1 Stove

There is a stove in JOI-kun's room. Since JOI-kun gets used to the cold temperature, he does not need to turn on the stove when he is alone in his room. But, when there is a guest, he needs to turn on the stove.

One day, N guests will visit JOI-kun. The i-th guest ($1 \leq i \leq N$) will arrive at time T_i, and leave at time $T_i + 1$. At most one guest visits JOI-kun at any time.

JOI-kun can turn on the stove or turn off the stove at any time. JOI-kun uses a match when he turns on the stove. JOI-kun has K matches only. Hence he can turn on the stove at most K times. In the beginning of the day, the stove is turned off.

When the stove is turned on, it needs fuel. Therefore, JOI-kun controls when he turns on or turns off the stove, and he wants to minimize the total operating time of the stove.

Task

Given the data of the guests visiting JOI-kun and the number of matches JOI-kun has, write a program which calculates the minimum of the total operating time of the stove.

Input

Read the following data from the standard input.

- The first line of input contains two space separated integers N, K. This means N guests will visit JOI-kun, and JOI-kun has K matches.
- The i-th line ($1 \leq i \leq N$) of the following N lines contains an integer T_i. This means the i-th guest ($1 \leq i \leq N$) will arrive at time T_i, and leave at time $T_i + 1$.

Output

Write one line to the standard output. The output should contain the minimum of the total operating time of the stove.

Constraints

All input data satisfy the following conditions.

- $1 \leq N \leq 100\,000$.

- $1 \leq K \leq N$.
- $1 \leq T_i \leq 1\,000\,000\,000$ $(1 \leq i \leq N)$.
- $T_i < T_{i+1}$ $(1 \leq i \leq N - 1)$.

Subtask

Subtask 1 [20 points]

The following conditions are satisfied.

- $N \leq 20$.
- $1 \leq T_i \leq 20$ $(1 \leq i \leq N)$.

Subtask 2 [30 points]

- $N \leq 5000$.

Subtask 3 [50 points]

- There are no additional constraints.

Sample Input and Output

Sample Input 1	Sample Output 1
3 2 1 3 6	4

In this sample input, three guests will visit JOI-kun. If he turns on and turns off the stove in the following way, then the stove is turned on when a guest is visiting, he turns on the stove twice, and the total operating time of the stove is $(4 - 1) + (7 - 6) = 4$.

- He turns on the stove at time 1 when the first guest comes.
- He turns off the stove at time 4 when the second guest leaves.
- He turns on the stove at time 6 when the third guest comes.
- He turns off the stove at time 7 when the third guest leaves.

Since the total operating time of the stove cannot be less than 4, output 4.

Sample Input 2	Sample Output 2
3 1 1 2 6	6

In this sample input, JOI-kun can turn on the stove only once. Therefore, he turns on the stove at time 1 when the first guest comes, and he turns off the stove at time 7 when the third guest leaves.

Note that the time when a guest leaves can be the same as the time when the next guest comes.

Sample Input 3	Sample Output 3
3 3 1 3 6	3

In this sample input, JOI-kun turns on the stove when each guest comes, and he turns off the stove when each guest leaves.

Sample Input 4	Sample Output 4
10 5 1 2 5 6 8 11 13 15 16 20	12

2 Art Exhibition

An art exhibition will be held in Republic of JOI. Many artworks from all over the country will be displayed in the art exhibition.

There are N artworks which are candidates for the exhibition. The artworks are numbered from 1 to N. Two integers are defined for each artwork: its *size* and its *value*. The size of the artwork i ($1 \leq i \leq N$) is A_i, and the value of the artwork i is B_i.

