1

Bitaro the Brave

Bitaro the Brave faces the Devil.

Bitaro is going to attack the Devil by arranging jewels, orbs and ingots on an H times W grid and casting a spell. The square at the i-th row ($1 \le i \le H$) from the top and the j-th column ($1 \le j \le W$) from the left is denoted by (i, j).

Now, Bitaro has arranged one of these three types on each square. Bitaro is going to cast a spell, the power of which is determined by the arrangement of jewels, orbs and ingots. Specifically, the power equals to the number of quadruplets of integers (i, j, k, ℓ) ($1 \le i < k \le H$, $1 \le j < \ell \le W$) satisfying the following condition.

> Condition: Bitaro has arranged a jewel on the square (i, j), an orb on the square (i, ℓ) and an ingot on the square (k, j).

Bitaro is wondering the power of the spell.

Write a program which, given the arrangement of jewels, orbs and ingots, calculates the power of the spell Bitaro casts.

Input

Read the following data from the standard input.

H W

S_1

:

S_H

S_i ($1 \le i \le H$) is a string of length W. The item arranged on the square (i, j) ($1 \le j \le W$) is a jewel if the j-th character of S_i is `J`, an orb if it is `O` and an ingot if it is `I`.

Output

Write one line to the standard output. The output should contain the power of the spell Bitaro casts.

Constraints

- $2 \leq H \leq 3\,000$.
- $2 \leq W \leq 3\,000$.
- S_i is a string of length W ($1 \leq i \leq H$).
- Each character of S_i is `J`, `O`, or `I` ($1 \leq i \leq H$).

Subtasks

1. (20 points) $H \leq 100$, $W \leq 100$.
2. (30 points) $H \leq 500$, $W \leq 500$.
3. (50 points) No additional constraints.

Sample Input and Output

Sample Input 1	Sample Output 1
3 4 JOIJ JIOO IIII	3

In this sample, 3 quadruplets $(i, j, k, \ell) = (1, 1, 3, 2), (2, 1, 3, 3), (2, 1, 3, 4)$ satisfy the condition, so you should output 3.

Sample Input 2	Sample Output 2
4 4 JJOO JJOO IIJO IIIJ	17

2 Exhibition

You are going to hold an exhibition of pictures. In the exhibition, you will put some pictures into frames and exhibit them, lining them up in a row.

There are N candidate pictures for the exhibition, numbered from 1 through N. The picture i ($1 \leq i \leq N$) has size S_i and value V_i.

Also, there are M frames for the pictures, numbered from 1 through M. The frame j ($1 \leq j \leq M$) has size C_j. Only pictures of size at most C_j can be put into the frame j. At most one picture can be put into a frame.

Every picture to be exhibited must be put into a frame. For the sake of appearance, they must satisfy the following conditions:

- For any neighboring two pictures, the size of the frame containing the right picture must be at least the size of the frame containing the left picture.
- For any neighboring two pictures, the value of the right picture must be at least the value of the left picture.

You want to exhibit as many pictures as possible.

Write a program which, given the number of pictures, the number of frames, and their sizes and values, calculates the maximum number of pictures to be exhibited.

Input

Read the following data from the standard input.

N M
S_1 V_1
$\vdots$
S_N V_N
C_1
$\vdots$
C_M

Output

Write one line to the standard output. The output should contain the maximum number of pictures to be exhibited.

Constraints

- $1 \leq N \leq 100\,000$.
- $1 \leq M \leq 100\,000$.
- $1 \leq S_i \leq 1\,000\,000\,000$ $(1 \leq i \leq N)$.
- $1 \leq V_i \leq 1\,000\,000\,000$ $(1 \leq i \leq N)$.
- $1 \leq C_j \leq 1\,000\,000\,000$ $(1 \leq j \leq M)$.

Subtasks

1. (10 points) $N \leq 10$, $M \leq 10$.
2. (40 points) $N \leq 1000$, $M \leq 1000$.
3. (50 points) No additional constraints.

