SHACO-1

A SHORTHAND CODING SYSTEM FOR THE IBM 701 CALCULATOR

Group T-1
701 Programming Section
Los Alamos Scientific Laboratory
June, 1953

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INTRODUCTION

This report describes the use of a shorthand coding system (abbreviated "SHACO I") which has the effect of making the 701 calculator simulate a three address all floating decimal machine. A detailed knowledge of how the 701 operates is not necessary in order to use SHACO I.

The numbers with which one operates while using SHACO I are in standard floating notation. The instructions are in decimal and have three addresses, A, B and C. The A and B addresses refer to input and the C address to output for arithmetic instructions. The instructions are stored in the calculator and are subsequently executed in the sequence of their "locations" until the course of control is changed by an instruction called a transfer instruction.

A coding system such as SHACO I provides several advantages which make coding and debugging easier than longhand coding. Among these advantages are the following:

1) floating point system
2) decimal code and number system throughout
3) ease in employing auxiliary storage (drums and tapes)
4) three address system with address algebra still possible
5) easily programmed card or tape dumps which allow compact storage of a problem as well as protection against excessive lost time when machine errors occur.

6) self-checking tandem operations

The speed of SHACO I in comparison with longhand coding for the 701 or with CPC's must be evaluated for every different problem. The speed is 20 to 60 times the speed of a CPC depending strongly on what fraction of the numbers calculated are actually printed. For a 701 problem that would require floating point subroutines due to scaling difficulties the convenience of SHACO I costs about a factor of two in speed. Floating point routines on the 701 are about half as fast as fixed point for multiplication, division, square root, and transcendentals, and about one-tenth as fast for addition and subtraction routines.

It is believed that the main uses of SHACO I will be for the following types of problems:

1) Short problems
2) High-priority-rush problems where debugging and coding time must be minimized.
3) Problems which are to be run with only one or two sets of parameters
4) Exploratory problems which cannot be scaled for fixed point calculation due to unfamiliarity with the problem
5) Problems which do not warrant a large investment in coding time

Our experience to date indicates a saving of a factor of 10 to 30 in coding time for SHACO I as opposed to longhand coding.

SHACO I was developed and debugged by the following people, listed in alphabetical order:

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GENERAL

In order to use SHACO I, the problem must be reduced to "three address" operations which will specifically be described later. These operations are of five types:

1) Three address arithmetic "A operation B = C"
2) Two address functional "OP (B) = C"
3) Sequence control
4) Storage manipulation
5) Other operations

The initial values of the variables and all necessary data must be loaded into the calculator prior to actual calculation of the problem. This "loading of the constants into the 701" must also be done stepwise with the fundamental step being $C_1 \rightarrow X$ for variables being set to their initial value, meaning "the variable X takes on the value of the constant C_1". The following example illustrates this "reducing" process:

Example 1. Compute $f(X) = X^2 + \ln X$

for $X = 10$

For this example a linear sequence of steps will suffice, as follows:

Step 1. $10 \rightarrow X$

Step 2. $X \cdot X = C_1$

Step 3. $\ln X = C_2$

Step 4. $C_1 + C_2 = f(X)$

Step 1 may be done while loading constants into the 701.

Example 2. Compute $f(X) = (1 + X^2) \div (3 - \sin^2 X)$

for $X = .75$ and 1.50

Sequence control may be used for this example as follows:

Step 1. $1 \rightarrow C_1$

Step 2. $.75 \rightarrow C_4$

These two steps may be done while loading the constants into the machine, while the following steps are programmed as instructions:

Step 3. $C_1 + C_1 \rightarrow C_2$

Step 4. $C_1 + C_2 \rightarrow C_3$

Step 5. $C_4 + C_4 \rightarrow C_5$

Step 6. $C_4 \rightarrow X$ (op 7)

Step 7. $X \cdot X = C_6$

Step 8. $C_1 + C_6 = C_7$

Step 9. $\sin X = C_8$

Step 10. $C_8 \cdot C_8 = C_9$

Step 11. $C_3 - C_9 = C_{10}$

Step 12. $C_7 \div C_{10} = f(X)$

Step 13. $X - C_1 = C_{11}$

Step 14. is $C_{11} > 0$? if yes → stop

if no → Step 15. $C_5 \rightarrow X$

Step 16. TR to step 7

Once the calculation begins (step 2 example 1 and step 3 example 2) the symbol → refers to programmed operations rather than loading of constants. Although one could load these storages while loading constants it would be wasteful of machine time to do so.

Storages are available in SHACO I for both constants and orders. The orders are represented by numbers and are called "instructions". The storages for numbers act as containers for the variables and constants in the problem. Generally, there are few storages preset to a given constant value. Hence, the constants in a given problem must be loaded into storages, as well as initial values of the variables. With SHACO I, the storages for the instructions are indicated by two numbers, called a block number and an instruction number. Floating decimal numbers are stored in numbered storages.

After a description of the instructions and operations available, attention will be returned to actually putting a problem on the machine, illustrated by the above two examples.

INSTRUCTIONS

Each SHACO I instruction is of the following form:

j n S_A C_A OP S_B C_B C_C .

"j" is the block number of the instruction and may range from 0 through 23. The block number specifies a section of storage to be used for instructions. The same blocks, labeled 0 through 23, may be used for slow storage of constants (see operations 16, 17, 51, 52). Any one of the blocks may be used for either instructions or constants, but not both.

"n" is the instruction number. Each instruction block contains 127 instruction numbers, labeled 1 through 127. If control is started at j = i; n = k, control will continue in sequence j = i; n = k + 1, k+2,... unless a transfer of control is executed. The last instruction in each block is always a transfer of control.

"S_A" is the sign control of A, where $\overline{A}$ is the first floating point input number. Unless otherwise stated for a particular operation, S_A may be used for sign control of A according to the following rule:

S_A	number entered in calculation
0	+ A
1	+ |A|
2	- A
3	- |A|

The number actually used in the calculation will be called $\bar{A}$.

"C_A" is the storage address for the number A, unless otherwise stated for a particular operation. C_A may range from 1 through 705. Storages 1 through 701 may contain the coders constants and values of variables. 702 through 705 contain the following floating point numbers, permanently:

Storage	Contents
702	$\sqrt{2/2}$
703	1
704	$-\frac{\pi}{2}$
705	10

"OP" is the number of the operation to be performed. It may range through the table of operations below, roughly 0 through 63.

"S_B" is the sign control of B where $\bar{B}$ is the second floating point input number. Unless otherwise stated for a particular operation, S_B may be used for sign control of B exactly as S_A was used for sign control of A. $\bar{B}$ will denote the number actually used in the calculation.

"C_B" is the storage address for the number B, unless otherwise stated for a particular operation. C_B may range from 1 through 705. These storages 1 through 705 have the same significance as for C_A.

"C_C" is the storage address for the number C, the floating point output of the operation, unless otherwise stated for a particular operation. C_C may range from 1 through 701. The number C will be put

into storage C_C providing C_C is used to indicate the output of the instruction.

OPERATIONS

Following are the SHACO I operations to date. The operation number is followed by an explanation of the operation.

00. Print A through B. The contents of storages C_A through C_B are printed out in floating decimal by this operation. The first line of the print-out will contain the j, n, C_A, and C_B of the print A through B order. Then will follow at 150 lines per minute, the contents of storages C_A through C_B, five to a line. Five numbers are printed on every line, so that, for example, if C_A = 101 and C_B = 112, the contents of 101 through 105, then the contents of 106 through 110, then the contents of 111 through 115 would print out. If it happens that the contents of the mythical storages greater than 705 print out, no harm is done to the required print-out. If any exponent is greater than 999 in magnitude,999 with the correct sign will be printed instead of that exponent.

01. Addition. $A + B \rightarrow C$.

02. Exponential. $e^{\overline{B}} \rightarrow C$. In order for C not to exceed the limits of the machine, $|\overline{B}| < 2302$.

03. Multiplication. $\overline{A} \cdot \overline{B} \rightarrow C$.

04. Division. $\overline{A} \div \overline{B} \rightarrow C$.

05. Square Root. $\sqrt{\overline{B}} \rightarrow C$.

06. Logarithm. $\text{Log}_e \overline{B} \rightarrow C$.

07. B to C transfer. $\overline{B} \rightarrow C$.

08. Arc tangent. $\tan^{-1} \overline{B} \rightarrow C$. The result C is always in the first quadrant if $\overline{B}$ is positive and in the first negative quadrant if $\overline{B}$ is negative.

09. Cosine. $\cos \overline{B} \rightarrow C$. $|\overline{B}| < 1608$.

10. Store n and j. The $n = C_A$ and $j = C_B$ are stored in C_C for use in the variable transfer order (operation 14).

11. Transfer unconditionally. When this instruction is encountered, control will go to $j = C_C$ and $n = C_A$.

12. Transfer plus. If $\overline{B} > 0$, control will go to instruction $j = C_C$, $n = C_A$.

13. Transfer zero. If $\overline{B} = 0$, control will go to instruction $j = C_C$, $n = C_A$.

14. Variable transfer. This is an unconditional transfer to the n and j previously stored in storage C_B by the store n and j order (operation 10).

15. ADD^2. Add to address adds the C_A, C_B, and C_C of the instruction containing operation 15 to the C_A, C_B, and C_C of the next instruction. The C_A, C_B, and C_C of ADD^2 must each be zero or positive. Each time the sequence of control goes through ADD^2 and the next instruction, the C_A, C_B, and C_C of the next instruction increase above their values in a cumulative manner. This next instruction is restored to its original value whenever a transfer to a different block is executed.

16. Read Drum. This operation reads 170 floating point numbers (previously stored on the drum by operation 17) into storage from block j = C_C. The first number is put into C_A, and the others in sequence through C_B. C_A must be even, C_B odd, and $C_B - C_A = 169$.

17. Write Drum. This operation writes 170 floating point numbers from storage into block j = C_C of the drums. The first number is taken from C_A, and the others in sequence through C_B. C_A must be even, C_B odd, and $C_B - C_A = 169$.

18. Read Tape. The tape specified by C_C = 0, 1, 2, or 3 is read. Numbers must previously have been written on the specified tape by operation 19. The numbers are read into storage beginning with C_A (which must be even) and going in sequence through C_B (which must be odd). C_B minus C_A when reading must be the same as C_B minus C_A when the block was written. Before using this operation, the tape must be positioned to just before the block to be read.

19. Write Tape. The tape specified by C_C = 0, 1, 2, or 3 is written on from storage C_A (even) through storage C_B (odd). When all the blocks needed have been written on the given tape, the write end of file operation (op. 23) must be given before any of the other tape operations (ops. 18, 20, 21, 24) may be used.

20. Move tape backward. Move the tape specified by C_C = 0, 1, 2, or 3 back one block.

21. Move tape forward. The tape specified by C_C = 0, 1, 2, or 3 is moved forward one block.

22. Stop and Transfer. When console start is pressed twice, control will go to $j = C_C$, $n = C_A$.

23. Write end of file. The tape specified by $C_C = 0, 1, 2, 3$ is prepared for any tape operation other than read tape (op 18) and write tape (op 19).

24. Rewind. The tape specified by $C_C = 0, 1, 2,$ or 3 is rewound.

25. Dump on cards. A complete dump on binary cards of the SHACO problem is made. This may be used to condense the cards necessary to start the problem. If a machine error occurs later in the problem, it will serve to start over at the point of the dump.

26. Dump on tape. This operation does the same thing as operation 25, except on tape (alternately #2 or 3) instead of cards.