In the art exhibition, at least one artwork will be chosen and displayed. Since the exhibition hall is large enough, it is possible to display all of the N artworks. However, due to the aesthetic sense of people in Republic of JOI, we want to choose artworks for the exhibition so that the difference between the sizes of the displayed artworks is not too large. On the other hand, we want to display many artworks with large value. We decided to choose the artworks for the exhibition by the following rule:

- Among chosen artworks for the exhibition, let $A_{\max}$ be the largest size of the chosen artworks, and $A_{\min}$ be the smallest size of the chosen artworks. Let S be the total value of the chosen artworks.
- Then, we want to maximize $S - (A_{\max} - A_{\min})$.

Task

Given the number of candidates of artworks for the exhibition, and the size and the value of each artwork, write a program which calculates the maximum of $S - (A_{\max} - A_{\min})$.

Input

Read the following data from the standard input.

- The first line contains an integer N, the number of candidates of artworks for the exhibition.
- The i-th line ($1 \leq i \leq N$) of the following N lines contains two space separated integers A_i, B_i. This means the size of the artwork i is A_i, and the value of the artwork i is B_i.

Output

Write one line to the standard output. The output should contain the maximum of $S - (A_{\max} - A_{\min})$.

Constraints

All input data satisfy the following conditions.

- $2 \leq N \leq 500\,000$.
- $1 \leq A_i \leq 1\,000\,000\,000\,000\,000 = 10^{15}$ $(1 \leq i \leq N)$.
- $1 \leq B_i \leq 1\,000\,000\,000$ $(1 \leq i \leq N)$.

Subtask

Subtask 1 [10 points]

- $N \leq 16$.

Subtask 2 [20 points]

- $N \leq 300$.

Subtask 3 [20 points]

- $N \leq 5000$.

Subtask 4 [50 points]

- There are no additional constraints.

Sample Input and Output

Sample Input 1	Sample Output 1
3 2 3 11 2 4 5	6

In this sample input, there are 3 candidates of artworks for the exhibition. The size and the value of each artwork are as follows:

- The artwork 1 has size 2, and value 3.
- The artwork 2 has size 11, and value 2.

- The artwork 3 has size 4, and value 5.

In this case, if we choose the artwork 1 and the artwork 3 for the exhibition, we have $S - (A_{\max} - A_{\min}) = 6$ by the following way:

- Among the chosen artworks, the artwork 3 has the largest size. Therefore, $A_{\max} = 4$.
- Among the chosen artworks, the artwork 1 has the smallest size. Therefore, $A_{\min} = 2$.
- The total value of the chosen artworks is $3 + 5 = 8$. Therefore, $S = 8$.

Since $S - (A_{\max} - A_{\min})$ cannot be greater than 7, output 6.

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

Sample Input 3	Sample Output 3
15 1543361732 260774320 2089759661 257198921 1555665663 389548466 4133306295 296394520 2596448427 301103944 1701413087 274491541 2347488426 912791996 2133012079 444074242 2659886224 656957044 1345396764 259870638 2671164286 233246973 2791812672 585862344 2996614635 91065315 971304780 488995617 1523452673 988137562	4232545716

3 Dango Maker

You are a professional confectioner making dangos, Japanese sweet dumplings. Now, you are about to skewer the dumplings.

The dumplings are placed on a grid of cells with N rows and M columns. Each cell contains one dumpling. The color of each dumpling is either red (R), green (G), or white (W).

You will choose three consecutive dumplings from the cells, and skewer them to a stick. The direction of the chosen three consecutive dumplings must be from left to right, or from top to bottom.

Now, you want to make sticks of dumplings whose colors are red, green, white, in this order. You want to make as many sticks of dumplings as possible. The order of dumplings skewered to a stick must be the same as the order of dumplings chosen from the cells. You are not allowed to skewer more than one sticks to one dumpling.

How many sticks of dumplings can you make?

Task

Given the colors of dumplings placed on the cells, write a program which calculates the maximum number of sticks of dumplings you can make. The colors must be red, green, white, in this order.

Input

Read the following data from the standard input.

