Replay of Intra UAP
Programming Contest 2020

https://toph.co/c/intra-uap-2020-r

Toph

Schedule

The contest will run for **3h0m0s**.

Authors

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Rules

This contest is formatted as per the official rules of ICPC Regional Programming Contests.

You can use Bash 5.0, Brainf*ck, C# Mono 6.0, C++11 GCC 7.4, C++14 GCC 8.3, C++17 GCC 9.2, C11 GCC 9.2, Common Lisp SBCL 2.0, Erlang 22.3, Free Pascal 3.0, Go 1.13, Haskell 8.6, Java 1.8, Kotlin 1.1, Node.js 10.16, Perl 5.30, PHP 7.2, PyPy 7.1 (2.7), PyPy 7.1 (3.6), Python 2.7, Python 3.7, Ruby 2.6, and Whitespace in this contest.

Be fair, be honest. Plagiarism will result in disqualification. Judges' decisions will be final.

Notes

There are 8 challenges in this contest.

Please make sure this booklet contains all of the pages.

If you find any discrepencies between the printed copy and the problem statements in Toph Arena, please rely on the later.

A. Shamim Wants to Hide a Gun

Shamim Tourist has discovered a very powerful gun and he doesn't want anyone to see it. So he put the gun into a bag and locked the bag with a combination lock.

Shamim's combination lock is a little different from a regular combination lock. There are three discs and all the discs are rotatable in clockwise direction only. Every disc contains digits from 0 to 9 in anticlockwise order. There is an unlock button. If the current combination is the code of the lock, pressing the unlock button will unlock the lock.

After locking the lock Shamim just remembered that his tourist visa was also in the bag.

The current combination of the lock is 0-0-0. Shamim knows the code already. In every second Shamim can either select a disc and rotate it 1 unit or press the unlock button. Shamim will unlock the lock within the minimum time. Can you tell how many seconds Shamim will take to unlock the lock?

Input

Input contains three space separated integers representing the code of the combination lock.

Output

Output contains only one integer on a single line representing the time in seconds Shamim will take to unlock the lock.

Samples

Input	Output
1 2 3	7

Input	Output
The initial combination is 0-0-0. Shamim can do the following steps to unlock the lock. 1. Select the first disc and rotate it 1 unit and the combination is now 1-0-0. 2. Select the second disc and rotate it 1 unit and the combination is now 1-1-0. 3. Select the second disc and rotate it 1 unit and the combination is now 1-2-0. 4. Select the third disc and rotate it 1 unit and the combination is now 1-2-1. 5. Select the third disc and rotate it 1 unit and the combination is now 1-2-2. 6. Select the third disc and rotate it 1 unit and the combination is now 1-2-3. 7. Press the unlock button. This is how he can unlock the lock within 7 seconds.	

Input	Output
5 1 4	11

B. Cipher

In cryptography a cipher (or cypher) is an algorithm for performing encryption or decryption-a series of well-defined steps that can be followed as a procedure. An alternative, less common term is encipherment. To encipher or encode is to convert information into cipher or code. In common parlance, "cipher" is synonymous with code, as they are both a set of steps that encrypt a message; however, the concepts are distinct in cryptography, especially classical cryptography.

In this problem you have to implement one basic encryption method. You will be given a N x M matrix and a string S containing uppercase English letters only along with an instruction set containing M number of instructions. Each instruction of the instruction set will contain one uppercase character U or D followed by an integer K. For i^{th} instruction of the instructions set, you have to shift each character of matrix's i^{th} column K times upward if the ith instruction's character is U. Otherwise, you have to shift each character of matrix's i^{th} column K times downward. Note that the matrix is circular that means it's first row is connected with it's last one.

Input

First line contains an integer T , numbers of test cases. ( ). For each test case,The first line will contain two integers ( ) and M ( ) numbers of row and column of the matrix. Second line will contain a string (x) containing uppercase letters only. Then there will be M lines of instruction to be performed on the matrix. Each line contains one uppercase character U or D followed by an integer K ( )

Output

Output the string after encryption operation.