27. Load Card Dump. Loads any previous card dump. The binary cards should be put in the card hopper and started off when the card reader "select" light goes on. When the cards are all read in, calculation will start at the first instruction following the card dump order (op. 25).

28. Load Tape Dump. This operation is similar to operation 27. Loads last or next to the last tape dump accordingly as $C_C = 1$ or 2.

29. Prepare Tapes for Dump. This operation must be given before the first tape dump (op. 26).

30. Floating Address. This operation converts addresses into floating point numbers for discrimination purposes. The C_A, C_B, or C_C of instruction $n = C_A$ (of op. 30) in the block of the floating

address operation is converted to floating point. S_A = 0, 1, or 2 determines that C_A, C_B, or C_C is converted into floating point. The result is stored in C_C of operation 30.

INITIAL INPUT, DEBUGGING, AND RUNNING

The examples considered above can now be put in numerical form, as instructions and loading procedures. This stage of doing a problem is called "coding".

Example 1. Compute $f(X) = X^2 + \ell n\ X$ for $X = 10$

Procedure — Comments

Load: 10 → storage 1 — Storage 1 holds X

Instructions:

j	n	S_A	C_A	OP	S_B	C_B	C_C	
00	001	0	001	03	0	001	0700	X^2 → 700
00	002	0	000	06	0	001	701	$\ell n\ X$ → 701
00	003	0	700	01	0	701	701	f(X) → 701
00	004	0	000	22	0	000	000	Stop: Calculation completed.

Example 2. Compute $f(X) = (1 + X^2) \div (3 - \sin^2 X)$

for $X = .75$ and 1.50

Procedure — Comments

Load 1 → storage 1

Load .75 → storage 4

Instructions:

j	n	S_A	C_A	OP	S_B	C_B	C_C	
00	001	0	001	01	0	001	002	2 → storage 2
00	002	0	001	01	0	002	003	3 → storage 3
00	003	0	004	01	0	004	005	1.50 → storage 5
00	004	0	000	07	0	004	020	20 = location of X = .75 at first

j	n	S_A	C_A	OP	S_B	C_B	C_C	
00	005	0	020	03	0	020	006	X^2 → storage 6
00	006	0	001	01	0	006	007	$1 + X^2$ → storage 7
00	007	0	704	01	0	020	019	$X - \frac{\pi}{2}$ → storage 19
00	008	0	000	09	0	019	008	$\cos(X - \frac{\pi}{2}) = \sin X$ → storage 8
00	009	0	008	03	0	008	009	$\sin^2 X$ → storage 9
00	010	0	003	01	2	009	010	$3 + (-\sin^2 X)$ → storage 10
00	011	0	007	04	0	010	019	f(X) → storage 19
00	012	0	019	00	0	024		f(X),X, three nonentities, printed
00	013	0	020	01	2	001	011	X - 1.00 → storage 11
00	014	0	017	12	0	011	000	TR if X-1.00 > 0 to j = 0, n = 17
00	015	0	000	07	0	005	020	1.5 → storage 20 which contains X
00	016	0	005	11	0	000	000	TR → n = 5
00	017	0	0	22	0	0	0	STOP, FINISHED

Discussion of these examples will be completed after the details of putting any SHACO I problem on the 701 are explained.

Instruction Cards. For the initial input of an instruction, the instruction is punched on a card, as follows:

Instruction:	j	n	S_A	C_A	9	OP	S_B	C_B	C_C
Card Cols:	13-14	17-19	32	35-37	45	49-50	55	66-68	71-73

The 9 punch in column 45 is used to distinguish between instruction cards and loading cards. Each of the card columns above should have one and only one numeric punch. There should be no other numeric punches on the card except in those columns, or in columns 1 through 8.

Loading Cards. These are the cards by which one does the initial loading of constants and initial values of variables. Two floating point constants per card may be loaded. Each floating point number is of the type:

$d \cdot 10^e$, where d is ten digits and $0 \leqq d < 10$; $|e| \leqq 999$.

The loading card layout is as follows for $D = d \cdot 10^e$ and $F = f \cdot 10^g$, and with an example:

Information:	9	C_D	d	e	C_F	f	g
Card Cols.:	9	10-12	13-22	23-26	28-30	31-40	41-44
Example:	9	010	$3,14159265^{x}_{4}$	0000	700	1000000000	$^{x}_{0001}$

"C_D" is the storage address for D, and "C_F" is the storage address for F. The 9 punch in column 9 is used to distinguish between loading and instruction cards. Each of the card columns above should have one and only one numeric punch. The sign of d is punched over column 22, and 11 punch for minus, no 11 or 12 punch for plus. Similarly the sign of e is punched over column 26, that of f over column 40, and that of g over column 44.

Integers may be loaded by a leading zero method, for example, $3 = 0.000000003 \cdot 10^9$. This is the only way of loading EXACT numbers, with a plus nine exponent.

Starting the Problem. When all of the instruction and loading cards are punched, they may be put after the SHACO I binary deck. It is advisable to have the blocks of instructions together, since this saves

machine time (see "Times of Running"). In addition to the SHACO I binary deck and the instruction and loading deck there must be a "zero card", which tells the calculator where to begin after the instruction and loading cards have been read in. The 0 card is punched just like any instruction card except that n = 0. The 0 card should be a transfer order to the beginning j and n of the problem. This card may be put anywhere in the instruction and loading deck. The complete deck is then put in the card reader and loaded into the 701 by means of the load button with the instruction entry keys set to zero. The card read switch (Sense Switch #1) should be put down before the first instruction or loading card is read, and should be put up before the last such card is read. Upon reading the last card, with no more cards in the hopper, the calculation will begin at instruction j and n.

A good procedure is to immediately dump the SHACO I problem on cards, so that the longer instruction and loading deck will not have to be used again. This will save time on any problem of over 300 loading and assembly cards.

Sense Lights: Three of the sense lights on the console of the 701 have a meaning for the SHACO user. These are as follows:

#1. Intermittent error light. If the "tandem" switch (see below) is up, each SHACO operation is performed twice, as a check. If two trials do not agree, light #1 is turned on. The light is turned off after the operation is done successfully. A flickering of this light indicates imperfect machine operation.

#3. Blank Card Light. While reading loading and instruction cards, a card without a 9 punch in either 9 or 45 has been encountered. Card reading will continue, but light #3 goes on.

#4. Card Error Light. While reading loading and instruction cards, an error in the card just read or a card reading error has been found. Light #4 will go on and the 701 will stop at $(5660)_8$. See $(5660)_8$ in the table of stops for a list of the conditions which are considered to be errors in the card just read.

Sense Switches: Four sense switches are used by SHACO I, as follows:

#1. Card Read Switch. Up: No effect. Down: Read loading and instruction cards.

#2. Conditional Print Switch. Up: No effect. Down: If there is an 11 punch in column 50 of the instruction j,n, instruction j,n will be printed after it is executed. The printed line will look the same as for tracing (see below).

#3. Long List Switch, or Tracing Switch. Up: No effect. Down: After each instruction is executed, it will be printed. See below for a general description of instruction printing (tracing).

#4. Tandem Switch. Up: Operations will be performed twice, as a check. Intermittent error light (#1) indicates an error, but calculation will continue full speed when two consecutive results from the operation agree. Down: Operations performed only once.

Instruction Printing, Tracing. With switch #3 down, each instruction will be printed after it is executed. This should be useful for

debugging purposes, and hence the name "tracing". Also, if switch #2 is down, and if an instruction card was punched with an 11 punch in column 50, that instruction will print after it is executed. In either case the instruction will be printed as follows:

j n S_A C_A OP S_B C_B C_C A B C

Coding. Now the examples considered on previous pages can be put in final form. Coding sheets are available for SHACO I in the 701 Ready Room. These sheets may be taken to the key punchers and the loading and instruction cards will then be punched up by them and finally made ready for the 701. When using the coding sheets, it is not necessary to put the zeros in the columns not used for some SHACO operations. The key punchers will punch zeros for blanks. Following are the two examples, all coded up.

LOADING DECK

SHACO I, 701, GROUP T—I

9	ADDR. 10 11 12	DECIMAL POINT 13 14 15 16 17 18 19 20 21 22	EXP. 23 24 25 26	ADDR. 28 29 30	DECIMAL POINT 31 32 33 34 35 36 37 38 39 40	EXP. 41 42 43 44
9		1 1	1			
9						
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NOTE TO KEYPUNCHER: PLEASE PUNCH ZEROS FOR BLANKS

INSTRUCTION DECK

SHACO I, 701, GROUP T—I

BL'K NO. 13 14	CARD NO. 17 18 19	S A 32	A 35 36 37	45	OP 49 50	S B 55	B 66 67 68	C 71 72 73	REMARKS
	1		1	9	3		1 7	0	Example 1 - Compute
	2			9	6		1 7	0 1	f(X) = X² + ln X for X=10
	3		7 0 0	9	X 1		7 0 1 7	0 1	result printed out with
	4			9	2 2				switch #2 down.
				9					
	0 0 0		1	9	1 1				Zero Card
				9					
				9					
				9					
				9					
				9					
				9					
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				9					
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				9					
				9					

LOADING DECK

SHACO I, 701, GROUP T—1

ADDR.	DECIMAL POINT	EXP.	ADDR.	DECIMAL POINT	EXP.
9	1.1		475		X 1
9					
9					
9					
9					
9					
9					
9					
9					
9					
9					
9					
9					
9					
9					
9					
9					
9					

NOTE TO KEYPUNCHER: PLEASE PUNCH ZEROS FOR BLANKS

INSTRUCTION DECK

SHACO I, 701, GROUP T—1

BLK NO.	CARD NO.	S A	A		OP	S B	B		C		REMARKS
00	1		1	9	1		1			2	
	2		1	9	1		2			3	
	3		4	9	1		4			5	
	4		0	9	7		4		2	0	
	5		2	0 9	3		2	0		6	
	6		1	9	1		6			7	$1+X^2$
	7	7	0 4	9	1		2	0	1	9	
	8		0	9	9		1	9		8	$\cos(-\frac{\pi}{2}+X)$
	9		8	9	3		8			9	$\sin^2 X$
	10		3	9	1	2	9		1	0	$3-\sin^2 X$
	11		7	9	4		1	0	1	9	$[1+X^2]\div[3-\sin^2 X]$
	12	1	9	9	0		2	0		0	
	13	2	0	9	1	2	1		1	1	
	14	1	7	9	1	2	1	1		0	
	15		0	9	7		5		2	0	
	16		5	9	1	1	0			0	
	17		0	9	2	2	0			0	
000			1	9	1	1					Zero Card
				9							
				9							

Immediate Execution. Certain operations can be performed while the instruction and loading cards are being read in. These are as follows:

Op. No.		
51	Read Drum, see	op. 16
52	Write Drum, see	op. 17
53	Read Tape, see	op. 18
54	Write Tape, see	op. 19
55	Move Tape Back, see	op. 20
56	Move Tape Up, see	op. 21
57	Write End of File, see	op. 23
58	Rewind Tape, see	op. 24

TIMES OF RUNNING

Although the preceding sections give information enough to code and run a problem using SHACO I, some information on the times for the various SHACO I procedures should be known in order to use machine time efficiently.

Tracing, or printing of instructions, takes place at 150 lines per minute except for the following operations:

06 $\ln \overline{B}$ (tandem)

08 $\tan^{-1} \overline{B}$ (tandem)

or any transfer of control to a different instruction block.

