

Course: Advanced Algorithm and Problem Solving

WEEK 14- Exams, Quizzes, and Assignments

Lemlem Kassa (Ph.D.)

Addis Ababa Science and Technology University, Ethiopia

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Contents

1. Multiple Choice
2. Short Answer Questions
3. Workout home take assignment

Description of the Exam

TIME ALLOTTED FOR THE EXAM – 1:30 HOUR .

- The exam is designed to assess the students' knowledge and skills in Advanced algorithm and problem solving . The evaluation is out off 100 which consists of three different question types.

PART 1 : Multiple Choice Questions (Total 30 pts)

- Multiple Choice Questions: Total: 20 questions, 1.5 mark each

PART 2. Short Answer Questions (Total 40pts)

- Short Answer Questions: Total: 7 questions

PART 3. WORKOUT HOME TAKE ASSIGNMENT (30pts)

- This assignment is designed to assess students' practical skills on the fundamental graph algorithms (BFS, Prim's, Kruskal's).
- The assignment is individual and expected to complete in two weeks and the report should be submitted to the instructor .

Part 1. Multiple choice

1. ____ of an algorithm is the amount of time required for it to execute.
 - A. Time complexity
 - B. Space complexity
 - C. Compiling timed.
 - D. Best case
2. _____ A vertex of a graph is called even or odd depending upon _____
 - A. Total number of edges in a graph is even or odd
 - B. Total number of vertices in a graph is even or odd
 - C. Its degree is even or odd
 - D None of these

3. _____ Let S be an NP-complete problem and Q and R be two other problems not known to be in NP. Q is polynomial-time reducible to S and S is polynomial-time reducible to R . Which one of the following statements is true?

A. R is NP-complete

B. R is NP-hard

C. Q is NP-complete

D. Q is NP-hard

4. Which of the following is false in the case of a spanning tree of a graph G ?

A. It is tree that spans G

B. It is a subgraph of the G

C. It includes every vertex of the G

D. It can be either cyclic or acyclic

5. _____ Consider the graph below.



How many spanning trees can we find from the given graph?

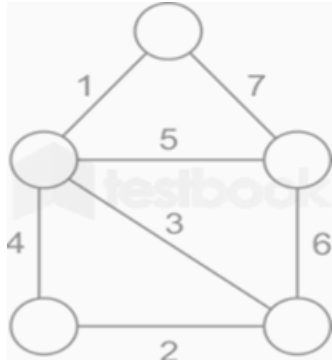
A. 10

B. 8

C. 9

D. 5

6. _____ What is the minimum cost-spanning tree for the given graph?



A. 10

B. 11

C. 3

D. 5

7. _____ is the class of decision problems that can be solved by non-deterministic polynomial algorithms.

A. NP

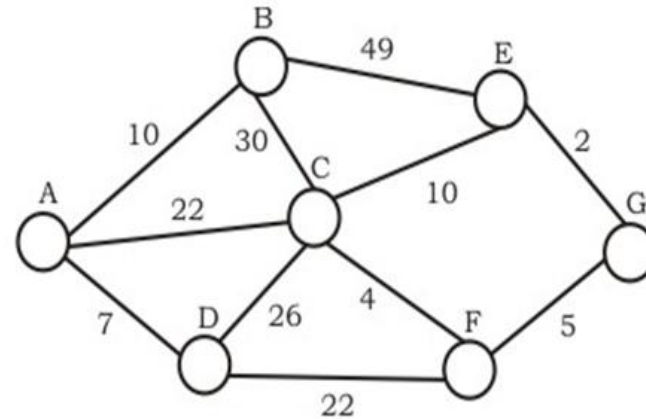
B. P

C. Hard

D. Complete

7. _____ The necessary condition for using binary search in an array is? _____
- A. The array should not be too long
 - B. The array should of more size
 - C. The array should be sorted
 - D. None of these
8. _____ A problem that is both _____ and _____ is said to be an NP-complete problem
- A. NP, P
 - B. NP, NP-hard
 - C. P, P complete
 - D. None

9. _____ Consider the undirected graph below: Using Prim's algorithm to construct a minimum spanning tree starting with node A, which one of the following sequences of edges represents a possible order in which the edges would be added to construct the minimum spanning tree?



- A. (E, G), (C, F), (F, G), (A, D), (A, B), (A, C)
- B. (A, D), (A, B), (A, C), (C, F), (G, E), (F, G)
- C. (A, B), (A, D), (D, F), (F, G), (G, E), (F, C)
- D. (A, D), (A, B), (D, F), (F, C), (F, G), (G, E)

10. _____ Backtracking can be used to solve_____
- A. Linear programming problems
 - B. Problems with a single feasible solution
 - C. Combinatorial optimization problems
 - D. Problems with a fixed set of solutions
11. _____ Let S be an NP-complete problem and Q and R be two other problems not known to be in NP. Q is polynomial-time reducible to S and S is polynomial-time reducible to R . Which one of the following statements is true?
- A. R is NP-complete
 - B. R is NP-hard
 - C. Q is NP-complete
 - D. Q is NP-hard

12. Given an unsorted array. The array has this property that every element in the array is at most k distance from its position in a sorted array where k is a positive integer smaller than the size of an array. Which sorting algorithm can be easily modified for sorting this array and what is the obtainable time complexity?