Samples

Input	Output
1 4 4 SENDMORETROOPS U 3 D 2 U 1 D 3	PRRESSOOME TOND

Explanation of Sample I/O

For given input the encryption method follow these steps,

- First we will fill the matrix starting from the first row, with the characters from the given string sequentially. Each column of every row will contain exactly one character. If there is no character in any box these boxes will be considered as a space. After filling the matrix with characters from the given string it will look like the following

S	E	N	D
M	O	R	E
T	R	O	O
P	S		

- Now we have to perform given M numbers of instructions on the matrix. First instruction from our given set is U 3. So we have to shift each character of the first column of our matrix 3 times upward. If we do so, state of our matrix would be ,

P	E	N	D
S	O	R	E
M	R	O	O
T	S		

- Second instruction from our given set is D 2. So if we shift each character of the second column of our matrix 2 times downwards, state of our matrix would be,

P	R	N	D
S	S	R	E
M	E	O	O
T	O		

- After performing all these instruction on our matrix final state of our matrix would be

P	R	R	E
S	S	O	O
M	E		
T	O	N	D

Now we have to output the matrix as a string. For given input, the output would be "PRRESSOOME TOND"

C. Maximum Subtree Sum

You are given a rooted tree consisting of **N** nodes numbered from **1** to **N**. The root of the tree is the node number **1**. You can find the definition of a rooted tree by the following link

Each node has a value in it.

A subtree of some node is a subgraph containing that node and all its descendants.

You have to perform **Q** queries on that tree. For each query, you will be given a node **V**. Let **X** be the set of nodes in the subtree of node **V**. Find the sum of values written on each node of subtree X_i for each i from 1 to size of that set. Among all the sum of values find the maximum value. See the example below for better understanding.
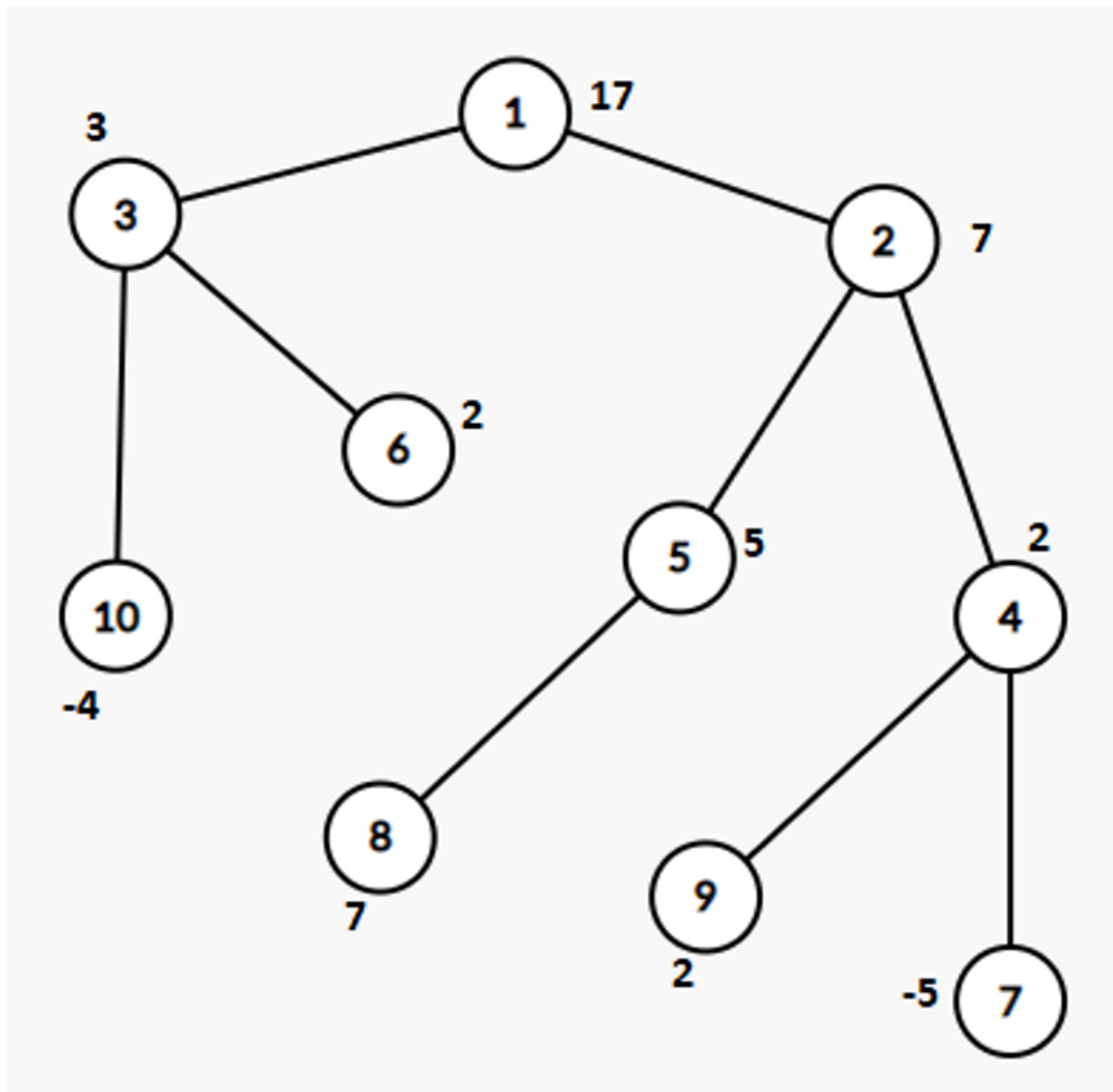
This is the tree for sample test case. If the query value **V** equals to 3. The subtree set **X** of node **V** consists of nodes 3, 6, and 10.

