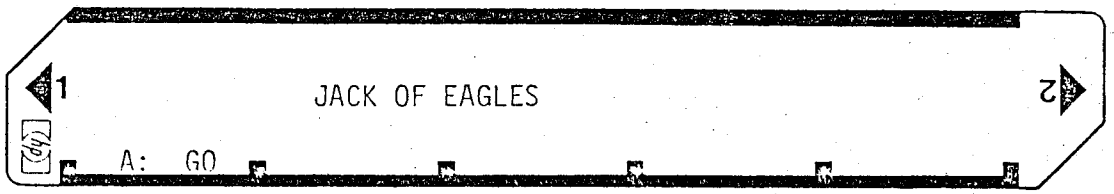
SOLUTIONS

KEYSTROKE	COMMENT	OUTPUT	COMMENTS
(A)		7	Game limit is 7.
(CHS)(R/S)	I select a negative number	-1.0	Machine guessed -1. I lose.
		0.1	My score = 0, machine's = 1.
(CHS)(R/S)	Negative again.	1.0	Machine guesses positive. I
		1.1	win. My score = 1, Machine's = 1.
(R/S)	Positive.	1.0	Machine guesses positive. I lose
		1.2	My score = 1 Machine's = 2.
(R/S)	Positive	1.0	I lose again.
		1.3	New Scores.
(CHS)(R/S)	Negative. Will it get the sequence?	-1.0	Yes! I lose again.
		1.4	
(R/S)	Positive. Break sequence.	-1.0	Yes. I win.
		2.4	
(CHS)(R/S)	And again	-1.0	Hmmm...How did it know?
		2.5	
(CHS)(R/S)	Break new sequence.	-1.0	Oh dear. One chance left.
		2.6	
(CHS)(R/S)	Never had 3 negatives before	-1.0	What the !....?
INVERT DISPLAY		0.BLISS	Try again.
-5(A)	New Game	5	Game limit is 5. ETC.

Reference(s)

Attached notes: "Jack of Eagles Theory" (Jenssen)

User Instructions



STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load sides 1 and 2			
2	INITIALIZE: Do one of 2a, 2b			
2a	Either: For normal game limit		A	7
2b	Or: For any other game limit, A	A	A	|A|
	NOTE: $0 < \|A\| < 10$. If A = 0 or $\|A\| > 9$,			
	the word 'Error' is displayed. Clear			
	and restart.			
3	MAKE A CHOICE. Do one of 3a, 3b			
3a	Either: to choose a positive number		R/S	
3b	Or: to choose a negative number		CHS R/S	
	The machine guess as to the human's choice is			
	displayed for 1 second.			G
	G = ± 1.			
	The machine now analyzes the human's last 10			
	plays and makes a guess as to his next choice.			
	This step takes about 20 seconds on the			
	average. The current scores are then displayed			
	on the stop.			H·M
	H is the human's score, M is the machine's.			
4	CONTINUE			
	Return to 3 until the game ends--when the			
	display changes. Invert display and			
	read message.			
5	FOR A NEW GAME			
	GO TO STEP 2.			
	TO CHEAT ON ANY MOVE			
	Instead of 3a or 3b do:		RCL B	
	This choice must win on the current play.		CHS R/S	

Program Listing

STEP	KEY ENTRY	KEY CODE	COMMENTS
001	f LBL A		
	7		
	h F? 3		
	h xy		
	RCL 6		
	f AREG		
	f PS		
	f AREG		
	STO 6		
010	h R↓		
	h ABS		
	STO 7		
	÷		
	9		
	RCL 7		
	g x≷y		
	g SIN⁻¹		
	1		
	0		
020	STO E		
	GTO 6		
	f LBL 0		
	STO B		
	RCL 8		
	RCL 9		
	RCL E		
	÷		
	+		
	f x=0		
	RCL 7		
	R/S		
	h CF 3		
	f x=0		
	1		
	f GSB C		
	RCL A		
	h xy		
	STO A		
	X		
040	4		
	h STI		
	h R↓		
	h F? 0		
	f DSZ		
	STO + (i)		
	RCL B		
	h PAUSE		
	RCL A		
	X		
050	h SF 0		
	f x≠0		
	h CF 0		
	8		
	h STI		
	h F? 0		
	f ISZ		
	g [illegible]	ISZ i	
	0		
	STO B		
060	RCL 8		
	RCL 7		
	g x≷y		
	GTO 8		
	7		
	7		
	3		
	4		
	h RTN		
	f LBL 8		
070	RCL 9		
	h xy		
	g x≷y		
	GTO 8		
	5		
	5		
	1		
	7		
	8		
	h RTN		
080	f LBL 8		
	RCL A		
	RCL 0		
	f x≠0		
	f GSB C		
	X		
	STO + 2		
	RCL A		
	RCL 1		
	f x≠0		
090	f GSB C		
	X		
	STO + 5		
	f PS		
	RCL 8		
	STO 9		
	RCL 7		
	STO 8		
	RCL 6		
	STO 7		
100	RCL 5		
	STO 6		
	RCL 4		
	STO 5		
	RCL 3		
	STO 4		
	RCL 2		
	STO 3		
	RCL 1		
	STO 2		
110	RCL 0		
	STO 1		
	RCL A		