16 Read drum

17 Write drum

18 Read tape

19 Write tape

20 Move tape backward

21 Move tape forward

22 Stop tr

25 Dump on cards

26 Dump on tape

27 Load card dump

28 Load tape dump

The most efficient way to arrange instruction cards is to have all the cards in any one block together, that is, have all instruction cards

labeled by a given block number j, together. They may be out of order on the instruction number n but that will not matter timewise.

Following are average speeds of SHACO I operation:

	Numeric Operations	
	Time (seconds)	
Op. No.	Tandem	Non-tandem
01	.010	.005
02	.053	.027
03	.011	.006
04	.011	.006
05	.016	.008
06	.088	.044
07	.005	.003
08	.130	.065
09	.079	.040
10	.007	.004
30	.008	.004

The remainder of the SHACO I operations are done non-tandem no matter what the condition of the tandem switch.

Transfer Operations			
	Time (seconds)		
Op. No.	No. Transfer	Transfer within same block	Transfer to a different block
11	---	.004	.360
12	.004	.004	.360
13	.004	.004	.360
14	.004	.004	.360

Other Operations	
Op. No.	Time (seconds)
00	(150 lines per minute) 2.5 lines per second.
15	.004
16	.360
17	.360
18	.008 for first storage, .0015 for each storage thereafter.
19	Same as for operation 18.
20	Takes the same amount of time as writing the block of storages took.
21	Same as for operation 20.
23	Operation takes 1.2 seconds, but calculation may go on while the operation is being executed except for operations 20, 23, and 24 for the same tape.
24	Operation takes somewhat less time than the total time of writing on the given tape. Calculation may go on while this operation is being executed, except for operations 18 and 21.
25	210 seconds, 3-1/2 minutes.
26	15 seconds.
27	210 seconds, 3-1/2 minutes.
28	15 seconds.
29	Calculation may go on while this operation is being executed, except for operations 25, 26, 27, 28. Time depends on which of the tapes 2 and 3 has the most information on it since this operation rewinds those tapes.

Checking Features

(a) General Procedures.

1. To display the number of errors found by the tandem feature for various operations, look at the following storages:

Octal Location		
$(6556)_8$	addition	01
$(6723)_8$	exp.	02
$(6630)_8$	mult.	03
$(6641)_8$	div.	04
$(7034)_8$	Square root	05
$(6772)_8$	$\tilde{l}_n$	06
$(7163)_8$	$\tan^{-1}$	08
$(7074)_8$	cos	09
$(7266)_8$	str n & j	10

2. If while printing out with print A through B an error occurs, a minus sign will print on the line following the error, and the 701 will keep trying to print a corrected line.

3. To read loading and instruction cards, transfer manually to $(6505)_8$.

TABLE OF STOPS

Octal Location	
$(6275)_8$	Instruction encountered which was not loaded. Put in a correction card and a zero card.
$(6443)_8$	Error in drum reading - writing. Press start or bypass by transferring to $(6444)_8$. Drum number is found at $(6405)_8$.
$(6501)_8$	Same as preceding stop.
$(6536)_8$	Error in tape reading - writing. Start over at last convenient place.
$(5375)_8$	Error in reading in a card dump. Try again or dump again.
$(6204)_8$	Operation 22 programmed stop. Press start twice.
$(5660)_8$	Error in loading or instruction card just read. Correct card, reload starting with corrected card and press console "start".
$(6202)_8$	Exponent overflow or similar violation of condition. Press start to print-out critical operation.

SUMMARY

1. General Operation: Cards are used for initial input of instructions and floating decimal numbers. After these are loaded the machine performs the calculation step by step.

2. Notation:

a : the factor part of A.

A : the first floating decimal input number.

$\overline{A}$: A with the sign change, or sign, called for by S_A.

b : the factor part of B.

B : the second floating decimal input number.

$\overline{B}$: B with the sign change, or sign, called for by S_B.

c : the factor part of C.

C : the floating decimal output number.

C_A: coder's address for A.

C_B: coder's address for B.

C_C: coder's address for C.

j : block number of an instruction.

n : the instruction number.

OP: the operation number.

S_A: sign control of A.

S_B: sign control for B.

X : the exponent part of A.

y : the exponent part of B.

Z : the exponent part of C.

3. Restrictions on numbers. After being loaded into 701, D = 0, or $1.000000000 \times 10^{-999} \leqq |D| < 1.000000000 \times 10^{1000}$

4. Operations:

Op.	Operation	Special Restrictions
0	print A through B	
1	$\overline{A} + \overline{B} \rightarrow C$	
2	$e^{\overline{B}} \rightarrow C$	$\lvert\overline{B}\rvert < 2302$
3	$\overline{A} \cdot \overline{B} \rightarrow C$	
4	$\overline{A} \div \overline{B} \rightarrow C$	$\overline{B} \neq 0$
5	$\sqrt{\overline{B}} \rightarrow C$	$\overline{B} \geqq 0$
6	$\ln \overline{B} \rightarrow C$	$\overline{B} < 0$
7	$\overline{B} \rightarrow C$	
8	$\tan^{-1} B \rightarrow C$	$\lvert C\rvert \leqq \frac{\pi}{2}$
9	$\cos \overline{B} \rightarrow C$	$\lvert B\rvert < 1608$
10	store n and j	
11	transfer to n = C,	$0 \leqq C_C \leqq 23$
	$j = C_C$	$0 \leqq C_A \leqq 127$
12	transfer to n = C_A,	$0 \leqq C_C \leqq 23$
	$j = C_C$, if $\overline{B} > 0$	$1 \leqq C_A \leqq 127$
13	transfer to n = C_A,	$0 \leqq C_C \leqq 23$
	$j = C_C$, if $\overline{B} = 0$	$1 \leqq C_A \leqq 127$
14	variable transfer	
15	ADD^2	
16	read drum	

Op.	Operation	Special Restrictions
17	write drum	
18	read tape	
19	write tape	
20	move tape backward	
21	move tape forward	
22	stop and transfer	
23	write end of file	
24	rewind	
25	dump on cards	
26	dump on tape	
27	load card dump	
28	load tape dump	
29	prepare tapes for dump	
30	floating address	

5. Instruction Cards. Instruction cards load the machine with the following information:

j n S_A C_A OP S_B C_B C_C

6. Switches:

#1 Card Read

#2 Conditional Print

#3 Tracing, Long List

#4 Tandem

7. Lights:

#1 Intermittent error

#3 Blank card

#4 SHACO card error

ALL CARDS, COL'S 13,14
BLOCK NUMBER [21]

INSTRUCTION DECK
SHACO FORM FOR 701, GROUP T-I

NOTE TO KEYPUNCHER:
PLEASE PUNCH ZEROES
FOR BLANKS.

CARD NO. 17 18 19	± 32	A 33 34 35 36 37	45	OP 49	± 50	B 55 56 66 67 68	C 71 72 73	REMARKS
001			9	7		302638		$X_0 \rightarrow$ [638]
002			9	7		303639		$y_0 \rightarrow$ [639]
003		5	9	10		1628		(1;5) → [628]
004		60	9	11			1	TR → (1;60) → Δy Routine
005			9	7		640305		$U_5 \rightarrow$ 305
006		615	9	1		302307		$X_1 \rightarrow$ 307
007		619	9	1		303308		$y_1 \rightarrow$ 308
008			9	72		619309		$-\Delta y_1 \rightarrow$ 309
009			9	7		307638		$X_1 \rightarrow$ [638]
010			9	7		308639		$y_1 \rightarrow$ [639]
011		13	9	10		1628		(1;13) → [628]
012		60	9	11			1	TR → (1;60) → Δy Routine
013			9	7		640310		$U_1 \rightarrow$ 310
014		615	9	1		307312		$X_2 \rightarrow$ 312
015		619	9	1		308313		$y_2 \rightarrow$ 313
016			9	72		619314		$-\Delta y_2 \rightarrow$ 314
017			9	7		312638		$X_2 \rightarrow$ [638]
018			9	7		313639		$y_2 \rightarrow$ [639]
019		21	9	10		1628		(1;21) → [628]
020		60	9	11			1	TR → (1;60) → Δy Routine
021			9	7		640315		$U_2 \rightarrow$ 315
022		615	9	1		312317		$X_3 \rightarrow$ 317
023		619	9	1		313318		$y_3 \rightarrow$ 318
024			9	72		619319		$-\Delta y_3 \rightarrow$ 319
025			9	7		317638		$X_1 \rightarrow$ [638]
026			9	7		318639		$y_3 \rightarrow$ [639]
027		29	9	10		1628		(1;29) → [628]
028		60	9	11			1	TR → (1;60) → Δy Routine
029			9	7		640320		$U_3 \rightarrow$ 320
030		615	9	1		317322		$X_4 \rightarrow$ 322
031		619	9	1		318323		$y_4 \rightarrow$ 323 $y_4 = y_4$(tri)
032			9	72		619324		$-\Delta y_4 \rightarrow$ 324

CARD NO. 17 18 19	± 32	A 33 34 35 36 37	45	OP 49	± 50	B 55 56 66 67 68	C 71 72 73	REMARKS
033			9	7		323638		$X_4 \rightarrow$ [638]
034			9	7		323639		$y_4 \rightarrow$ [639]
035		37	9	10		1628		(1;37) → [628]
036		60	9	11			1	TR → (1;60) → Δy Routine
037			9	7		640325		$U_5 \rightarrow$ 325
038			9	7		305633		$U_0 \rightarrow$ [633]
039		6329	9	3		310634		$4U_1 \rightarrow$ [634]
040		6329	9	3		315635		$2U_2 \rightarrow$ [635]
041		6329	9	3		320636		$4U_3 \rightarrow$ [636]
042			9	7		325637		$U_4 \rightarrow$ [637]
043		6339	9	1		634701		$U_0 + 4U_1$
044		7019	9	1		635701		$U_0 + 4U_1 + 2U_2$
045		7019	9	1		636701		$U_0 + 4U_1 + 2U_2 + 4U_3$
046		7019	9	1		637701		$U_0 + 4U_1 + 2U_2 + 4U_3 + U_4$
047		7019	9	3		615701		$\frac{1}{6}[U_0 + 4U_1 + 2U_2 + 4U_3 + U_4]$
048		7019	9	4		630701		$\frac{4}{5}[U_0 + 4U_1 + 2U_2 + 4U_3 + U_4]$
049		7019	9	1		303701		$y_0 + \frac{1}{5}[U_0 + 4U_1 + 2U_2 + 4U_3 + U_4]: y_1$(cor)
050		7019	9	12		323701		y_0(cor) $- y_0$(tri) $= \delta y_0$
051		6149	9	13		701701		$10^{-2} > \lvert\delta y_0\rvert$
052			9	7		703301		Identification → 301
053			9	7		703306		"
054			9	7		703311		"
055			9	7		703316		"
056			9	7		703321		"
057		19	12			701	2	TR → (2;1) To Milne Mesh $10^{-2} > \lvert\delta y_0\rvert > 0$
058		6159	9	4		623615		$\frac{1}{2} \rightarrow h$
059		19	11				1	TR → (1;1) Repeat Runge-Kutta
060			9	7 X		638624		$X \rightarrow \bar{X}$ } Begin Δy Routine. Store Arguments
061			9	7 X		639625		$y \rightarrow \bar{y}$ } For Δ & U Routines
062		649	10			1627		(1;64) → [627]
063		739	11				2	TR → (2;73) U Routine
064			9	7		626640		Store U

FORM 501

ALL CARDS, COL'S 13,14
BLOCK NUMBER [01]

INSTRUCTION DECK
SHACO FORM FOR 701, GROUP T-I

NOTE TO KEYPUNCHER:
PLEASE PUNCH ZEROES
FOR BLANKS.

