UNGRADED Quiz 2

1. Email *

2. Which of the following statements is true? 2 points

Mark only one oval.

- ◯ Any optimization problem that can be solved using DP can also be solved using a Greedy Algorithm.
- ◯ Any optimization problem that can be solved using a Greedy Algorithm can also be solved using DP.
- ◯ No optimization problem can be solved using both DP and a Greedy Algorithm.
- ◯ Every Greedy Algorithm must first sort the data before making greedy choices.

3. Consider the problem of k-Sum. Given a set of n distinct integers, a number k and a number X, the problem asks you to find k numbers in the set whose sum equals X. Which of the following expressions best describes the running time of the exhaustive algorithm for this problem: 2 points

(a) $T(n,k) = O(2^{n+k})$
(b) $T(n,k) = O(nk)$
(c) $T(n,k) = O(nlgk)$
(d) $T(n,k) = O\left(\binom{n}{k}\right)$
(e) $T(n,k) = O((n+k)!)$

Mark only one oval.

- a
- b
- c
- d
- e

4. In 'Weighted Activity Selection' every activity has an associated weight and our goal is to select a set of non-overlapping activities which maximizes the overall weight. Consider that we are solving Weighted Activity Selection problem where the weight of each activity is simply equal to its duration (length). Which of the following statements are true? 3 points

Check all that apply.

- [ ] The greedy algorithm that picks activities based on increasing finish times may no longer produce an optimal set of activities.
- [ ] A greedy algorithm that picks the longest activity first will produce a optimal set of activities.
- [ ] The exhaustive algorithm for this problem will take exponential time.
- [ ] A greedy algorithm that picks activities based on decreasing finish times will produce an optimal set of activities.
- [ ] This problem could have more than one possible optimal solutions.

Section 2

5. We are constructing a Huffman Encoding for a file containing symbols a , b and c only. Assume that the algorithm generates codes 0, 10 and 11 for symbols a, b and c respectively. Which of the following may be the frequencies of a, b and c in the file? 3 points

Mark only one oval.

- f(a) = 30K, f(b) = 50K, f(c) = 80K
- f(a) = 60K, f(b) = 50K, f(c) = 80K
- f(a) = 100K, f(b) = 90K, f(c) = 10K
- f(a) = 50K, f(b) = 100K, f(c) = 50K

6. Given the same file of symbols a, b and c, is it possible for Huffman's algorithm to produce the following codes? code(a) = 1, code(b) = 01, code(c) = 11 3 points

Mark only one oval.

- Yes
- No

7. Suppose a long file made of repetitions of n unique symbols has been encoded using Huffman's algorithm. What could be the maximum possible length of a code produced by the algorithm? 3 points

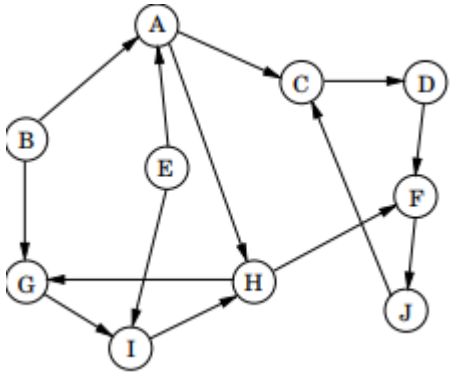
Mark only one oval.

- lgn
- n-1
- n
- 2n
- Cannot be determined without knowing the exact size of the file.

Section 3

The questions in this section pertain to the graph in Figure 1 given below.

Figure 1



8. A DFS of the graph in Figure 1 will produce: 2 points

Mark only one oval.

- A single DFS tree.
- A DFS forest with 2 trees.
- A DFS forest with 3 trees.
- A DFS forest with 4 trees.
- A DFS desert.

9. The graph in Figure 1 is: 3 points

Check all that apply.

- [ ] An undirected graph
- [ ] A directed graph
- [ ] A directed acyclic graph
- [ ] A graph containing sink nodes.
- [ ] A graph containing source nodes
- [ ] A graph that can be linearized (topologically ordered).

10. We run DFS on the graph in Figure 1, (starting at A and exploring unvisited neighbors in the alphabetical order.) Which edges will be tree edges, which will be back edges, forward edges and cross edges? Let's assume the following edge type numbers: 1 means tree edge, 2 means back edge, 3 means forward edge and 4 means cross edge. Write the correct sequence of edge type numbers for edges: (A, H), (I, H), (J, C), (B, G) and (H, F). Please note: your answer must be numbers separated by commas with no spaces anywhere. e.g. 1,2,3,4 4 points

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11. Which of the following statements must always be true for the graph in Figure 1? (DFS may start anywhere and not follow alphabetical order when exploring non-visited neighbors). 3 points

Mark only one oval.

- ◯ post[A] > post[I]
- ◯ pre[E] > pre[A]
- ◯ pre[E] < pre[A]
- ◯ post[F] > post[G]
- ◯ post[B] > post[x], for all nodes x of the graph.

Section 4

12. Given a directed graph G=(V, E) and an edge e=(x, y) in E. We wish to detect whether e is part of a cycle in G. Your friend, the batch topper, suggests the following algorithm: We run DFS on G and mark each node with pre and post numbers. Then we check the edge e=(x, y). If it is a back edge, then e is part of a cycle. Else e is not part of a cycle. Is this a correct algorithm? 3 points

Mark only one oval.

- ◯ Yes
- ◯ No

13. Suppose in the topological sort algorithm we do not use a stack to push vertices at the end of the explore method. Your friend, the batch topper, claims that we we can still accomplish topological sort in linear time by first doing a DFS marking pre/post numbers, and then sorting nodes in decreasing order of post numbers using a linear time sort. Is your friend's claim correct or incorrect? 3 points

Mark only one oval.

- ◯ Correct
- ◯ Incorrect

14. Which of the following apps/computing agents may use graphs as one of their information structures? 3 points

Check all that apply.

- ☐ Uber
- ☐ Twitter
- ☐ The Perseverance rover on Mars.
- ☐ A network router.
- ☐ An image analysis software.

15. Which of the following questions can be correctly answered in O(|V|+|E|) using a DFS traversal on a map stored as a directed graph? 3 points

Check all that apply.

- ☐ Is there a path from point A to point B?
- ☐ What is the shortest path from point A to point B?
- ☐ What is the longest path from point A to point B?
- ☐ Is there a cycle containing both points A and B?
- ☐ Do there exist paths from point A to everywhere else?

Section 5

16. These ungraded quizzes are a good idea. 10 points

Mark only one oval.

- ◯ True
- ◯ False