ICPC Japan Alumni Group Summer Camp 2019 Day 1

JAG Summer Camp 19 Day 1

Problems

A	AIGo
B	Non-trivial Common Divisor
C	Universal and Existensial Quantifier
D	Permutation Sort
E	Consistent Trading
F	All your base are belong to us
G	Route Calculator Returns
H	N-by-M grid calculation
I	Zombie Land
J	Rooks Game
K	Bombing

This page is intentionally left blank.

Problem A

AIGo

Time limit: 2 seconds

Recently, AIs which play Go (a traditional board game) are well investigated. Your friend Hikaru is planning to develop a new awesome Go AI named Sai and promote it to company F or company G in the future. As a first step, Hikaru has decided to develop an AI for 1D-Go, a restricted version of the original Go.

In both of the original Go and 1D-Go, capturing stones is an important strategy. Hikaru asked you to implement one of the functions of capturing.

In 1D-Go, the game board consists of L grids lie in a row. A state of 1D-go is described by a string S of length L. The i-th character of S describes the i-th grid as the following:

- When the i-th character of S is B, the i-th grid contains a stone which is colored black.
- When the i-th character of S is W, the i-th grid contains a stone which is colored white.
- When the i-th character of S is ., the i-th grid is empty.

Maximal continuous stones of the same color are called a chain. When a chain is surrounded by stones with opponent's color, the chain will be captured.

More precisely, if i-th grid and j-th grids ($1 < i + 1 < j \leq L$) contain white stones and every grid of index k ($i < k < j$) contains a black stone, these black stones will be captured, and vice versa about color.

Please note that some of the rules of 1D-Go are quite different from the original Go. Some of the intuition obtained from the original Go may curse cause some mistakes. You are given a state of 1D-Go that next move will be played by the player with white stones. The player can put a white stone into one of the empty cells. However, the player can not make a chain of white stones which is surrounded by black stones even if it simultaneously makes some chains of black stones be surrounded. It is guaranteed that the given state has at least one grid where the player can put a white stone and there are no chains which are already surrounded.

Write a program that computes the maximum number of black stones which can be captured by the next move of the white stones player.

Input

The input consists of one line and has the following format:

L S

L ($1 \leq L \leq 100$) means the length of the game board and S ($|S| = L$) is a string which describes the state of 1D-Go. The given state has at least one grid where the player can put a white stone and there are no chains which are already surrounded.

Output

Output the maximum number of stones which can be captured by the next move in a line.

Sample Input 1	Sample Output 1
5 .WB..	1

Sample Input 2	Sample Output 2
5 .WBB.	2

Sample Input 3	Sample Output 3
6 .WB.B.	0

Sample Input 4	Sample Output 4
6 .WB.WB	0

Sample Input 5	Sample Output 5
5 BBB..	0

Note

In the 3rd and 4th test cases, the player cannot put a white stone on the 4th grid since the chain of the white stones will be surrounded by black stones. This rule is different from the original Go.

In the 5th test case, the player cannot capture any black stones even if the player put a white stone on the 4th grid. The player cannot capture black stones by surrounding them with the edge of the game board and the white stone. This rule is also different from the original Go.

Problem B

Non-trivial Common Divisor

Time limit: 2 seconds

You are given a positive integer sequence A of length N. You can remove any numbers from the sequence to make the sequence "friendly". A sequence is called friendly if there exists an integer k (>1) such that every number in the sequence is a multiple of k. Since the empty sequence is friendly, it is guaranteed that you can make the initial sequence friendly.

You noticed that there may be multiple ways to make the sequence friendly. So you decide to maximize the sum of all the numbers in the friendly sequence. Please calculate the maximum sum of the all numbers in the friendly sequence which can be obtained from the initial sequence.

Input

The input consists of a single test case formatted as follows.

N
A_1
$\vdots$
A_N

The first line consists of a single integer N ($1 \leq N \leq 1000$). The $i+1$-st line consists of an integer A_i ($1 \leq A_i \leq 10^9$ for $1 \leq i \leq N$).

Output

Print the maximum sum of all the numbers in the friendly sequence which can be obtained from the initial sequence.

