CP1 [2023] Lab - 3

A. Oil-search

1 second, 512 megabytes

Boe Jiden is on a mission to extract oil from the middle east. There are n locations in the middle east where oil exists. The locations are numbered $1, 2,...n$. His journey starts at location number 1 and should end at location number n.

These locations have **one way paths** between them. It is guaranteed that there does not exist a path that leads to a already visited location. Jiden wants to know what is the maximum number of locations he can visit starting from 1 and ending at n.

Input

The first line contains the two integers n and m $(2 \leq n \leq 10^5, 1 \leq m \leq 2 * 10^5)$, where n is the number of places where oil exists and m are the number of paths between two any places.

Next m lines contain two integers x_i and y_i, which means there is a path $\mathbf{from\ x_i\ to\ y_i}$.

Output

In the first line print the maximum number of places he can visit on his route. If there is no path, print "IMPOSSIBLE".

input
4 4 3 1 3 4 1 2 2 4
output
3

input
10 10 2 6 1 2 4 6 5 6 2 5 7 8 6 10 1 10 3 5 4 9
output
5

B. Is it a tree? Is it a star?

1 second, 256 megabytes

Given a tree with N vertices and $N-1$, you need to determine if the given tree is a star.

A *star* is a tree that contains only one interior (non-leaf) node, connected to all other (leaf) nodes.

Input

The first line contains a single integer N $(3 \leq N \leq 10^5)$, the number of nodes in the tree.

$N-1$ lines follow. Each line contains 2 integers u and v $(1 \leq u, v \leq N)$, denoting that node u is connected to node v.

It is guaranteed that the input forms a tree.

Output

Print `YES` if the input tree is a star, and print `NO` otherwise.

input
5 1 4 2 4 3 4 4 5
output
YES

input
4 2 4 1 4 2 3
output
NO

In the first test, Node 4 is an interior node, and all other nodes are leaf nodes.

In the second test, both nodes 2 and 4 are interior nodes.

C. The tree game

1 second, 256 megabytes

Jamun has recently made a remarkable discovery in the field of trees, introducing a new type called the evolved tree. Inspired by this revolutionary finding, Jamun devised a game for children that utilizes evolved trees.

The game is played on a tree consisting of n nodes, numbered from 1 to n. Each node i initially holds a value, denoted as $init_i$, which can be either 0 or 1. The root of the tree is designated as node 1.

During the game, players can perform various operations on the tree. The only available operation involves selecting a node x. Once a node x is chosen, its value flips (from 0 to 1 or vice versa), while the values of its immediate children remain unchanged. Similarly, the values of grandchildren of x flip, and the values of great-grandchildren remain the same, continuing this pattern.

The objective of the game is to achieve a specific value, $goal_i$, for each node i, where $goal_i$ can be either 0 or 1. The goal is to accomplish this objective using the minimum possible operations.

Input

The first line contains an integer n $(1 \leq n \leq 10^5)$. Each of the next n-1 lines contains two integers u_i and v_i $(1 \leq u_i, v_i \leq n; u_i \neq v_i)$ meaning there is an edge between nodes u_i and v_i.

The next line contains n integer numbers, and the i^{th} of them corresponds to $init_i$ ($init_i$ is either 0 or 1). The following line also contains n integer numbers, the i^{th} number corresponds to $goal_i$ ($goal_i$ is either 0 or 1).

Output
In the first line output an integer number $count$, representing the minimal number of operations you perform. Each of the next $count$ lines should contain an integer x_i, representing that you pick a node x_i, sorted in increasing order of value of node.

input
10 2 1 3 1 4 2 5 1 6 2 7 5 8 6 9 8 10 5 1 0 1 1 0 1 0 1 0 1 1 0 1 0 0 1 1 1 0 1

output
2 4 7

D. Shortest-metro-route

2 seconds, 256 megabytes

Vatik lives in Delhi and travels by metro most of the time. Delhi metro map is very complex and there exist multiple ways of travelling from one place to another. She has to sit for internships soon and wants to save as much time as possible.