CARD NO	±	A	OP	±	B	C	REMARKS
065		615 9	x 3		626 617		$K_1 = hU \rightarrow [616]$
066		615 9	4		623 629		$5/2 \rightarrow 629$
067		629 9	x 1		638 624		$x + 5/2 \rightarrow \bar{x}$
068		616 9	4		623 701		$K/2 \rightarrow 701$
069		701 9	x 1		639 625		$y + K/2 \rightarrow \bar{y}$
070		729 10			1 627		$(1;72) \rightarrow [627]$
071		739 11			2		$TR \rightarrow (2;73) \rightarrow U$ Routine
072		615 9	x 3		626 617		$K_2 = hU \rightarrow [617]$
073		617 9	4		623 701		$K/2 \rightarrow 701$
074		701 9	x 1		639 625		$y + K/2 \rightarrow \bar{y}$
075		779 10			1 627		$(1;77) \rightarrow [627]$
076		739 11			2		$TR \rightarrow (2;73) \rightarrow U$ Routine
077		615 9	x 3		626 618		$K_3 = hU \rightarrow [618]$
078		615 9	x 1		638 624		$x + h \rightarrow \bar{x}$
079		618 9	x 1		639 625		$y + K_3 \rightarrow \bar{y}$
080		829 10			1 627		$(1;82) \rightarrow [627]$
081		739 11			2		$TR \rightarrow (2;73) \rightarrow U$ Routine
082		615 9	x 3		626 619		$K_4 = hU \rightarrow [619]$
083		617 9	3		623 617		$2K_2 \rightarrow [617]$
084		618 9	3		623 618		$2K_3 \rightarrow [618]$
085		616 9	1		617 617		$K_1 + 2K_2$
086		617 9	1		618 618		$K_1 + 2K_2 + 2K_3$
087		618 9	1		619 619		$K_1 + 2K_2 + 2K_3 + K_4$
088		619 9	x 4		631 619		$1/6 [K_1 + 2K_2 + 2K_3 + K_4] = \Delta y$
089		9 14			628		$TR \rightarrow$ Preset $(j;n)$ (End Δy Routine)
090		9					
091		9					
092		9					
093		9					
094		9					
095		9					
096		9					

CARD NO	±	A	OP	±	B	C	REMARKS
097		9					
098		9					
099		9					
100		9					
101		9					
102		9					
103		9					
104		9					
105		9					
106		9					
107		9					
108		9					
109		9					
110		9					
111		9					
112		9					
113		9					
114		9					
115		9					
116		9					
117		9					
118		9					
119		9					
120		9					
121		9					
122		9					
123		9					
124		9					
125		9					
126		9					
127		9	11				

FORM 502

ALL CARDS, COL'S 1,3,4
BLOCK NUMBER 21

INSTRUCTION DECK
SHACO FORM FOR 701, GROUP T–I

NOTE TO KEYPUNCHER:
PLEASE PUNCH ZEROES
FOR BLANKS.

CARD NO	±	A	OP	±	B	C	REMARKS
001			9 / 5		5		ADD^2
002			9 7 (x)		3 0 5	6 3 3	$U_n \rightarrow [633]$
003			9 / 5		5		ADD^2
004		6 3 2 9	3 (x)		3 1 0	6 3 4	$4U_{n+1} \rightarrow [634]$
005			9 / 5		5		
006		6 2 3 9	3 (x)		3 1 5	6 3 5	$2U_{n+2} \rightarrow [635]$
007			9 / 5		5		
008		6 3 2 9	3 (x)		3 2 0	6 3 6	$4U_{n+3} \rightarrow [636]$
009		6 3 4 9	1		2 6 3 5	7 0 1	$4U_{n+1} - 2U_{n+2}$
010		7 0 1 9	1		6 3 6	7 0 1	$4U_{n+1} - 2U_{n+2} + 4U_{n+3}$
011		7 0 1 9	3		6 1 5	7 0 1	$h[4U_{n+1} - 2U_{n+2} + 4U_{n+3}]$
012		7 0 1 9	3		6 2 3	7 0 1	$2h[4U_{n+1} - 2U_{n+2} + 4U_{n+3}]$
013		7 0 1 9	4		6 3 0	7 0 1	$\frac{2h}{3}[4U_{n+1} - 2U_{n+2} + 4U_{n+3}]$
014			9 / 5 (x)		5		
015		7 0 1 9	1		3 0 3	6 2 5	$y_n + \frac{2h}{3}[4U_{n+1} - 2U_{n+2} + 4U_{n+3}] = \overrightarrow{y_{n+1}}$ (tri)
016		5 9	1 5			5	
017		3 1 7 9	1		6 1 5	3 2 2	$x_{n+1} + h = x_{n+1} \rightarrow [302 + 5n]$
018			9 / 5		5		
019			9 7 (x)		3 2 2	6 2 4	$x_{n+1} \rightarrow \bar{x}$
020		6 3 3 9	1		6 3 4	7 0 1	$U_n + 4U_{n+1}$
021		7 0 1 9	1		6 3 5	7 0 1	$U_n + 4U_{n+1} + 2U_{n+2}$
022		7 0 1 9	1		6 3 6	7 0 1	$U_n + 4U_{n+1} + 2U_{n+2} + 4U_{n+3}$
023		7 0 1 9	3		6 1 5	7 0 1	$h[U_n + 4U_{n+1} + 2U_{n+2} + 4U_{n+3}]$
024		7 0 1 9	4		6 3 0	7 0 1	$\frac{2h}{3}[U_n + 4U_{n+1} + 2U_{n+2} + 4U_{n+3}]$
025			9 / 5		5		
026		7 0 1 9	1		3 0 3	7 0 1	$y_n + \frac{2h}{3}[U_n + 4U_{n+1} + 2U_{n+2} + 4U_{n+3}]$
027		2 9 9 / 0			2 6 2	7 (2;29)	$\rightarrow [627]$
028		7 3 9 / /				2	TR → (2;73) → U Routine
029		6 2 6 9	3		6 1 5	7 0 0	$h\,U_{n+3}$
030		7 0 0 9	4 (x)		6 3 0	7 0 0	$\frac{2h}{3}\,U_{n+3}$
031		7 0 1 9	1		7 0 0	7 0 0	$y_n + \frac{2h}{3}[U_n + 4U_{n+1} + 2U_{n+2} + 4U_{n+3} + U_{n+3}]$ = y_{n+1} (cor)
032		6 2 5 9	1	2	7 0 0	7 0 1	y_{n+1} (tri) − y_{n+1} (cor) = δy_{n+1}

CARD NO	±	A	OP	±	B	C	REMARKS
033		6 1 4 9	1		3 7 0	1 7 0	$10^{-3} - 18y_{n+1}$
034		3 7 9	1 (x)		7 0 1	2	TR → (2;37) $10^{-3} - 18y_{n+1} > 0$
035		9	7 (x)		7 0 0	6 2 5	y_{n+1} (Cor) → $\bar{y}$
036		2 7 9	1		2		TR → (2;27) Recompute U_{n+3} With Corrected y_{n+1}
037		9 / 5				5	
038		9	7		7 0 0	3 2 3	Final y_{n+1} → [303+5n]
039		9 / 5				5	
040		9	7		7 0 3	3 2 1	Iden. → [301+5n]
041		5 9 / 5			5	5	
042		3 1 8 9	1	2	3 2 3	3 2 4	$y_{n+1} - y_{n+3} = \Delta y_{n+1}$ → [309+5n]
043		9 / 5				5	
044		9	7		6 2 6	3 2 5	Cor. U_{n+3} → [305+5n]
045		6 2 4 9	1	2	3 0 2	6 1 2	$\bar{x}_n - x_n = \Delta \bar{x}_n$
046		6 3 1 9	3		7 0 5	7 0 1	60 → 701
047		7 0 1 9	3		6 1 5	7 0 1	60h → 701
048		6 1 2 9	1	2	7 0 1	7 0 1	$\Delta \bar{x}_n - 60h$
049		5 1 9	1	2	7 0 1	2	$\Delta \bar{x}_n - 60h > 0$ TR → (2;51) Page of Results Comp
050		1 9	1			2	TR → (2;1) Continue Milne
051		3 0 1 9	6	0	6 0 5		Prime Storages 301 – 605 Insert cells (2;52) to (2;71)
052		9	7		5 F F	2 3 0 2	Store Last Four Lines of Page of Results in Storage Locations
053		9	7		5 F F	3 3 0 3	of Results of First Four Lines
054		9	7		5 F F	4 3 0 4	To Compare New Page of Results
055		9	7		5 F F	5 3 0 5	
056		9	7		5 F F	7 3 0 7	
057		9	7		5 F F	3 0 8	
058		9	7		5 F F	9 3 0 9	
059		9	7		5 F	0 3 1 0	
060		9	7		5 F	2 3 1 2	
061		9	7		5 F	3 3 1 3	
062		9	7		5 F	4 3 1 4	
063		9	7		5 F	5 3 1 6	
064		9	7		5 F	7 3 1 7	

FORM 501

ALL CARDS, COL'S 13,14
BLOCK NUMBER 01

INSTRUCTION DECK
SHACO FORM FOR 701, GROUP T-I

NOTE TO KEYPUNCHER:
PLEASE PUNCH ZEROES
FOR BLANKS.

CARD NO.	±	A	OP	±	B	C	REMARKS
065		9	7		5998	318	
066		9	7		5999	319	
067		9	7		6003	320	
068		9	7		6023	322	
069		9	7		6033	323	
070		9	7		6043	324	
071		9	7		6053	325	
072		19	11			3	TR → (3,1)
073		6249	x 1		7047	700	$\bar{x}-\pi/2$ Sears U Routine
074		9	x 9		7007	00	$\cos(\bar{x}-\pi/2)=\sin\bar{x}$
075		9	x 2		4246	999	$e^{\bar{x}}$
076		6255	x 3		4256	718	$\bar{y}^2$
077		7009	x 3		6997	00	$e^{\bar{x}}\sin\bar{x}$
078		7009	x 3		6978	00	$\bar{y}^2 e^{\bar{x}}\sin\bar{x}$
079		7009	x 1		2625	626	$\bar{y}^2 e^{\bar{x}}\sin\bar{x}-\bar{y}=U$
080		914			627		TR → Prosec (j,in) (End U Routine)
081		9					
082		9					
001		19	11			2	TR → (2,1) → To Milne and New Page of Results
084		9					
085		9					
086		9					
087		9					
088		9					
089		9					
090		9					
091		9					
092		9					
093		9					
094		9					
095		9					
096		9					

Blocs →

CARD NO.	±	A	OP	±	B	C	REMARKS
097		9					
098		9					
099		9					
100		9					
101		9					
102		9					
103		9					
104		9					
105		9					
106		9					
107		9					
108		9					
109		9					
110		9					
111		9					
112		9					
113		9					
114		9					
115		9					
116		9					
117		9					
118		9					
119		9					
120		9					
121		9					
122		9					
123		9					
124		9					
125		9					
126		9					
127		911					

FORM 502

NOTE TO KEYPUNCHER:
PLEASE PUNCH ZEROES
FOR BLANKS.

