Problem A. Falfa with Polygon

Input file:	standard input
Output file:	standard output
Time limit:	3 seconds
Memory limit:	512 megabytes

Falfa is studying computational geometry recently, and she came up with a interesting idea:

Give a n-point-convex on Cartesian plane and a constant k. You can choose any k points from the given points and these points will compose a sub-convex of the given convex. Falfa wants to find the k-point-subconvex with maximum perimeter.

Can you help her find it?

Input

The first line contains 2 integers n and $k(3 \leq k \leq n \leq 2000)$, as the legend.

The i-th of the next n lines contains two integers x_i and y_i $(-10^4 \leq x_i, y_i \leq 10^4)$, represent the coordinate of the i-th point of the convex.

It is guaranteed that the points of the convex will be given in clockwise or counterclockwise order.

Output

A real number, representing the answer.

Your answer is considered correct if its absolute or relative error does not exceed 10^{-6}.

Formally, let your answer be a, and the jury's answer be b. Your answer is accepted if and only if $\frac{|a-b|}{\max(1,|b|)} \leq 10^{-6}$.

Examples

standard input	standard output
4 3 1.00 1.00 1.00 -1.00 -1.00 -1.00 -1.00 1.00	6.828427125
8 3 1.00 2.00 2.00 1.00 2.00 -1.00 1.00 -2.00 -1.00 -2.00 -2.00 -1.00 -2.00 1.00 -1.00 2.00	11.404918347

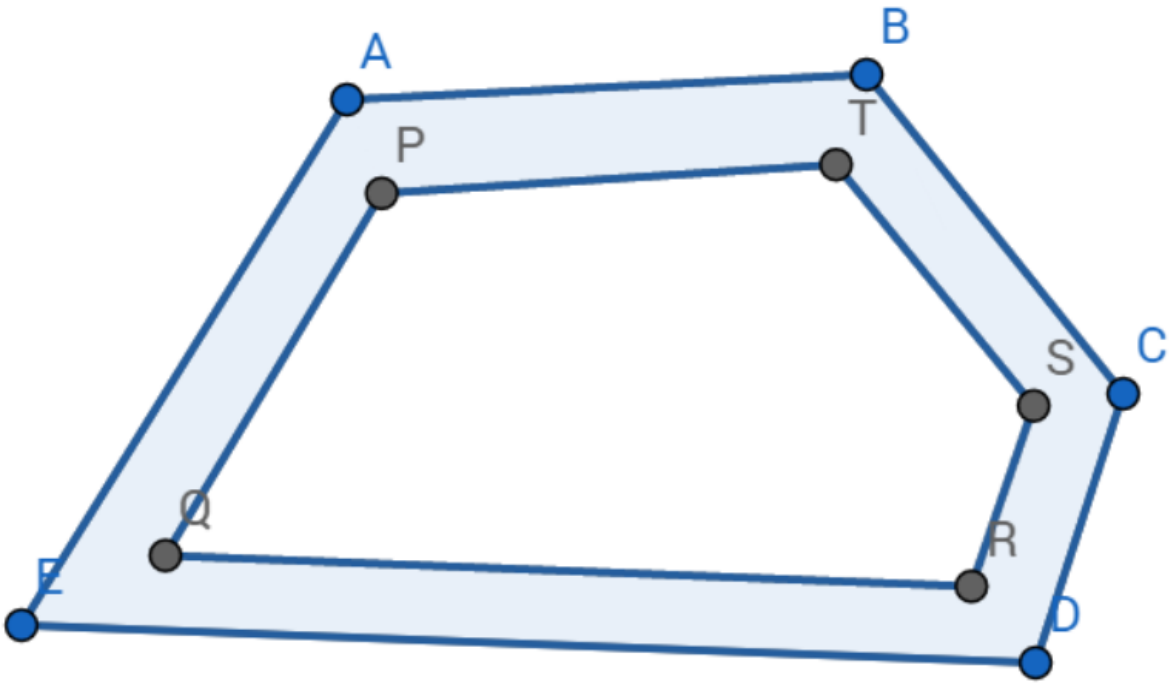
Problem B. light

Input file:	`standard input`
Output file:	`standard output`
Time limit:	3 seconds
Memory limit:	256 megabytes

The campus is surrounded by a convex polygon fence with thickness and equal height, (the fence is impervious to light and has no holes). With moonlight shining, ask how much area on the ground in the campus is illuminated by moonlight.

The top view of the fence is shown below, it can be considered as the edge of the inner circle is obtained by translating the edge of the outer circle inward by an equal distance

Note that we regard the moonlight here as a point light source, and the coordinate information will be given in the input



Input

The input consists of multiple test cases.

