Final Exam

Quiz, 10 questions

2 points

1.
Consider a directed graph $G = (V, E)$ with non-negative edge lengths and two distinct vertices s and t of V. Let P denote a shortest path from s to t in G. If we add 10 to the length of every edge in the graph, then: [Check all that apply.]

- [ ] P definitely does not remain a shortest $s - t$ path.
- [x] If P has only one edge, then P definitely remains a shortest $s - t$ path.
- [x] P might or might not remain a shortest $s - t$ path (depending on the graph).
- [ ] P definitely remains a shortest $s - t$ path.

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2 points

2.
What is the running time of depth-first search, as a function of n and m, if the input graph $G = (V, E)$ is represented by an adjacency matrix (i.e., NOT an adjacency list), where as usual $n = |V|$ and $m = |E|$?

- ( ) $\theta(n^2 \log m)$
- (•) $\theta(n^2)$
- ( ) $\theta(n * m)$
- ( ) $\theta(n + m)$

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3.

What is the asymptotic running time of the Insert and Extract-Min operations, respectively, for a heap with n objects?

- $\Theta(1)$ and $\Theta(\log n)$
- $\Theta(\log n)$ and $\Theta(\log n)$
- $\Theta(n)$ and $\Theta(1)$
- $\Theta(\log n)$ and $\Theta(1)$

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2 points

4.

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

- ...cannot decrease
- ...might or might not remain the same (depending on the graph).
- ...cannot change
- ...cannot decrease by more than 1

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2 points

5.

Which of the following statements hold? (As usual n and m denote the number of vertices and edges, respectively, of a graph.) [Check all that apply.]

- [x] Breadth-first search can be used to compute shortest paths in $O(m+n)$ time (when every edge has unit length).
- [x] Depth-first search can be used to compute a topological ordering of a directed acyclic graph in $O(m+n)$ time.

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- [x] Breadth-first search can be used to compute the connected components of an undirected graph in $O(m+n)$ time.
- [x] Depth-first search can be used to compute the strongly connected components of a directed graph in $O(m+n)$ time.

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2 points

6.

When does a directed graph have a unique topological ordering?

- ( ) Whenever it has a unique cycle
- ( ) Whenever it is directed acyclic
- ( ) Whenever it is a complete directed graph
- (•) None of the other options

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2 points

7.

Suppose you implement the operations Insert and Extract-Min using a *sorted* array (from biggest to smallest). What is the worst-case running time of Insert and Extract-Min, respectively? (Assume that you have a large enough array to accommodate the Insertions that you face.)

- (•) $\Theta(n)$ and $\Theta(1)$
- ( ) $\Theta(n)$ and $\Theta(n)$
- ( ) $\Theta(\log n)$ and $\Theta(1)$
- ( ) $\Theta(1)$ and $\Theta(n)$

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2 points

8.

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Which of the following patterns in a computer program suggests that a heap data structure could provide a significant speed-up (check all that apply)?

- [x] Repeated minimum computations
- [x] Repeated maximum computations
- [ ] Repeated lookups
- [ ] None of the other options

---

2 points

9.

Which of the following patterns in a computer program suggests that a hash table could provide a significant speed-up (check all that apply)?

- [ ] Repeated maximum computations
- [ ] None of the other options
- [x] Repeated lookups
- [ ] Repeated minimum computations

---

2 points

10.

Which of the following statements about Dijkstra's shortest-path algorithm are true for input graphs that might have some negative edge lengths? [Check all that apply.]

- [ ] It may or may not terminate (depending on the graph).
- [x] It may or may not correctly compute shortest-path distances (from a given source vertex to all other vertices), depending on the graph.
- [x] It is guaranteed to terminate.
- [ ] It is guaranteed to correctly compute shortest-path distances (from a given source vertex to all other vertices).

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