

Assignment #3: Graph Basic

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CSED331 (Hee-kap Ahn)

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Problem 1. Shortest path

Problem Statement

For given graph $G = (V, E)$, find a shortest path from a start node 0 to a destination node $(|V| - 1)$. In this problem, all edges have unit cost.

Input Statement

First line contains t which is the number of test cases.

At the first line of each test case contains the size of graph $|V|(\leq 100,000)$ and $|E|(\leq 200,000)$.

Each of next $|E|$ lines contains two integers u and v that represents an edge (u, v) .

Output Statement

For each test case, print the length of shortest path from start to destination.

If there is no available path, print -1 instead of the length.

Input Example

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

Output Example

```
1
4
```

Problem 2. Cheese cakes

Problem Statement

We have a grid map with size of h by w .

Each grid of the map contains value of 0 or 1 that represents a cheese piece is in the grid or not.

Our goal is to find all cheese cakes in the grid map.

A cheese cake is defined as the 'set of connected cheese pieces'. In other word, if two cheese pieces are adjacent to each other, then the pieces are parts of same cheese cake.

We define two grids are adjacent, if and only if two grids share at least a corner.

Write a program that find all cheese cakes in the given grid map.

Input Statement

First line contains t which is the number of test cases.

At the first line of each test case contains the size of map h and w ($1 \leq h, w \leq 1000$).

Each of next n lines contains w integers that represents a cheese piece is in the grid or not.

Output Statement

Print the number of cheese cakes in a line for each test case.

Input Example

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

Output Example

```
4
1
```

Problem 3. Airline Ticket

Problem Statement

Sunghwan has a plan to visit Culebra, Puerto Rico.

Because there is no direct flights from Pohang, Korea to Culebra, he should stop at some other airports.

As he is a graduate student, he have limited time and limited money.

Thus, he want to find a cheapest plan with visiting up to $k - 1$ stops. (0 = direct).

Fortunately, there is a travel agent provides special package that satisfies his requirements.

In this package, user can take at most k airplains cheaper than x won for paying only x won. (WoW!)

The goal is write a program that takes airline informations and the number of tickets included in the package k , then finds cheapest x .

The price of airline ticket is upper bounded to 1,000,000.

Input Statement

First line contains t which is the number of test cases.

First line of each test case contains three numbers $|V|, |E|, k$, which represents the number of airports, airlines, and tickets included in the package respectively. ($0 < |V| \leq 100,000$), ($0 < |E| \leq 200,000$), and ($k \leq n$) Each of next m lines contains three integers u, v, p that represents a airline from u to v and its price p . The node 0 is departure airport, Pohang, Korea and the node $(|V| - 1)$ is destination airport, Culebra, Puerto Rico.

Output Statement

For each test case, the print minimum price x that Sunghwan should pay to reach Culebra. If there is no path from Pohang to Culebra in k hops, then print -1 instead of the price.

Input Example

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

Output Example

```
1
3
```