- The first line of input contains two space separated integers N and M.
- The i-th line ($1 \leq i \leq N$) of the following N lines contains a string of size M consisting of `R`, `G`, or `W`. The j-th character ($1 \leq j \leq M$) of this string is the color of the dumpling in the i-th row from the top, and the j-th column from the left.

Output

White one line to the standard output. The output should contain the maximum number of sticks of dumplings.

Constraints

All input data satisfy the following conditions.

- $1 \leq N \leq 3\,000$.
- $1 \leq M \leq 3\,000$.

Subtask

Subtask 1 [13 points]

The following conditions are satisfied.

- $N \leq 4$.
- $M \leq 4$.

Subtask 2 [20 points]

The following conditions are satisfied.

- $N \leq 10$.
- $M \leq 10$.

Subtask 3 [67 points]

- There are no additional constraints.

Sample Input and Output

Sample Input 1	Sample Output 1
3 4 RGWR GRGG RGWW	3

By the following way, you can make 3 sticks of dumplings.

- You choose three consecutive dumplings from the first row from top, and the first column from left. The direction is from left to right. Then, you skewer them to a stick in this order.
- You choose three consecutive dumplings from the first row from top, and the 4-th column from left. The direction is from top to bottom. Then, you skewer them to a stick in this order.
- You choose three consecutive dumplings from the third row from top, and the first column from left. The direction is from left to right. Then, you skewer them to a stick in this order.

Since you cannot make 4 sticks, output 3.

Sample Input 2	Sample Output 2
4 4 RGWR GRRG WGGW WWWR	4

By the following way, you can make 4 sticks of dumplings.

- You choose three consecutive dumplings from the first row from top, and the first column from left. The direction is from left to right. Then, you skewer them to a stick in this order.
- You choose three consecutive dumplings from the first row from top, and the 4-th column from left. The direction is from top to bottom. Then, you skewer them to a stick in this order.
- You choose three consecutive dumplings from the second row from top, and the second column from left. The direction is from top to bottom. Then, you skewer them to a stick in this order.
- You choose three consecutive dumplings from the second row from top, and the third column from left. The direction is from top to bottom. Then, you skewer them to a stick in this order.

Since you cannot make 5 sticks, output 4.

Sample Input 3	Sample Output 3
5 5 RGRGW GRRGW WGGWR RWRGW RGWGW	6

4 Commuter Pass

JOI-kun is living in a city with N stations. The stations are numbered from 1 to N. There are M railways numbered from 1 to M. The railway i ($1 \leq i \leq M$) connects the station A_i and the station B_i in both directions, and the fare is C_i yen.

JOI-kun is living near the station S, and goes to the IOI high school near the station T. He is planning to buy a commuter pass connecting these two stations. When he buys a commuter pass, he needs to choose a route between the station S and the station T with minimum cost. Using this commuter pass, he can take any railways contained in a chosen route in any directions without additional costs.

JOI-kun often goes to bookstores near the station U and the station V. Therefore, he wants to buy a commuter pass so that the cost from the station U to the station V is minimized.

When he moves from the station U to the station V, he first choose a route from the station U to the station V. Then the fare he has to pay is

- 0 yen if the railway i is contained in a route chosen when he buys a commuter pass, or
- C_i yen if the railway i is not contained in a route chosen when he buys a commuter pass.

The sum of the above fare is the cost from the station U to the station V.

He wants to know the minimum cost from the station U to the station V if he chooses a route appropriately when he buys a commuter pass.

Task

Write a program which calculates the minimum cost from the station U to the station V if he chooses a route appropriately when he buys a commuter pass.

Input

Read the following data from the standard input.

- The first line of input contains two space separated integers N, M. This means the city JOI-kun lives in has N stations and M railways.
- The second line contains two space separated integers S, T. This means JOI-kun is planning to buy a commuter pass from the station S to the station T.
- The third line contains two space separated integers U, V. This means JOI-kun wants to minimize the cost from the station U to the station V.
- The i-th line ($1 \leq i \leq M$) of the following M lines contains three space separated integers A_i, B_i, C_i. The railway i connects the station A_i and the station B_i in both directions, and the fare is C_i yen.