Sample Input and Output

Sample Input 1	Sample Output 1
3 4 10 20 5 1 3 5 4 6 10 4	2

In this sample, you can exhibit 2 pictures by lining them up as (picture 2, frame 2), (picture 1, frame 3) from left to right. As you cannot exhibit 3 or more pictures, output 2. Here, (picture i, frame j) denotes the picture i put in the frame j.

Sample Input 2	Sample Output 2
3 2 1 2 1 2 1 2 1 1	2

Sample Input 3	Sample Output 3
4 2 28 1 8 8 6 10 16 9 4 3	0

Sample Input 4	Sample Output 4
8 8 508917604 35617051 501958939 840246141 485338402 32896484 957730250 357542366 904165504 137209882 684085683 775621730 552953629 20004459 125090903 607302990 433255278 979756183 28423637 856448848 276518245 314201319 666094038 149542543	3

3 Growing Vegetables is Fun 3

JOI-kun, an expert of home garden, grows vegetables of Joy grass in his home garden. In his garden, there are N flowerpots aligned in the east-west direction. These flowerpots are numbered by $1, \ldots, N$ from the west end. There are N Joy grasses. In each flowerpot, there is one Joy grass planted.

In the spring, JOI-kun noticed that, against his expectations, Joy grasses had yielded leaves of various colors. Additionally, he discovered that Joy grasses had not grown as much as expected. He looked up books, and found the following facts:

- There are 3 kinds of Joy grasses, yielding red, green, or yellow leaves.
- If Joy grasses with the same leaf color are closely placed, their growth is prevented.

Therefore, JOI-kun decided to rearrange flowerpots so that no Joy grasses with the same leaf color adjoin. Flowerpots are so heavy that JOI-kun can only swap two Joy grasses in neighboring flowerpots in a single operation. In other words, what JOI-kun can do in a single operation is choosing an arbitrary flowerpot i ($1 \leq i \leq N-1$) and then swapping Joy grasses in flowerpots i and $i+1$.

Write a program which, given the number of Joy grasses and the colors of them, calculates the minimum number of operations which are required to rearrange Joy grasses so that no Joy grasses with the same leaf color adjoin.

Input

Read the following data from the standard input.

N

S

S is a string of length N. Its i-th ($1 \leq i \leq N$) character is `R`, `G`, and `Y` if the leaf color of the Joy grass in flowerpot i is red, green, and yellow, respectively.

Output

Write a line containing the minimum number of required operations to the standard output. If it is impossible to rearrange Joy grasses so that no Joy grasses with the same leaf color adjoin, write -1 instead.

Constraints

- $1 \leq N \leq 400$.

- S is a string of length N.
- Each character of S is `R`, `G` or `Y`.

Subtasks

1. (5 points) $N \leq 15$.
2. (55 points) $N \leq 60$.
3. (15 points) Each character of S is either `R` or `G`.
4. (25 points) No additional constraints.

Sample Input and Output

Sample Input 1	Sample Output 1
5 RRGYY	2

The following is a way to rearrange Joy grasses so that no Joy grasses with the same leaf color adjoin:

- First, swap Joy grasses in flowerpots 3 and 4.
- Second, swap Joy grasses in flowerpots 2 and 3.

After this, the order of Joy grasses will be `RYRGY`. Since it is impossible to rearrange Joy grasses with at most 1 operation, the answer is 2.

Sample Input 2	Sample Output 2
6 RRRRRG	-1

In this example, regardless of the operations, it is impossible to rearrange Joy grasses so that no Joy grasses with the same leaf color adjoin.

Sample Input 3	Sample Output 3
20 YYGYYYGGGGRGYYGRGRYG	8

4

Coin Collecting

Mr. JOI has a huge desk in his collection room, and there are a number of rare coins on it. To clean up the desk, he is going to rearrange the coins.