Whole subtree of node 3 consists of nodes 3, 6, and 10. Sum of values written on these nodes equals to 3 + 2 - 4 equals to 1. Now subtree of node 6 have only one node. So, sum

of value will be equals to 2. Subtree of node 10 have only one node. So, sum of value will be equals to -4.

Now we have three values equals to 1 for node 3, 2 for node 6, and -4 for node 10. Among all these values our answer will be te maximum value 2.

Input

The first line of the input contains two integers **N** and **Q** ($2 \leq N \leq 2 \cdot 10^5$, $1 \leq Q \leq 2 \cdot 10^5$) - the number of nodes in the tree and the number of queries.

Next line contains **N** space separated integers, i^{th} integer denoting the value of ith node. Values can be both positive and negative. It is guaranteed that they will fit in signed 32-bit integer.

Next **N**-1 lines describe the edges of the tree in form U_i and V_i ($1 \leq U_i, V_i \leq N$, $U_i \neq V_i$). It is guaranteed that given graph is a tree.

The next **Q** lines describe queries. For each query you will be given an integer **V**($1 \leq V \leq N$) the number of the node.

Output

For each query print the answers to the queries in the order the queries appear in the input in separate lines.

Samples

Input	Output
10 6 17 7 3 2 5 2 -5 7 2 -4 1 2 1 3 2 4 2 5 4 7 4 9 5 8 3 6 3 10 1 7 4 2 5 3	36 -5 2 18 12 2

D. Cutting Stick

You have a stick of length **n** and there are **m** holes(a_1, a_2, a_3,..., a_m) in it. Your friend Bob asks you what is the minimum number of cuts (possibly zero) you need to perform such as there is no hole in your newly formed sticks. There are some restrictions on cutting your stick. After cutting the stick, all the new stick's length has to be equal and there must be no holes.