Sample Input 1

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

Sample Output 1

```
12
```

Sample Input 2

```
3
173
1733
111733
```

Sample Output 2

```
111733
```

Sample Input 3

```
4
1
1
1
1
```

Sample Output 3

```
0
```

Sample Input 4

```
10
999999999
999999999
999999999
999999999
999999999
999999999
999999999
999999999
999999999
```

Sample Output 4

```
9999999990
```

Sample Input 5

```
1
999999999
```

Sample Output 5

```
999999999
```

Sample Input 6

```
10
28851
8842
9535
2311
25337
26467
12720
10561
8892
6435
```

Sample Output 6

```
56898
```

Problem C

Universal and Existensial Quantifier

Time limit: 2 seconds

You are given a list of N intervals. The i-th interval is $[l_i, r_i)$, which denotes a range of numbers greater than or equal to l_i and strictly less than r_i. In this task, you consider the following two numbers:

- The minimum integer x such that you can select x intervals from the given N intervals so that the union of the selected intervals is $[0, L)$.
- The minimum integer y such that for all possible combinations of y intervals from the given N interval, it does cover $[0, L)$.

We ask you to write a program to compute these two numbers.

Input

The input consists of a single test case formatted as follows.

$N\ L$
$l_1\ r_1$
$l_2\ r_2$
$\vdots$
$l_N\ r_N$

The first line contains two integers N ($1 \leq N \leq 2 \times 10^5$) and L ($1 \leq L \leq 10^{12}$), where N is the number of intervals and L is the length of range to be covered, respectively. The i-th of the following N lines contains two integers l_i and r_i ($0 \leq l_i < r_i \leq L$), representing the range of the i-th interval $[l_i, r_i)$. You can assume that the union of all the N intervals is $[0, L)$

Output

Output two integers x and y mentioned in the problem statement, separated by a single space, in a line.

Sample Input 1

```
3 3
0 2
1 3
1 2
```

Sample Output 1

```
2 3
```

Sample Input 2

```
2 4
0 4
0 4
```

Sample Output 2

```
1 1
```

Sample Input 3

```
5 4
0 2
2 4
0 3
1 3
3 4
```

Sample Output 3

```
2 4
```

This page is intentionally left blank.

Problem D
Permutation Sort
Time limit: 2 seconds

One day (call it day 0), you find a permutation P of N integers written on the blackboard in a single row. Fortunately you have another permutation Q of N integers, so you decide to play with these permutations.

Every morning of the day 1,2,3,... , you rewrite every number on the blackboard in such a way that erases the number x and write the number Q_x at the same position. Please find the minimum non-negative integer d such that in the evening of the day d the sequence on the blackboard is sorted in increasing order.

Input

The input consists of a single test case in the format below.

N
$P_1 \dots P_N$
$Q_1 \dots Q_N$

The first line contains an integer N ($1 \leq N \leq 200$). The second line contains N integers $P_1, \dots, P_N$ ($1 \leq P_i \leq N$) which represent the permutation P. The third line contains N integers $Q_1, \dots, Q_N$ ($1 \leq Q_i \leq N$) which represent the permutation Q.

Output

Print the minimum non-negative integer d such that in the evening of the day d the sequence on the blackboard is sorted in increasing order. If such d does not exist, print -1 instead.

It is guaranteed that the answer does not exceed 10^{18}.

Sample Input 1

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

Sample Output 1

```
4
```

Sample Input 2

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

Sample Output 2

```
0
```

Sample Input 3

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

Sample Output 3

```
-1
```

This page is intentionally left blank.

Problem E
Consistent Trading
Time limit: 2 seconds

Your company is developing a video game. In this game, players can exchange items. This trading follows the rule set by the developers. The rule is defined as the following format: "Players can exchange one item A_i and x_i item B_i". Note that the trading can be done in both directions. Items are exchanged between players and the game system. Therefore players can exchange items any number of times. Sometimes, testers find bugs that a repetition of a specific sequence of tradings causes the unlimited increment of items. For example, the following rule set can cause this bug.

1. Players can exchange one item 1 and two item 2.
2. Players can exchange one item 2 and two item 3.
3. Players can exchange one item 1 and three item 3.

In this rule set, players can increase items unlimitedly. For example, players start tradings with one item 1. Using rules 1 and 2, they can exchange it for four item 3. And, using rule 3, they can get one item 1 and one item 3. By repeating this sequence, the amount of item 3 increases unlimitedly.

