CS 180 Homework 2

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1. Exercise 3 Page 107

The following algorithm finds a topological order of G if G is a DAG or indicates that G has a cycle if G is not a DAG.

To compute a topological ordering of G (not necessarily a DAG):

Find a node v with no incoming edges and order it first

Delete v from G

Recursively compute a topological ordering of G−{v} and append this order after v

If there are no nodes with no incoming edges

G has a cycle

2. Exercise 4 on Page 107

Construct a graph showing the relationship of specimens. If is marked as “different”, we say there is an edge between node and node . Now we traverse the graph using a [BFS or DFS] to see if the graph is bipartite. If the graph can be split into two sets, and , then we can confirm that the judgements were consistent.

Consider the case of 3 arbitrary specimens: nodes . If judgements are , , , then this would result in a graph that looks like a triangle between the three nodes, also known as. is not a bipartite graph because there is no way to partition the nodes into two sets where there are no edges within a set.

3. Exercise 9 on page 110

We use BFS to produce a spanning tree of starting with the root node . The spanning tree will have levels, which will represent the length of the shortest path from s to the nodes in that level of the spanning free. We are given that the length of is strictly greater than so the node must be past the level . Now we look at the levels between s and t. The total number of nodes in levels 1 through is at most (since nodes s and t don’t appear in any of these levels). If each of these levels has 2 or more nodes, then total number of nodes in will exceed . Therefore, there must be at least one level in the range 1 through containing just one node, say . If we remove the only node in that level, , then we break the path from to .

Construct a BFS spanning tree of G

Construct a list of the nodes at each level of the tree

For any level i where 1 ≤ j ≤ n/2 and there is only 1 node in level 1 (called v)

return v

4. Exercise 11 on page 111

5. Exercise 12 on page 112

6. An array of n elements contains all but one of the integers from 1 to n+1.

(a) Give the best algorithm you can for determining which number is

missing if the array is sorted, and analyze its asymptotic worst-case

running time.

(b) Give the best algorithm you can for determining which number is

missing if the array is not sorted, and analyze its asymptotic worst-

case running time.