

# 02900D Program Description I

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**Program Description, Equations, Variables** Telepathy is a card trick utilising a discovery by Martin D. Kruskal of Princeton University. The trick is described by Martin Gardner in his column in Scientific American, where he suggests that a computer could perhaps be programmed to play the part of the magician, using a deck of punched cards. The 67/97 does it easily in only 120 steps, though the values of the cards have to be entered manually. The trick is performed as follows:

The subject thinks of any number between one and ten, and then shuffles and deals a deck of cards. The cards are dealt slowly and placed face up in a pile. As the cards are dealt, the subject counts to himself, and notes the value of the card dealt at the chosen number. That card's number then becomes the key number, and the next card dealt is counted as one until the key number is counted. The value of that card then becomes the key number, and so on until there are no more cards left in the deck. Even if there are insufficient cards at the end to complete the count, the subject deals through to the end without hesitation, so as not to give away the value of the last card chosen by this counting procedure. To simplify the count, all face or picture cards are given a value of five.

On page 32 of the magazine, Gardner prints a sketch of a typical chain. Refer to that if the description given below of the count is not clear enough. Assume the number first thought of is 4, and the deal is begun. The 4th card is an ace, ~~which has a value of one.~~ which has a value of one. The Ace then becomes the new key card, and the following card is counted as one. Since this ends the count, it becomes the new key. It happens to be a king, which has a value of 5, and is the next key card. The count begins again with the next dealt card and the fifth card is an eight. Eight is then the key card and eight cards are dealt to produce a queen which has a value of five. The count continues in this fashion until the 49th card which is a key card and the Jack of Hearts. This has a value of

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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# 02900B Program Description II

~~XXXXXXXXXX~~ five, but there are only three cards left, so when all cards are dealt the Jack of Hearts remains as the last key card. This then is the selected card. The count has been silent, of course, and performed slowly enough so as to go without hesitation which would give away the key card. As the cards are dealt, they are entered into the 67/97 by entering the face value of the card as a digit (Ace =1; J=11, Q=12, K=13 these are the values for the machine, not the five which is their value in the count for J,Q,K). followed by the appropriate key (A,B,C,D) for the suit.

After the deal is finished, the subject is asked to name his card. He is then invited to press key E, which should print out (HP-97) and display 11.2 which is the Jack of Hearts! (11 = J, decimal 2 = H). It is emphasised that this result

~~Sample Problem~~ is not certain, but that the probability of its being the correct answer is about 5/6.

The trick is not yet over, there is a further variation suggested by Cy Endfield of London. The key-card, in this case the Jack of Hearts, is removed from the deck, and the remaining 51 cards handed back to the subject. He is asked to repeat the procedure, thinking again of any number between 1 and 10, but this time the deck is NOT shuffled. Explain that for this attempt, the machine will read his mind and predict in advance what the key card will be. Turn the machine away from the audience and press F and E (LBLE). The machine will print out and display the predicted card, again with the same probability (5/6) of it being the correct one. Assume that card 50 in the original deck was the Ace of Clubs and cards 51 and 52 were the King of Diamonds and the 7 of Clubs. The machine will predict that the chosen card will be 13.3 (King of Diamonds), and the chances of it being correct are 5 out of 6!

~~XXXXXXXXXX~~ The subject repeats the procedure, but this time the cards are not entered into the machine, which has already predicted the outcome. Ask him to display the card selected by him, and then turn the machine around so that he can see the display of the card the machine had predicted he would choose.

The fact that the trick sometimes fails makes it seem more uncanny. Gardner cites the instance when Uri Geller failed on the Johnny Carson show, and Merv Griffin declared that the failure proved to him that Geller's powers were genuine. Gardner also states that if two decks shuffled together are used, failure is extremely unlikely. Picture cards are valued at five to increase the number of low cards.

Reference(s) Martin Gardner, Scientific American, in his monthly column  
"Mathematical Games", issue of February 1978, pp 27 thru 32.

## PROGRAM DESCRIPTION II (CONTINUED)

## SAMPLE PROBLEM AND SOLUTION:

Assume that the number thought of is 4, and that the deck as dealt has the distribution shown as follows (this is the same as the sketch shown by Gardner).

