

CIS 121
Practice Problems for Exam 2
March 20, 2018

- 1.** Prove or disprove: You are given a connected undirected graph $G = (V, E)$ with a weight function w defined over its edges. Let $s \in V$ be an arbitrary vertex in G . Starting at vertex s , if you do a depth-first search (DFS) in G such that the edges going out of any vertex are always explored in increasing order of weight, then the resulting DFS tree is also a minimum spanning tree.

- 2.** You are given an input stream which will display n integers, and you only get to view each element once. Design an efficient algorithm which will find the k largest elements in the stream, using at most $O(k)$ space (assume $k \ll n$).

- 3.** Prove that an edge e is contained in every spanning tree for a connected graph G if and only if removal of e disconnects G .

- 4.** Let $G = (V, E)$ be a strongly connected directed graph and let T be a DFS tree in G . Prove that if all the forward edges in G , with respect to T , are removed from G , the resulting graph is still strongly connected.

- 5.** Give an example of a weighted connected undirected graph $G = (V, E)$ and a vertex v such that the minimum spanning tree of G is different than the shortest path tree rooted at v . Can the two trees be completely disjoint?