For example, let your stick length is 20 and the number of holes in your stick is 3 and their position is 5, 10, 15.
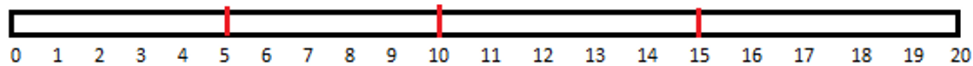
If you perform cuts on positions 5, 10, and 15 then you will get 4 sticks of length 5 and there is no hole in any new sticks, so it's a valid cut. But if you cut to stick on position 10 will get 2 sticks of length 10 but there is a hole at position 5 in 1st stick and position 15 in 2nd stick, so it's not a valid cut.

Calculate the minimum number of cut(s) you need to perform where there is no hole in any stick after cutting your Initial stick.

Input

The first line contains two integers **n, m** where ($0 \leq n \leq 10^9$), ($m \leq min(n, 10^5)$) length of stick and number of holes. Second-line contains **m** integers a_1, a_2, a_3,..., a_m where ($0 \leq a_i \leq n$) the positions of holes.

Output

The minimum number of cuts you need to perform for removing holes.

Samples

Input	Output
20 3 5 10 15	3

E. Lost in Binary Tree

You have a rooted unweighted binary tree. But somehow you forgot which vertex was the root. Well, you can ask me. I remember. But let's play a game. In each move, you can pick a vertex and ask me the distance of that vertex from that root. And I'll tell you so. However, I'll answer no more than 20 of your queries.

Input

The first line of input will contain an integer N denoting the number of vertices. Following $N - 1$ lines will describe the tree. Each line will have two space-separated integers u, v representing an edge between u and v.

- $1 \le N \le 10^5$.
- Vertices are numbered from 1 to N.
- You can be assured that the input will describe a valid tree.

Interaction

To ask a question, that is to ask how far a vertex v is from root, print "? v" without the quotes in a single line and flush the output. The judge will reply with an integer d as the answer to your query. After you have figured out the root vertex r, you can submit your answer via printing "! r" without quotes in a single line.

After submitting the root properly, your program must quit immediately since the interactor will stop interaction and depending upon the submission you'll receive "Accepted" or "Wrong answer". If you have asked more than 20 questions or any of your output format is wrong, the interactor will output an integer value of -1 and will stop interaction immediately. At any point after receiving -1, Your program must quit immediately and will receive "Wrong answer".

Note that submitting the root r is not counted as one of the 20 queries.

Sample I/O

```
> 4
> 1 2
> 1 3
> 1 4
< ? 1
> 1
< ? 2
> 2
< ! 3
```

$_>$ indicates what your program reads and $_<$ indicates what your program writes. These symbols are here to make it easy to understand. You must not print such symbols from your program.
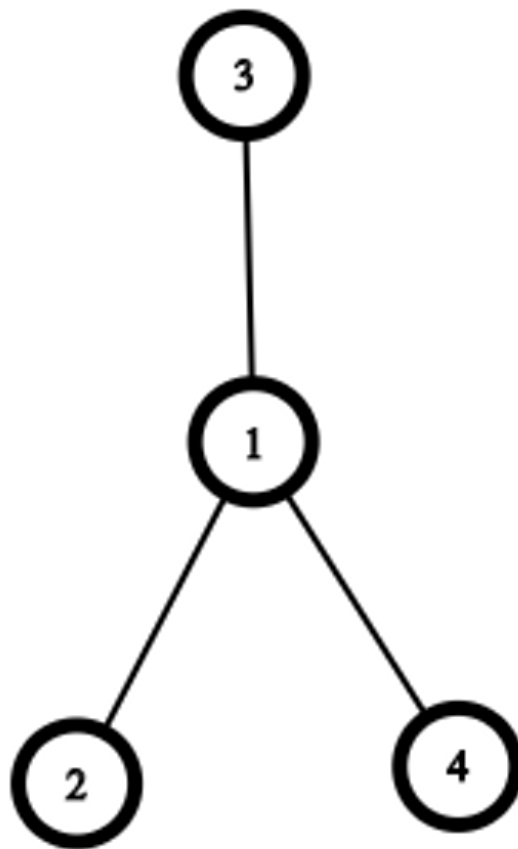
The above figure describes the tree from input in line 1 to 4 in Sample I/O.

