Hidden keys

Mouse Binna and Mouse Stofl have won a prize for the first round of Mouse Olympiad of Informatics: a giant chest of cheese. To protect their chest from cat Tigro, they have secured the chest with a special lock requiring two keys. For added security, the mice want to hide the keys in a rectangular field containing colored rocks with n rows and m columns. They decided to put keys under two different rocks. To make it exceptionally difficult for Tigro, the chosen stones should be in different rows *and* different columns *and* have different colors. Help Binna and Stofl to find two rocks that meet their security requirements.

Input

In the first line there are two integers n and m representing the dimensions of the rectangular field (number of rows and columns, respectively).

There are following n lines, each line contains m non-negative integers c_{ij} representing the colors of rocks in each row.

Output

If it is not possible to find two such rocks, in a single line print -1. Otherwise in a single line print four integers: r_1, c_1, r_2, c_2 indicating the row and column indices (0-based) of the two selected rocks.

Limits

There are 3 subtasks. In all subtasks we have that $0 \leq c_{ij} \leq 10^6$ for all $0 \leq i < n$ and $0 \leq j < m$.

- In subtask 1, worth 32 points, we have $n \cdot m \leq 100$.
- In subtask 2, worth 19 points, we have $n, m \leq 300$ (note that here the restriction is not on the total area).
- In subtask 3, worth 49 points, we have $n \cdot m \leq 500\,000$.

Examples

1 1 1	-1

1 3 1 2 3	-1

2 3 1 2 3 4 5 6	0 0 1 2

Moving Faster

Before participating in the IMOI (International Mouse Olympiads in Informatics), Mouse Stofl wants to learn a bit more about Egypt's history and decides to join one of the teams preparing an expedition to the recently discovered Greater Pyramid of Giza. His team plans to split into 2 groups to explore 2 different rooms simultaneously and Stofl is responsible to communicate information between the 2 groups. To complete his task, Stofl decides to transmit all discoveries on foot by running between the 2 rooms. He will enter the pyramid with group 1 and after each new discovery from the group he is with, he will run to the other group to inform them of the new discovery. During each run he visits every room at most once. He repeats this process of going back and forth between the 2 groups until both groups are satisfied and have shared a total of k discoveries.

The pyramid contains rooms connected to each other by corridors filled with traps. All rooms in the pyramid can be reached on foot from any other room. Mouse Stofl has a map with the pyramid's layout and the traps locations. Since he loves obstacle courses he is able to predict with great accuracy how long it takes him to go through each corridor. He also knows that after going through a corridor he will be more familiar with the traps and how to overcome them so he will be faster by d units of time each time he uses this corridor in the future. Specifically if corridor i has been traversed x times the next time Stofl uses this corridor it will only take him $t_i - x \cdot d_i$ time.

He now asks you to calculate the minimum time he will need to share all discoveries between the 2 groups of explorers.

Input

The first line contains 5 numbers n, m, k, s and e where

- n is the number of rooms in the pyramid
- m is the number of corridors
- k is the number of messages Stofl needs to transmit
- s is the number of the first group's room
- e is the number of the second group's room

Then m lines follow each describing a corridor and containing 4 numbers a, b, t and d where

- a is the first endpoint of the corridor
- b is the second endpoint of the corridor
- t is the initial time needed to use the corridor
- d is the number by which the time needed to use the corridor decreases after using it

Output

Output a single number t, the minimum time needed to transmit all k messages between the groups in rooms s and e

Limits

In all subtasks we have $2 \leq n \leq 10^5, n-1 \leq m \leq 3 \cdot 10^5, 1 \leq k \leq 3 \cdot 10^3, 1 \leq d_i \leq 10^4, d_i \cdot k < t_i \leq 5 \cdot 10^8$.

There are 4 subtasks.

- In subtask 1 (17 points), we have $m = n - 1$
- In subtask 2 (15 points), we have $k = 1$
- In subtask 3 (22 points), all t are equal at the start
- In subtask 4 (46 points), no further restrictions

Examples

5 4 3 0 2 0 1 20 3 3 1 30 4 1 2 15 2 2 4 40 5	90

6 6 1 0 4 0 1 7 1 1 2 10 2 1 3 17 3 2 3 6 1 3 4 30 4 4 5 13 2	53

Ruined Chocolates

Mouse Stofl and Mouse Binna have found the legendary elemental kumquats! After eating them, they are no longer Mouse Stofl and Mouse Binna, but Fire Stofl and Ice Binna! With their newfound powers, they decide to hunt for chococolates in the mysterious chocolate tree.

The chocolate tree is a connected graph with N nodes and $N-1$ edges. Each node has an amount of chocolates.

Fire Stofl and Ice Binna find themselves in two (not necessarily different) nodes in the tree. However, because fire and ice don't go well together, all the chocolates on the unique path between them are ruined. Because being elemental mice is hard work, they now want to find the maximum amount of chocolates in an unruined node as a reward.

