Problem A
Rocket Simulator

Time Limit & Memory Limit: Refer to DOMjudge System

You are required to make a small rocket simulator. The rocket simulator simulates a rocket travelling in a perfect straight line.

The simulator is required to accept two commands at any point in time.

- Set a velocity target at a particular point in time.
- Calculate the distance the rocket travel between two points in time, accounting for all velocity target that have been specified before.

The rocket starts with zero velocity. The rocket will increase or decrease its velocity linearly between two velocity targets. If there are no further velocity target, the rocket will keep its current velocity. The rocket will not have negative velocity (it cannot reverse). No two sets velocity command will have the same time.

Linear velocity change means that the following holds true:

$$\frac{v_a - v_n}{t_a - t_n} = \frac{v_{n+1} - v_n}{t_{n+1} - t_n}$$

where t_n and t_{n+1} are the time for two consecutive velocity target, v_n and v_{n+1} are the velocity for the two consecutive velocity target, t_a is any point in time between t_n and t_{n+1} and v_a is the velocity at time t_a.

The equation of total distance travelled between two points in time with start and end velocity, assuming linear velocity change between the two time is:

$$\frac{(v_1 + v_2) \times (t_2 - t_1)}{2}$$

where t_1 and t_2 is start time and end time respectively and v_1 and v_2 is the start and end velocity respectively.

Input

The first line consists of one integer N ($1 \leq N \leq 2 \times 10^5$), the number of commands for the simulator.

The next N lines each represents a command.
A set velocity target command starts with the letter ‘S’ followed by two floating point number t ($0 \leq t \leq 10^3$) and v ($0 \leq v \leq 10^3$), which are the time and the target velocity respectively.

A calculate command starts with the letter ‘C’ followed by two floating point numbers a, b ($0 \leq a < b \leq 10^3$) which are the start and end time respectively.

Output

For each calculate command, output a line with a single number which is the total distance the rocket travelled between the two time. Your answer will be considered correct if the absolute or relative error doesn’t exceed 10^{6}.

Sample Input	Sample Output
6 S 5.0 10 C 0.0 5.0 C 2.5 6.0 S 7.0 2.5 C 2.5 6.0 C 6.0 8.0	25 28.75 26.875 6.875

Note

In the example, during the first calculate command, the total distance travelled between 0.0 to 5.0 is $\frac{10\times 5}{2}$.

For the second calculate command, the distance travelled between 2.5 to 5.0 is $\frac{(5.0+10.0)\times 2.5}{2}=18.75$ and the distance travelled between 5.0 to 6.0 is 10.0, so the total is 28.75.

During the third calculate command an additional speed target was added at point 7.0, so the distance travelled between 5.0 to 6.0, changed to $\frac{(10+6.25)\times 1}{2}=8.125$, hence the total is 26.875.

For the forth calculate command, between 6.0 to 7.0, the distance is 4.375 and between 7.0 to 8.0 is 2.5, so the total is 6.875.

Problem B
Boring Problem

Time Limit & Memory Limit: Refer to DOMjudge System

Mina was attending algorithms class while the teacher was teaching on the famous problem which is called *Find the K_{th} smallest number*. This time teacher tried to make the lesson interesting and asked the students to find the K_{th} largest number.

If you have a list with N number and you sorted it in decreasing order, then the K_{th} largest number is the element in the list with index K.
Even with this change that the teacher has made, Mina still finds the lesson and problem boring. So, he decided to add some queries that challenges him more.

Initially you start with an empty list. Then there are three types of queries:

1. X - which means add X to current list.
2. Idx - which means you must restore the list which exist before applying query with index Idx, if Idx equals the index of current query, then nothing happens.
3. K - which means print the K_{th} largest number, it's guaranteed that K is $\leq$ the current size of list.

Now, Mina found the problem more interesting but he doesn't know how to solve it. Can you help him?

Input

First line contains one numbers Q ($1 \leq Q \leq 10^6$), number of queries. Then Q lines where q_i in one of following formats:

1. X ($1 \leq X \leq 10^6$)
2. Idx ($1 \leq Idx \leq i$), where i is the index of current query.
3. K ($1 \leq K \leq Len$), where Len is the current size of list before applying this query.

Output

For each query of type 3 print the K_{th} largest number.