<u>CARD</u>	<u>SUBJECT'S COUNT</u>	<u>KEY ENTRY</u>	<u>DISPLAY</u>
3 of D(iamonds)	1	3[C]	3.3
10 S(pades)	2	10[A]	10.1
9 H(earts)	3	9[B]	9.2
A S	4(New Key = 1)	1[A]	1.1
K H	1(New Key = 5)	13[B]	13.2
10 D	1	10[C]	10.3
A D	2	1[C]	1.1
K S	3	13[A]	13.1
7 D	4	7[C]	7.3
8 S	5(New Key =8)	8[A]	8.1
3 S	1	3[A]	3.1
5 C(1ubs)	2	5[D]	5.4
K C	3	13[D]	13.4
9 S	4	9[A]	9.1
J C	5	11[D]	11.4
4 S	6	4[A]	4.1
6 C	7	6[D]	6.4
Q C	8(New Key =5)	12[D]	12.4
6 S	1	6[A]	6.1
5 H	2	5[B]	5.2
5 S	3	5[A]	5.1
6 H	4	6[B]	6.2
3 H	5(New Key =3)	3[B]	3.2
8 H	1	8[B]	8.2
Q S	2	12[A]	12.1
10 C	3(New Key =10)	10[D]	10.4
Q H	1	12[B]	12.2
6 D	2	6[C]	6.3
3 C	3	3[D]	3.4
2 H	4	2[B]	2.2
2 S	5	2[A]	2.1
Q D	6	12[C]	12.3
4 D	7	4[C]	4.3
2 C	8	2[D]	2.4
7 H	9	7[B]	7.2
2 D	10(New Key =2)	2[C]	2.3
10 H	1	10[B]	10.2
7 S	2(New Key =7)	7[A]	7.1
8 D	1	8[C]	8.3
J S	2	11[A]	11.1
8 C	3	8[D]	8.4
4 H	4	4[B]	4.2
5 D	5	5[C]	5.3
A H	6	1[B]	1.2
4 C	7(New Key =4)	4[D]	4.4

## PROGRAM DESCRIPTION II (CONTINUED)

CARD		SUBJECT'S COUNT	KEY ENTRY	DISPLAY
J	D	1	11[C]	11.3
9	C	2	9[D]	9.4
9	D	3	9[C]	9.3
J	H***	4(New Key =5)***	11[B]***	11.2***
A	C	1	1[D]	1.4
K	D	2	13[C]	13.3
7	C	3	7[D]	7.4

(Remember that picture cards have a value of 5 for the subject's count).

That completes the dealing and counting procedure. The last key card was the Jack of Hearts. This is allotted a value of five for the subjects count, but the count could not be completed because there were only three cards left in the deck. The Jack of Hearts is then the card that is chosen by the procedure when 4 is the number initially thought of by the subject before starting the count, and is marked \*\*\* in the sample above.

At this point, the subject is asked to write down the card he has chosen. He is then asked to press the calculator key marked CARD [E]. The calculator will then print (HP-97) and display 11.2, which of course is the calculator code for the Jack of Hearts!

Since the result was correct, one can attempt the second part of the trick. Explain that the calculator is now so in tune with the subject's mind that it will predict what card he will choose next before he himself knows! (See page 6)

Remove the Jack of Hearts from the deck and put it aside. The calculator should be turned away, and the PREDICT key [f] [E] pressed. The calculator will now print out and display 13.3 which is the display for the King of Diamonds. If an HP-97 is being used, the tape could be torn off and placed face down in front of the audience, the calculator being left on in any case.

The deck of 51 cards is now handed back to the subject. This time, he is not to shuffle it, but is again to think of a number between one and ten, and then repeat the procedure of counting as before. The chances are again 5/6 that he will pick the King of Diamonds.

How does the psychic calculator do it?

Kruskal discovered that if a count is begun on the first low card, the probability is about 5/6 that the two series will intersect. Once that happens, then of course they continue to go in step, and both counts will end with the same key card.

The second, prediction part, of the trick has the same probability. The series remains the same, since the deck will not be shuffled, and so it does not need to be entered again, and therefore can make its count BEFORE the subject does! In fact, it does not count again at all. Since the original key card was removed from the deck, the next card in sequence automatically becomes the last key card if there are not sufficient cards to carry the count further. A special case would be if the original key card were the last card in the deck. In that case, the previous key card would become the chosen card. In the case where a continuation of the count becomes possible, the count is continued in the same fashion.

## PROGRAM DESCRIPTION II (CONTINUED)

THE PROGRAM

The program itself is pretty straightforward, and would be much shorter if the second part of the trick were not to be attempted.

LBLa (START) clears the registers and sets flag 0. Flag 0 is also set when the program is loaded, so there is no real need to press START the first time the program is used after loading. Flag 0 is used as the indicator that this is a new series and the first card with a value of 5 or less should be used to start the count - it is cleared immediately the count is started.

LBLs A, B, C, and D are used to attach the suit indicators (.1 thru .4) as a simpler way of identifying the suit rather than having to remember to key them in each time.

LBL 0 sets Flag 1 if a picture card has been entered, sends the program to LBL 1 if flag 0 is set, to LBL 2 if a count is in progress, and to LBL 3 if the next card is a new key card, after storing the entered card, and counting it.

LBL 1 starts the count when a card of value 5 or less is first encountered and clears Flag 0 once the count is started via LBL 4. The I register is used for the count.

LBL 2 merely increases the program run time when the count is in progress so that there is not a major difference in the times when a key card is identified.

LBL 3 stores the new key card, the previous key card, and sets register I to the value for the next count after clearing the registers.