These bugs can spoil the game, therefore the developers decided to introduce the system which prevents the inconsistent trading. Your task is to write a program which detects whether the rule set contains the bug or not.

Input

The input consists of a single test case in the format below.

$N\ M$
$A_1\ B_1\ x_1$
$\vdots$
$A_M\ B_M\ x_M$

The first line contains two integers N and M which are the number of types of items and the number of rules, respectively ($1 \leq N \leq 100000$, $1 \leq M \leq 100000$). Each of the following M lines gives the trading rule that one item A_i and x_i item B_i ($1 \leq A_i, B_i \leq N, 1 \leq x_i \leq 1000000000$) can be exchanged in both directions. There are no exchange between same items, i.e., $A_i \neq B_i$.

Output

If there are no bugs, i.e., repetition of any sequence of tradings does not cause an unlimited increment of items, output “Yes”. If not, output “No”.

Sample Input 1

```
4 4
1 2 2
2 3 2
3 4 2
4 2 3
```

Sample Output 1

```
No
```

Sample Input 2

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

Sample Output 2

```
Yes
```

Sample Input 3

```
4 4
1 2 101
2 3 99
1 4 100
4 3 100
```

Sample Output 3

```
No
```

Sample Input 4

```
5 6
3 1 4
2 3 4
5 4 15
2 1 16
2 4 20
5 3 3
```

Sample Output 4

```
Yes
```

Problem F

All your base are belong to us

Time limit: 2 seconds

In A.D. 2101, war was beginning. The enemy has taken over all of our bases. To recapture the bases, we decided to set up a headquarters. We need to define the location of the headquarters so that all bases are not so far away from the headquarters. Therefore, we decided to choose the location to minimize the sum of the distances from the headquarters to the furthest K bases. The bases are on the 2-D plane, and we can set up the headquarters in any place on this plane even if it is not on a grid point.

Your task is to determine the optimal headquarters location from the given base positions.

Input

The input consists of a single test case in the format below.

$N\ K$
$x_1\ y_1$
$\vdots$
$x_N\ y_N$

The first line contains two integers N and K. The integer N is the number of the bases ($1 \leq N \leq 200$). The integer K gives how many bases are considered for calculation ($1 \leq K \leq N$). Each of the following N lines gives the x and y coordinates of each base. All of the absolute values of given coordinates are less than or equal to 1000, i.e., $-1000 \leq x_i, y_i \leq 1000$ is satisfied.

Output

Output the minimum sum of the distances from the headquarters to the furthest K bases. The output can contain an absolute or a relative error no more than 10^{-3}.

Sample Input 1

```
3 1
0 1
1 0
1 1
```

Sample Output 1

```
0.70711
```

Sample Input 2

```
6 3
1 1
2 1
3 2
5 3
8 5
13 8
```

Sample Output 2

```
17.50426
```

Sample Input 3	Sample Output 3
9 3 573 -50 -256 158 -751 14 314 207 293 567 59 -340 -243 -22 -268 432 -91 -192	1841.20904

Problem G

Route Calculator Returns

Time limit: 2 seconds

You have a grid with H rows and W columns. Each cell contains one of the following 11 characters: an addition operator +, a multiplication operator $\star$, or a digit between 1 and 9.

There are paths from the top-left cell to the bottom-right cell by moving right or down $H + W - 2$ times. Let us define the value of a path by the evaluation result of the mathematical expression you can obtain by concatenating all the characters contained in the cells on the path in order. Your task is to compute the sum of values of any possible paths. Since the sum can be large, find it modulo M.

It is guaranteed the top-left cell and the bottom-right cell contain digits. Moreover, if two cells share an edge, at least one of them contains a digit. In other words, each expression you can obtain from a path is mathematically valid.

Input

The input consists of a single test case in the format below.

$H\ W\ M$
$a_{1,1} \cdots a_{1,W}$
$\cdots$
$a_{H,1} \cdots a_{H,W}$

The first line consists of three integers H, W and M ($1 \leq H, W \leq 2000$, $2 \leq M \leq 10^9$).The following H lines represent the characters on the grid. $a_{i,j}$ represents the character contained in the cell at the i-th row and j-th column. Each $a_{i,j}$ is either +, $\star$, or a digit between 1 and 9. $a_{1,1}$ and $a_{H,W}$ are both digits. If two cells share an edge, at least one of them contain a digit.

