Feedback — Problem Set-4

Help Center

You submitted this quiz on **Sat 7 Nov 2015 10:14 AM PST**. You got a score of **2.75** out of **5.00**. You can attempt again in 1 minutes.

Question 1

Given an adjacency-list representation of a directed graph, where each vertex maintains an array of its outgoing edges (but *not* its incoming edges), how long does it take, in the worst case, to compute the in-degree of a given vertex? As usual, we use n and m to denote the number of vertices and edges, respectively, of the given graph. Also, let k denote the maximum in-degree of a vertex. (Recall that the in-degree of a vertex is the number of edges that enter it.)

Your Answer		Score	Explanation
$\theta(k)$			
$\theta(n)$			
$\theta(m)$	✔	1.00	Without explicitly maintaining a list of incoming edges, you might have to scan all the edges to identify the incoming arcs.
Cannot determine from the given information			
Total		1.00 / 1.00	

Question 2

Consider the following problem: given an undirected graph G with n vertices and m edges, and two vertices s and t, does there exist at least one s-t path?

If G is given in its adjacency list representation, then the above problem can be solved in $O(m + n)$ time, using BFS or DFS. (Make sure you see why this is true.)
Suppose instead that G is given in its adjacency *matrix* representation. What running time is required, in the worst case, to solve the computational problem stated above? (Assume that G has no parallel edges.)

Your Answer	Score	Explanation
○ $\theta(n^2)$		
○ $\theta(n * m)$		
○ $\theta(m + n)$		
✖ ◉ $\theta(m + n \log n)$	0.00	If $m = O(n)$, this would imply that you're solving the problem despite looking at only a tiny fraction of the adjacency matrix.
Total	0.00 / 1.00	

Question 3

This problem explores the relationship between two definitions about graph distances. In this problem, we consider only graphs that are undirected and connected. The *diameter* of a graph is the maximum, over all choices of vertices s and t, of the shortest-path distance between s and t. (Recall the shortest-path distance between s and t is the fewest number of edges in an s-t path.) Next, for a vertex s, let $l(s)$ denote the maximum, over all vertices t, of the shortest-path distance between s and t. The *radius* of a graph is the minimum of $l(s)$ over all choices of the vertex s. Which of the following inequalities always hold (i.e., in every undirected connected graph) for the radius r and the diameter d? [Select all that apply.]

Your Answer	Score	Explanation
☐ $r \leq d$ ✖	0.00	By the definitions, $l(s) \leq d$ for every single choice of s.

☑ $r \geq d/2$	✔	0.25	Let c minimize $l(s)$ over all vertices s. Since every pair of vertices s and t have paths to c with at most r edges, stitching these paths together yields an s-t with only $2r$ edges; of course, the shortest s-t path is only shorter.
☐ $r \geq d$	✔	0.25	A path is a counterexample.
☐ $r \leq d/2$	✔	0.25	The triangle is a counterexample.
Total		0.75 / 1.00	

Question 4

Consider our algorithm for computing a topological ordering that is based on depth-first search (i.e., NOT the "straightforward solution"). Suppose we run this algorithm on a graph G that is NOT directed acyclic. Obviously it won't compute a topological order (since none exist). Does it compute an ordering that minimizes the number of edges that go backward? For example, consider the four-node graph with the six directed edges $(s, v), (s, w), (v, w), (v, t), (w, t), (t, s)$. Suppose the vertices are ordered s, v, w, t. Then there is one backwards arc, the (t, s) arc. No ordering of the vertices has zero backwards arcs, and some have more than one.

Your Answer		Score	Explanation
◉ If and only if the graph is a directed cycle	✖	0.00	The algorithm might get lucky even if the graph is not a directed cycle.
○ Always			
○ Never			
○ Sometimes yes, sometimes no			
Total		0.00 / 1.00	

Question 5

On adding one extra edge to a directed graph G, the number of strongly connected components...?

Your Answer		Score	Explanation
...never decreases (no matter what G is)			
...will definitely not change (no matter what G is)			
...never decreases by more than 1 (no matter what G is)			
...could remain the same (for some graphs G)	✔	1.00	For example, the graph might already be strongly connected.
Total		1.00 / 1.00	