Input

The first line will contain two integers N and Q, the number of nodes and queries. The next $N-1$ lines will contain two integers, A and B, with $0 \leq A, B \leq N-1$, representing an edge between the nodes A and B. The next lines will contain N values, the i-th value representing the amount of chocolates in node i.

The next Q lines are the queries: each containing two integers, X and Y, with $0 \leq X, Y \leq N-1$, representing the positions of Fire Stofl and Ice Binna.

Output

Output Q lines that represent the answers to the queries: what is the maximum amount of chocolate in an unruined node, assuming fire Fire Stofl and Ice Binna are located on nodes X and Y.

Limits

In all test cases, the amount of chocolates in each node is at most 10 000 000. Note: All queries are independent and it is guaranteed that no query will cover the entire tree.

There are several subtasks, each with different additional constraints.

- In subtask 1, worth 20 points, we have $N, Q \leq 1\,000$.
- In subtask 2, worth 30 points, we have $N, Q \leq 100\,000$. Additionally, we guarantee that for all queries, one of the nodes in the query is 0.
- In subtask 3, worth 25 points, we have $N, Q \leq 100\,000$.
- In subtask 4, worth 25 points, we have $N, Q \leq 500\,000$.

Examples

8 3 1 0 2 1 3 1 4 0 5 4 6 3 7 4 7 10 6 1 3 5 2 4 0 6 4 5 1 2	6 10 7

For the first query, we eliminate the chain from 0 to 6, so the nodes 0, 1, 3 and 6. Out of the remaining nodes, node 2 has the highest value, 6 For the second query, we eliminate the chain from 4 to 5, so the nodes 4 and 5. Out of the remaining nodes, node 1 has the highest value, 10 For the third query, we eliminate the chain from 1 to 2, so the nodes 1 and 2. Out of the remaining nodes, node 0 has the highest value, 6

Tramtickets

Mouse Stofl is studying at Mouseland Federal Institute of Technology and commutes to University by tram. As he is sure he will start going by bike as of tomorrow* (except for when the weather is bad, he needs to be there early, has heavy books to carry, wants to go out with friends afterwards ...) he decided that getting a monthly ticket was not worth it. Instead, he wants to minimize his spending by carefully planning on when to buy multiride tickets.

The ticket system for the Mouseland tram system is very easy. There are exactly two options for a ticket: A single ticket, valid for a single ride costing a Francs, and a multiride ticket valid for the next d hours costing b Francs.

Stofl has made a list of all the n rides he wants to make and needs your help in finding the minimal cost to buy the tickets for them. Every ride on the list is an integer t_i meaning that Stofl departs on this journey t_i hours from now. As the tram system in Mouseland is very advanced, all rides are instantly and you do not need to take the duration into account.

In the last subtasks, Mouse Binna decides to join Stofl. She has her own list of m rides she wants to make. As they have the multiride passes on their phones, they can share them instantly. Of course they cannot use the same multiride pass at the same time as this would raise suspicion in the system. In this case they buy a second ticket (single or multiride).

Input

The input consists of three lines, the first line contains 5 integers separated by spaces, n, m, a, b, and d. The number of rides Stofl and Binna are planning respectively, the price of a single ticket and the price and the duration of the multiride ticket. The next line contains n distinct integers t_i, the times that Stofl travels. The next line contains m distinct integers q_i, the times Binna travels.

Output

You should output a single integer p, the minimum amount of money Stofl and Binna have to pay for all their tickets.

Limits

There are 6 subtasks. In all subtasks we have $1 \leq n, m \leq 100\,000$, $1 \leq a \leq 1000$, $1 \leq b \leq 1000$, $1 \leq d \leq 10\,000$, and $0 \leq t_i, q_i \leq 10^{12}$. Note that whenever $m > 0$ we have $d \leq 50$.

- In subtask 1, worth 13 points, we have $m = 0$, $n \leq 100$ and $t_i \leq 10\,000$.
- In subtask 2, worth 13 points, we have $m = 0$, $d \leq 50$.
- In subtask 3, worth 25 points, we have $m = 0$.
- In subtask 4, worth 10 points, we have $n, m \leq 100$, $t_i, q_i \leq 10\,000$ and $d \leq 50$.
- In subtask 5, worth 13 points, we have $n, m \leq 100$ and $d \leq 50$.
- In subtask 6, worth 26 points, $d \leq 50$.

Examples

`7 0 2 3 2` `3 0 10 7 2 4 9`	`12`

Stofl buys two multiride tickets to cover the rides at $t_i = 3, 4$ *and* $t_i = 9, 10$*, the rest is covered by three single tickets. This gives a total cost of* $3 + 3 + 2 + 2 + 2 = 12$*.*

`5 0 1 2 3` `1 4 5 6 7`	`4`

`5 4 2 3 4`
`10 4 2 6 1`
`4 7 10 3`
	`10`

Baguette Magique

Mouse Stofl is exploring the beautiful city of Lausanne. Getting hungry, he went to a bakery and ordered a "baguette magique" since that sounded interesting.

