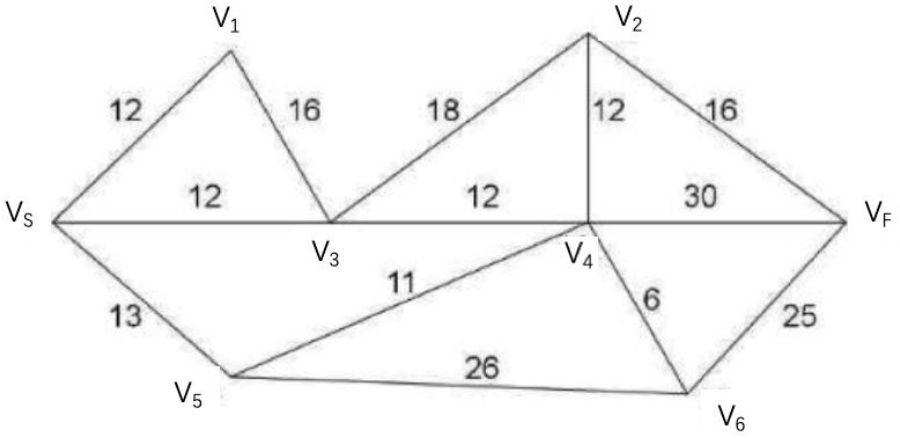
CSCI 2520 Data Structures and Applications
Assignment Four
Deadline: 23:55, May. 16, 2020
Total Marks: 100

Submission:
In this Assignment, you need to answer question 1 and question 2 in one pdf file. For question 3 and 4, you need to provide .c file for each question, which can be compiled and give the correct answer, the name should be q3.c and q4.c respectively.
Then compress all 4 files (one pdf file for q1 & q2 and three .c files for q3 and q4 respectively) as one zip named as `your_student_id_assign4.zip` and submit it via Blackboard.

1. Shortest-Path Algorithm (20 marks)

Use Dijkstra's algorithm to calculate the shortest distance from V_S to all vertices and the shortest path from V_S to V_F.



Note: Please use the table used in lecture (Shortest-Path Algorithm) to represent each step.
Example:

Initial Step

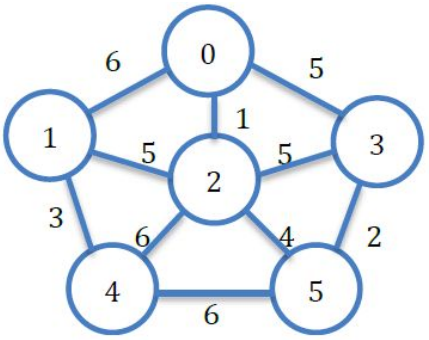
Vertex	distance	previous
V_S	0	0
V_1	∞	0
V_2	∞	0
V_3	∞	0
V_4	∞	0
V_5	∞	0
V_6	∞	0
V_F	∞	0

Step 1

Vertex	distance	previous
V_S	0	0
V_1	12	V_S
V_2	∞	0
V_3	12	V_S
V_4	∞	0
V_5	13	V_S
V_6	∞	0
V_F	∞	0

2. Minimum Spanning Tree (20 marks)

Given an undirected graph, find the minimum spanning tree. The number of the edge connecting vertex a and vertex b is ab. Like the edge with weight 1 in the graph, its number is 02.



(1) Use Prim's Algorithm starting from vertex 0 to find the minimum spanning tree, write the number of the edge added into the minimum spanning tree in turn (if there are many edges satisfy requirement, choose the edge with minimum number). Please use the table used in lecture (Prim's Algorithm) to represent each step.

Example:

Initial Step

Vertex	distance	previous
V_0	0	0
V_1	∞	0
V_2	∞	0
V_3	∞	0
V_4	∞	0
V_5	∞	0

Step 1

Vertex	distance	previous
V_0	0	0
V_1	6	V_0
V_2	1	V_0
V_3	5	V_0
V_4	∞	0
V_5	∞	0

(2) Use Kruskal's Algorithm and write the number of the valid edge with minimum merging cost in turn (if there are many edges satisfy requirement, choose the edge with minimum number).

3. The diameter of a graph (30 marks)

Definition: The distance d(u, v) between two vertices u and v is defined as the length of a shortest path from u to v. The diameter of a graph is the greatest distance between any pair of vertices.

Now give you a undirected graph, get the diameter of the graph.

The first line of input is the number of nodes **N** and edges **M.** Next **M** lines, contains three positive integers **x, y, w** means an undirected edge between vertex x and vertex y with length w.
(The data guarantees that the graph is connected.)

Input:

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

3 5 1
1 3 2
3 4 1
Output:
4

4. The power of the team. (30 marks)

We want to build the best team to solve a problem. Now there are **n** great people on the waiting list. Everyone has different strengths and weaknesses. The power of the team is the sum of the strength of the teammate multiplied by the minimum weakness of the team.(**Cannikin Law**). Since the budget is not sufficient, we can only choose at most **k** people. You need to solve this problem by finding the maximum power of the team you can have.(Hint: use heap to solve it)

The first line of input is **n and k. (1<= k <= n <= 10000)**

The following two lines are the strengths and weaknesses of the **n** people. All the values are less than 10000.

For example:

Input:
5 3
1 2 3 4 5
5 4 3 2 1
Output:
18

(There are two different ways to get the answer. You can choose the 1, 2, 3 and 2, 3, 4)