- Upon asking the distance from 1 in line 5, the interactor replies with 1 in line 6.
- Upon asking the distance from 2 in line 7, the interactor replies with 2 in line 8.
- Upon submitting the root as 3 in line 9, the interactor quits immediately.

Notes

Since this is an interactive problem, don't forget to flush your output after printing each line. You may use fflush(stdout) for printf/cout in C/C++, import sys and sys.stdout.flush

() in Python to flush the output. If you use some other programming language, consult it's documentation.

To learn more about Interactive Problems: https://help.toph.co/toph/interactive-problems

F. Stick Inside Pond

A stick placed in the middle of a pond, have P/Q portions of it's length outside water, and R/S portions inside the mud. A shadow of the stick's outside portion having N meter length is right-angled with the stick. Hyperbolic distance between the shadow and the stick's top point is M meter. Now you have to find out the length of the full stick and how much of it (in meter) is in the water (excluding mud).
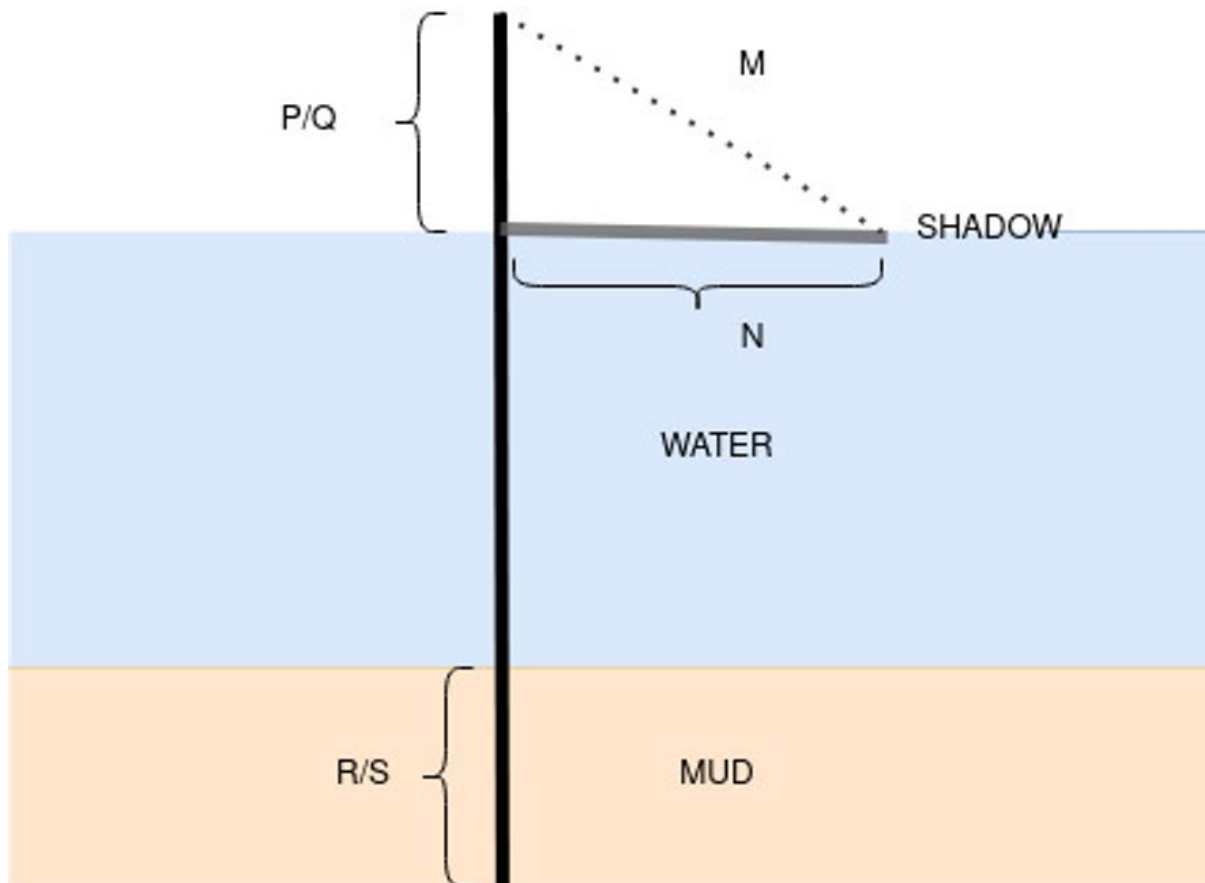
Input

