

Program Description I

Program Title 67-FORTY-FOUR: A GAME OF DEDUCTION

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Program Description, Equations, Variables Program generates and stores in secondary memory a pseudo-random number. Each guess entered by a player (by pressing "E") is compared with the target number, and a count is produced and placed as an exponent to ".guess" which is then re-displayed to the player (as a clue).

The number chosen by the calculator is generated one digit at a time, and stored in secondary registers S1 through S4 (one for each digit). Digits are slightly disguised.

RANDOM DIGITS are generated by using the modulo 997 generator. Each time a digit is generated, a new seed is stored in memory where the old seed had been. This will be called "incrementing the seed." (seed_i is replaced by seed_{i+1}.)

Each time "C" is pressed, the seed is incremented once. Each time "B" is pressed, a whole new number is stored in S1 through S4, and the seed is incremented four times. Further, each time a guess is entered, the seed is incremented, ensuring that after the first number (6678) subsequent numbers are fairly unpredictable.

Each time "A" (start) is pressed, the seed .7058031 is stored in register C. To start with a different number, simply input any other fairly complex seed between zero and one. ("Fairly complex" means more than three digits after the decimal.) For example, the seed .5284136 input by pressing "D" (input seed) yields the number 8520 rather than the number 6678 which is obtained by pressing "A" (start).

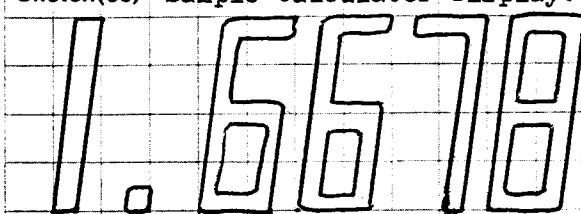
Operating Limits and Warnings WARNING: Repeating digits cause problems in making deductions. Example: Suppose the number is really 0005. You guess 0123. Count is 11. Since you only offered one zero, you are not told of the other two. You guess 0011. Count is 22, since two zeros were offered and at least two were found. You guess 0000. Count is 33, since of four zeros offered, three matched up. DUPLICATED DIGITS as in 0005 and 6678 occur frequently (49.6% of the time), and should therefore NOT be assumed away (as is often tempting). This offers additional challenge to FORTY-FOUR players.

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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Program Description II

Sketch(es) Sample Calculator Display:

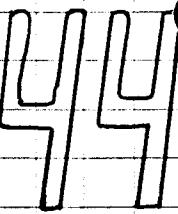


Used for exponent stability

Guess as entered by player.

Number of Correct Digits

Number of Correctly Located Digits



Sample Problem(s) Lead the program (both sides) and press "A" (start). Calculator responds with "0.0000 00" display. A number is safely tucked away, and we must guess it.

Enter 1234 and press "E" (test). 1234 is our first guess. After 15 seconds or so, the calculator responds with "1.1234 00" in the display. 00 is the count. It tells us that no 1, 2, 3, or 4 appears in the number we are trying to deduce. (I.e. zero correct digits and zero in the right places.) For our second guess, enter 5678 and press "E" (test). After another 15 seconds (we also try to teach patience) the display is "1.5678 33" (We may as well tell you now: The "1" before the decimal point serves no other purpose than to keep the exponent where we want it. You can ignore it. This tells us that of the digits 5, 6, 7, and 8, three occur in our target number, and they are correctly positioned in our guess. One number is still wrong. For our third guess enter 1678 "E" The display again reads "1.1678 33" We know that 1 is not in our target number, so therefore the correct digits must be 6, 7, and 8, located right where they are! For the fourth try (let's do the right one) enter 6678 "E" We

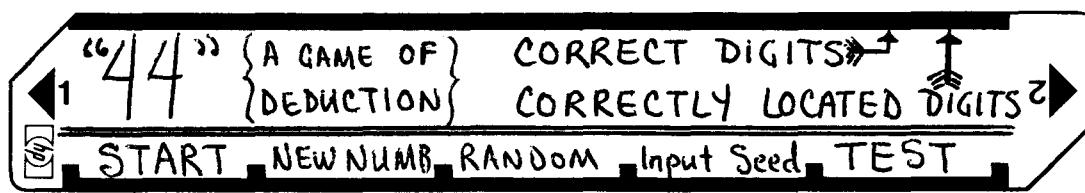
Solution(s) should get the following displays: first "1.6678 44" for five seconds, then second "4." for another five seconds (it means we got it on the fourth try), and last, after some slight delay, "0.0000 00" indicating a new number awaits us. Before making a guess, press RCL 1, RCL 2, RCL 3, and RCL 4. You should see a record of your guessing. This is always available to help you figure out the target number. You may prefer to keep track on paper also. Now, the next number is 7230 BUT DON'T ENTER IT YET! Make a few wrong guesses first. With the knowledge you have of the number, you should be able to become quite familiar with the interpretation of the "COUNT" displayed after each guess. When you think you have it down well, enter 7230. And Happy Deducing! LDC

