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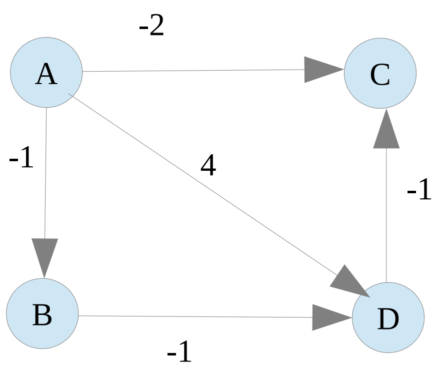
10-15-14
HW5

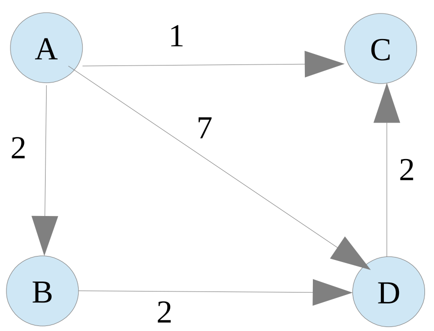
Honor Code Pledge: ____

Question 1

No, this is not a valid method. Because the answer that is given by using Professor Lake's algorithm can differ from what the actual shortest route of the graph is. This is due to the fact that this algorithm does not take into account the length of the paths. If for example we have the graph:



The shortest path to get from A to C is to go from A to B to D to C, because this gives you a path length of -3. Now, if we add 3 to every edge length, the graph becomes:



And now the shortest path is to just go directly from A to C. This is because in the original shortest path (A, B, D, C) there are 3 edges, and because we are adding a value of 3 to each of those edges, the path length is increased by 9. Whereas on the new path (A, C) we are only adding on value of 3, so the new path length does not increase by as much as the original path length.

Question 2

Because this applies to the real-world scenario of constructing a new road, it is safe to assume that the array of possible new roads E' will not contain any roads that already exist in the graph. So, first run Dijkstra's algorithm on the original graph to find the shortest path between cities *s* and *t*. Then we iterate through E' adding each new road to the graph one at a time and again running Dijkstra's to see if the path between *s* and *t* decreases at all. Whichever new road gives the shortest path length to the graph is the one that should be built. The complexity of this algorithm would be:

$O\,((E'+1)(|E| + |V|\log|V|))$

Question 3

Code submitted on moodle.