First line of the input will contain an integer T, number of test cases $(1 \leq T \leq 1000)$.

For each test case, The first line will contain two integers & . Second line will contain two integers and $S(2 \leq S \leq 100000)$. Third line will contains two integers $N(1 \leq N \leq 1000)$ and

Output

For each test case output two numbers, the length of the stick placed in the middle of the pond and how much of it (in meters) is in the water (excluding mud).

For every output number, if the absolute difference between your and judge's output are less than 10^{-4}, your output will be considered correct. That means, if one of your output is A and the judge has B as it's output, your output would be considered correct if is satisfied.

Samples

Input	Output
2 1 3 1 4 4 5 3 8 2 7 4 8	9.000000 3.750000 18.475209 6.268374

G. Riddle of the Mythical Spell Book

There are two great magicians called Rubick, the Grand Magus and Carl, the Invoker. These two geniuses found an ancient spell book named "Mathematics is as vast as Cosmos". In that spell book there is only one spell and that was the apex of all magic! But they couldn't cast that spell. Because they needed to solve some mathematical problems to learn the spell. They are not good at mathematics so they hired you to solve the problem. The first problem's description is given below.

You need to find the value of **F(X)**. Where,
G(0) = 2
G(1) = 1
G(X) = 2·G(X-1) + G(X-2)
F(0) = 2
F(X) = F(X-1) + G(M·(X-1))
The answer may be very large, so you should divide this answer by 1000000007 and just output the remainder instead.

Input

Input starts with an integer **T (T ≤ 50000)**, denoting the number of test cases. Each case contains two integers **X (0 ≤ X ≤ 10^9)** and **M (0 ≤ M ≤ 10^9)** in a single line.

Output

For each case, print the case number and the value of F(X) % 1000000007.

Samples

Input	Output
5 2 1 3 2 4 7 22 27 30 26	Case 1: 5 Case 2: 30 Case 3: 70750838 Case 4: 380477592 Case 5: 849191624

H. Train to Khulna

UAP_Lumos, UAP_SpamBytes, and UAP_let's_see three teams counting 9 members from UAP were in a train going for an IUPC a.k.a Inter University Programming Contest in Khulna. Sushmoy was told to take a deck of cards with him. Around 10.30 or 11 pm Labib Bhai enthusiastically spoke out "Contestant Assemble!".

Till today, they consider this as so unfortunate that in the deck of cards there were only 8 cards. It's a soft reminder that a deck of cards actually contains 52 cards having Spades, Hearts, Diamonds, Clubs while these four suits contain 13 cards for each. Sushmoy's deck of cards had only 8 cards from Heart suits.

As there were 9 Contestants but only 8 cards, they all became so pale-faced. Instantly Towfique Bhai The DP_Master came across a new game plan. He asked Nihad to sit beside him and to take the cards.

