

Lab 9: Weighted Shortest Path

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Number of Problems: 1

Objective

- The student must be able to find a shortest path in a weighted graph.

The Shortest Path Problem

A weighted graph is a graph that each edge has an attached number. The number indicates the weight of that particular edge. A weight of a path in a graph is a summation of weight of every edge in the path. The shortest path from a vertex u to v is a path from u to v that has minimum weight. There are several algorithms to solve this problem, e.g., Dijkstra's algorithm, Bellman-Ford algorithm and Floyd-Warshall algorithm.

In this problem, the student will write a program that solves a shortest path problem.

The Task

You are to write a program that reads a graph and the weights of edges. A pair of vertices is also given. The task is to identify the **shortest path** between the pair and also the **weight** of that path.

The Input

The input is given as a text file using this format. The first line contains the number of vertices $1 \leq N \leq 1000$ of the graph. Each vertex is identified by a number from 1 to N . The second line contains a number M that indicates the number of edges. It is followed by M lines where each line contain three numbers a_i , b_i and c_i indicating that there is an edge from vertex a_i to b_i having the weight as c_i . Be noted that the graph is undirected. Finally, the last line contains two numbers u and v which indicates the starting and the final vertices of the shortest path.

The graph given is assumed to be connected.

The Output

The output is to be printed on the screen. The output must has 2 lines. The first line gives the weight of the shortest path and the second line give the path itself.

Example

Input

```
5 4 <-- numbers of vertices and edges
1 2 4 <-- this says that there is an edge from 1 to 2 with weight 4
2 3 5
3 4 6
4 5 7
1 5 <-- this asks for a shortest path from 1 to 5
```

Output

```
The shortest path from 1 to 5 has the length of 22
The path is: 1 2 3 4 5
```

The Starting Code

As always, the starting code can be downloaded at <http://www.nattee.net/2110327/2552-a>. The source code has only one file, "main.c". For simplicity, the code already declares and initializes an adjacency matrix but you are not required to use this one.