Sample Input	Sample Output

9
1 1
1 2
1 3
2 3
3 1
2 4
3 1
2 5
3 1
	2
	3
	2

Problem C
Clash of Clans

Time Limit & Memory Limit: Refer to DOMjudge System

Nowadays, everyone plays clash of clans (a video game). In the game, everyone owns a castle and tries to protect it by building post guards around the castle. The enemy tries to penetrate a castle by destroying the post guards. Each post guard has a strength **H** and covers a circular area with center **(X, Y)** and radius **R.** The enemy needs exactly **H** attackers to destroy the post guard and it can shoot enemies in the area it covers. One attacker can only attack one post guard and the attacker will die after attacking the post guard. The enemy will send his attackers and destroy some post guards for making a safe path to the castle. The enemy always wants to minimize the number of attackers who die to make a safe path to the castle.

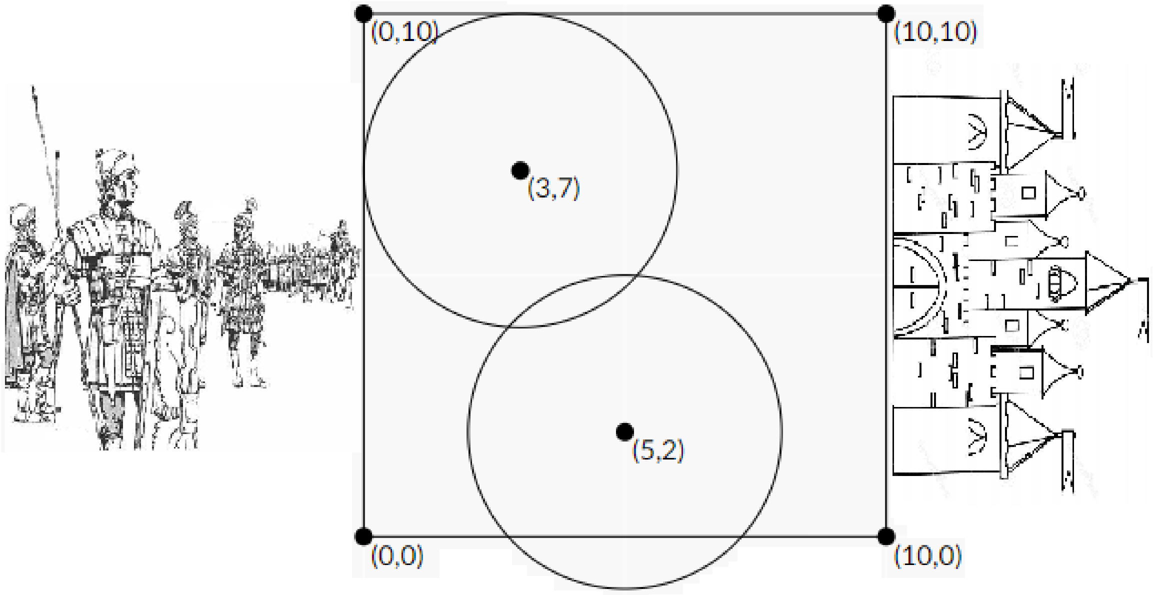


Figure: First test case

You and your enemy are in a **2D** plane which contains a rectangle which is bounded by **(0, 0), (0, m), (n, m) and (n, 0)**. Your castle is situated on the right side of **(n, 0), (n, m)** line and the enemy is on the left side of **(0, 0), (0, m)** line. The enemy can't go around the rectangle to your castle, they must enter the rectangle by the left side of the rectangle and can't leave the rectangle until reaching the right side of the rectangle. You have **D** dollars. You can invest **1** dollar to increase the strength of one post guard by **1**. You want to increase the strength of a few post guards in such a way that the minimum number of attackers needed by the enemy to make a path is maximized.

Input

The first line of the input contains an integer **T**, denoting the number of test cases.

Each test case starts with **2** integers **n**, **m** in one line. The next line will have **2** integers **D** and **P,** which represent that you have **D** dollars and **P** post guards. Next **P** lines will have information of each post guard. Each of the next P lines will have **4** integers $\mathbf{X_i}$, $\mathbf{Y_i}$, $\mathbf{R_i}$ and $\mathbf{H_i}$. $\mathbf{X_i}$, $\mathbf{Y_i}$ is the coordinate of the center, $\mathbf{R_i}$ is the radius of the area it covers and $\mathbf{H_i}$ is the strength of the **i**-th post guard.

