Islamic University of Technology
Department of Computer Science and Engineering

Lab 4: Shortest Path (Dijkstra)

CSE 4404: Algorithms Lab
Summer 2023-24

Task A. Not The Best

Time Limit: 1 second | Memory Limit: 256 MB

Robin has moved to a small village and enjoys visiting one of his best friends. He usually takes a longer route because he appreciates the scenery along the way. He has decided to take the second-best path rather than the shortest path. He knows that there must be a second-best path.

The countryside consists of R bidirectional roads, each linking two of the N intersections, conveniently numbered from 1 to N. Robin starts at intersection 1, and his friend is at intersection N.

The second-best path may share roads with any of the shortest paths, and it may backtrack, i.e., use the same road or intersection more than once. The second-best path is the shortest path whose length is longer than the shortest path(s). That is, if two or more shortest paths exist, the second-shortest path is the one whose length is longer than those but no longer than any other path.

Input Format

The first line of input contains an integer T ($1 \leq T \leq 10$), the number of test cases.

Each of the next T test cases begins with two integers N ($1 \leq N \leq 5000$) and R ($1 \leq R \leq 10^5$).

Then follow R lines, each containing three integers u, v, and w ($1 \leq u, v \leq N,\ 1 \leq w \leq 5000$) — denoting that there is a bidirectional road between intersections u and v of length w.

Output Format

For each test case, output a line in the format:

Case x: y

Where x is the test case number (starting from 1), and y is the length of the second-best path from intersection 1 to intersection N.

Examples

Sample Input	Sample Output
2 3 3 1 2 100 2 3 200 1 3 50 4 4 1 2 100 2 4 200 2 3 250 3 4 100	Case 1: 150 Case 2: 450

Task B. Flight Routes

Time Limit: 1 second | *Memory Limit: 512 MB*

Your task is to find the k shortest flight routes from Syrjälä to Metsälä. A route can visit the same city several times.

Note that there can be several routes with the same price, and each of them should be considered.

Input Format

The first input line has three integers n, m, and k: the number of cities, the number of flights, and the number of required shortest routes.

After this, there are m lines describing the flights. Each line has three integers a, b, and c: a flight begins at city a, ends at city b, and its price is c. All flights are one-way flights.

You may assume that there are at least k distinct routes from city 1 (Syrjälä) to city n (Metsälä).

Output Format

Print k integers: the prices of the k cheapest routes from Syrjälä to Metsälä sorted in ascending order.

Constraints

$2 \le n \le 10^5$
$1 \le m \le 2 \cdot 10^5$
$1 \le a, b \le n$
$1 \le c \le 10^9$
$1 \le k \le 10$

Examples

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

Marks Distribution

Task	**Marks**
Task A	50%
Task B	50%

Practice Problems

Problem	**Links**