Islamic University of Technology
Department of Computer Science and Engineering

Lab 6: Minimum Spanning Tree

CSE 4404: Algorithms Lab
Summer 2023-24

Task A. Data Center Disaster

Time Limit: 1 second | Memory Limit: 512 MB

It's July 4202 and the cables connecting the data centers of a country were destroyed — due to excessive rain or, strangely enough, water dropped from helicopters.

Due to a sudden drop in foreign remittance, the government can no longer afford to repair all damaged cables. Instead, it has decided to restore connectivity by selectively repairing a subset of the cables — just enough to ensure that every data center can communicate with every other. The restoration must be done with the minimum possible cost.

Unfortunately, the engineer assigned to create the repair plan holds a BSc. in *Theatre and Performance Studies* and has long forgotten how to do math. So he has come to you for help in calculating the minimum budget for the project.

Input Format

The first line contains two integers n and m ($1 \leq n \leq 10^5,\ 1 \leq m \leq 2 \cdot 10^5$) — the number of data centers and cables.

Then, there are m lines, each containing three integers a, b, and c ($1 \leq a, b \leq n,\ 1 \leq c \leq 10^9$) — indicating that there is a cable between data center a and data center b, and repairing it will cost c.

All cables are bidirectional, and each connects two different data centers. There is at most one cable between any two data centers.

Output Format

Print one integer — the minimum total cost to repair enough cables so that every data center is reachable from every other, directly or indirectly.

If it is impossible to connect all data centers, print `IMPOSSIBLE`.

Examples

Sample Input	Sample Output
5 6 1 2 3 2 3 5 2 4 2 3 4 8 5 1 7 5 4 4	14

Notes

For this task, make 2 submissions with 2 different minimum spanning tree algorithms:

1. Prim's Algorithm
2. Kruskal's Algorithm

Task B. Poneglyph Decoding

Time Limit: 7 seconds | Memory Limit: 512 MB

Nico Robin has discovered a hidden Poneglyph deep within an ancient ruin. The stone tablet contains n lines of mysterious text, each line consisting of m symbols represented as lowercase English letters.

To decode the full message, Robin must carefully interpret all the lines. She may freely choose one line to decode first. Each subsequent line must be decoded by referencing one of the lines she has already interpreted.

The difficulty of decoding a line is measured by the *difference* from a previously decoded line — defined as the largest absolute difference between corresponding letters in the same column. For example, the difference between `abc` and `axz` is $\max(|a-a|, |b-x|, |c-z|) = \max(0, 23, 23) = 23$.

Robin wants to decode the entire message while minimizing the hardest step she must face. Help her determine the **smallest possible value of the largest decoding difficulty** if she chooses the order optimally.

Input Format

The first line contains two integers n and m ($2 \leq n \leq 2000,\ 1 \leq m \leq 25$) — the number of lines on the Poneglyph and the number of characters per line.

The next n lines each contain a string of m lowercase English letters.

Output Format

Print a single integer: the minimum possible value of the largest difficulty Robin must face during decoding.

Examples

Sample Input	Sample Output
3 3 abc elm xet	19

Notes

One possible order is to decode the first line `abc` first. Then, decoding the second line `elm` has a difficulty of $|b-l| = 10$ (as column 2 has the largest difference). Finally, decoding the third line `xet` using the second line gives a maximum column-wise difference of $|x-e| = 19$. The largest cost incurred during the decoding is 19, which is the answer.

Marks Distribution

Task	**Marks**
Task A	60%
Task B	40%