Constraints

- $1 \le \mathbf{T} \le 5$
- $10 \le \mathbf{n}, \mathbf{m} \le 10^6$
- $1 \le \mathbf{D} \le 10^9$
- $1 \le \mathbf{P} \le 100$
- $1 \le \mathbf{X_i} < \mathbf{n}$, $1 \le \mathbf{Y_i} < \mathbf{m}$
- $1 \le \mathbf{R_i} \le 10^6$, $1 \le \mathbf{H_i} \le 10^9$

Output

For each test case, print a line containing the case number and the minimum number of attackers needed by the enemy to make a path, if you increase the strength of a few post guards optimally.

Sample Input

```
2
10 10
2 2
5 2 3 10
3 7 3 6
20 20
13 5
15 2 4 10
12 9 6 6
5 2 3 10
6 16 5 2
16 17 3 4
```

Sample Output

```
Case 1: 8
Case 2: 11
```

Problem D
Polynomial Extrapolation

Time Limit & Memory Limit: Refer to DOMjudge System

We are given a sequence a_0, a_1, a_2, …., a_N . For each i between 0 to N (inclusive) a_i represents the value of the polynomial

$$(C_{N-1} * X^{N-1} + C_{N-2} * X^{N-2} + \ldots + C_2 * X^2 + C_1 * X^1 + C_0 * X^0) \ \% \ 10007$$

for $X = i$. Given K let us compute the value of a_K.

Input

Input starts with T, the number of test cases. Each test case consists of two lines. First line contains two integers N and K. Second line contains $N + 1$ integers representing the sequence a_0, a_1, a_2, …., a_N .

Output

For each test case, output a single integer a_K in a single line.

Constraints

- $1 \leq T \leq 100$
- $1 \leq N \leq 20$
- $N < K \leq 10^{17}$
- $0 \leq a_i \leq 10007$
- $0 \leq C_i \leq 10007$ (Please note that even though C_i will not be part of the input it is guaranteed that the coefficients of the polynomial will be in this range.

Sample Input

```
6
2 5
0 1 2
3 4
0 1 4 9
3 6
1 3 7 13
3 7
1 4 9 16
3 7
4 9 16 25
3 1000
4 9 16 25
```

Sample Output

```
5
16
43
64
81
3304
```

Sample Case Explanation

- case#1 the polynomial is x and thus a_5 is 5
- case#2 the polynomial is x^2 and thus a_4 is $4^2 = 16$
- case#3 the polynomial is $x^2 + x + 1$ and thus a_6 is $6^2 + 6 + 1 = 43$
- case#4 the polynomial is $x^2 + 2x + 1$ and thus a_7 is $7^2 + 2 * 7 + 1 = 64$
- case#5 the polynomial is $x^2 + 4x + 4$ and thus a_7 is $7^2 + 4 * 7 + 4 = 81$
- case#6 the polynomial is the same as the previous one, but please note that the integer need to be modulo 10007.

Problem E

Flooding

Time Limit & Memory Limit: Refer to DOMjudge System

You are making a 2D simulation. The simulated world is represented by an n × m grid. In the simulation, each cell can represent a house, a water source and a water barricade. The purpose of the simulator is to determine how many house or houses will be flooded given some water source.

Input

The first line of the input consists of two integers n and m ($0 \leq n, m \leq 1000$) which is the number of rows and column that represent the map.
The next n line consists of a string of m characters which made up a grid which represent the map of the simulated world.
In the grid, character '_' (underscore) represents a cell of water source. Character '.' represents a space in which the water can flow. Character 'H' represents a house. And character '#' represents water barricade that water can't traverse.

The water source has infinite supply of water. The water can flow to all eight directions, up, up right, right, down right, down, down left, left and up left. The water can flow through a house. The water cannot flow through the water barricade and the water cannot flow outside the map.

Output

Print a single integer, the number of house or houses that will not be flooded.

Sample Input 1

```
10 10
..H#...__.
...#...__.
.H.#...__.
...#.H.__.
...#...__.
..H#...__.
...#...__.
.H.#H..__.
...#...__.
...#...__.
```

Sample Output 1

```
4
```

Sample Input 2

```
10 10
_..####...
_..#HH....
_..####...
_.........
_..###....
_..#H#....
_..##.....
_########.
_#H.#...#.
_##...#...
```

Sample Output 2

```
0
```

Problem F

Minimum and Maximum Base

Time Limit & Memory Limit: Refer to DOMjudge System

Given *n* and *t* you will have to find minimum and maximum positive integer bases in which *n!* (Factorial *n*) has exactly *t* zeros.

Input

The input file contains 10000 lines of inputs. Each line contains two integers n ($2 \leq n \leq 100000$) and t ($2 \leq t \leq 10000$). Input is terminated by a line containing a two zeroes. This line should not be processed.