- A. Insertion Sort with time complexity $O(k^n)$
- B. Heap Sort with time complexity $O(n \log k)$
- C. Quick Sort with time complexity $O(k \log k)$
- D. Merge Sort with time complexity $O(k \log k)$

13. In what case would you prefer the use of the hash table instead of the binary search tree?

- A. When sorted order of elements is required
- B. When there are frequent insertions and deletions
- C. When memory usage needs to be minimized
- D. When elements need to be accessed in sorted order

14. What is the key difference between supervised and unsupervised learning?
- A. Supervised learning requires labeled data, while unsupervised learning does not.
 - B. Supervised learning predicts labels, while unsupervised learning discovers patterns.
 - C. Supervised learning is used for classification, while unsupervised learning is used for regression.
 - D. Supervised learning is always more accurate than unsupervised learning.

15. Which of the following is true about Huffman Coding?

- A . Huffman coding may become lossy in some cases
- B . Huffman Codes may not be optimal lossless codes in some cases
- C . In Huffman coding, no code is prefix of any other code.
- D. All of the above

16. A text is made up of the characters a, b, c, d, e each occurring with the probability 0.11, 0.40, 0.16, 0.09 and 0.24 respectively. The optimal Huffman coding technique will have the average length of:

- A. 2.40
- B. 2.16
- C. 2.26
- D. 2.15

17. Which of the following is not a supervised machine learning algorithm?

- A. K-means
- B. Naïve Bayes
- C. SVM for classification problems
- D. Decision tree

18. In which scenario would you prefer using Depth-First Search (DFS) over Breadth-First Search (BFS)?

- A. When finding the shortest path between two nodes
- B. When the graph is weighted
- C. When the graph is very deep and solutions are rare
- D. When the graph is sparse

19. Which of the following are common classes of problems in machine learning?

- A. Regression
- B. Classification
- C. Clustering
- D. all for the above

20. Which is true regarding BFS (Breadth First Search)?

- A. BFS will get trapped exploring a single path
- B. The entire tree so far been generated must be stored in BFS
- C. BFS is not guaranteed to find a solution if exists
- D. BFS is nothing but Binary First Search

Part 2. Short Answer Questions

Answer the following open ended questions clearly and precisely

1. Where can Applications of Recursion Algorithms be applied ? (4 pts)

ANS:

2. Specify at least five types of Trees in Data Structure (5pts)

ANS:

3. What is a full binary tree? (2pts)

Ans.

4. In a full binary tree if there are L leaves, then total number of nodes N are? (2pts)

Ans.

5. What is a spanning tree of a graph? (4pts)

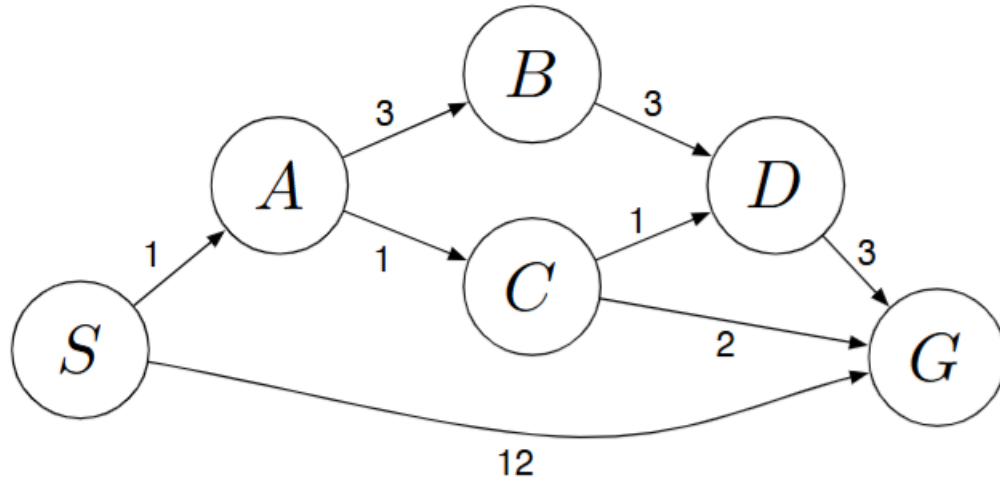
Ans.

6. How machine learning algorithms work?(7pts)

ANS:



7. Answer the given question below the figure using this graph (16, 4pts each)



Answer the following questions about the search problem shown above. Break any ties alphabetically.

For the questions that ask for a path, please give your answers in the form $S - A - D - G$.

- What path would breadth-first graph search return for this search problem?
- What path would uniform cost graph search return for this search problem?
- What path would depth-first graph search return for this search problem?
- What path would A^* graph search, using a consistent heuristic, return for this search problem?

Part 3. WORKOUT HOME TAKE ASSIGNMENT (30pts)

Objective of the this individual Assignment

This assignment is designed to:

- Assess understanding of fundamental graph algorithms (BFS, Prim's, Kruskal's)
- Evaluate ability to implement these algorithms correctly
- Test knowledge of time complexity analysis
- Demonstrate proficiency with different graph representations (adjacency lists/matrices)
- Develop skills in comparing algorithm efficiency
- Practice clean, well-documented coding

1. Write a code and state the time complexity for the following algorithm
 - i. Breadth-first search using adjacency lists or an adjacency matrix (10pts)
 - ii. Prim's minimum spanning tree algorithm for adjacency lists (10pts)
 - iii. Kruskal's minimum spanning tree algorithm for adjacency lists (10pts)

End of the Course !

Thank You!

For your attention