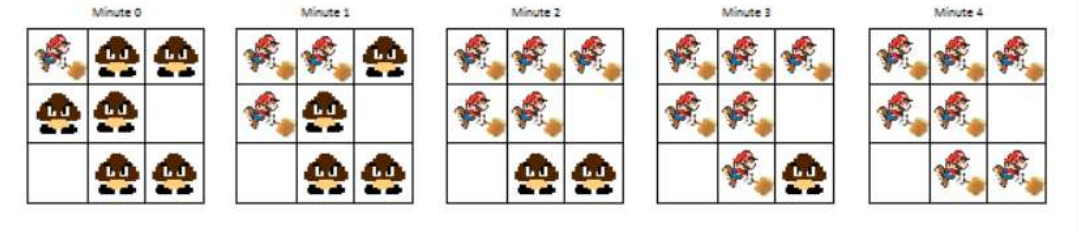
Problem A: Marios War

Here is the field, where each cell can have one of three values:

- "0" - an empty cell;
- "1" - a cell with the brown mushroom;
- "2" - a cell with Mario.

Every minute, Mario crushes any brown mushroom that is adjacent to his position (up, down, top, bottom) and new Mario appears instead of mushroom, Mario does not move to the empty cell.

How many minutes will it take for Mario to kill all brown mushrooms in each cell? The number of Marios can be more than one. If this is impossible, return -1.



Input format

The first line contains two integers, m - number of rows of a field, n - number of columns of a field ($1 \leq m, n \leq 1000$). The following m lines contain n values (0, 1, or 2).

Output format

Print the minimum time (in minutes) that must elapse until no cell will contain a brown mushroom. If any mushroom is unreachable for every Mario in a field print -1.

Examples

Input

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

Output

```
4
```

Input

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

Output

```
-1
```

Input

```
1 3
0 2 0
```

Output

```
0
```

Notes

The picture illustrates the procedure of the first example.

In the second example, the mushroom at (3, 1) is unreachable, because Mario can move 4-directionally. So, the output is -1.

In the last example, there are no brown mushrooms, there is nothing to kill, so the answer is 0.

Problem B. Path

In an undirected graph, you need to find the shortest path between two vertices.

Input format

In the first line given one number n, number of vertices ($1 \leq n \leq 100$). In n lines given, and n elements in each line '0' or '1' where 0 indicates the absence of an edge, 1 indicates the presence of an edge. In the next line two numbers are given: start and end of a path.

Output format

Print the length of the shortest path. If the path does not exist, print a single number -1.

Examples

Input

```
5
0 1 0 0 1
1 0 1 0 0
0 1 0 0 0
0 0 0 0 0
1 0 0 0 0
3 5
```

Output

```
3
```

Input

```
5
0 1 1 1 1
1 0 0 0 0
1 0 0 0 0
1 0 0 0 0
1 0 0 0 0
3 5
```

Output

```
2
```

Problem C: Aho-Corazick

You are given two numbers A and B.

You can do one of the operations with A in each turn.

- Multiply number by 2.
- Decrease the number by 1.

You need to find the minimum number of operations, to make A equal to B.

Also print the every element after doing the operation.

Input format

In the first line given two integers A, B where $1 \leq A, B \leq 10^4$.

Output format

Print one integer m the minimum number of operations. In the second line print m integers, number after every operation.

Examples

Input

```
5 9
```

Output

```
2
10 9
```

Input

```
4 8
```

Examples

Input

```
5 9
```

Output

```
2
10 9
```

Input

```
4 8
```

Output

```
1
8
```

Input

```
4 4
```

Output

```
0
```

Notes

Be careful about overflow

Problem D: Try Again

You are given undirected graph with n vertices, m edges, and q queries. Initially all vertices are black. There are two types of queries.

1. $1\ v$ - Change the color of vertex v to red.

2. $2\ v$ - Output the distance to the nearest red vertex to v, or -1 is there is no such vertex.

Input format

First line contains three integers $1 \leq n, m \leq 5000, 1 \leq q \leq 10^5$. Next m lines contain information about edges. Next q lines contain queries as described in the statement.

Output format

Output answer to queries of type 2.

Examples

Input

```
5 4 7
1 2
2 3
3 4
4 5
2 1
1 1
2 1
2 2
2 5
1 3
2 5
```

Output

```
-1
0
1
4
2
```

Problem E: KH2O - potassium hydroxide???

One minion is learning chemistry but its going to be so hard. One day when he was doing an experiment with potassium and oxygen, he accidentally blew up the flask. Now this time he wants to be careful with the elements. It has an adjacency matrix where it is written which element can be added with which, and which cannot be added. The teacher gave him q different requests where each request has 3 chemical elements, it is necessary to say whether it is possible to add these 3 elements so that the flask does not explode.

Input format

The first line contains two integers n, q $(1 \leq n \leq 1000, 1 \leq q \leq 100000)$ — the number of elements and number of queries.

The next n lines contains n integers $a[i][j]$, that means element i can be added to element j if $a[i][j] = 1$ and if $a[i][j] = 0$ they cannot be added. It is guaranteed that $a[i][i] = 1$

Output format

Print “YES” if we can add 3 elements, otherwise print “NO”.

