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50.004 – Home Exercises Week 10

Q1. False

For an unweighted graph, to find the shortest path in linear time, we can use Breadth First Search (BFS). Hence, the data structure we can use is a queue and not a stack. A stack can be used to implement Depth First Search, however it would not give us the shortest path.

Q2. False

A DFS is not used to find the shortest path. We can instead, use a Breadth First Search (BFS) in this case to compute the shortest path from S in linear time, $O(|V| + |E|)$.

Q3. True

The Bellman-Ford algorithm runs in O(VE) time. However, for a complete graph (dense), $|E| \sim |V|^2$. Hence, the overall time complexity for Bellman-Ford algorithm on a complete graph is $O(n^3)$. (since $|V| = n$ and $|E| = O(n^2)$)

Q4. False

In the original Dijkstra's algorithm to find the shortest path from a single source, we pick the vertex with the minimum distance value (and not visited) and finalise the distance from the source to this vertex. This can be done because it relies on the fact that once we visit a vertex, we will not ever find a shorter path to it.

However, for a maximum distance problem, we cannot finalise the distance to a vertex after visiting it since there can be a longer path through not yet visited vertices. Hence, the changes proposed in the question to Dijkstra's algorithm would not allow us to find the longest simple path.