LOADING DECK
SHACO FORM FOR 701, GROUP T-1

ADDR	DECIMAL POINT DIGITS	EXPONENT	ADDR	DECIMAL POINT DIGITS	EXPONENT
9 10 11 12	13 14 15 16 17 18 19 20 21 22 23 24 25 26		27 28 29 30 31	32 33 34 35 36 37 38 39 40 41 42 43 44	
9 6 1 4	1 0 0 0 0 0 0 0 0 0 0 0 0 0	x 3	6 1 5	1 0 0 0 0 0 0 0 0 0 0 0 0 0	x 3
9 6 2 1	3 5 0 0 0 0 0 0 0 0 0 0 0 0	0	6 2 3	2 0 0 0 0 0 0 0 0 0 0 0 0 0	0
9 6 3 0	3 0 0 0 0 0 0 0 0 0 0 0 0 0	0	6 3 1	6 0 0 0 0 0 0 0 0 0 0 0 0 0	0
9 6 3 2	4 0 0 0 0 0 0 0 0 0 0 0 0 0	0	3 0 2	2 0 0 0 0 0 0 0 0 0 0 0 0 0	0
9 3 0 3	8 5 4 4 6 8 6 2 3 6 0 0 0	x 2			
9					
9					
9	STORAGES			USED	
9 3 0 1 6 0 5	L (Problem Results)			6 3 3 L (U_2)	
9 6 1 4	L (10^{-8})			6 3 4 L ($\frac{1}{2}U_{max}$)	
9 6 1 5	L (1)			6 3 5 L ($2U_{max}$)	
9 6 1 6	L (K)			6 3 6 L ($\frac{1}{4}U_{max}$)	
9 6 1 7	L (K_2)			6 3 7 L (U_{max})	
9 6 1 8	L (K_3)			6 4 0 L (U) Temporary	
9 6 1 9	L (K_4)			7 0 0 Erasable	
9 6 2 1	L (3.5)			7 0 1 Erasable	
9 6 2 3	L (2)			7 0 2 L ($\frac{1}{2}\pi^2$)	
9 6 2 4	L (π)			7 0 3 L (1)	
9 6 2 5	L (9)			7 0 4 L ($-\frac{1}{15}$)	
9 6 2 6	L (U)			7 0 5 L (10)	

LOADING DECK
SHACO FORM FOR 701, GROUP T-1

ADDR	DECIMAL POINT DIGITS	EXPONENT	ADDR	DECIMAL POINT DIGITS	EXPONENT
9 10 11 12	13 14 15 16 17 18 19 20 21 22 23 24 25 26		27 28 29 30 31	32 33 34 35 36 37 38 39 40 41 42 43 44	

FORM 502

.00	000	0	0	001	.11	0	000	001	0.000000000	999	0.000000000	-999	0.000000000	-999
.01	001	0	0	000	.07	0	302	638	0.000000000	-999	1.999999999	000	1.999999999	000
.01	002	0	0	000	.07	0	303	639	1.999999999	000	8.544686237	-002	8.544686237	-002
.01	003	0	0	005	.10	0	001	628	0.000000000	999	0.000000000	999	0.000762939	-001
.01	004	0	0	060	.11	0	000	001	0.000000000	-001	0.000762939	-001	0.000762939	-001
.01	060	0	0	000	.07	0	638	624	0.000762939	-001	1.999999999	000	1.999999999	000
.01	061	0	0	000	.07	0	639	625	1.999999999	000	8.544686237	-002	8.544686237	-002
.01	062	0	0	064	.10	0	001	627	0.000000000	-001	0.000000000	999	0.009765625	-001
.01	063	0	0	073	.11	0	000	002	0.000000000	-001	0.009765625	-001	0.009765625	-001
.02	073	0	0	624	.01	0	704	700	1.999999999	000	-1.570796326	000	4.292036731	-001
.02	074	0	0	000	.09	0	700	700	4.292036731	-001	4.292036731	-001	9.092974268	-001
.02	075	0	0	000	.02	0	624	699	9.092974268	-001	1.999999999	000	7.389056098	000
.02	076	0	0	625	.03	0	625	698	8.544686237	-002	8.544686237	-002	7.301166286	-003
.02	077	0	0	700	.03	0	699	700	9.092974268	-001	7.389056098	000	6.718849696	000
.02	078	0	0	700	.03	0	698	700	6.718849696	000	7.301166286	-003	4.905543889	-002
.02	079	0	0	700	.01	2	625	626	4.905543889	-002	-8.544686237	-002	-3.639142345	-002
.02	080	0	0	064	.14	0	627	001	-3.639142345	-002	0.009765625	-001	0.009765625	-001
.01	064	0	0	000	.07	0	626	640	0.009765625	-001	-3.639142345	-002	-3.639142345	-002
.01	065	0	0	615	.03	0	626	616	0.999999999	-003	-3.639142345	-002	-3.639142346	-005
.01	066	0	0	615	.04	0	623	629	0.999999999	-003	1.999999999	000	5.000000000	-004
.01	067	0	0	629	.01	0	638	624	5.000000000	-004	1.999999999	000	2.000499999	000
.01	068	0	0	616	.04	0	623	701	-3.639142346	-005	1.999999999	000	-1.819571173	-005
.01	069	0	0	701	.01	0	639	625	-1.819571173	-005	8.544686237	-002	8.542866666	-002
.01	070	0	0	072	.10	0	001	627	0.000000000	-001	0.000000000	999	0.010986328	-001
.01	071	0	0	073	.11	0	000	002	0.000000000	-001	0.010986328	-001	0.010986328	-001
.02	073	0	0	624	.01	0	704	700	2.000499999	000	-1.570796326	000	4.297036730	-001
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.02	075	0	0	000	.02	0	624	699	9.090892397	-001	2.000499999	000	7.392751549	000
.02	076	0	0	625	.03	0	625	698	8.542866666	-002	8.542866666	-002	7.298057084	-003
.02	077	0	0	700	.03	0	699	700	9.090892397	-001	7.392751549	000	6.720670885	000
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.02	079	0	0	700	.01	2	625	626	4.904783977	-002	-8.542866666	-002	-3.638082686	-002
.02	080	0	0	072	.14	0	627	001	-3.638082686	-002	0.010986328	-001	0.010986328	-001
.01	072	0	0	615	.03	0	626	617	0.999999999	-003	-3.638082686	-002	-3.638082686	-005
.01	073	0	0	617	.04	0	623	701	-3.638082686	-005	1.999999999	000	-1.819041343	-005
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.01	075	0	0	077	.10	0	001	627	0.000000000	-001	0.000000000	999	0.011749267	-001
.01	076	0	0	073	.11	0	000	002	0.000000000	-001	0.011749267	-001	0.011749267	-001
.02	073	0	0	624	.01	0	704	700	2.000499999	000	-1.570796326	000	4.297036730	-001
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.02	077	0	0	700	.03	0	699	700	9.090892397	-001	7.392751549	000	6.720670885	000
.02	078	0	0	700	.03	0	698	700	6.720670885	000	7.298057989	-003	4.904784585	-002
.02	079	0	0	700	.01	2	625	626	4.904784585	-002	-8.542867196	-002	-3.638082608	-002
.02	080	0	0	077	.14	0	627	001	-3.638082608	-002	0.011749267	-001	0.011749267	-001
.01	077	0	0	615	.03	0	626	618	0.999999999	-003	-3.638082608	-002	-3.638082608	-005
.01	078	0	0	615	.01	0	638	624	0.999999999	-003	1.999999999	000	2.000999999	000
.01	079	0	0	618	.01	0	639	625	-3.638082608	-005	8.544686237	-002	8.541048155	-002
.01	080	0	0	082	.10	0	001	627	0.000000000	-001	0.000000000	999	0.012512207	-001
.01	081	0	0	073	.11	0	000	002	0.000000000	-001	0.012512207	-001	0.012512207	-001
.02	073	0	0	624	.01	0	704	700	2.000999999	000	-1.570796326	000	4.302036731	-001
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.02	075	0	0	000	.02	0	624	699	9.088808253	-001	2.000999999	000	7.396448850	000
.02	076	0	0	625	.03	0	625	698	8.541048155	-002	8.541048155	-002	7.294950355	-003
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.01	082	0	0	615	.03	0	626	619	0.999999999	-003	-3.637024680	-002	-3.637024680	-005
.01	083	0	0	617	.03	0	623	617	-3.638082686	-005	1.999999999	000	-7.276165373	-005
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.01	085	0	0	616	.01	0	617	617	-3.639142346	-005	-7.276165373	-005	-1.091530771	-004
.01	086	0	0	617	.01	0	618	618	-1.091530771	-004	-7.276165217	-005	-1.819147293	-004
.01	087	0	0	618	.01	0	619	619	-1.819147293	-004	-3.637024680	-005	-2.182849761	-004
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.01	089	0	0	005	.14	0	628	001	-3.638082936	-005	0.000762939	-001	0.000762939	-001
.01	005	1	0	000	.07	0	640	305	0.000762939	-001	-3.639142345	-002	-3.639142345	-002
.01	006	1	0	615	.01	0	302	307	0.999999999	-003	1.999999999	000	2.000999999	000
.01	007	1	0	619	.01	0	303	308	-3.638082936	-005	8.544686237	-002	8.541048154	-002
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.01	011	0	0	013	.10	0	001	628	0.000000000	999	0.000000000	999	0.001983642	-001
.01	012	0	0	060	.11	0	000	001	0.000000000	-001	0.001983642	-001	0.001983642	-001
.01	060	0	0	000	.07	0	638	624	0.001983642	-001	2.000999999	000	2.000999999	000
.01	061	0	0	000	.07	0	639	625	2.000999999	000	8.541048154	-002	8.541048154	-002
.01	062	0	0	064	.10	0	001	627	0.000000000	-001	0.000000000	999	0.009765625	-001
.01	063	0	0	073	.11	0	000	002	0.000000000	-001	0.009765625	-001	0.009765625	-001
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.02	080	0	0	064	.14	0	627	001	-3.637024680	-002	0.009765625	-001	0.009765625	-001
.01	064	0	0	000	.07	0	626	640	0.009765625	-001	-3.637024680	-002	-3.637024680	-002
.01	065	0	0	615	.03	0	626	616	0.999999999	-003	-3.637024680	-002	-3.637024680	-005
.01	066	0	0	615	.04	0	623	629	0.999999999	-003	1.999999999	000	5.000000000	-004
.01	067	0	0	629	.01	0	638	624	5.000000000	-004	2.000999999	000	2.001499999	000
.01	068	0	0	516	.04	0	623	701	-3.637024680	-005	1.999999999	000	-1.818512340	-005
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.01	070	0	0	072	.10	0	001	627	0.000000000	-001	0.000000000	999	0.010986328	-001
.01	071	0	0	073	.11	0	000	002	0.000000000	-001	0.010986328	-001	0.010986328	-001
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.02	075	0	0	000	.02	0	624	699	9.086721838	-001	2.001499999	000	7.400147999	000
.02	076	0	0	625	.03	0	625	698	8.539229642	-002	8.539229642	-002	7.291844284	-003
.02	077	0	0	700	.03	0	699	700	9.086721838	-001	7.400147999	000	6.724308643	000
.02	078	0	0	700	.03	0	698	700	6.724308643	000	7.291844284	-003	4.903261155	-002
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.01	073	0	0	617	.04	0	623	701	-3.635968485	-005	1.999999999	000	-1.817984242	-005
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.01	075	0	0	077	.10	0	001	627	0.000000000	-001	0.000000000	999	0.011749267	-001
.01	076	0	0	073	.11	0	000	002	0.000000000	-001	0.011749267	-001	0.011749267	-001
.02	073	0	0	624	.01	0	704	700	2.001499999	000	-1.570796326	000	4.307036731	-001
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.02	080	0	0	077	.14	0	627	001	-3.635968406	-002	0.011749267	-001	0.011749267	-001
.01	077	0	0	615	.03	0	626	618	0.999999999	-003	-3.635968406	-002	-3.635968406	-005
.01	078	0	0	615	.01	0	638	624	0.999999999	-003	2.000999999	000	2.001999999	000
.01	079	0	0	618	.01	0	639	625	-3.635968406	-005	8.541048154	-002	8.537412186	-002
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.01	081	0	0	073	.11	0	000	002	0.000000000	-001	0.012512207	-001	0.012512207	-001
.02	073	0	0	624	.01	0	704	700	2.001999999	000	-1.570796326	000	4.312036732	-001
.02	074	0	0	000	.09	0	700	700	4.312036732	-001	4.312036732	-001	9.084633150	-001
.02	075	0	0	000	.02	0	624	699	9.084633150	-001	2.001999999	000	7.403848999	000

