Walchand College of Engineering, Sangli
Computer Science & Engineering
Third Year

Course: Design and analysis of algorithm Lab

Lab course coordinator:
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Assignment No.9

Graphs,Dynamic Programming

1)

Problem

You are given a weighted tree with N nodes and $N-1$ edges.

E is defined as $\sum_{i=1}^{i=N} \sum_{j=i+1}^{j=N} F(i,j)$. Also, $F(i,j)$ is equal to = (Maximum value of the edge that is present on the simple path between node i and j) $\times i \times j$

You are required to determine the value of E modulo 10^9+7.

Input format

- The first line contains an integer N denoting the number of nodes in a tree.
- The next $N-1$ lines contain three space-separated integers u, v, w denoting an edge between node u and v with weight w.

Output format

Print the required value of E modulo 10^9+7.

Constraints

$1 \leq N \leq 2 \times 10^5$
$1 \leq w \leq 10^6$
$1 \leq u, v \leq N$

Sample Input	Sample Output
3 1 2 10 1 3 2	86

2)

Problem

There is a country with N villages and each village has a number associated with them and M roads, a road connects two different villages
In this country, the Prime minister decided to test the hospitals to see if they can handle another wave of the coronavirus pandemic.
A village has the vaccine if the number associated with it is a prime number (villages numbered 2,3,5,7,11... will have a vaccine with them)
For each village find the minimum time required for the vaccine to arrive there if for each road between villages u and v it takes $max(u, v)$ time to travel this road

Note: The graph does not have self-loops or multi edges

Input :
The first line will contain N and M, the number of villages and the number of roads respectively
The next M lines contain two integers u and v (meaning there is a road between villages u and v and it takes $max(u, v)$ time to travel this road)

Output:
Print N space-separated integers which is the minimum time for the vaccine to arrive at that village, if it's impossible for the vaccine to arrive at a particular village then print **-1**

Constraints:

$$1 \le N \le 2 * 10^5$$

$$0 \le M \le min(2 * 10^5, (N * (N - 1))/2)$$

$$1 \le u, v \le N$$

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

3)

Problem

You are organizing a new year's party and you have invited a lot of guests. Now, you want each of the guests to handshake with every other guest to make the party interactive. Your task is to know what will be the minimum time by which every guest meets others. One person can handshake with only one other person at once following the handshake should be of **3** seconds sharp.

You have prepared some data for each guest which is the order in which the $Guest(i)$ will meet others. If the data is inconsistent, then print **-1**. Otherwise, print the minimum time in seconds.

Hint: The data will be inconsistent if the handshake sequence of one person contradicts with another person, for instance:

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

$G(1)$ wants to meet $G(2)$ first, but $G(2)$ will meet $G(1)$ after meeting $G(3)$. $G(3)$ will be meeting $G(2)$ after meeting $G(4)$ and $G(1)$ respectively while $G(4)$ will meet $G(3)$ after meeting $G(1)$ and $G(1)$ will meet $G(4)$ only after meeting $G(2)$ and $G(3)$. Hence, no one will be able to shake hands following this order as each handshake require some prior handshakes to happen.

Note: G(i) denotes the i^{th} guest.

Input format

- The first line will contain an integer N denoting the number of guests invited.
- Next N lines will container $N-1$ integers where the i^{th} line will denote the sequence in which$Guest(i)$ met other guests.

Output format

If the input data is inconsistent, print **-1**. Otherwise, print the minimum time required for the handshakes (in seconds).

Constraints

$$1 \leq G(i) \leq N \leq 1000$$

Sample Input	Sample Output
4 2 3 4 1 3 4 4 1 2 3 1 2	12

4)

Let's consider some weird country with **N** cities and **M** bidirectional roads of 3 types. It's weird because of some unusual rules about using these roads: men can use roads of types **1** and **3** only and women can use roads of types **2** and **3** only. Please answer the following very interesting question: what is maximum number of roads it's possible to destroy that the country will be still connected for both men and women? Connected country is country where it's possible to travel from any city to any other using existing roads.

Input

The first line contains **2** space-separated integer: **N** and **M**. Each of the following **M** lines contain description of one edge: three different space-separated integers: **a**, **b** and **c**. **a** and **b** are different and from **1** to **N** each and denote numbers of vertices that are connected by this edge. **c** denotes type of this edge.

Output

For each test case output one integer - maximal number of roads it's possible to destroy or **-1** if the country is not connected initially for both men and women.

Constraints

- **1** <= **N** <= **1000**
- **1** <= **M** <= **10 000**
- **1** <= **a**, **b** <= **N**
- **1** <= **c** <= **3**

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

5)

Telecom towers are an integral part of the telecom network infrastructure. In fact they are the most expensive to build and the valuations are heavy. The newly started mobile company in Hacker Land built n towers to enhance the connectivity of their users. You can assume that the Cartesian coordinate system is used in Hacker Land and the location of i^{th} tower is given as (x_i, y_i).

After the construction of the towers company realised that there are many call drops happening with the users. One identified reason for the frequent call drop was that the pair of towers which are at Euclidean distance d were causing destructive interference. To resolve the issue the company decided to destroy some towers such that no two towers are at d distance. You have to tell the minimum number of towers that the company need to destroy such that no two towers are at distance d.

Note: The Euclidean distance between points (x_1, y_1) and (x_2, y_2) is the length of the line segment connecting them, which is same as $\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$

Constraints:

- $2 \leq n \leq 10^4$
- $1 \leq d \leq 200$
- $1 \leq x_i, y_i \leq 200$
- There are no two towers with same location.

Input Format:

The first line contains two space-separated integers n and d denoting the number telecom towers constructed initially and the distance which causes destructive interference respectively.

Next n lines contains two-space separated integers denoting the x_i and $y_i -$ location of the towers.

Output Format:

Print a single lines denoting the minimum number of towers that should be destroyed such that no two towers are separated by distance d.

Sample Input	Sample Output
5 2 1 3 3 1 3 3 3 5 5 3	1