Name: Georges Hatem

CS590 Homework Assignment 12: Creativity Exercises

Due Date: April 17, 2022

Problem 14.7.15:

Single Source Shortest Path Explanation:

Single source shortest path is an algorithm which is used to find out the shortest path from the single source vertex to all the other vertex present in the graph.

- In this single source shortest path, negative weights of the paths are also allowed which is not possible in the case of Dijkstra's algorithm.
- This single source shortest path algorithm uses the bottom up approach for finding the shortest path from the source to the destination.

Algorithm in O (n + m):

- The objective of using the single source shortest path is to convert the given weighted graph into an unweighted graph

in which all the vertex are visited from a single vertex.

- Given that number of nodes are linear to the value of n and the number of edges are linear to the value of m.
- Now the algorithm works as:
  - For every given edge which is (u, v) with the corresponding weight as w, create a set of w-1 nodes that to connect u and v.
  - Like there is an edge (e1, e2) with the weight as 3 then create two dummy nodes d1 and d2 and connect the e1 and e2 using the dummy nodes as **e1 - d1 - d2 - e2.**
  - The number of nodes now becomes **O (n + cm) = O (n + m).**
  - The number of edges becomes **O (m + cm) = O(m)**
  - As the BFS approach is linear to the number of edges and the number of nodes present in the network.

- Hence, the runtime is of the order: **O(n + m + m) = O(n + m)**