Output

Print the sum of values of all possible paths modulo M.

Sample Input 1

```
2 3 1000
3*1
+27
```

Sample Output 1

```
162
```

Sample Input 2

```
4 4 3000000
24+7
*23*
9+48
*123
```

Sample Output 2

```
2159570
```

This page is intentionally left blank.

Problem H
N-by-M grid calculation
Time limit: 2 seconds

Have you experienced 10-by-10 grid calculation? It's a mathematical exercise common in Japan. In this problem, we consider the generalization of the exercise, N-by-M grid calculation.

In this exercise, you are given an N-by-M grid (i.e. a grid with N rows and M columns) with an additional column and row at the top and the left of the grid, respectively. Each cell of the additional column and row has a positive integer. Let's denote the sequence of integers on the column and row by a and b, and the i-th integer from the top in the column is a_i and the j-th integer from the left in the row is b_j, respectively.

Initially, each cell in the grid (other than the additional column and row) is blank. Let (i, j) be the cell at the i-th from the top and the j-th from the left. The exercise expects you to fill all the cells so that the cell (i, j) has $a_i \times b_j$. You have to start at the top-left cell. You repeat to calculate the multiplication $a_i \times b_j$ for a current cell (i, j), and then move from left to right until you reach the rightmost cell, then move to the leftmost cell of the next row below. At the end of the exercise, you will write a lot, really a lot of digits on the cells. Your teacher, who gave this exercise to you, looks like bothering to check entire cells on the grid to confirm that you have done this exercise. So the teacher thinks it is OK if you can answer the d-th digit (not integer, see an example below), you have written for randomly chosen x. Let's see an example.

	1	7	3
8	8	56	24
1	1	7	3

For this example, you calculate values on cells, which are 8, 56, 24, 1, 7, 3 in order. Thus, you would write digits 8, 5, 6, 2, 4, 1, 7, 3. So the answer to a question 4 is 2.

You noticed that you can answer such questions even if you haven't completed the given exercise. Given a column a, a row b, and Q integers $d_1, d_2, \ldots, d_Q$, your task is to answer the d_k-th digit you would write if you had completed this exercise on the given grid for each k. Note that your teacher is not so kind (unfortunately), so may ask you numbers greater than you would write. For such questions, you should answer 'x' instead of a digit.

Input

The input consists of a single test case formatted as follows.

N M
$a_1 \ldots a_N$
$b_1 \ldots b_M$
Q
$d_1 \ldots d_Q$

The first line contains two integers N ($1 \leq N \leq 10^5$) and M ($1 \leq M \leq 10^5$), which are the number of rows and columns of the grid, respectively.

The second line represents a sequence a of N integers, the i-th of which is the integer at the i-th from the top of the additional column on the left. It holds $1 \leq a_i \leq 10^9$ for $1 \leq i \leq N$.

The third line represents a sequence b of M integers, the j-th of which is the integer at the j-th from the left of the additional row on the top. It holds $1 \leq b_j \leq 10^9$ for $1 \leq j \leq M$.

The fourth line contains an integer Q ($1 \leq Q \leq 3 \times 10^5$), which is the number of questions your teacher would ask.

The fifth line contains a sequence d of Q integers, the k-th of which is the k-th question from the teacher, and it means you should answer the d_k-th digit you would write in this exercise. It holds $1 \leq d_k \leq 10^{15}$ for $1 \leq k \leq Q$.

Output

Output a string with Q characters, the k-th of which is the answer to the k-th question in one line, where the answer to k-th question is the d_k-th digit you would write if d_k is no more than the number of digits you would write, otherwise 'x'.

Sample Input 1

```
2 3
8 1
1 7 3
5
1 2 8 9 1000000000000000
```

Sample Output 1

```
853xx
```

Sample Input 2

```
3 4
271 828 18
2845 90 45235 3
7
30 71 8 61 28 90 42
```

Sample Output 2

```
7x406x0
```

Problem I
Zombie Land
Time limit: 2 seconds

Your friend, Tatsumi, is a producer of Immortal Culture Production in Chiba (ICPC). His company is planning to form a zombie rock band named Gray Faces and cheer Chiba Prefecture up.