Output

For each line of input, produce one line of output. This line should contain modulo 1000007 values of min and max. Here min is the smallest possible base where *n!* has exactly *t* zeroes and max is the largest possible base where *n!* has exactly *t* zeroes. If no such base is found, then print two -1 instead.

Sample Input	Sample Output

5 5
100 5
0 0
	-1 -1
	17 353355

Problem G
Ahmad's Plantation

Time Limit & Memory Limit: Refer to DOMjudge System

Ahmad have a plantation. He organizes his plantation as a grid with size of $N \times N$ ($1 \leq N \leq 3 \times 10^3$). Each cell is numbered with its row and column starting from top to bottom and left to right. Because Ahmad is quite tech savvy, he uses a drone to fertilize his plantation.

His drone can accept two commands:

1. Fertilize a rectangular portion of his plantation.
2. Measure the total amount of fertilizer for a particular cell.

One day, his drone's fertilizer sensor was broken, so his drone cannot give him the measurement that he needs. Now, you are tasked to write a program that accept the series of command that Ahmad gives to his drone, and calculate the total amount of fertilizer for a cell when Ahmad query for it.

Input

Let's denote each cell as G_{rc} ($1 \leq r, c \leq N$) where r is the row and c is the column. The first line consists of two integer N, C ($1 \leq N, C \leq 3 \times 10^3$) the size of the plantation and the number of commands.

The next C lines each represent a command.
A fertilize command starts with the letter 'F' and followed by five integer a_1, b_1, a_2, b_2, d ($1 \leq a_1 \leq a_2 \leq N$), ($1 \leq b_1 \leq b_2 \leq N$), ($1 \leq d \leq 10^4$). a_1, b_1 is the row and column of the top left cell that form the rectangle and a_2, b_2 is the row and column of the bottom right cell of the rectangle. In other words, each cell G_{rc}, with $a_1 \leq r \leq a_2$ and $b_1 \leq c \leq b_2$ will be fertilized. d is the amount of fertilizer used for each cell.

A query command starts with the letter 'Q' and followed by two integer j, k ($1 \leq j \leq k \leq N$). You need to return the total amount of fertilizer applied to the cell G_{jk} at the moment of the query.

Output

For each query command, output a line with a single integer which is the total amount of fertilizer applied to the cell.

Sample Input

```
10 4
F 1 1 10 10 1
F 6 6 8 10 2
Q 6 10
Q 10 5
```

Sample Output

```
3
1
```

Problem H
Psyco Pass

Time Limit & Memory Limit: Refer to DOMjudge System

In the future people have been able to invent a machine which can detect if people are criminals or not just by measuring a number for them called "Psycho Pass". One day, Mina developed a theory of how this number is calculated and now he wants to test this theory.

The theory states that if you have a group of N people and you know the first name of each one, then you calculate the maximum number of people with condition that the length of common substring in all these people names is at least as equal as their number, this will be the Psycho Pass for the group. In other words, Mina would like to choose subset from group of size X such that there exist a common substring of length X or more. Mina would like to maximize the value X.

So for example if you have $N = 4$ and people names are [*mina, ahmed, sina, john*] then the Psycho Pass for this group will be equal to 2 because there are no subset of this group with length X and $X > 2$ so that the names of the people in this subset have common substring of length at least X.

Mina is so confident of his theory but he wants you to help him test it, so given group of people can you find their Psycho Pass?

Input

First line contains N $(1 \leq N \leq 10^5)$, number of people in the group.
Then N lines each of them contains string S_i $(1 \leq |S_i| \leq 10^5)$, names of people in the group where S_i means the length of string.
It's guaranteed that total length of strings will be $\leq 2 \times 10^5$ and all strings consist only of lowercase Latin letters.

Output

One number represents the Psycho Pass for the group.

Sample Input 1	Sample Output 1
4 mina ahmed sina mohamed	2

Sample Input 2	Sample Output 2
3 aaaaa aaaaa aaaaa	3

Problem I
Activist Meeting

Time Limit & Memory Limit: Refer to DOMjudge System

Pillowtropolis is a country consisting of N cities represented as a tree graph. A tree graph is an undirected acyclic graph. The Activist group on Peace and Justice of Pillowtropolis decided to hold Q meetings. For the i^{th} meeting, there will be K_i activist in different cities.

For each meeting, the activist wanted to find a city such that the maximum distance between any of the K_i cities and this city is minimum. Note that this city doesn't have to be one of the K_i cities.
Can you help them?