LBL E recalls and prints the last key card.

LBL e determines what the predicted card will be. If the card after the last key card will not permit a further count, that card is printed. If a further count is possible, it enters a loop till no further count is possible and then prints the final key card. If the original key card were the last card in the deck, then it goes to LBL 6 to print the key card before that. LBL 7 is the loop.

LBL 9 prints the predicted card.

Primary Registers 1 thru 9 and Secondary Register 0 are used to store cards input after a key card, addressed by the I Register. They are cleared whenever a new key card is input. The key card is stored in Register E, the previous key card in Register C, and the last input in Register D.

All this storage is needed for the second part of the trick, the "Prediction". The program would run much faster if this were eliminated, but the run time is not too long, and it is this part of the trick which is most impressive.

Register A is used for temporary storage of the possibly predicted card, and Register 0 (Primary) is used in this routine to determine if a further count is possible. The I Register is again used to address the registers storing the sequence of input cards.

## PROGRAM DESCRIPTION II (CONTINUED)

There are two ways of doing the second part of the trick, depending on whether or not the first card chosen by the calculator was correct. If the calculator was correct, then the trick is performed as described previously, with the chosen card being removed from the deck.

If the first card picked was incorrect, then the second part of the trick cannot work if the card chosen by the subject is removed. In this case, remove the card chosen by the calculator, even though it was the wrong card for the first part of the trick. Ask the subject to pick a starting number between one and ten which is different from the one he had picked for the first attempt. This eliminates an unsuccessful chain, and the chances of success are very high. A successful prediction at this stage of the trick is very mystifying to one who does not know how it is done.



STEP	KEY ENTRY	KEY CODE	COMMENTS	STEP	KEY ENTRY	KEY CODE	COMMENTS
001	*LBL0	21 16 11		057	*LBL3	21 03	
002	CLX	-51		058	RCLC	36 15	
003	CLRG	16-53		059	CLRG	16-53	
004	P2S	16-51		060	STOC	35 13	
005	CLRG	16-53		061	R+	-31	
006	SF0	16 21 00		062	STOE	35 15	
007	RTN	24		063	STOD	35 14	
008	*LBLA	21 11		064	INT	16 34	
009	.	-62		065	F1?	16 23 01	
010	1	01		066	5	05	
011	GT00	22 00		067	STOI	35 46	
012	*LBLB	21 12		068	RCLD	36 14	
013	.	-62		069	RTN	24	
014	2	02		070	*LBL4	21 04	
015	GT00	22 00		071	STOI	35 46	
016	*LBLC	21 13		072	RCLD	36 14	
017	.	-62		073	CF0	16 22 00	
018	3	03		074	RTN	24	
019	GT00	22 00		075	*LBLE	21 15	
020	*LBLD	21 14		076	SFC	16-11	
021	.	-62		077	RCLC	36 15	
022	4	04		078	PRTX	-14	
023	*LBLE	21 00		079	RTN	24	
024	CF1	16 22 01		080	*LBLe	21 16 15	
025	X2Y	-41		081	RCLC	36 15	
026	1	01		082	STOA	35 11	
027	1	01		083	GSB5	23 05	
028	X2Y?	16-35		084	ST00	35 00	
029	SF1	16 21 01		085	STOI	35 46	
030	R+	-31		086	RCLi	36 45	
031	+	-55		087	X=0?	16-43	
032	STOD	35 14		088	GT06	22 06	
033	F0?	16 23 00		089	*LBL7	21 07	
034	GT01	22 01		090	STOA	35 11	
035	STOI	35 45		091	GSB5	23 05	
036	DSZ1	16 25 46		092	ST-0	35-45 00	
037	GT02	22 02		093	RCL0	36 00	
038	GT03	22 03		094	X=0?	16-43	
039	*LBL1	21 01		095	GT09	22 05	
040	5	05		096	X<0?	16-45	
041	F1?	16 23 01		097	GT09	22 09	
042	GT04	22 04		098	STOI	35 46	
043	RCLD	36 14		099	RCLi	36 45	
044	INT	16 34		100	X=0?	16-43	
045	X2Y?	16-35		101	GT09	22 09	
046	GT04	22 04		102	GT07	22 07	
047	RCLD	36 14		103	*LBL5	21 05	
048	RTN	24		104	INT	16 34	
049	*LBL2	21 02		105	1	01	
050	RCLD	36 14		106	0	00	
051	RCLD	36 14		107	X2Y	-41	
052	RCLD	36 14		108	X>Y?	16-34	
053	RCLD	36 14		109	5	05	
054	RCLD	36 14		110	RTN	-24	
055	RCLD	36 14		111	*LBL6	21 06	
056	RTN	24		112	RCLC	36 13	

## REGISTERS

0	1	2	3	4	5	6	7	8	9
S0	S1	S2	S3	S4	S5	S6	S7	S8	S9
A	B	C	D	E	I				



[illegible]