Examples

Input

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

Output

```
YES
NO
YES
NO
```

Problem F: John's graph

Mom gave John an undirected graph for his birthday. After some time, he came up with a game with a graph. He takes two vertices and checks to see if they are in the same component.

Input format

The first line contains two integers n and m ($2 \leq n \leq 100000$, $0 \leq m \leq 99999$), where n is the number of vertices and m is the number of edges. Following m lines contain one edge each in form x, y ($1 \leq x, y \leq n$), where x, y are edge endpoints. The last line contains two integers s and f ($1 \leq s, f \leq n$), vertices you have to check.

Output format

Print "YES", if s and f vertices are in the same component, otherwise print "NO".

Examples

Input

```
3 3
1 2
2 3
3 1

1 3
```

Output

```
YES
```

Input

```
4 2
1 2
2 3

1 4
```

Output

```
NO
```

Problem G: Fly Me to the Moon

Giving up halfway is worse than never trying at all

— Misato Katsuragi, *Evangelion*

I think you've all heard about Keqing and her love for solving puzzles. But it's time for you to find out about her friend Ganyu, who also loves to solve various problems. Unlike Keqing, Ganyu likes graph problems more. This time she has a directed graph of n vertices and m edges. She is very interested to know if she can turn her primordial graph into an acyclic graph. Moreover, she set herself an additional condition — she can delete only one edge from the graph. Unfortunately, Ganyu has a lot to do at work, so she didn't have time to solve this problem. Therefore, she asked you to help her. Try your best for this problem because she believes in you!

Input format

The first line contains n and m — the number of vertices and the number of edges. Then m lines follow. Each line contains two integers x and y denoting a directed edge going from vertex x to vertex y. Each ordered pair (x, y) is listed at most once. However, loops for the vertex itself in the graph are possible. $(2 \leq n \leq 500, 1 \leq m \leq min(n(n-1), 10^5))$.

Output format

Print the answer. YES — if it is possible. NO — otherwise.

Examples

Input

```
5 6
1 3
2 1
3 5
4 3
5 4
3 2
```

Output

```
NO
```

Input

```
5 6
1 3
2 1
3 5
4 3
5 4
3 2
```

Output

```
NO
```

Input

```
2 2
1 2
2 1
```

Output

```
YES
```

Input

```
2 2
1 1
1 2
```

Output

```
YES
```

Notes

Acyclic graph - each edge directed from one vertex to another, such that following those directions will never form a closed loop.

Good Luck & Have Fun!

Problem H: Number of Island

Given a map as 2d char array of '1's (land) and '0's (water). Your task to compute the number of islands. An island is set of land cells that are surrounded by water, such that from any cell you can reach any other cell in the islland moving only horizontally or vertically to adjacent cells. You may assume that area outside a map is a water.

Input format

In the first line given n and m, size of array ($1 \leq n, m \leq 100$) In the next n line contain m character '0' or '1'.

Output format

Single number - the number of islands.

Examples

Input

```
4 5
11110
11010
11000
00000
```

Output

```
1
```

Input

```
4 5
11000
11000
00100
00011
```

Output

```
3
```

Problem I: Beta Tester

Arman works as a beta tester for a game development company. Today he is testing a game that has quests, and in order to win the game, the player needs to complete all the quests. However, some quests only become available after completing certain other quests. The developers give Arman a list of requirements, which indicates which quest must be completed in order to open the next one. Help Arman determine whether is it possible to complete this game, and if possible, output one of the scenarios for the passage.

Input format

The first line of input contains a pair of numbers n and m ($1 \leq n \leq 10^5, 0 \leq m \leq 10^5$), the number of quests and requirements, respectively. The next m lines contains a pair of integers i and j ($1 \leq i, j \leq n$), which means that in order to make quest j available, you must complete quest i.

Output format

Determine whether it is possible to complete the game, and output 'Impossible' if not, otherwise output 'Possible' and the scenario of the passage. If there are several of them, output any.

Examples

Input

```
5 5
1 2
2 3
1 3
4 5
3 4
```

Output

```
Possible
1 2 3 4 5
```

Input

```
6 6
4 2
4 3
2 3
1 5
6 2
6 4
```

Output

```
Possible
1 5 6 4 2 3
```

Input

```
8 17
8 1
2 3
7 3
5 4
1 7
4 8
1 7
3 6
2 5
7 2
8 7
5 4
5 8
2 8
2 5
2 7
4 8
```

Output

```
Impossible
```

Input

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

Output

```
Impossible
```

Problem J: Who has a big Family?

Given a graph without cycles or self loops. In any connected component of the graph, vertex with the lowest value in that component serves as the root. A vertex is *BigFam* if it is a root or it has more children than its parent. Count the number of BigFam vertices in the given graph.

Input format

On the first line there are two separated integers N and M $(1 \leq N, M \leq 10^5)$ and the following M lines consist of two separated integers X and Y meaning that there is an edge between vertices X and Y.

Output format

Print the number of BigFam vertices.

Examples

Input

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

Output

```
2
```