Output

Write one line to the standard output. The output should contain the minimum cost from the station U to the station V if he chooses a route appropriately when he buys a commuter pass.

Constraints

All input data satisfy the following conditions.

- $2 \leq N \leq 100\,000$.
- $1 \leq M \leq 200\,000$.
- $1 \leq S \leq N$.
- $1 \leq T \leq N$.
- $1 \leq U \leq N$.
- $1 \leq V \leq N$.
- $S \neq T$.
- $U \neq V$.
- $S \neq U$ or $T \neq V$.
- JOI-kun can move from any stations to any other stations taking railways.
- $1 \leq A_i < B_i \leq N$ $(1 \leq i \leq M)$.
- For every $1 \leq i < j \leq M$, either $A_i \neq A_j$ or $B_i \neq B_j$.
- $1 \leq C_i \leq 1\,000\,000\,000$ $(1 \leq i \leq M)$.

Subtask

Subtask 1 [16 points]

- $S = U$.

Subtask 2 [15 points]

- There is a unique route with minimum cost from the station S to the station T.

Subtask 3 [24 points]

- $N \leq 300$.

Subtask 4 [45 points]

- There are no additional constraints.

Sample Input and Output

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

In this sample input, there is only one route JOI-kun can choose when he buys a commuter pass: Station 1 → Station 2 → Station 3 → Station 5 → Station 6.

In order to minimize the cost from the station 1 to the station 4, he chooses the following route: Station 1 → Station 2 → Station 3 → Station 5 → Station 4. When he chooses this route, the fare he has to pay is

- 2 yen for the railway 5 connecting the station 4 and the station 5, and
- 0 yen for other railways.

Hence the total cost is 2 yen.

Sample Input 2	Sample Output 2
6 5 1 2 3 6 1 2 1000000000 2 3 1000000000 3 4 1000000000 4 5 1000000000 5 6 1000000000	3000000000

In this sample input, JOI-kun does not use the commuter pass when he moves from the station 3 to the station 6.

Sample Input 3	Sample Output 3
8 8 5 7 6 8 1 2 2 2 3 3 3 4 4 1 4 1 1 5 5 2 6 6 3 7 7 4 8 8	15

Sample Input 4	Sample Output 4
5 5 1 5 2 3 1 2 1 2 3 10 2 4 10 3 5 10 4 5 10	0

Sample Input 5	Sample Output 5
10 15 6 8 7 9 2 7 12 8 10 17 1 3 1 3 8 14 5 7 15 2 3 7 1 10 14 3 6 12 1 5 10 8 9 1 2 9 7 1 4 1 1 8 1 2 4 7 5 6 16	19

5 Snake Escaping

JOI Laboratory has 2^L poisonous snakes. The snakes are numbered $0, 1, \ldots, 2^L - 1$. Each snake is divided into L parts from the head to the tail. The color of each part is either blue or red. For the poisonous snake i, let $i = \sum_{k=1}^{L} c_k 2^{L-k}$ $(0 \leq c_k \leq 1)$ be the binary expression of i. Then,

- if $c_k = 0$, the color of the k-th part of the poisonous snake i from the head is blue, and
- if $c_k = 1$, the color of the k-th part of the poisonous snake i from the head is red.

Each poisonous snake has an integer between 0 and 9, inclusive, called the *toxicity*. A string S of length 2^L consisting of `0`, `1`, `2`, `3`, `4`, `5`, `6`, `7`, `8`, `9` is given. The i-th character $(1 \leq i \leq 2^L)$ is the toxicity of the poisonous snake $i - 1$.

Since poisonous snakes are quick, they often escape from JOI Laboratory. Complaints are given to JOI Laboratory by people living near the laboratory who saw poisonous snakes escaping from the laboratory.