The first line contains an integer T ($1 \le T \le 10^5$) – the number of test cases.

For each test case:

The first line contains two positive integers $n, h (3 \le n \le 2 * 10^3, 1 \le h \le 100)$, indicating the number of outer prisms of the fence (number of points in the top view), and the height of the fence.

The second line, a number $w(0.01 < w \leq 100$, with at most 2 decimal places), indicates the thickness of the fence.

In the next n lines, each line contains two integers x_i, y_i ($|x_i|, |y_i| \leq 10^4$), indicates the coordinates of the projection of a prism on the ground, ensuring that these points are given counterclockwise in the top view.

The last line contains three integers, $x, y, z(1 \leq z \leq 100, |x_i|, |y_i| \leq 10^4)$, denote the coordinates of the light source: a light source with height z at (x, y).

It is guaranteed that the sum of n over all test cases doesn't exceed $2 * 10^5$

Output

For each test, output a number in a line indicates the answer.

If the light is strictly inside the wall, the answer is 0.

Your answer is considered correct if its absolute or relative error does not exceed 10^{-6}.

Formally, let your answer be a, and the jury's answer be b. Your answer is accepted if and only if $\frac{|a-b|}{\max(1,|b|)} \leq 10^{-6}$.

Example

standard input	standard output
3 4 1 0.5 0 0 2 0 2 2 0 2 2 0 5 4 2 0.5 0 0 2 0 2 2 0 2 3 0 1 4 2 0.5 0 0 2 0 2 2 0 2 1 1 1	0.7656250000 0.0000000000 1.0000000000

Problem C. Link with Nim Game

Input file:	standard input
Output file:	standard output
Time limit:	1 second
Memory limit:	256 megabytes

Link is playing nim game with fried-chicken. If you don't know this game, here's the rules:

There are two players in this game, called Alice and Bob. The game starts with n piles of stones, the i-th pile contains a_i stones.

Alice and Bob take turns to play this game, Alice goes first. In each turn, the player should choose one pile of stones, and remove $x(x > 0)$ stones from that pile. The player who can not operate loses.

Obviously, one of Alice and Bob has a winning strategy. If one player has a winning strategy, he or she wants to win in minimum turns. If one player will lose, he or she wants to lose in maximum turns.

Now, fried-chicken wonders, if both player uses the best strategy:

How many turns will take before the game ends?

How many kinds of operation can Alice do in the first turn under the restrictions above?

Input

Each test contains multiple test cases. The first line contains the number of test cases $T(1 \le T \le 10^5)$. Description of the test cases follows.

The first line contains a single integer $n(1 \le n \le 10^5)$.

The second line contains n integers $a_1, a_2, \ldots, a_n(1 \le a_i \le 10^9)$.

It is guaranteed that the sum of n over all test cases does not exceed 5×10^5.

Output

For each test case, output two integers in one line, which is the turns taken before the game ends and the kinds of operation Alice can do in the first turn under the restrictions above.

Example

standard input	standard output
6 1 1 1 2 2 1 1 3 1 2 3 6 1 1 4 5 1 4 6 1 9 1 9 8 10	1 1 1 1 2 2 6 2 13 3 37 1

Problem D. Link with Game Glitch

Input file:	standard input
Output file:	standard output
Time limit:	1 second
Memory limit:	256 megabytes

Link is developing a game. In this game, players can craft things using various types of resources, and things crafted can also be used to craft other things.

Formally speaking, there are n types of items, numbered from 1 to n, and m recipes in the game. In the i-th recipe, players can use $k * a_i$ items of the b_i-th type to craft $k * c_i$ items of the d_i-th type, where k can be any positive real number.

One day, he finds that one player owns more than 18,446,744,073,709,551,615 identical items, which causes a server crash. This is obviously impossible without using glitches.

Link soon finds out that there is something wrong with the crafting recipe. Players may get infinite resources by crafting some special things over and over again!

Link doesn't want to adjust the recipes one by one, so he simply added an argument w. Now players can use $k * a_i$ items of the b_i-th type to craft $w * k * c_i$ items of the d_i-th type.

Link wonders: What's the maximum w that he can set so that no player can get infinite items by crafting things over and over again?

Input

The first line contains two integers $n, m (2 \le n \le 1000, 2 \le m \le 2000)$, which are the number of item types and the number of recipes.