There are n metro stations in Delhi numbered $1, 2, .. n$. Vatik knows which stations have a direct connection between them and how much time it takes to travel from them.

She needs your help to find out what will the minimum travel time for q such pairs of stations x and y and wants to know what the minimum time to travel from x to y will be and output "-1" if there is no way to travel between the given stations.

Input
The first line contains three integers n, m and q $(2 \leq n \leq 500, 0 \leq m \leq min((n * (n-1)/2, 1000), 1 \leq q \leq 10^5)$ where n is the number of stations, m are the number of connected stations and q is the number of queries.

Next m lines contain three integers n_i, $n_j (1 \leq n_i, n_j \leq n, n_i \neq n_j)$ and $w (1 \leq w \leq 10^5)$ where n_i and n_j are station numbers that are connected and w is the travel time between them.

Next q lines contain 2 integers x_i, x_j between which you have to find the minimum travel time.

Output
On the i^{th} line, print the answer of i^{th} query.

input
6 5 2 1 5 3 5 4 2 1 3 8 3 4 6 2 6 8 1 4 2 3

output
5 -1

E. Traffic

2 seconds, 256 megabytes

The city of Bangalore has a very complicated road network consisting of n intersections. Rich has to travel from his house(which lies on intersection 1) to the airport of Bangalore(which lies on intersection n). He knows m roads which bidirectionally connect two intersections and the time it takes to pass from one intersection to the other.

There is traffic jams at these intersection at certain times. If there is a jam at intersection x when Rich arrives there, he has to stop there for 1 minute until the jam clears, unless there is a jam at the next minute also.

Knowing the information of the roads and the jams, determine the minimum time in which Rich can travel from his house to the airport.

Input
The first line contains two space-separated integers: $n (2 \leq n \leq 10^5)$ that denotes the number of intersections, and $m (0 \leq m \leq 10^5)$ the number of paths.

The next m lines contains three space-separated integers: x ,y($1 \leq x, y \leq n, x \neq y$) and $t (1 \leq t \leq 10^4)$, which means there is a path that connects intersection x and intersection y and it takes t minutes to go from x to y or vice-versa.

Then n lines follow. The i_{th} line contains an integer $k_i (0 \leq k_i \leq 10^5)$: the number of moments in time that there is a traffic jam at the i_{th} intersection. The next k_i numbers store space-separated integers t_j $(0 \leq t_j < 10^9)$ follow, sorted in ascending order.

It is guaranteed that the sum of all k_i does not exceed 10^5.

Output
Output a single number - the least amount of time Rich needs to get from his house to the airport of Bangalore.

input
3 2 1 2 2 2 3 1 0 1 2 0

output
4

input
3 1 1 2 1000 0 0 0

output
-1

In the above example, there is a road connecting 1 and 2, and it takes 2 minutes to travel to location 2. Since there is a traffic jam at location 2 at minute 2, Rich will have to wait a minute before moving to 3 and thus the total time taken is 2 + 1 + 1 = 4.

F. The k-tree problem

1 second, 256 megabytes

After attending a lecture on trees, a student named Jamun became inspired and devised a unique tree structure called a k-tree.

A k-tree is an endless tree with a central root where the following conditions apply:

Every vertex within the tree has precisely k children.

Each edge in the tree possesses a distinct weight.

When examining the edges extending from a particular vertex to its children (exactly k edges), their weights follow a sequential pattern of 1, 2, 3, ..., k.

Upon learning about the k-tree concept, Altaf, a close friend of Jamun, became intrigued and raised an intriguing question: "In a k-tree, originating from the root and including at least one edge with a weight of d or higher, how many paths exist with a total weight of n (sum of edge weights)?"

Help Altaf find an answer to his question. As the number of ways can be rather large, print it modulo 1000000007 ($10^9 + 7$).

Input

A single line contains three space-separated integers: n, k and d ($1 \leq n, k \leq 100; 1 \leq d \leq k$).

Output

Print a single integer — the answer to the problem modulo 1000000007 ($10^9 + 7$).

input
4 3 2
output
6