.02	076	0	0	625	.03	0	625	698	8.537412186	-002	8.537412186	-002	7.288740680	-003
.02	077	0	0	700	.03	0	699	700	9.084633150	-001	7.403848999	000	6.726125206	000
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.01	082	0	0	615	.03	0	626	619	0.999999999	-003	-3.634913942	-002	-3.634913942	-005
.01	083	0	0	617	.03	0	623	617	-3.635968485	-005	1.999999999	000	-7.271936970	-005
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.01	089	0	0	013	.14	0	628	001	-3.635968734	-005	0.001983642	-001	0.001983642	-001
.01	013	1	0	000	.07	0	640	310	0.001983642	-001	-3.637024680	-002	-3.637024680	-002
.01	014	1	0	615	.01	0	307	312	0.999999999	-003	2.000999999	000	2.001999999	000
.01	015	1	0	619	.01	0	308	313	-3.635968734	-005	8.541048154	-002	8.537412186	-002
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.01	017	0	0	000	.07	0	312	638	3.635968734	-005	2.001999999	000	2.001999999	000
.01	018	0	0	000	.07	0	313	639	2.001999999	000	8.537412186	-002	8.537412186	-002
.01	019	0	0	021	.10	0	001	628	0.000000000	999	0.000000000	999	0.003204345	-001
.01	020	0	0	060	.11	0	000	001	0.000000000	-001	0.003204345	-001	0.003204345	-001
.01	060	0	0	000	.07	0	638	624	0.003204345	-001	2.001999999	000	2.001999999	000
.01	061	0	0	000	.07	0	639	625	2.001999999	000	8.537412186	-002	8.537412186	-002
.01	062	0	0	064	.10	0	001	627	0.000000000	-001	0.000000000	999	0.009765625	-001
.01	063	0	0	073	.11	0	000	002	0.000000000	-001	0.009765625	-001	0.009765625	-001
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.02	080	0	0	064	.14	0	627	001	-3.634913942	-002	0.009765625	-001	0.009765625	-001
.01	064	0	0	000	.07	0	626	640	0.009765625	-001	-3.634913942	-002	-3.634913942	-002
.01	065	0	0	615	.03	0	626	616	0.999999999	-003	-3.634913942	-002	-3.634913942	-005
.01	066	0	0	615	.04	0	623	629	0.999999999	-003	1.999999999	000	5.000000000	-004
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.01	023	1	0	619	.01	0	313	318	-3.633861461	-005	8.537412186	-002	8.533778324	-002
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.02	079	0	0	700	.01	2	625	626	-9.377294572	-003	-1.855883972 -002	-2.793613429 -002
.02	080	0	0	029	.14	0	627	002	-2.793613429	-002	0.008892404 -001	0.008892404 -001
.02	029	0	0	626	.03	0	615	700	-2.793613429	-002	0.999999999 -003	-2.793613429 -005
.02	030	0	0	700	.04	0	630	700	-2.793613429	-005	2.999999999 000	-9.312044765 -006
.02	031	0	0	701	.01	0	700	700	1.856815181	-002	-9.312044765 -006	1.855883976 -002
.02	032	0	0	625	.01	2	700	701	1.855883972	-002	-1.855883976 -002	-4.456524038 -011
.02	033	0	0	614	.01	3	701	701	0.999999999	-003	-4.456524038 -011	9.999999554 -004
.02	034	0	0	037	.12	0	701	002	-9.940338765	999	9.999999554 -004	9.999999554 -004
.02	037	0	0	000	.15	0	000	005	9.999999554	-004	9.999999554 -004	9.999999554 -004
.02	038	1	0	000	.07	0	700	333	9.999999554	-004	1.855883976 -002	1.855883976 -002
.02	039	0	0	000	.15	0	000	005	1.855883976	-002	1.855883976 -002	1.855883976 -002

02	051	X 301	605	y	-Δy	U
1.000000000	000	1.999999999	000	8.544686237 -002	0.000000000 -002	-3.639142345 -002
1.000000000	000	2.000999999	000	8.541048154 -002	3.638082936 -005	-3.637024680 -002
1.000000000	000	2.001999999	000	8.537412186 -002	3.635968734 -005	-3.634913942 -002
1.000000000	000	2.002999999	000	8.533778324 -002	3.633861461 -005	-3.632810134 -002
1.000000000	000	2.004000000	000	8.530146563 -002	3.631761117 -005	-3.630713254 -002
1.000000000	000	2.005000000	000	8.526516896 -002	3.629667480 -005	-3.628623303 -002
1.000000000	000	2.006000000	000	8.522889314 -002	3.627581827 -005	-3.626540281 -002
1.000000000	000	2.007000000	000	8.519263813 -002	3.625501267 -005	-3.624464189 -002
1.000000000	000	2.008000000	000	8.515640383 -002	3.623429074 -005	-3.622395025 -002
1.000000000	000	2.009000000	000	8.512019020 -002	3.621363066 -005	-3.620332792 -002
1.000000000	000	2.010000000	000	8.508399715 -002	3.619305425 -005	-3.618277487 -002
1.000000000	000	2.011000000	000	8.504782463 -002	3.617252150 -005	-3.616229113 -002
1.000000000	000	2.012000000	000	8.501167255 -002	3.615207606 -005	-3.614187668 -002
1.000000000	000	2.013000000	000	8.497554086 -002	3.613169610 -005	-3.612153153 -002
1.000000000	000	2.014000000	000	8.493942946 -002	3.611139982 -005	-3.610125569 -002
1.000000000	000	2.015000000	000	8.490333832 -002	3.609113991 -005	-3.608104914 -002
1.000000000	000	2.016000000	000	8.486726735 -002	3.607097096 -005	-3.606091190 -002
1.000000000	000	2.017000000	000	8.483121648 -002	3.605087113 -005	-3.604084397 -002
1.000000000	000	2.018000000	000	8.479518562 -002	3.603085133 -005	-3.602084534 -002
1.000000000	000	2.019000000	000	8.475917476 -002	3.601086791 -005	-3.600091602 -002
1.000000000	000	2.020000000	000	8.472318378 -002	3.599097544 -005	-3.598105600 -002
1.000000000	000	2.021000000	000	8.468721263 -002	3.597115573 -005	-3.596126530 -002
1.000000000	000	2.022000000	000	8.465126122 -002	3.595140879 -005	-3.594154392 -002
1.000000000	000	2.023000000	000	8.461532951 -002	3.593170549 -005	-3.592189184 -002
1.000000000	000	2.024000000	000	8.457941742 -002	3.591208951 -005	-3.590230908 -002
1.000000000	000	2.025000001	000	8.454352487 -002	3.589254993 -005	-3.588279564 -002
1.000000000	000	2.026000001	000	8.450765179 -002	3.587307583 -005	-3.586335152 -002
1.000000000	000	2.027000001	000	8.447179814 -002	3.585365266 -005	-3.584397672 -002
1.000000000	000	2.028000001	000	8.443596383 -002	3.583431316 -005	-3.582467123 -002
1.000000000	000	2.029000001	000	8.440014878 -002	3.581505006 -005	-3.580543507 -002
1.000000000	000	2.030000001	000	8.436435292 -002	3.579585609 -005	-3.578626824 -002
1.000000000	000	2.031000001	000	8.432857622 -002	3.577670577 -005	-3.576717074 -002
1.000000000	000	2.032000001	000	8.429281857 -002	3.575764640 -005	-3.574814255 -002
1.000000000	000	2.033000001	000	8.425707991 -002	3.573865978 -005	-3.572918371 -002
1.000000000	000	2.034000001	000	8.422136017 -002	3.571974229 -005	-3.571029418 -002
1.000000000	000	2.035000001	000	8.418565930 -002	3.570087210 -005	-3.569147400 -002
1.000000000	000	2.036000001	000	8.414997721 -002	3.568208921 -005	-3.567272314 -002
1.000000000	000	2.037000001	000	8.411431383 -002	3.566337545 -005	-3.565404162 -002
1.000000000	000	2.038000001	000	8.407866909 -002	3.564474172 -005	-3.563542944 -002
1.000000000	000	2.039000001	000	8.404304294 -002	3.562614438 -005	-3.561688660 -002
1.000000000	000	2.040000001	000	8.400743530 -002	3.560764162 -005	-3.559841310 -002
1.000000000	000	2.041000001	000	8.397184610 -002	3.558920434 -005	-3.558000894 -002
1.000000000	000	2.042000001	000	8.393627525 -002	3.557084710 -005	-3.556167412 -002
1.000000000	000	2.043000001	000	8.390072273 -002	3.555252624 -005	-3.554340865 -002
1.000000000	000	2.044000001	000	8.386518842 -002	3.553430360 -005	-3.552521252 -002
1.000000000	000	2.045000001	000	8.382967228 -002	3.551614281 -005	-3.550708574 -002
1.000000000	000	2.046000002	000	8.379417422 -002	3.549806206 -005	-3.548902831 -002
1.000000000	000	2.047000002	000	8.375869420 -002	3.548001768 -005	-3.547104024 -002
1.000000000	000	2.048000002	000	8.372323212 -002	3.546207881 -005	-3.545312151 -002
1.000000000	000	2.049000002	000	8.368778793 -002	3.544418723 -005	-3.543527214 -002
1.000000000	000	2.050000002	000	8.365236155 -002	3.542638660 -005	-3.541749212 -002
1.000000000	000	2.051000002	000	8.361695293 -002	3.540861871 -005	-3.539978146 -002
1.000000000	000	2.052000002	000	8.358156197 -002	3.539095996 -005	-3.538214016 -002
1.000000000	000	2.053000002	000	8.354618862 -002	3.537334487 -005	-3.536456821 -002
1.000000000	000	2.054000002	000	8.351083280 -002	3.535582072 -005	-3.534706564 -002
1.000000000	000	2.055000002	000	8.347549447 -002	3.533833296 -005	-3.532963242 -002
1.000000000	000	2.056000002	000	8.344017352 -002	3.532095070 -005	-3.531226857 -002
1.000000000	000	2.057000002	000	8.340486991 -002	3.530360845 -005	-3.529497408 -002
1.000000000	000	2.058000002	000	8.336958354 -002	3.528636807 -005	-3.527774896 -002
1.000000000	000	2.059000002	000	8.333431439 -002	3.526915315 -005	-3.526059320 -002
1.000000000	000	2.060000002	000	8.329906234 -002	3.525205102 -005	-3.524350681 -002

