DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
NATIONAL INSTITUTE OF TECHNOLOGY

Algorithm Laboratory (CSLR41)

Assignment 5A

Problem Statement: Implement Dijkstra and Bellman-Ford algorithms to find the shortest path from any source node to all nodes as destinations of a weighted graph of *n* vertices.

Input: A number *n*.
The program should have options to generate a random graph of *n* vertices, as well as, take as input a user-defined *n* vertex graph in the form of an adjacency list.

Tasks:

1. For small *n*, print the intermediate steps.
2. Consider both directed and undirected graphs given from user input as well as generated randomly. For the Bellman-Ford algorithm, the graph should have negative weights as well.
3. Compare the performance of these two different algorithms.
    a. Check for different *n* in the range of 100 to 10000.
    b. Plot and find the time complexity in terms of asymptotic notation for all cases (best, worst, and average over many random cases) by varying input size and noting down the time required for minding the minimum spanning tree.
    c. Find a function *g(n)* and the associated constants for which the plot is bounded above and by *g(n)* for each of the algorithms.
4. Which algorithm will work better and in which situation(s)? Compare the final graph obtained in each algorithm with the minimum spanning tree obtained in Assignment 4. Can you find any relation(s)? Write your observations and derive possible conclusions.

Assignment 5B

Problem Statement: Implement BFS and DFS algorithms to traverse any graph of *n* vertices and print the traversal sequence.

Input: A number *n*.
The program should have options to generate a random graph of *n* vertices, as well as, take as input a user-defined *n* vertex graph in the form of an adjacency list.

Tasks:

1. For small *n*, print the intermediate steps.
2. Consider both directed and undirected graphs given from user input as well as generated randomly.
3. Compare the performance of these two different algorithms.
    a. Check for different *n* in the range of 100 to 10000.

b. Plot and find the time complexity in terms of asymptotic notation for the worst (best, worst, and average over many random cases) by varying input size and noting down the time required for minding the minimum spanning tree.
c. Find a function *g(n)* and the associated constants for which the plot is bounded above and by *g(n)* for each of the algorithms.

4. Consider that your graph has edges of equal weight. Now for this graph, compare the final traversal tree obtained in each BFS and DFS algorithm taking one node (say, A) with the shortest path to all destinations from this node A obtained in Assignment 4. Can you find any relation(s)? Write your observations and derive possible conclusions.