But, unfortunately, there is only one zombie in ICPC. So, Tatsumi decided to release the zombie on a platform of Soga station to produce a sufficient number of zombies. As you may know, a zombie changes a human into a new zombie by passing by the human. In other words, a human becomes a zombie when the human and a zombie are at the same point. Note that a zombie who used to be a human changes a human into a zombie too.

The platform of Soga station is represented by an infinitely long line, and Tatsumi will release a zombie at a point with coordinate x_Z. After the release, the zombie will start walking in the positive direction at v_Z per second. If v_Z is negative, the zombie will walk in the negative direction at $|v_Z|$ per second.

There are N humans on the platform. When Tatsumi releases the zombie, the i-th human will be at a point with coordinate x_i and will start walking in the positive direction at v_i per second. If v_i is negative, the human will walk in the negative direction at $|v_i|$ per second as well as the zombie.

For each human on the platform, Tatsumi wants to know when the human becomes a zombie. Please help him by writing a program that calculates a time when each human on the platform becomes a zombie.

Input

The input consists of a single test case in the following format.

N
$x_Z\ v_Z$
$x_1\ v_1$
$\vdots$
$x_N\ v_N$

The first line consists of an integer N ($1 \leq N \leq 2 \times 10^5$) which is the number of humans on a platform of Soga station. The second line consists of two integers x_Z ($-10^9 \leq x_Z \leq 10^9$) and v_Z ($-10^9 \leq v_Z \leq 10^9$) separated by a space, where x_Z is an initial position of a zombie Tatsumi will release and v_Z is the velocity of the zombie. The i-th line in the following N lines contains two integers x_i ($-10^9 \leq x_i \leq 10^9$) and v_i ($-10^9 \leq v_i \leq 10^9$) separated by a space, where the x_i is an initial position of the i-th human and v_i is the velocity of the human. There is no human that shares their initial position with the zombie. In addition, initial positions of the humans are different from each other.

Output

The output consists of N lines. In the i-th line, print how many seconds it will take for the i-th human to become a zombie. If the i-th human will never become a zombie, print -1 instead. The answer will be considered as correct if the values output have an absolute or relative error less than 10^{-9}.

Sample Input 1

```
6
3 1
-5 0
5 0
-4 -3
0 -2
6 -3
2 -1
```

Sample Output 1

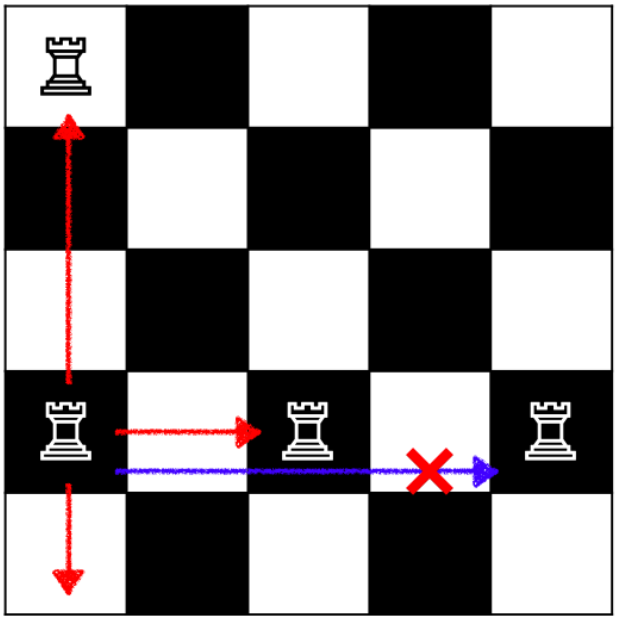
```
3.66666666666667
2.00000000000000
-1
6.00000000000000
0.75000000000000
2.00000000000000
```

Sample Input 2	Sample Output 2
5 31415 -926 5358 979 323846 26 -433832 7950 288 -4 -1971 -69	13.67821522309711 95.61812216052499 52.41629112212708 33.76030368763558 38.95682613768962

Problem J
Rooks Game
Time limit: 2 seconds

"Rooks Game" is a single-player game and uses a chessboard which has $N \times N$ grid and M rook pieces.