The desk can be regarded as a $2\,000\,000\,001 \times 2\,000\,000\,001$ grid. The columns are numbered from $-1\,000\,000\,000$ through $1\,000\,000\,000$ from left to right, and the rows are numbered from $-1\,000\,000\,000$ through $1\,000\,000\,000$ from bottom to top. The cell with the column number x and the row number y is denoted by (x, y).

There are $2N$ coins. Currently, the i-th coin ($1 \leq i \leq 2N$) is placed at the cell (X_i, Y_i). Mr. JOI's goal is to place a coin on each cell (x, y) with $1 \leq x \leq N$ and $1 \leq y \leq 2$. In order not to hurt the coins, the only operation he can perform is to choose a coin and move it to one of the neighboring cells (a cell neighbors another if and only if they share an edge). It is allowed that multiple coins are placed on a cell at some point. He wants to achieve the goal with as few operations as possible.

Write a program which, given the number of coins and the cells where the coins are currently placed, calculates the minimum number of operations needed to achieve the goal.

Input

Read the following data from the standard input.

N

X_1 Y_1

$\vdots$

X_{2N} Y_{2N}

Output

Write one line to the standard output. The output should contain the minimum number of operations needed to achieve the goal.

Constraints

- $1 \leq N \leq 100\,000$.
- $-1\,000\,000\,000 \leq X_i \leq 1\,000\,000\,000$ ($1 \leq i \leq 2N$).
- $-1\,000\,000\,000 \leq Y_i \leq 1\,000\,000\,000$ ($1 \leq i \leq 2N$).

Subtasks

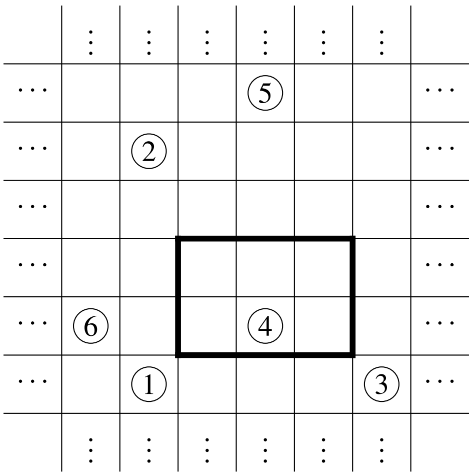
1. (8 points) $N \leq 10$.
2. (29 points) $N \leq 1\,000$.
3. (63 points) No additional constraints.

Sample Input and Output

Sample Input 1	Sample Output 1

`3`
`0 0`
`0 4`
`4 0`
`2 1`
`2 5`
`-1 1`
	`15`

In this sample input, 6 coins are placed as the figure below. The goal is to collect the coins inside the thick lines.



For example, Mr. JOI can achieve the goal with 15 operations by the following moves:

- The 1st coin: $(0, 0) \to (1, 0) \to (1, 1) \to (1, 2)$
- The 2nd coin: $(0, 4) \to (1, 4) \to (1, 3) \to (2, 3) \to (3, 3) \to (3, 2)$
- The 3rd coin: $(4, 0) \to (4, 1) \to (3, 1)$
- The 5th coin: $(2, 5) \to (2, 4) \to (2, 3) \to (2, 2)$
- The 6th coin: $(-1, 1) \to (0, 1) \to (1, 1)$

As he cannot achieve the goal with 14 or less operations, you should output 15.

Sample Input 2	Sample Output 2
4 2 1 2 1 2 1 3 1 3 1 3 1 3 1 3 1	9

Multiple coins may be placed on a cell.

Sample Input 3	Sample Output 3
5 1000000000 1000000000 -1000000000 1000000000 -1000000000 -1000000000 1000000000 -1000000000 -1 -5 -2 2 2 8 4 7 -2 5 7 3	8000000029

5 Unique Cities

There are N cities in JOI Country, numbered from 1 through N. The cities are connected by $N - 1$ roads. The i-th road ($1 \leq i \leq N - 1$) connects the cities A_i and B_i bidirectionally. From any city to any city, it is possible to travel using some roads.