02	051	X 301	605	y	-Δy	U
1.000000000	000	2.672000031	000	6.236320984 -002	3.688989454 -005	-3.689886609 -002
1.000000000	000	2.673000031	000	6.232630197 -002	3.690786979 -005	-3.691682718 -002
1.000000000	000	2.674000031	000	6.228937619 -002	3.692577411 -005	-3.693480880 -002
1.000000000	000	2.675000031	000	6.225243237 -002	3.694382394 -005	-3.695281070 -002
1.000000000	000	2.676000031	000	6.221547054 -002	3.696182284 -005	-3.697083267 -002
1.000000000	000	2.677000031	000	6.217849067 -002	3.697987631 -005	-3.698887448 -002
1.000000000	000	2.678000032	000	6.214149281 -002	3.699786066 -005	-3.700693591 -002
1.000000000	000	2.679000032	000	6.210447682 -002	3.701599052 -005	-3.702501670 -002
1.000000000	000	2.680000032	000	6.206744275 -002	3.703406764 -005	-3.704311666 -002
1.000000000	000	2.681000032	000	6.203039055 -002	3.705219933 -005	-3.706123552 -002
1.000000000	000	2.682000032	000	6.199332029 -002	3.707026007 -005	-3.707937310 -002
1.000000000	000	2.683000032	000	6.195623183 -002	3.708846452 -005	-3.709752913 -002
1.000000000	000	2.684000032	000	6.191912521 -002	3.710661803 -005	-3.711570340 -002
1.000000000	000	2.685000032	000	6.188200039 -002	3.712482248 -005	-3.713389566 -002
1.000000000	000	2.686000032	000	6.184485743 -002	3.714295598 -005	-3.715210570 -002
1.000000000	000	2.687000032	000	6.180769619 -002	3.716123501 -005	-3.717033327 -002
1.000000000	000	2.688000032	000	6.177051674 -002	3.717945583 -005	-3.718857814 -002
1.000000000	000	2.689000032	000	6.173331901 -002	3.719773303 -005	-3.720684008 -002
1.000000000	000	2.690000032	000	6.169610307 -002	3.721593384 -005	-3.722511887 -002
1.000000000	000	2.691000032	000	6.165886879 -002	3.723428199 -005	-3.724341425 -002
1.000000000	000	2.692000032	000	6.162161622 -002	3.725257192 -005	-3.726172600 -002
1.000000000	000	2.693000032	000	6.158434530 -002	3.727091279 -005	-3.728005387 -002
1.000000000	000	2.694000032	000	6.154705612 -002	3.728918090 -005	-3.729839766 -002
1.000000000	000	2.695000032	000	6.150974853 -002	3.730759272 -005	-3.731675710 -002
1.000000000	000	2.696000032	000	6.147242258 -002	3.732594632 -005	-3.733513195 -002
1.000000000	000	2.697000032	000	6.143507824 -002	3.734434903 -005	-3.735352199 -002
1.000000000	000	2.698000032	000	6.139771555 -002	3.736268081 -005	-3.737192699 -002
1.000000000	000	2.699000033	000	6.136033440 -002	3.738115083 -005	-3.739034670 -002
1.000000000	000	2.700000033	000	6.132293484 -002	3.739956810 -005	-3.740878087 -002
1.000000000	000	2.701000033	000	6.128551681 -002	3.741802538 -005	-3.742722928 -002
1.000000000	000	2.702000033	000	6.124808039 -002	3.743641718 -005	-3.744569168 -002
1.000000000	000	2.703000033	000	6.121062545 -002	3.745494359 -005	-3.746416783 -002
1.000000000	000	2.704000033	000	6.117315203 -002	3.747341725 -005	-3.748265749 -002
1.000000000	000	2.705000033	000	6.113566010 -002	3.749192910 -005	-3.750116042 -002
1.000000000	000	2.706000033	000	6.109814973 -002	3.751037547 -005	-3.751967639 -002
1.000000000	000	2.707000033	000	6.106062077 -002	3.752895463 -005	-3.753820514 -002
1.000000000	000	2.708000033	000	6.102307329 -002	3.754748104 -005	-3.755674644 -002
1.000000000	000	2.709000033	000	6.098550725 -002	3.756604382 -005	-3.757530004 -002
1.000000000	000	2.710000033	000	6.094792271 -002	3.758453931 -005	-3.759386570 -002
1.000000000	000	2.711000033	000	6.091031954 -002	3.760316758 -005	-3.761244317 -002
1.000000000	000	2.712000033	000	6.087269780 -002	3.762174492 -005	-3.763103222 -002
1.000000000	000	2.713000033	000	6.083505745 -002	3.764035136 -005	-3.764963258 -002
1.000000000	000	2.714000033	000	6.079739855 -002	3.765889596 -005	-3.766824405 -002
1.000000000	000	2.715000033	000	6.075972098 -002	3.767756788 -005	-3.768686634 -002
1.000000000	000	2.716000033	000	6.072202479 -002	3.769619070 -005	-3.770549922 -002
1.000000000	000	2.717000033	000	6.068430995 -002	3.771483898 -005	-3.772414245 -002
1.000000000	000	2.718000033	000	6.064657653 -002	3.773342541 -005	-3.774279578 -002
1.000000000	000	2.719000033	000	6.060882438 -002	3.775214281 -005	-3.776145896 -002
1.000000000	000	2.720000034	000	6.057105358 -002	3.777080200 -005	-3.778013174 -002
1.000000000	000	2.721000034	000	6.053326409 -002	3.778949212 -005	-3.779881387 -002
1.000000000	000	2.722000034	000	6.049545597 -002	3.780811493 -005	-3.781750512 -002
1.000000000	000	2.723000034	000	6.045762910 -002	3.782687053 -005	-3.783620522 -002
1.000000000	000	2.724000034	000	6.041978354 -002	3.784556611 -005	-3.785491392 -002
1.000000000	000	2.725000034	000	6.038191925 -002	3.786429260 -005	-3.787363099 -002
1.000000000	000	2.726000034	000	6.034403630 -002	3.788294998 -005	-3.789235618 -002
1.000000000	000	2.727000034	000	6.030613456 -002	3.790173832 -005	-3.791108920 -002
1.000000000	000	2.728000034	000	6.026821409 -002	3.792046481 -005	-3.792982985 -002
1.000000000	000	2.729000034	000	6.023027487 -002	3.793922405 -005	-3.794857785 -002
1.000000000	000	2.730000034	000	6.019231696 -002	3.795791053 -005	-3.796733296 -002
1.000000000	000	2.731000034	000	6.015434022 -002	3.797673161 -005	-3.798609491 -002
1.000000000	000	2.732000034	000	6.011634474 -002	3.799548358 -005	-3.800486347 -002

02	051	x 301	605	y	−Δy	U
1.000000000	000	3.680000079	000	2.209685022 −002	3.204841686 −005	−3.202313083 −002
1.000000000	000	3.681000079	000	2.206485233 −002	3.199788716 −005	−3.198889144 −002
1.000000000	000	3.682000079	000	2.203287444 −002	3.197788555 −005	−3.195461095 −002
1.000000000	000	3.683000079	000	2.200094314 −002	3.193130396 −005	−3.192034061 −002
1.000000000	000	3.684000079	000	2.196903178 −002	3.191135965 −005	−3.188602937 −002
1.000000000	000	3.685000079	000	2.193717104 −002	3.186074081 −005	−3.185173630 −002
1.000000000	000	3.686000079	000	2.190533032 −002	3.184072193 −005	−3.181740280 −002
1.000000000	000	3.687000079	000	2.187353627 −002	3.179405120 −005	−3.178308035 −002
1.000000000	000	3.688000079	000	2.184176217 −002	3.177409234 −005	−3.174871765 −002
1.000000000	000	3.689000079	000	2.181003879 −002	3.172338528 −005	−3.171437406 −002
1.000000000	000	3.690000079	000	2.177833543 −002	3.170335275 −005	−3.167999068 −002
1.000000000	000	3.691000079	000	2.174667884 −002	3.165659654 −005	−3.164561927 −002
1.000000000	000	3.692000079	000	2.171504221 −002	3.163662495 −005	−3.161120825 −002
1.000000000	000	3.693000079	000	2.168345638 −002	3.158583422 −005	−3.157681727 −002
1.000000000	000	3.694000079	000	2.165189059 −002	3.156579077 −005	−3.154238714 −002
1.000000000	000	3.695000080	000	2.162037164 −002	3.151895180 −005	−3.150796987 −002
1.000000000	000	3.696000080	000	2.158887266 −002	3.149897202 −005	−3.147351365 −002
1.000000000	000	3.697000080	000	2.155742457 −002	3.144809852 −005	−3.143907837 −002
1.000000000	000	3.698000080	000	2.152599652 −002	3.142804780 −005	−3.140460459 −002
1.000000000	000	3.699000080	000	2.149461539 −002	3.138112970 −005	−3.137014456 −002
1.000000000	000	3.700000080	000	2.146325424 −002	3.136114446 −005	−3.133564621 −002
1.000000000	000	3.701000080	000	2.143194405 −002	3.131019184 −005	−3.130116972 −002
1.000000000	000	3.702000080	000	2.140065392 −002	3.129013657 −005	−3.126665535 −002
1.000000000	000	3.703000080	000	2.136941078 −002	3.124314207 −005	−3.123215564 −002
1.000000000	000	3.704000080	000	2.133818762 −002	3.122315501 −005	−3.119761823 −002
1.000000000	000	3.705000080	000	2.130701549 −002	3.117212599 −005	−3.116310358 −002
1.000000000	000	3.706000080	000	2.127586342 −002	3.115207073 −005	−3.112855168 −002
1.000000000	000	3.707000080	000	2.124475842 −002	3.110500074 −005	−3.109401532 −002
1.000000000	000	3.708000080	000	2.121367341 −002	3.108501550 −005	−3.105944189 −002
1.000000000	000	3.709000080	000	2.118263949 −002	3.103391281 −005	−3.102489211 −002
1.000000000	000	3.710000080	000	2.115162563 −002	3.101386118 −005	−3.099030571 −002
1.000000000	000	3.711000080	000	2.112065891 −002	3.096671935 −005	−3.095573572 −002
1.000000000	000	3.712000080	000	2.108971217 −002	3.094673865 −005	−3.092112928 −002
1.000000000	000	3.713000080	000	2.105881661 −002	3.089556412 −005	−3.088654738 −002
1.000000000	000	3.714000080	000	2.102794109 −002	3.087551976 −005	−3.085192948 −002
1.000000000	000	3.715000080	000	2.099711278 −002	3.082830880 −005	−3.081732886 −002
1.000000000	000	3.716000081	000	2.096630445 −002	3.080833539 −005	−3.078269239 −002
1.000000000	000	3.717000081	000	2.093554735 −002	3.075709446 −005	−3.074808136 −002
1.000000000	000	3.718000081	000	2.090481029 −002	3.073705829 −005	−3.071343492 −002
1.000000000	000	3.719000081	000	2.087412051 −002	3.068978185 −005	−3.067880664 −002
1.000000000	000	3.720000081	000	2.084345069 −002	3.066981753 −005	−3.064414311 −002
1.000000000	000	3.721000081	000	2.081283218 −002	3.061851384 −005	−3.060950590 −002
1.000000000	000	3.722000081	000	2.078223369 −002	3.059848859 −005	−3.057483388 −002
1.000000000	000	3.723000081	000	2.075168254 −002	3.055114939 −005	−3.054018087 −002
1.000000000	000	3.724000081	000	2.072115134 −002	3.053119871 −005	−3.050549323 −002
1.000000000	000	3.725000081	000	2.069067151 −002	3.047983227 −005	−3.047083276 −002
1.000000000	000	3.726000081	000	2.066021169 −002	3.045982430 −005	−3.043613809 −002
1.000000000	000	3.727000081	000	2.062979926 −002	3.041242325 −005	−3.040146328 −002
1.000000000	000	3.728000081	000	2.059940678 −002	3.039248895 −005	−3.036675442 −002
1.000000000	000	3.729000081	000	2.056906571 −002	3.034106521 −005	−3.033207361 −002
1.000000000	000	3.730000081	000	2.053874463 −002	3.032107451 −005	−3.029735917 −002
1.000000000	000	3.731000081	000	2.050847102 −002	3.027361435 −005	−3.026266545 −002
1.000000000	000	3.732000081	000	2.047821732 −002	3.025370188 −005	−3.022793825 −002
1.000000000	000	3.733000081	000	2.044801510 −002	3.020221993 −005	−3.019323998 −002
1.000000000	000	3.734000081	000	2.041783285 −002	3.018225197 −005	−3.015850865 −002
1.000000000	000	3.735000081	000	2.038769811 −002	3.013473724 −005	−3.012379888 −002
1.000000000	000	3.736000081	000	2.035758326 −002	3.011484659 −005	−3.008905622 −002
1.000000000	000	3.737000082	000	2.032751995 −002	3.006331098 −005	−3.005434332 −002
1.000000000	000	3.738000082	000	2.029747658 −002	3.004336758 −005	−3.001959795 −002
1.000000000	000	3.739000082	000	2.026748078 −002	2.999580101 −005	−2.998487496 −002
1.000000000	000	3.740000082	000	2.023750485 −002	2.997593583 −005	−2.995011965 −002