Reference(s) This game has appeared in several forms, with colors instead of digits (MASTERMIND game by INVICTA), and with letters of the alphabet (JOTTO by SELCHOW and RIGHITER, makers of SCRABBLE). My first acquaintance was with "OX," a game using O's and X's to represent the count. "OX" was on an Altair 680 mini-computer (with CRT) owned by a friend. At that time I became interested in putting it on my HP-67. LDC

00552D

User Instructions

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STEP	INSTRUCTIONS	INPUT DATA/UNITS	KEYS	OUTPUT DATA/UNITS
1	Load side 1 and side 2.			0.0000 00
2	Input seed by either of the following methods: (A) Use the seed provided at "A" (start) (B) Provide a seed between zero and one	.nnnnnnnn	A D	0.0000 00 0.0000 00
	Your number is now ready to be guessed.			
3	Enter your four-digit guess The exponent ("cc") part of the calculator response is the COUNT for your guess.	nnnn	E	1.nnnn cc
4	Continue guessing (step 3) until you finally get the right number. Say it was wwww	wwww	E	1.wwww 44
	Right while you watch, n (the number of guesses you entered) is displayed 5 sec. Then a new number is generated for you, and you are tempted to go back to step 3.			n. 0.0000 00
	<u>NOTE:</u> There is never any need to use steps 5 and 6. They are used by the program, and simply made available to users who might find them useful (as has the author).			
5	In order to get a completely new number to work on (say for example that you know the first one is 6678 anyway) just press "B"		B	0.0000 00
6	If you have any use for a random digit (between zero and nine) press "C" "r" is your random digit.		C	r.0000 00
7	To review a past guess and its count, determine what number guess it was, and use the last digit of that number as follows: EXAMPLE: say the number is 9 EXAMPLE: say the number is 4 EXAMPLE: say it was the 20th guess EXAMPLE: say it was the 11th guess Note that only the most recent ten guesses are available in the manner described.		RCL 9 RCL 4 RCL 0 RCL 1	1.nnnn cc 1.nnnn cc 1.nnnn cc 1.nnnn cc

Program Listing I

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL0	21 14		057	4	04	guess
002	ST00	35 15		058	÷	-24	-----
003	ST0E	22 12		059	ST+5	35-55 05	pull off the 1st
004	*LBLR	21 11		060	1	01	digit and store
005	.	-62		061	0	.00	it in reg. 6
006	7	07		062	X	-35	-----
007	6	06		063	INT	16 34	-----
008	5	05	(which is: .7058031)	064	ST06	35 06	-----
009	3	06		065	LSTX	16-63	-----
010	8	08		066	X#Y	-41	-----
011	3	03		067	-	-45	-----
012	1	01		068	1	01	-----
013	ST00	35 13		069	0	00	-----
014	*LBL0	21 12	Generate a four-	070	X	-35	pull off 2nd digit
015	F48	16-51	-digit "target"	071	INT	16 34	put in reg. 7
016	CLX	-51	number to be guessed	072	ST07	35 67	-----
017	ST00	35 00	Zero out guess count	073	LSTX	16-63	-----
018	GSBC	23 13		074	X#Y	-41	-----
019	ST01	35 01	store first rand dgt	075	-	-45	-----
020	GSBC	23 13		076	1	01	-----
021	ST02	35 02	store 2nd rand digit	077	0	00	-----
022	GSBC	23 13		078	1	-35	-----
023	ST03	35 03	store 3rd rand digit	079	INT	16 34	-----
024	GSBC	23 13		080	ST08	35 08	-----
025	ST04	35 04	store 4th rand digit	081	LSTX	16-63	-----
026	1	01		082	X#Y	-41	-----
027	ST01	35 46	increment each digit	083	-	-45	-----
028	GSBC	23 00		084	1	01	-----
029	F48	16-51	-----	085	0	00	-----
030	RTN	24	return	086	X	-35	-----
031	*LBL0	21 13	RANDOM DIGIT ROUTINE	087	INT	16 34	-----
032	ROL0	36 13	recall seed	088	ST09	35 06	-----
033	9	05		089	0	06	-----
034	9	09		090	ST09	35 46	increment each digit
035	1	07		091	GSBC	23 00	-----
036	X	-35		092	ROL1	36 01	was dgt 1 guessed?
037	FRC	16 44	"increment the seed"	093	GSB1	23 01	-----
038	ST00	35 13		094	ROL2	36 02	was dgt 2 guessed?
039	1	01		095	GSB1	23 01	-----
040	0	00		096	ROL3	36 03	was dgt 3 guessed?
041	X	-35		097	GSB1	23 01	-----
042	INT	16 34	produce random digit	098	ROL4	36 04	was dgt 4 guessed?
043	RTN	24		099	GSB1	23 01	-----
044	*LBL0	21 15		100	ROL1	36 01	-----
045	F48	16-51		101	ROL6	36 06	-----
046	ST05	35 05		102	ABS	16 31	-----
047	GSBC	23 13	increment the seed	103	X#Y	16-32	is dgt 1 exactly
048	ROL0	36 06	on the first	104	GSB3	23 03	right?
049	X=0?	16-43	guess, we zero	105	ROL2	36 02	
050	GSB4	23 04	out guess rcrd.	106	ROL7	36 07	
051	ROL5	36 05		107	ABS	16 31	
052	1	01		108	X=0?	16-33	is dgt 2 exactly
053	ST+0	35-55 00	# of guesses: increment count	109	GSB3	23 03	right?
054	ST0E	35 05		110	ROL3	36 03	-----
055	X#Y	-41		111	ROL6	36 06	is dgt 3 exactly
056	EEH	-23	Bring back the	112	ABS	16 31	right?