You are given a list of complaints for Q days. The complaints for the d-th day $(1 \leq d \leq Q)$ is a string T_d of length L consisting of `0`, `1`, `?`.

- If the j-th character $(1 \leq j \leq L)$ of T_d is `0`, this means the j-th part of every poisonous snake escaping from the laboratory on the d-th day is blue,
- If the j-th character $(1 \leq j \leq L)$ of T_d is `1`, this means the j-th part of every poisonous snake escaping from the laboratory on the d-th day is red, and
- If the j-th character $(1 \leq j \leq L)$ of T_d is `?`, this means no information was given by people concerning the j-th part of poisonous snakes escaping from the laboratory on the d-th day.

All the complaints are precise information. All the poisonous snakes escaping from the laboratory were kept by the staffs of JOI Laboratory on the same day. It may happen that the same snake escapes on a different day.

In order to estimate the risk of escaping poisonous snakes, Professor K, the executive director of JOI Laboratory, wants to know the sum of toxicities of the snakes which might escape from the laboratory. Your task is to write a program which calculates, given the list of complaints for Q days, the sum of toxicities of the snakes which might escape from the laboratory for each day.

Task

Given the string S describing the toxicities of the poisonous snakes and the list of complaints for Q days, write a program which calculates the sum of toxicities of the snakes which might escape from the laboratory for each day.

Note that the memory limit is small for this task.

Input

Read the following data from the standard input.

- The first line contains two space separated integers L, Q. They are the number of parts of each poisonous snake and the number of days for the complaints, respectively.
- The second line contains a string S of length 2^L. It describes the toxicities of the poisonous snakes.
- The d-th line ($1 \leq d \leq Q$) of the following Q lines contains a string T_d of length L. It is the complaints of the d-th day.

Output

Write Q lines to the standard output. The d-th line should contain an integer, the sum of toxicities of the snakes which might escape from the laboratory on d-th day.

Constraints

All input data satisfy the following conditions.

- $1 \leq L \leq 20$.
- $1 \leq Q \leq 1\,000\,000$.
- S is a string of length 2^L,
- The string S consists of `0`, `1`, `2`, `3`, `4`, `5`, `6`, `7`, `8`, `9`.
- T_d is a string of length L ($1 \leq d \leq Q$).
- The string T_d consists of `0`, `1`, `?` ($1 \leq d \leq Q$).

Subtask

Subtask 1 [5 points]

The following conditions are satisfied.

- $L \leq 10$.
- $Q \leq 1\,000$.

Subtask 2 [7 points]

- $L \leq 10$.

Subtask 3 [10 points]

- $L \leq 13$.

Subtask 4 [53 points]

- $Q \leq 50\,000$.

Subtask 5 [25 points]

- There are no additional constraints.

Sample Input and Output

Sample Input 1	Sample Output 1
3 5 12345678 000 0?? 1?0 ?11 ???	1 10 12 12 36

In this sample input, $L = 3$. There are $2^3 = 8$ poisonous snakes. Each of them is divided into 3 parts. The complaints are given for 5 days.

- On the first day, the poisonous snakes which might escape from the laboratory is the poisonous snake 0 only. The sum of toxicities is 1.
- On the second day, the poisonous snakes which might escape from the laboratory are the poisonous snakes $0, 1, 2, 3$. The sum of toxicities is 10.
- On the third day, the poisonous snakes which might escape from the laboratory are the poisonous snakes $4, 6$. The sum of toxicities is 12.
- On the fourth day, the poisonous snakes which might escape from the laboratory are the poisonous snakes $3, 7$. The sum of toxicities is 12.

- On the fifth day, the poisonous snakes which might escape from the laboratory are the poisonous snakes $0, 1, 2, 3, 4, 5, 6, 7$. The sum of toxicities is 36.

Sample Input 2	Sample Output 2
4 8 3141592653589793 0101 ?01? ??1? ?0?? 1?00 01?1 ??10 ????	9 18 38 30 14 15 20 80