A rook moves through any number of unoccupied squares horizontally or vertically. When a rook can attack another rook, it can capture the rook and move to the square which was occupied. Note that, in Rooks Game, we don't distinguish between white and black, in other words, every rook can capture any of other rooks.



Initially, there are M rooks on the board. In each move, a rook captures another rook. The player repeats captures until any rook cannot be captured. There are two types of goal of this game. One is to minimize the number of captured rooks, and the other is to maximize it.

In this problem, you are requested to calculate the minimum and maximum values of the number of captured rooks.

Input

The input consists of a single test case in the format below.

N M
x_1 y_1
$\vdots$
x_M y_M

The first line contains two integers N and M which are the size of the chessboard and the number of rooks, respectively ($1 \leq N, M \leq 1000$). Each of the following M lines gives the position of each rook. The i-th line with x_i and y_i means that the i-th rook is in the x_i-th column and y_i-th row ($1 \leq x_i, y_i \leq N$). You can assume any two rooks are not in the same place.

Output

Output the minimum and maximum values of the number of captured rooks separated by a single space.

Sample Input 1

```
8 3
1 1
1 8
8 8
```

Sample Output 1

```
1 2
```

Sample Input 2

```
8 4
1 1
1 8
8 8
8 1
```

Sample Output 2

```
2 3
```

Sample Input 3

```
5 5
1 1
2 2
3 3
4 4
5 5
```

Sample Output 3

```
0 0
```

Sample Input 4

```
100 1
100 100
```

Sample Output 4

```
0 0
```

Sample Input 5

```
10 12
1 2
1 4
1 6
3 6
5 6
10 7
8 7
6 7
4 7
2 7
7 3
9 5
```

Sample Output 5

```
7 8
```

Problem K
Bombing
Time limit: 2 seconds

JAG land is a country, which is represented as an $M \times M$ grid. Its top-left cell is $(1, 1)$ and its bottom-right cell is (M, M).

Suddenly, a bomber invaded JAG land and dropped bombs to the country. Its bombing pattern is always fixed and represented by an $N \times N$ grid. Each symbol in the bombing pattern is either `X` or `.`. The meaning of each symbol is as follows.

- '`X`': Bomb
- '`.`': Empty

Here, suppose that a bomber is in (br, bc) in the land and drops a bomb. The cell $(br + i - 1, bc + j - 1)$ will be damaged if the symbol in the i-th row and the j-th column of the bombing pattern is `X` $(1 \leq i, j \leq N)$.

Initially, the bomber reached $(1, 1)$ in JAG land. The bomber repeated to move to either of 4-directions and then dropped a bomb just L times. During this attack, the values of the coordinates of the bomber were between 1 and $M - N + 1$, inclusive, while it dropped bombs. Finally, the bomber left the country. The moving pattern of the bomber is described as L characters. The i-th character corresponds to the i-th move and the meaning of each character is as follows.

- '`U`': Up
- '`D`': Down
- '`L`': Left
- '`R`': Right

Your task is to write a program to analyze the damage situation in JAG land. To investigate damage overview in the land, calculate the number of cells which were damaged by the bomber at least K times.

Input

The input consists of a single test case in the format below.

$N\ M\ K\ L$
B_1
$\vdots$
B_N
S

The first line contains four integers N, M, K and $L(1 \leq N < M \leq 500, 1 \leq K \leq L \leq 2 \times 10^5)$. The following N lines represent the bombing pattern. B_i is a string of length N. Each character of B_i is either '`X`' or '`.`'. The last line denotes the moving pattern. S is a string of length L, which consists of either '`U`', '`D`', '`L`' or '`R`'. It's guaranteed that the values of the coordinates of the bomber are between 1 and $M - N + 1$, inclusive, while it drops bombs in the country.

Output

Print the number of cells which were damaged by the bomber at least K times.

Sample Input 1	Sample Output 1
2 3 2 4 XX X. RDLU	3

Sample Input 2	Sample Output 2
7 8 3 5 .XXX.X. X..X.X. ...XX.X XX.XXXX ..XXXX. X.X.... ..XXXXX DRULD	26