Each of the next m lines contains four integers $a_i, b_i, c_i, d_i (1 \le b_i, d_i \le n, b_i \ne d_i, 1 \le a_i, c_i \le 10^3)$, describing a recipe.

It is guaranteed that players can get infinite items using the recipes above (when $w = 1$).

Output

Output a real number w, which is the maximum w satisfying the condition.

Your answer will be accepted if and only if the absolute error between your answer and the correct answer is no more than 10^{-6}

Example

standard input	standard output
3 3 1 1 2 2 1 2 2 1 1 3 1 1	0.5000000000

Note

In the first example:

When $w = 1$, players can use 1 item of the first type to get 2 items of the second type. Then use 2 items of the second type to get 4 items of the first type. Thus, players got 4 items of the first type from 1 item of the first type. By doing so repeatly, players can get infinite items of the first type, so $w = 1$ does not satisfy the condition. It can be shown that 0.5 is the maximum possible w.

Note that players can never get infinite items of the thrid type, but that doesn't matter. You must make sure that players can't get infinite items of any type.

Problem E. Falfa with Substring

Input file:	`standard input`
Output file:	`standard output`
Time limit:	2 seconds
Memory limit:	256 megabytes

Falfa defines the bit-value of a string S is the time that string "bit"occurs in the string S and defines $F_{n,k}$ = the number of n-length-lowercase-letter-string whose bit-value is k.

Falfa gives you a integer n, and she wants to know the value of $F_{n,0}, F_{n,1}, F_{n,2}, ..., F_{n,n}$.

Note that the answer may be very big, so you should output the answer modulo 998244353.

Input

The first line contains a single integer n ($1 \leq n \leq 10^6$).

Output

n integers in a single line, separated with space.

Example

standard input	standard output
3	17575 1 0 0

Problem F. NIO with String Game

Input file:	`standard input`
Output file:	`standard output`
Time limit:	2 seconds
Memory limit:	512 megabytes

NIO is playing a string game with OIN. If you don't know this game, here's the rules:

OIN writes down a main string s and a set G with n strings $t_1 \sim t_n$, and NIO needs to answer the number of strings in G that are lexicographically less than s as fast as possible.

However, it is too easy for NIO to solve this problem, so OIN decides to make the problem a little more difficult. Now he has four kinds of operations:

- 1 i c , add one lowercase Latin letter c at the back of string $t_i (1 \le i \le n)$.
- 2 p , erase the last p letters of string s, where $|s| > p$.
- 3 k c, add k lowercase Latin letters c at the back of string $s (k \le 10^9)$.
- 4 , ask the number of strings in G that are strictly lexicographically less than s.

OIN will do the operations above for q times. However, it is still easy for NIO, and he thinks it is boring, so he wants you to write a program to solve it automatically.

Note

String a is lexicographically less than string b if $a \neq b$ and one of two conditions is satisfied:

- a is a prefix of the string b;
- For some i, the first i characters of the string a are equal to the corresponding characters of the string b, and $a_{i+1} < b_{i+1}$

Input

The first line contains two integers n and q — the number of strings in G and the number of operations $(1 \le n, q \le 2 \times 10^5)$.

The second line contains a string s consisting of no more than 2×10^5 lowercase Latin letters.

The i-th of the next n line contains one string t_i which is in the set G. It is guaranteed that the total length of strings in G does not exceed 2×10^5.

The following q lines contain descriptions of operations.

All strings contain only lowercase Latin letters, s will never be an empty string.

Output

For each operator 4, output one line with a single integer—the answer to the question.

Example

standard input	standard output
6 11 abe aaa aa aab aac abd bc 4 2 1 4 3 1 d 4 3 2 a 4 2 4 4 1 3 d 4	5 4 4 5 0 0

Problem G. Link with Monotonic Subsequence

Input file:	standard input
Output file:	standard output
Time limit:	1 second
Memory limit:	256 megabytes

First, let's review some definitions. Feel free to skip this part if you are familiar with them.

A sequence a is a increasing (decreasing) subsequence of a sequence b if a can be obtained from b by deletion of several (possibly, zero or all) elements and all elements are in increasing (decreasing) order from the beginning to the end.

A permutation is an array consisting of n distinct integers from 1 to n in arbitrary order. For example, $[2, 3, 1, 5, 4]$ is a permutation, but $[1, 2, 2]$ is not a permutation (2 appears twice in the array) and $[1, 3, 4]$ is also not a permutation ($n = 3$ but there is 4 in the array).

The problem starts from here.

Link has an array. He is currently learning the longest increasing subsequence algorithm. So he comes up with the following question.