Input

On the first line, you are given 2 integers N and Q ($1 \leq N, Q \leq 3 \times 10^5$).
The following N - 1 lines contain an edge u, v each ($1 \leq u, v \leq N$). It's guaranteed that this graph is a tree.
Followed by Q queries. Each query consists of 2 lines. On the first line, you are given K_i the number of cities in the i^{th} query ($1 \leq K_i \leq N$).
On the second line, you are given K_i pair-wise distinct integers X ($1 \leq X_j \leq N$).
The sum of K_i overall queries will not exceed 3×10^5.

Output

Print Q lines, each line contains a city with the minimum distance to all other cities. In the case of multiple answers print any of them.

Sample Input 1

```
7 4
1 2
1 3
1 4
2 5
2 6
4 7
1
1
3
1 5 6
3
1 6 7
2
3 6
```

Sample Output 1

```
1
2
1
2
```

Sample Input 2

```
7 5
1 2
1 3
2 4
2 5
3 6
3 7
2
2 6
3
4 2 1
4
4 5 6 7
2
1 3
5
1 4 7 2 3
```

Sample Output 2

```
3
2
1
3
1
```

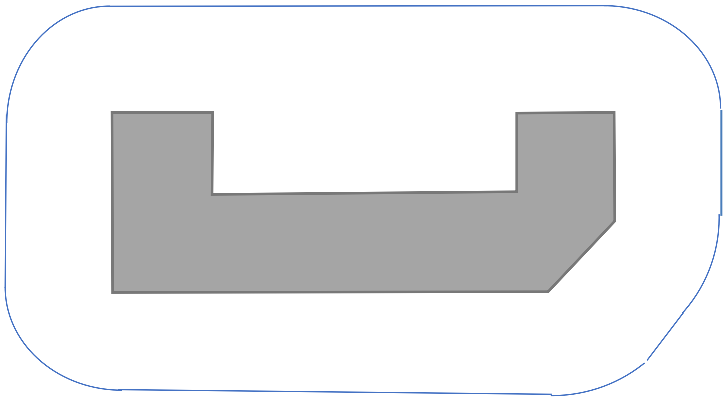
Problem J
A Thread of Gold Around My Mansion

Time Limit & Memory Limit: Refer to DOMjudge System

Once upon a time there was a slick and cunning successful trader named Mr. Sadiq Segaraga who uses his three beautiful daughters to trick wealthy young potential men who would like to court any one of his daughters. In every attempt in the past, Sadiq gave a ridiculous but simple condition to get his blessing for marriage. Numerous men have failed in the past and left poorer than the day they came.

Whoever intends to court any one of my daughters, you must first bring a thread of gold as a deposit, that is long enough to be laid around my mansion. Second, when laid around my mansion, the thread of gold may not lay too close to any part of the mansion and must be laid at a certain distance set by Mr. Sadiq. Third, if the thread is too short or too long by more than ¾ of a meter, you will not get Sadiq's blessing and will have to forfeit your deposit.

Mr. Sadiq have always managed to trick potential men by laying out the gold thread in the most optimal length needed to satisfy his conditions. In most cases, the gold thread is usually too long. The picture below illustrates how a thread can be laid out and satisfy all the conditions.



In turn, if you are successful, Mr. Sadiq will give his blessing to marry any one of his daughters, bear the cost of the wedding and return your deposit. Your task is to outsmart Mr. Sadiq. The task is somewhat simplified by the fact that the Sadiq's mansion has a polygon shape and is situated on flat ground. You have already established a Cartesian coordinate system and has precisely measured the coordinates of all castle's vertices in meters.

Input

The first line of the input file contains two integer numbers N and L separated by a space. $N (3 \leq N \leq 1000)$ is the number of vertices in the mansion, and L $(1 \leq L \leq 1000)$ is the minimal number of meter that Mr. Sadiq allows for the thread to come close to the mansion.

The next N lines describe the coordinates of the mansion's vertices in a clockwise order. Each line contains two integer numbers X_i and Y_i separated by a space $(-10000 \leq X_i, Y_i \leq 10000)$ that represents the coordinates of the i-th vertex. All vertices are different, and the sides of the castle do not intersect anywhere except for vertices.

Output

Your output is the single number that represent the minimal possible length of the thread in meters that could be laid around the mansion to satisfy Mr. Sadiq's conditions. You must present the integer number of meters so that you will be able to buy the exact length of gold thread needed. You can round the number to the nearest integer.

Sample Input	Sample Output

9 1
4 1
4 2
5 2
5 0
4 -1
-5 -1
-5 2
-4 2
-4 1
	32