Towfique Bhai explained his newly invented card game to Nihad. He said, "The 'J' has 3 points, The 'B' has 2 points, The 'A' has 1 point, The 'C' has 1 point and the rest of the cards will not have any points".

He added "The cards will be well-shuffled and there will be only 2 players. Each player will have 4 random cards". Nihad showed his excitement by saying "Bhai, only you and I will play". With his famous enthusiastic smile, Towfique Bhai also replied "Okay! But I will have the first move. Then you will have the second move and then I…". Nihad being so upset told "Bhai, This is not legal, Juniors first". Towfique Bhai many times heard "Ladies First" but never heard of "Juniors First theory" however he changed the game plan. He said "Okay you will play first. But the player who will win the current move will play the next move first". Then the question arose "how a player will win?" Towfique Bhai explained "The player who will play the first move has to play the card which has the highest rank among all the cards he has remaining in his hand and in the reply the second Player will have to play the card which has the highest ranks in his hand. From these two played cards whose card will have the highest rank will be the winner for this round and will keep these **two cards** from the current round for him to count the points he gained after all the rounds are finished. And like this, 4 rounds will be held and in each round the current winner will be the first player in the next round. When all the rounds end, both players will count the points from all the cards they have won from the four rounds and add them up. The player with the highest point will be the final winner."

As had been said earlier, Nihad started and will always start the game with his first move in the first round. Then in reply Towfique Bhai played his move. Then the first round finished and the second round started…

At a time while paying Towfiqe Bhai had realized he was losing. So again he added a new rule as he had 2 cards, 'K' and 'Q' remained in his hand. He proposed "Oh! One thing! If a player gets the pair of 'K' and 'Q' meaning if a player gets 'K' and 'Q' cards in his hand before the game starts the opposite player will lose 3 points."

With this new cleverly enforced rule, Towfique Bhai finally won that game.

The Contestants named the game **FFT Game of Cards**.

Input

Now you will be given 2 lines of inputs. In the first line, 4 card names will be given. These are the cards Towfique Bhai will play with, and in the second line, Nihad's four cards' names will be given. Can you guess who will win in the end? The cards names are given here with their rank from the highest ranks to the lowest: J > B > A > C > K > Q > X > Y.

Output

If Towfique Bhai wins you may appreciate him saying "Towfique Bhai, The DP_Master!" If Nihad wins you should print "Nihad Bhai, The_Mathematician!" as he loves solving more math problems than others. But if the game draws you should output a single line "Oh! It is a draw" without quotation.

Samples

Input	Output
J K Y A B X C Q	Towfique Bhai, The DP_Master!

Input	Output
As Towfique Bhai gets "J K Y A" and Nihad Bhai gets "B X C Q", then the four round will look like this

First Round:

Nihad bhai plays first. As both player has to play the highest ranked card. Nihad Bhai have to play "B". Towfique bhai in the reply has to play the highest ranked card in his hand and that is "J".

From comparing these two cards we can see Towfiue bhai wins. As he played "J" which is higher ranked than "B", played by Nihad Bhai. In this first round Towfique bhai gets 3(J) + 2 (B) = 5 points.

Towfique Bhai will keep the cards ("J", "B") aside from the cards and the game continues with the remaining cards.

Second Round:

As Towfique Bhai has won the last round, he will play first in this second round.

He has to play the card "A", which is the highest ranked card in his hand. Nihad Bhai will Play "C", the highest ranked card remained in his hand.

Towfique Bhai again Wins!! As he played "A" which is higher ranked than "C". Towfique Bhai keeps the cards aside getting 1(A) + 1(C) = 2 points.

…and the rounds end like these.

When the game ends, Towfique Bhai will have 3 (J) + 2(B) + 1(A) + 1(C) = 7 points in his hand, Thus Towfique Bhai wins. | |

Input	Output
A Y K B
J C X Q	Nihad Bhai, The_Mathematician!

Input	Output
C K X Y
A B J Q	Nihad Bhai, The_Mathematician!