Let the value of a permutation p be $\max(\text{lis}(p), \text{lds}(p))$, where $\text{lis}(p)$ is the longest increasing subsequence of p and $\text{lds}(p)$ is the longest decreasing subsequence of p. For all permutations of length n, which one has the minimum value?

Input

Each test contains multiple test cases. The first line contains the number of test cases $T(1 \le T \le 1000)$.

For each test case, there is only one line, containing an integer $n(1 \le n \le 10^6)$.

It is guaranteed that the sum of n over all test cases does not exceed 10^6.

Output

For each test case, output a single line containing a permutation of length n.

If there are multiple answers, print any of them.

Example

standard input	standard output
3 1 2 3	1 2 1 2 1 3

Problem H. Take the Elevator

Input file:	standard input
Output file:	standard output
Time limit:	1 second
Memory limit:	256 megabytes

There is a tall building called Arasaka Tower in the center of the Night City. People go up and down in the Arasaka Tower everyday.

Arasaka Tower has k floors. Today, there are n people going to take the elevator, the i-th person wants to go from the a_i-th floor to the b_i-th floor. The elevator may carry up to m people at a time, and it starts from the first floor. The elevator takes 1 unit of time to go up or down one floor. The time people enter and exit the elevator can be ignored.

However, there is something wrong with the elevator today. The running direction of the elevator can no longer be changed arbitrarily. When the elevator is going down, it can change its running direction if and only if it reaches the first floor.

What is the minimum time to carry all people to their destination and let the elevator back to the first floor?

Input

The first line contains three integers n, m and k ($1 \le n, m \le 2 \times 10^5, 1 \le k \le 10^9$).

The i-th of the next n lines contains two integers a_i and b_i. ($1 \le a_i, b_i \le k, a_i \ne b_i$).

Output

Output the minimum time in a single line.

Examples

standard input	standard output
5 1 6 1 3 2 4 5 6 5 4 4 2	14
6 1 6 1 3 2 4 5 6 5 4 4 2 5 6	20
5 2 6 1 3 2 4 5 6 5 4 4 2	10

Note

In the first test case, the taking-order will be:2,3,4,5,1. So the sum of time will be $5(1 \to 2 \to 4 \to 5 \to 6) + 5(6 \to 5 \to 4 \to 1) + 2(1 \to 3) + 2(3 \to 1) = 14$.

Problem I. let fat tension

Input file:	`standard input`
Output file:	`standard output`
Time limit:	3 seconds
Memory limit:	256 megabytes

In a virtual world, namely Jianghu, there are n Kungfu master with their own unique skills. However, due to the lack of exercise, they were no longer skilled master and were even getting fat! To deal with this problem, they decided to hold a Kungfu conference titled as "let fat tension where they can deeply learn from each other to practise their skills.

The i-th Kungfu master has two attributes, which are the attribute of ability and the attribute of skill. The i-th master's attribute of ability can be represented as a vector X_i of length k while his attribute of skill can be represented as a vector Y_i of length d.

In the Kungfu conference, a master will deeply learn from every other Kungfu master to enhance their skills.

The learning efficiency between i-th master and j-th master is defined as $le(i, j)$, which is the cosine similarity between X_i and X_j. Formally, we have:

$$le(i,j) = \frac{X_i \cdot X_j}{|X_i||X_j|}$$

where "$\cdot$"denotes dot-product and "$|\cdot|$"denotes the magnitude of a vector. Note that $le(i, i) = 1$ always holds.

After deeply learning from others, the i-th master's attribute of skill will become:

$$Y_i^{new} = \Sigma_{j=1}^{n} le(i,j) * Y_j$$

The learning process for n Kungfu master happens simultaneously.

Please calculate the new attribute of skill for all Kungfu master.

Supplementary material:

The dot-product of two vector A and B with length L is defined as $A \cdot B = \Sigma_{i=1}^{L} A_i B_i$.

The magnitude of a vector A with length L is defined as $|A| = \sqrt{\Sigma_{i=1}^{L} A_i^2}$.

Input

The first line contains the $n, k, d (3 \le n \le 10^4, 1 \le k, d \le 50)$—— the number of Kungfu master, the length of X_i, the length of Y_i.

In the following n lines, the i-th line describes the X_i.

In the following n lines, the i-th line describes the Y_i.

It's guaranteed that the number in both X_i and Y_i are interger between 1 and 10^3.

Output

Your output should contain n lines and the i-th line is Y_i^{new}.

Your answer is considered correct if its absolute or relative error does not exceed 10^{-4}.

