Project 2: Graph Algorithms
Singles-source shortest path and Minimum Spanning Tree (MST)

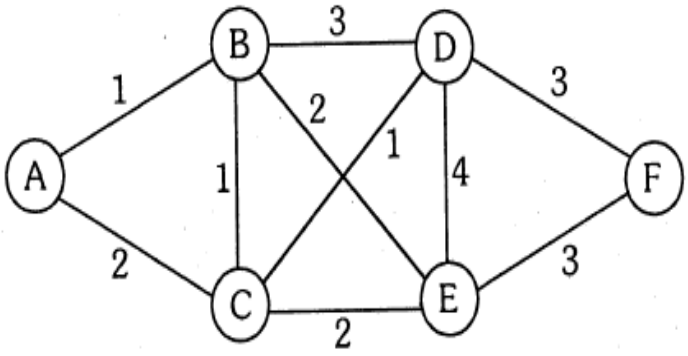
In this project, you will implement two graph algorithms mentioned below.

Note: You can work **alone or in a team of TWO max**.

Problem 1:
Find shortest path tree in both directed and undirected weighted graphs for a given source vertex. Assume there is no negative edge in your graph. You will print each path and path cost for a given source.

Problem 2:
Given a connected, undirected, weighted graph, find a spanning tree using edges that minimizes the total weight$w(T) = \sum_{(u,v)\in T} w(u,v)$. Use Kruskal algorithm to find Minimum Spanning Tree (MST). You will printout the edges of the tree and the total cost of your answer.

Input format:
For each problem, you will take input from a text file. Say you want to run algorithm on the following undirected graph. The corresponding file format would be:




```
6       10      U
A       B       1
A       C       2
B       C       1
B       D       3
B       E       2
C       D       1
C       E       2
D       E       4
D       F       3
E       F       3
A
```

Here, the first two numbers represent the number of vertices and edges. The letter U stands for undirected graph (D for directed). From the second line, it mentions all edges and its weight (e.g. $edge(A,B)$ and its weight is 1. The last line is optional. If given, it represents the source node.

Submission instructions:

- A well-formatted report covering a short description of each algorithm, data structure chosen, runtime of **your code**, sample input/output, instruction to run your program easily.
- For each problem, run your program for four different graphs of your choice. Use your judgement to define test graphs that you think interesting and reasonable. For example:
  - Undirected graph: at least 7 nodes and 12 edges
  - Directed graph: at least 7 nodes and 15 edges
- Clean code for TA to execute.
- You can use any programming language (e.g. C/C++, Java, Python, etc.)
- If worked in a team, both members are required to submit everything separately.
- **Hardcopy** of your report to me directly; one copy per team.

Late submission penalty:

- For each extra day -10 points penalty.
- No submission will be accepted after three days of deadline.

Grading scheme:

Shortest path in directed and undirected graphs (35)	
Implementation of shortest path finding algorithm in directed/undirected graphs	20
Test on four different graphs and showing paths and path cost	4 x 2 = 8
Using proper data structure	7
Minimum spanning tree (40)	
Implementation of minimum spanning tree algorithm	20
Test on four different graphs and printing tree edges and cost.	4 x 2 = 8
Using proper data structure	12
Report – according to the description	15
Input taken from text file	10
Total	**100**