REGISTERS

0 User's 10th gue.	1 User's 1st guess	2 User's 2nd guess	3 User's 3rd guess	4 User's 4th guess	5 User's 5th guess	6 User's 6th guess	7 User's 7th guess	8 User's 8th guess	9 User's 9th guess
S0 Current guess #	S1 Target digit1 +1	S2 Target digit2 +1	S3 Target digit3 +1	S4 Target digit4 +1	S5 Count preparrt	S6 Guess digit1 +1	S7 Guess digit2 +1	S8 Guess digit3 +1	S9 Guess digit4 +1
A unused cleared often	B unused cleared often	C random seed	D unused cleared often	E unused cleared often	F indexing for guess storage				

STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
113	X=YP	16-33		169	G3E2	23 02	
114	G3E3	23 03		170	F07	16 23 00	does it match
115	RCL4	36 04		171	RTN	24	guess dgt 3?
116	RCL9	36 09		172	G3E2	23 02	does it match
117	AEE	16 31	is dgt 4 exact-	173	RTN	24	guess dgt 4?
118	X=YP	16-33	ly right?	174	*LBL2	21 02	given a digit
119	G3E3	23 03		175	I6Z1	16 26 46	from the target
120	RCL8	36 08		176	RCL1	36 45	number, does it
121	.	-62	fix up the	177	X#Y	-41	NOT match this
122	i	01	index (guess #	178	X#Y	16-32	digit in guess?
123	.	-35	modulo 10) for	179	RTN	24	
124	FRC	16 44	storing this	180	i	01	
125	i	01	guess & count	181	STO	-22	If it did match,
126	9	08		182	STO	35-35 45	we flag guess
127	X	-35		183	SFO	16 21 00	digit
128	STO1	35 45		184	EEH	-23	and we set flag
129	EEH	-23	create a stan-	185	i	01	to quit looking
130	4	04	dard for test-	186	0	00	for another mch
131	4	04	ing completion	187	STO5	35-35 05	with target dgt.
132	RCL5	36 05		188	RTN	24	& increm. count!
133	P#S	16-51		189	*LBL3	21 03	Increment count
134	STO1	35 45	store the guess	190	i	01	by 1 in the
135	X#Y	16-35		191	0	00	"number correct
136	RTN	24	test completion	192	STO5	35-35 05	ly located" dgt
137	P#S	16-51		193	RTN	24	
138	PRTX	-14	5 sec. display	194	*LBL4	21 04	
139	FIX	-11		195	P#S	16-51	saving the seed,
140	DSP0	-63 00	5 sec. display	196	RCL0	36 13	zero out all the
141	RCL8	36 08	of # of guesses	197	CLRG	16-53	rest of primary
142	FRTX	-14	entered up to	198	STO0	35 13	memory.
143	SCI	-12		199	P#S	16-51	Restore seed.
144	DSP4	-63 04	now.	200	RTN	24	
145	P#S	16-51					
146	STO0	22 12	get a new				
147	*LBL0	21 00	random number				
148	CLW	-51					
149	I6Z1	16 26 45	increment four				
150	I6Z1	16 26 46	memories in a				
151	I6Z1	16 26 45	row, starting				
152	I6Z1	16 26 46	with memory "i"				
153	I6Z1	16 26 45	and ending at				
154	I6Z1	16 26 46	memory "i+3"	210			
155	I6Z1	16 26 45	(allows flagging				
156	RTN	24	of zeros)				
157	*LBL1	21 01					
158	CF0	16 22 00	digit comes from				
159	5	05	target number...				
160	STO1	35 45	starting at mem-				
161	CLW	-51	ory 5...				
162	+	-55					
163	G3E2	23 02					
164	F07	16 23 00	does it match	220			
165	RTN	24	guess dgt 1?				
166	G3E1	23 02					
167	F07	16 23 00	does it match				
168	RTN	24	guess dgt 2?				

LABELS

FLAGS

SET STATUS

A Start	B New Number	C Random Digit	D Input Seed	E TEST	F Do digits match?	G FLAGS	H TRIG	I DISP
a unused	b unused	c unused	d unused	e unused	1 unused	ON OFF	DEG	FIX
0 add 1 to each digit	1 check for each digit	2 compare given digits	3 if correct	4 clear 0-9 A,B,D,&E	2 unused	1 <input type="checkbox"/> <input checked="" type="checkbox"/>	GRAD	SCI
5 unused	6 unused	7 unused	8 unused	9 unused	3 unused	2 <input type="checkbox"/> <input checked="" type="checkbox"/>	RAD	ENG
						3 <input type="checkbox"/> <input checked="" type="checkbox"/>		n 4