Example

standard input	standard output
3 2 3 3 4 6 8 5 12 1 2 3 2 5 3 5 3 1	7.84615385 9.90769231 6.96923077 7.84615385 9.90769231 6.96923077 7.90769231 9.78461538 6.81538462

Problem J. Link with Arithmetic Progression

Input file:	standard input
Output file:	standard output
Time limit:	3 seconds
Memory limit:	256 megabytes

Link has an array a of length n, and wants it to be an arithmetic progression(i.e., $a_i = a_1 + (i-1)d$).

Link can arbitrary modify the value of a_i. For each i, he can modify at most once. Suppose Link changed the value from a_i to a'_i, the cost is $\sum_{i=1}^{n}(a_i - a'_i)^2$.

What is the minimum cost to make a an arithmetic progression?

Input

Each test contains multiple test cases. The first line contains the number of test cases T ($1 \le T \le 1000$). Description of the test cases follows.

The first line contains an integer n ($3 \le n \le 10^5$).

The second line contains n integers $a_1, a_2, \ldots, a_n$ ($|a_i| \le 10^9$).

It is guaranteed that the sum of n over all test cases does not exceed 10^6.

You should use faster IO.

Output

For each case, output your answer in one line.

Your answer is considered correct if its absolute or relative error does not exceed 10^{-6}.

Formally, let your answer be a, and the jury's answer be b. Your answer is accepted if and only if $\frac{|a-b|}{\max(1,|b|)} \le 10^{-6}$.

Example

standard input	standard output
3 3 -1 0 1 3 0 0 1 13 1 1 4 5 1 4 1 9 1 9 8 1 0	0.000000000000000 0.166666666666667 129.225274725274716

Note

In the second example, you may change a to $[-\frac{1}{6}, \frac{1}{3}, \frac{5}{6}]$ to minimize the cost.

Problem K. Link with Bracket Sequence I

Input file:	standard input
Output file:	standard output
Time limit:	1 second
Memory limit:	256 megabytes

Link has a bracket sequence a of length n, which is a subsequence of a **valid** bracket sequence b of length m.

Link doesn't remember b, so he wonders the number of possible sequence b.

A bracket sequence is valid if it satisfies any of the following conditions:

- Its length is 0.
- It can be represented as (A), where a is a valid bracket sequence.
- It can be represented as AB, where A and B are both valid bracket sequence.

A sequence a is a subsequence of a sequence b if a can be obtained from b by deletion of several (possibly, zero or all) elements.

Input

Each test contains multiple test cases. The first line contains the number of test cases T ($1 \le T \le 100$). Description of the test cases follows.

The first line contains two integers n, m ($1 \le n \le m \le 200$).

The second line contains a bracket sequence s of length n.

It is guaranteed that the sum of m over all test cases does not exceed 10^3.

Output

For each test cases, output the number of possible sequence b modulo $10^9 + 7$.

Example

standard input	standard output
3 2 2 () 2 4)(2 4 ()	1 1 2

Problem L. Link with Level Editor I

Input file:	standard input
Output file:	standard output
Time limit:	1 second
Memory limit:	32 megabytes

Please pay attention to the special memory limit.

Link is playing a game, called NIO's Game.

In this game, a level consists of several worlds. Each world consists of m nodes and some directed roads. Player starts on node 1 of the first world. In each world, player can either stay at current node or go through exactly one road that exists in that world. After that, player will be teleported to the next world without changing the ID of the node where he stays. If there is no next world, the game ends. Player wins if he ends on node m.

Link is editing a new level, he has already made n worlds (numbered from 1 to n) and wants to choose a **continuous subsegment** of them to form a new level. **The only limit is that there should be at least one way to win.**

Link doesn't want to **use** too many worlds. What is the **minimum** number of worlds Link need to use in the new level?

Input

The first line contains two integers n, m ($1 \le n \le 10^4, 2 \le m \le 2 \times 10^3$).

The following input describes the worlds from 1 to n. For each world:

The first line contains an integer l ($0 \le l \le m \times (m-1)$), which is the number of roads in this world.

The next l lines, each line contains two integers u, v ($1 \le u, v \le m, u \ne v$), which means there is a road from node u to node v in this world.

For each world, it is guaranteed that there is no duplicate edge.

For each test point, it is guaranteed that the sum of l does not exceed 10^6.

Output

Output a single integer, which is the minimum number of worlds Link need to use in the new level. If Link couldn't make such level, output -1.

Examples

standard input	standard output
3 3 1 2 1 1 2 3 1 1 2	-1
3 3 1 2 1 1 1 2 1 2 3	2