He received a baguette of length n centimeters. Each centimeter can potentially have a different flavor. Stofl doesn't like the mixture of flavors though, he wants his baguette to consist of just a single flavor. So he decides to repeatedly cut out parts of size at most k and feed them to the local pidgeons that gathered around him.

Formally, one operation of feeding the pidgeons means the following: Stofl picks some interval $[l, r)$ of length at most k ($r - l \leq k$) centimeters. He then cuts the baguette at positions l and r, feeds the part between l and r to the pigeons, and joins together the remaining parts of the baguette. Because the baguette is *magique* the remaining parts will magically fuse together giving him a new baguette that is $r - l$ centimeters shorter. Note that the endpoints of the interval can also include the left or right end of the baguette, in which case no fusing is necessary.

Since Stofl is lazy, he wants to know the minimum number of times he needs to feed the pigeons to make the baguette single flavored. He does not care about how large his baguette is at the end, as long as it is not empty.

The baguette is given as a string s of lowercase latin letters ("a" – "z"), different letters represent different flavors.

Input

The first line contains two integers n, the length of the baguette, and k, number of characters that can be removed in each cut. The second line contains a single string s of length n containing lowercase latin letters representing the baguette.

Output

Print an integer: the smallest number of times Stofl needs to feed the pigeons to make the baguette a single flavor.

Limits

There are 5 subtasks.

- In subtask 1, worth 12 points, we have $n \leq 50$ and $k = 1$.
- In subtask 2, worth 15 points, we have $n \leq 50$ and only character "a" and "b" in s.
- In subtask 3, worth 18 points, we have $n \leq 50$.
- In subtask 4, worth 22 points, we have $n \leq 1\,000$.
- In subtask 5, worth 33 points, we have $n \leq 10^7$.

Examples

`11 4` `exempelfall`	`3`

9 3 aabbabbba	2

Catering

Mouse Binna has volunteered to host this year's International Mouse Olympiad in Informatics (IMOI). The different events during IMOI will take place across n venues. There are m roads connecting these n venues. To make sure all the participants have a good time, she wants to hire a catering company to provide unlimited cheese on some of the roads. However, as everything in Switzerland, cheese is expensive. So Binna decided to only furnish enough roads such that between any two venues there is at least one path (a sequence of roads starting from one venue ending at the other) consisting only of the unlimited cheese roads. Binna got the price for covering each road from the catering company. However, just before asking you to help her figure out which roads to cover, she found a sponsor. The sponsor agreed to cover k roads chosen by Binna for free. Therefore your task is a bit more complicated. You should help Binna figure out the minimum price she has to pay to ensure unlimited cheese paths between every pair of venues given that she can cover k of the roads for free.

Input

The first line of input contains three space-separated integers, n, m, and k. The next m lines contains three space-separated integers each, u_i, v_i, and c_i, which denotes a road exists between u_i-th and v_i-th venues and covering it with unlimited cheese costs c_i.

Output

In the only line of input, write a single integer. The minimum price Binna has to pay to ensure all venues are connected using a series of unlimited cheese roads.

Limits

In all tests, we have $1 \leq c_i \leq 10^9$ and $0 \leq k \leq m$.

- In subtask 1 (6 points), we have $2 \leq n \leq 1000$, $n-1 \leq m \leq 2000$ and $k = 0$.
- In subtask 2 (6 points), we have $2 \leq n \leq 1000$, $n-1 \leq m \leq 2000$ and $k \leq 1$.
- In subtask 3 (6 points), we have $2 \leq n \leq 1000$, $n-1 \leq m \leq 2000$ and $1 \leq c_i \leq 2$.
- In subtask 4 (18 points), we have $2 \leq n \leq 1000$, $n-1 \leq m \leq 2000$.
- In subtask 5 (9 points), we have $2 \leq n \leq 10^5$, $n-1 \leq m \leq 2 \cdot 10^5$ and $k = 0$.
- In subtask 6 (9 points), we have $2 \leq n \leq 10^5$, $n-1 \leq m \leq 2 \cdot 10^5$ and $k \leq 1$.
- In subtask 7 (19 points), we have $2 \leq n \leq 10^5$, $n-1 \leq m \leq 2 \cdot 10^5$ and $1 \leq c_i \leq 2$.
- In subtask 8 (27 points), we have $2 \leq n \leq 10^5$, $n-1 \leq m \leq 2 \cdot 10^5$.

Examples

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

Binna asks the sponsor to cover the road from 2 to 3 for cost two. Then she only needs to cover the costs of the roads $0-1$ *and* $0-2$ *to make sure that there is a path between any two venues.*

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