CS140 - Midterm 3 Sample Problems: SOLUTIONS

Below are some practice problems to help give you study for the upcoming checkpoint. Note that not all of these would necessarily be good exam problems, but are there to provide you with some additional practice on the materials.

1. Suppose we are given a connected undirected graph with distinct edge weights. We greedily delete the heaviest edge that does not disconnect the graph, until we cannot delete any more edges. Is the result guaranteed to be a minimum spanning tree of the original graph? If so, justify your answer. If not, give a counterexample.

   SOLUTION: Yes! We only ever delete an edge that is part of a cycle, which would never be part of any MST.

2. T/F: If we make all the edges in a DAG undirected, we will always end up with a tree (undirected, acyclic graph).

   SOLUTION: False. Consider the DAG with four vertices a, b, c, d with edges $a \to b$, $a \to c$, $b \to d$, $c \to d$. If these edges are made undirected, we have a cycle.

3. T/F: If we modify DFS and BFS to record the edge (u, v) that was traversed to get to a particular vertex v and we run them starting at a particular vertex r in a tree (undirected, acyclic graph), BFS and DFS would always record identical edges for all vertices.

   SOLUTION: True. Given a starting point, every vertex has a single parent. Regardless of how the graph is traversed from this starting point, a given vertex will always be explored from its parent.

4. T/F: If we modify DFS and BFS to record the edge (u, v) that was traversed to get to a particular vertex v and we run them starting at a particular vertex r on a DAG, BFS and DFS would always record identical edges for all vertices.

   SOLUTION: False. In a DAG, a vertex can have more than one parent. Depending on the DFS/BFS implementation and the order in which the adjacent vertices are traversed, the way a vertex if visited may vary.