REGISTERS

0 G_E	1 G_S	2 S_E	3 a-b	4 d-c	5 S_S	6 Random number	7 Game limit	8 Human score	9 Machine score
S0	S1	S2 LAST 10	S3 HUMAN CHOICES	S4	S5	S6	S7	S8	S9

A Current Human Choice	B Final Guess	C Q	D P	E 10	I USED

Program Listing II

00727D

STEP	KEY ENTRY	KEY CODE	COMMENTS
	STO 0		
	1		
	STO D		
	f LBL 2		
	RCL D		
	h STI		
	RCL (i)		
120	RCL 0		
	g x≠y		
	GTO 8		
	1		
	STO C		
	f LBL 3		
	RCL C		
	h STI		
	RCL (i)		
	h xi		
130	RCL D		
	+		
	h xi		
	RCL (i)		
	g x≠y		
	GTO 7		
	RCL D		
	RCL C		
	g x=y		
	GTO 7		
140	1		
	+		
	STO C		
	+		
	RCL E		
	g x>y		
	GTO 3		
	f LBL 7		
	RCL D		
	1		
150	−		
	h STI		
	RCL (i)		
	RCL C		
	g x²		
	X		
	RCL B		
	+		
	STO B		
	f LBL 8		
160	RCL D		
	1		
	+		
	STO D		
	9		
	g x>y		
	GTO 2		
	f PS		
	RCL B		

STEP	KEY ENTRY	KEY CODE	COMMENTS
	STO 0		
170	RCL 4		
	h F? 0		
	RCL 3		
	RCL A		
	X		
	STO 1		
	RCL 2		
	RCL 0		
	X		
	f x≠0		
180	GTO 7		
	RCL 1		
	RCL 5		
	X		
	f LBL 7		
	STO B		
	f LBL 6		
	RCL B		
	f x=0		
	f GSB B		
190	f GSB C		
	GTO 0		
	f LBL B		
	RCL 6		
	h π		
	+		
	5		
	h yx		
	g FRAC		
	STO 6		
200	.		
	5		
	−		
	h RTN		
	f LBL C		
	h ABS		
	h LSTx		
	÷		
	h RTN		
210			
220			

LABELS

A GO	B Random # Generator	C Convert # to ± 1	D	E	
a	b	c	d	e	
0 Loop	1	2 Loop	3 Loop	4	
5	6 Transfer	7 Transfer	8 Transfer	9	

FLAGS

0	Off for bad machine
1	guess
2	
3	Game Limit input?

SET STATUS

FLAGS	ON	OFF
0	☐	☒
1	☐	☒
2	☐	☒
3	☐	☒

TRIG	
DEG	☒
GRAD	☐
RAD	☐

DISP	
FIX	☒
SCI	☐
ENG	☐
n	

00727D

JACK OF EAGLES THEORY

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 algortihm.

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 $G/|G|$.

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	No pattern starting at P exists
e.	Set Q = 1	Find length of pattern starting at P
f.	Extract D_Q	
g.	Extract D_{P+Q}	
h.	If $D_Q \neq D_{P+Q}$, go to l	The pattern ends
i.	If Q = P, go to l	(The pattern cannot be longer than P digits
j.	Q = Q + 1	Increase the length-of-pattern search
k.	If (P + Q) < 10, go to f	Only the last 10 choices are scanned
l.	$G = Q^2 \cdot D_{P-1}$	G is the current extrapolated guess ($G = \pm 1$), weighted for the length of the pattern found (Q). The longer the pattern, the larger is G.
m.	$G_e = G_e + G$	
n.	P = P + 1	Increase choice scan
o.	If P < N - 1, go to c	Continue scan of last 10 choices
p.	G_e is the guess.	

SWITCH/KEEP ALGORITHM

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

Let b be the number of times the human switches his choice when that choice won.

Let c be the number of times the human switches his choice when that choice lost.

Let d be the number of times the human keeps his choice when that choice lost.

Then if the last choice won, the guess is $G_s = (a-b)/|a-b|$

Then if the last choice lost, the guess is $G_s = (d-c)/|d-c|$