JOI Country has some local specialities. Each kind of speciality is assigned an integer between 1 and M, inclusive (some integer may not correspond to any speciality in JOI Country). Each city produces one kind of speciality. The city j ($1 \leq j \leq N$) produces the speciality C_j. Multiple cities may produce the same kind of speciality.

We define the distance between two cities as the minimum number of roads needed to pass to travel from one to the other. For the city x ($1 \leq x \leq N$), we say the city y ($1 \leq y \leq N$, $y \neq x$) is a **unique city** if for any city z ($1 \leq z \leq N$, $z \neq x$, $z \neq y$) the distance between the cities x and y is different from the distance between the cities x and z.

Mr. K, the Minister of Transport in JOI Country, wants to know for each j ($1 \leq j \leq N$), the number of kinds of specialities produced in the unique cities for the city j.

Write a program which, given the information of roads in JOI Country and the kind of specialities produced in each city, calculates for each city, the number of kinds of specialities produced in the unique cities for it.

Input

Read the following data from the standard input.

N M
A_1 B_1
$\vdots$
A_{N-1} B_{N-1}
$C_1 \cdots C_N$

Output

Write N lines to the standard output. The j-th line ($1 \leq j \leq N$) should contain the number of kinds of specialities produced in the unique cities for the city j.

Constraints

- $2 \leq N \leq 200\,000$.
- $1 \leq M \leq N$.

- $1 \le A_i \le N$ $(1 \le i \le N-1)$, $1 \le B_i \le N$ $(1 \le i \le N-1)$.
- $A_i \ne B_i$ $(1 \le i \le N-1)$.
- From any city to any city, it is possible to travel using some roads.
- $1 \le C_j \le M$ $(1 \le j \le N)$.

Subtasks

1. (4 points) $N \le 2\,000$.
2. (32 points) $M = 1$.
3. (32 points) $M = N$, $C_j = j$ $(1 \le j \le N)$.
4. (32 points) No additional constraints.

Sample Input and Output

Sample Input 1	Sample Output 1
5 4 1 2 2 3 3 4 3 5 1 2 1 2 4	2 0 1 1 1

The unique cities for the city 1 are the cities 2 and 3, in which the specialities 2 and 1 are produced, so the answer is 2.

There are no unique cities for the city 2, so the answer is 0.

The unique city for the city is the city 1, in which the speciality 1 is produced, so the answer is 1.

The unique cities for the city 4 are the cities 1 and 3, in both of which the speciality 1 is produced, so the answer is 1.

The unique cities for the city 5 are the cities 1 and 3, in both of which the speciality 1 is produced, so the answer is 1.

Note that there does not exist a speciality 3.

Sample Input 2	Sample Output 2
7 1 1 2 2 3 3 4 4 5 5 6 6 7 1 1 1 1 1 1 1	1 1 1 0 1 1 1

This sample input satisfies the constraints for the subtask 2.

Sample Input 3	Sample Output 3
10 10 2 6 5 8 10 8 1 4 10 6 4 5 10 7 6 9 3 7 1 2 3 4 5 6 7 8 9 10	4 3 4 2 0 2 2 0 3 2

This sample input satisfies the constraints for the subtask 3.

Sample Input 4	Sample Output 4
22 12	2
9 6	0
12 13	1
4 20	1
21 22	1
3 19	1
2 9	1
6 18	0
18 11	0
18 3	1
16 2	2
6 4	0
3 17	1
16 10	1
8 16	2
22 1	0
16 14	2
15 8	1
9 21	2
2 12	3
21 5	0
12 7	0
1 1 4 8 4 11 7 6 7 11 6 11 10 4 7 5 3 12 9 6 12 2	