X 02 029	Y 301 605		X	Y
1.999999999 000	8.544686236 -002	1.000000000 000	2.999999999 000	4.929376088 -002
2.000999999 000	8.541048154 -002	1.000000000 000	3.000999999 000	4.925134910 -002
2.001999999 000	8.537412185 -002	1.000000000 000	3.001999999 000	4.920892652 -002
2.002999999 000	8.533778323 -002	1.000000000 000	3.003000000 000	4.916649318 -002
2.004000000 000	8.530146561 -002	1.000000000 000	3.004000000 000	4.912404917 -002
2.005000000 000	8.526516894 -002	1.000000000 000	3.005000000 000	4.908159454 -002
2.006000000 000	8.522889312 -002	1.000000000 000	3.006000000 000	4.903912936 -002
2.007000000 000	8.519263810 -002	1.000000000 000	3.007000000 000	4.899665370 -002
2.008000000 000	8.515640381 -002	1.000000000 000	3.008000000 000	4.895416761 -002
2.009000000 000	8.512019018 -002	1.000000000 000	3.009000000 000	4.891167117 -002
2.010000000 000	8.508399713 -002	1.000000000 000	3.010000000 000	4.886916444 -002
2.011000000 000	8.504782460 -002	1.000000000 000	3.011000000 000	4.882664749 -002
2.012000000 000	8.501167252 -002	1.000000000 000	3.012000000 000	4.878412038 -002
2.013000000 000	8.497554082 -002	1.000000000 000	3.013000000 000	4.874158318 -002
2.014000000 000	8.493942943 -002	1.000000000 000	3.014000000 000	4.869903596 -002
2.015000000 000	8.490333828 -002	1.000000000 000	3.015000000 000	4.865647878 -002
2.016000000 000	8.486726731 -002	1.000000000 000	3.016000000 000	4.861391171 -002
2.017000000 000	8.483121643 -002	1.000000000 000	3.017000000 000	4.857133482 -002
2.018000000 000	8.479518559 -002	1.000000000 000	3.018000000 000	4.852874818 -002
2.019000000 000	8.475917471 -002	1.000000000 000	3.019000000 000	4.848615184 -002
2.020000000 000	8.472318374 -002	1.000000000 000	3.020000000 000	4.844354589 -002
2.021000000 000	8.468721258 -002	1.000000000 000	3.021000000 000	4.840093039 -002
2.022000000 000	8.465126118 -002	1.000000000 000	3.022000000 000	4.835830540 -002
2.023000000 000	8.461532947 -002	1.000000000 000	3.023000000 000	4.831567101 -002
2.024000000 000	8.457941737 -002	1.000000000 000	3.024000001 000	4.827302726 -002
2.025000001 000	8.454352482 -002	1.000000000 000	3.025000001 000	4.823037424 -002
2.026000001 000	8.450765175 -002	1.000000000 000	3.026000001 000	4.818771201 -002
2.027000001 000	8.447179809 -002	1.000000000 000	3.027000001 000	4.814504065 -002
2.028000001 000	8.443596377 -002	1.000000000 000	3.028000001 000	4.810236022 -002
2.029000001 000	8.440014872 -002	1.000000000 000	3.029000001 000	4.805967079 -002
2.030000001 000	8.436435287 -002	1.000000000 000	3.030000001 000	4.801697243 -002
2.031000001 000	8.432857616 -002	1.000000000 000	3.031000001 000	4.797426521 -002
2.032000001 000	8.429281850 -002	1.000000000 000	3.032000001 000	4.793154920 -002
2.033000001 000	8.425707985 -002	1.000000000 000	3.033000001 000	4.788882448 -002
2.034000001 000	8.422136011 -002	1.000000000 000	3.034000001 000	4.784609111 -002
2.035000001 000	8.418565923 -002	1.000000000 000	3.035000001 000	4.780334915 -002
2.036000001 000	8.414997713 -002	1.000000000 000	3.036000001 000	4.776059870 -002
2.037000001 000	8.411431376 -002	1.000000000 000	3.037000001 000	4.771783982 -002
2.038000001 000	8.407866903 -002	1.000000000 000	3.038000001 000	4.767507257 -002
2.039000001 000	8.404304287 -002	1.000000000 000	3.039000001 000	4.763229704 -002
2.040000001 000	8.400743522 -002	1.000000000 000	3.040000001 000	4.758951328 -002
2.041000001 000	8.397184603 -002	1.000000000 000	3.041000001 000	4.754672138 -002
2.042000001 000	8.393627518 -002	1.000000000 000	3.042000001 000	4.750392140 -002
2.043000001 000	8.390072265 -002	1.000000000 000	3.043000001 000	4.746111342 -002
2.044000001 000	8.386518834 -002	1.000000000 000	3.044000001 000	4.741829751 -002
2.045000001 000	8.382967220 -002	1.000000000 000	3.045000002 000	4.737547376 -002
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2.047000002 000	8.375869411 -002	1.000000000 000	3.047000002 000	4.728980296 -002
2.048000002 000	8.372323203 -002	1.000000000 000	3.048000002 000	4.724695607 -002
2.049000002 000	8.368778784 -002	1.000000000 000	3.049000002 000	4.720410162 -002
2.050000002 000	8.365236146 -002	1.000000000 000	3.050000002 000	4.716123968 -002
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2.054000002 000	8.351083271 -002	1.000000000 000	3.054000002 000	4.698971850 -002
2.055000002 000	8.347549436 -002	1.000000000 000	3.055000002 000	4.694682022 -002
2.056000002 000	8.344017341 -002	1.000000000 000	3.056000002 000	4.690391491 -002
2.057000002 000	8.340486981 -002	1.000000000 000	3.057000002 000	4.686100262 -002
2.058000002 000	8.336958345 -002	1.000000000 000	3.058000002 000	4.681808345 -002
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2.060000002 000	8.329906224 -002	1.000000000 000	3.060000002 000	4.673222472 -002 +

X 02	029	Y 301	605			X		Y	
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2.672000031	000	6.236320873	-002	1.000000000	000	3.672000031	000	2.235413285	-002
2.673000031	000	6.232630088	-002	1.000000000	000	3.673000031	000	2.232185326	-002
2.674000031	000	6.228937506	-002	1.000000000	000	3.674000031	000	2.228960781	-002
2.675000031	000	6.225243126	-002	1.000000000	000	3.675000031	000	2.225739653	-002
2.676000031	000	6.221546944	-002	1.000000000	000	3.676000031	000	2.222521943	-002
2.677000031	000	6.217848959	-002	1.000000000	000	3.677000032	000	2.219307651	-002
2.678000032	000	6.214149168	-002	1.000000000	000	3.678000032	000	2.216096780	-002
2.679000032	000	6.210447570	-002	1.000000000	000	3.679000032	000	2.212889330	-002
2.680000032	000	6.206744164	-002	1.000000000	000	3.680000032	000	2.209685304	-002
2.681000032	000	6.203038945	-002	1.000000000	000	3.681000032	000	2.206484704	-002
2.682000032	000	6.199331915	-002	1.000000000	000	3.682000032	000	2.203287529	-002
2.683000032	000	6.195623071	-002	1.000000000	000	3.683000032	000	2.200093781	-002
2.684000032	000	6.191912408	-002	1.000000000	000	3.684000032	000	2.196903463	-002
2.685000032	000	6.188199929	-002	1.000000000	000	3.685000032	000	2.193716575	-002
2.686000032	000	6.184485629	-002	1.000000000	000	3.686000032	000	2.190533118	-002
2.687000032	000	6.180769507	-002	1.000000000	000	3.687000032	000	2.187353094	-002
2.688000032	000	6.177051561	-002	1.000000000	000	3.688000032	000	2.184176504	-002
2.689000032	000	6.173331790	-002	1.000000000	000	3.689000032	000	2.181003350	-002
2.690000032	000	6.169610192	-002	1.000000000	000	3.690000032	000	2.177833632	-002
2.691000032	000	6.165886766	-002	1.000000000	000	3.691000032	000	2.174667352	-002
2.692000032	000	6.162161508	-002	1.000000000	000	3.692000032	000	2.171504511	-002
2.693000032	000	6.158434420	-002	1.000000000	000	3.693000032	000	2.168345109	-002
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2.705000033	000	6.113565897	-002	1.000000000	000	3.705000033	000	2.130701022	-002
2.706000033	000	6.109814855	-002	1.000000000	000	3.706000033	000	2.127586439	-002
2.707000033	000	6.106061962	-002	1.000000000	000	3.707000033	000	2.124475311	-002
2.708000033	000	6.102307214	-002	1.000000000	000	3.708000033	000	2.121367638	-002
2.709000033	000	6.098550612	-002	1.000000000	000	3.709000033	000	2.118263422	-002
2.710000033	000	6.094792153	-002	1.000000000	000	3.710000033	000	2.115162662	-002
2.711000033	000	6.091031837	-002	1.000000000	000	3.711000033	000	2.112065360	-002
2.712000033	000	6.087269664	-002	1.000000000	000	3.712000033	000	2.108971517	-002
2.713000033	000	6.083505631	-002	1.000000000	000	3.713000033	000	2.105881134	-002
2.714000033	000	6.079739736	-002	1.000000000	000	3.714000033	000	2.102794210	-002
2.715000033	000	6.075971981	-002	1.000000000	000	3.715000033	000	2.099710747	-002
2.716000033	000	6.072202363	-002	1.000000000	000	3.716000033	000	2.096630746	-002
2.717000033	000	6.068430881	-002	1.000000000	000	3.717000033	000	2.093554208	-002
2.718000033	000	6.064657534	-002	1.000000000	000	3.718000033	000	2.090481132	-002
2.719000033	000	6.060882321	-002	1.000000000	000	3.719000034	000	2.087411521	-002
2.720000034	000	6.057105242	-002	1.000000000	000	3.720000034	000	2.084345374	-002
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2.727000034	000	6.030613337	-002	1.000000000	000	3.727000034	000	2.062979397	-002
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2.729000034	000	6.023027370	-002	1.000000000	000	3.729000034	000	2.056906044	-002
2.730000034	000	6.019231575	-002	1.000000000	000	3.730000034	000	2.053874573	-002
2.731000034	000	6.015433903	-002	1.000000000	000	3.731000034	000	2.050846572	-002