南方科技大学 SOUTHERN UNIVERSITY OF SCIENCE AND TECHNOLOGY

Lab 8 - OJ Bonus Questions

CS208 Algorithm Design and Analysis

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Q1: Graph paths

Description

You are given a **directed** graph consisting of n vertices and m edges, and two integers K, P. Each edge has a non-negative weight w. **The graph does NOT have mutiple edges between vertices or self-loops.**

Let's denote $dis(1, n)$ as the total weight of path from 1 to n, calculate the number of paths from 1 to n satisfying $dis(1, n) \leq dis_{minimal}(1, n) + K$. Here, $dis_{minimal}(1, n)$ denotes the shortest path from 1 to n.

To avoid making the output too large, the answer should be modulo P.

If there are infinite number of such paths, output -1.

Q1: Graph paths

Input Format

There are total T testcases, for each testcase:

The first line contains four integers n, m, K, P.

Then m lines follow, each line contains three integers u_i, v_i and w_i, separated by space. Three integers denote there is an edge from u_i to v_i, and its weight is w_i.

Output Format

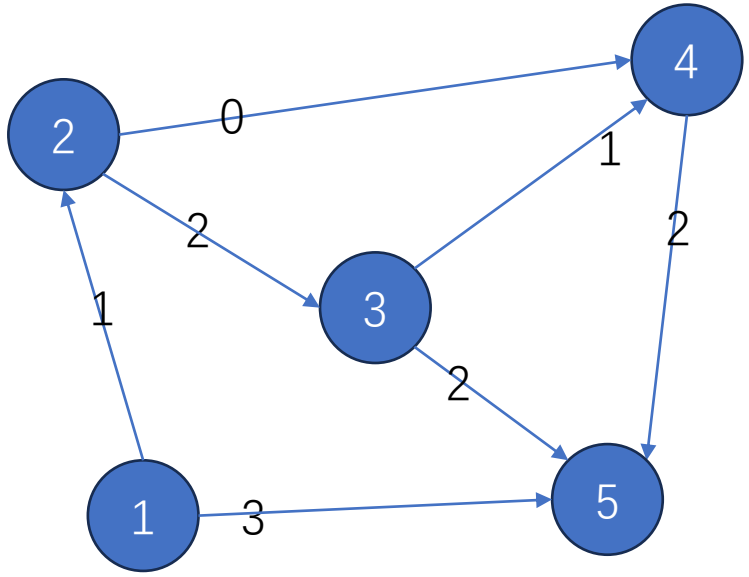
T lines, each line one single integer denoting the count of paths or -1.

Q1: Graph paths

Sample Input

```
1
5 7 2 10
1 2 1
2 4 0
4 5 2
2 3 2
1 5 3
3 4 1
3 5 2
```

n = 5, m = 7, K = 2, P = 10



Dis(1,5)=3, $Dis(1,5) + K = 5$
Shortest path: 1 → 5: $3 \leq 5$ ✅

Other paths:
1 → 2 → 4 → 5: $3 \leq 5$ ✅
1 → 2 → 3 → 5: $5 \leq 5$ ✅
1 → 2 → 3 → 4 → 5: $6 \geq 5$ ❌

Sample Output

```
3
```

Q2: Partial order

Description

You are given an three dimensional sequence A. For each element A_i, we have $A_i = (a_i, b_i, c_i)$.

For each element A_i, calculate how many pair (i, j) satisfying that $i \neq j, a_j \leq a_i, b_j \leq b_i, c_j \leq c_i$.

Input Format

The first line contains one integer n denoting the length of sequence.

In the following n lines, each line contains three integer a_i, b_i, c_i denoting A_i.

Output Format

n lines, each line has one integer denoting the count of pairs. The i-th line is the count for A_i.

Q2: Partial order

Sample Input

```
4
10 4 7
10 6 6
8 2 5
7 3 10
```

$$A_1 = (a_1, b_1, c_1) = (10,4,7)$$
$$A_2 = (a_2, b_2, c_2) = (10,6,6)$$
$$A_3 = (a_3, b_3, c_3) = (8,2,5)$$
$$A_4 = (a_4, b_4, c_4) = (7,3,10)$$

For A_1, among the other points $\{A_2, A_3, A_4\}$, only A_3 satisfies that

$$a_1 \geq a_3, b_1 \geq b_3, c_1 \geq c_3$$

So the output line for A_1 is 1

…

Sample Output

```
1
1
0
0
```

Grading

- Infinite times of submission allowed
- Deadline: Last week of this semester