

Course: Advanced Algorithm and Problem Solving

WEEK 14- Exams, Quizzes, and Assignments

(With Answer)

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WEEK 14- Exams, Quizzes, and Assignments

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

Ans: A

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

Ans: c

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

Ans. B

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

Ans. D

5. _____ Consider the graph below.



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

A. 10

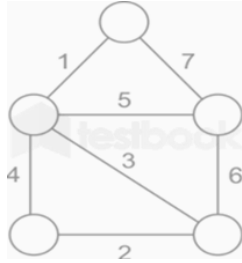
B. 8

C. 9

D. 5

Ans: B

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



A. 10

B. 11

C. 3

D. 5

Ans: B

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

A. NP

B. P

C. Hard

D. Complete

Ans. A

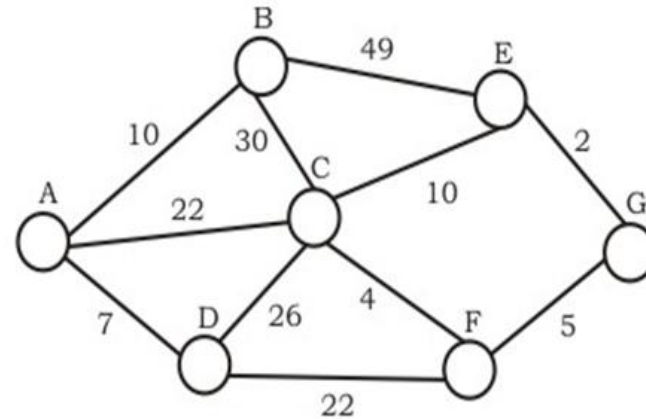
7. _____ The necessary condition for using binary search in an array is? _____
- A. The array should not be too long
 - B. The array should of more size
 - C. The array should be sorted
 - D. None of these

Ans. D

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

Ans. B

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)

Ans. D

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

Ans. C

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

Ans. B

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 $O(kn)$
- 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 $O(k\log k)$

Ans. B

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

Ans: B.

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.

Ans: A

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

Ans: C

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

Ans: B

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

Ans: A

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

Ans: C.

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

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

Ans. D

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

Ans. B

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:

- Tree and Graph Traversal
- Dynamic Programming
- Divide-and-Conquer
- Backtracking

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

ANS:

- Binary Search Tree (BST)
- Red-Black tree
- Binary tree
- B-Tree
- AVL tree

3. What is the P vs NP Problem? (2pts)

Ans.

- The P vs NP Problem is an unsolved question in Computer Science. It asks if every problem whose solution can be checked quickly can also be solved quickly.

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

Ans.

- $N=2*L-1$.

5. **Ans.**

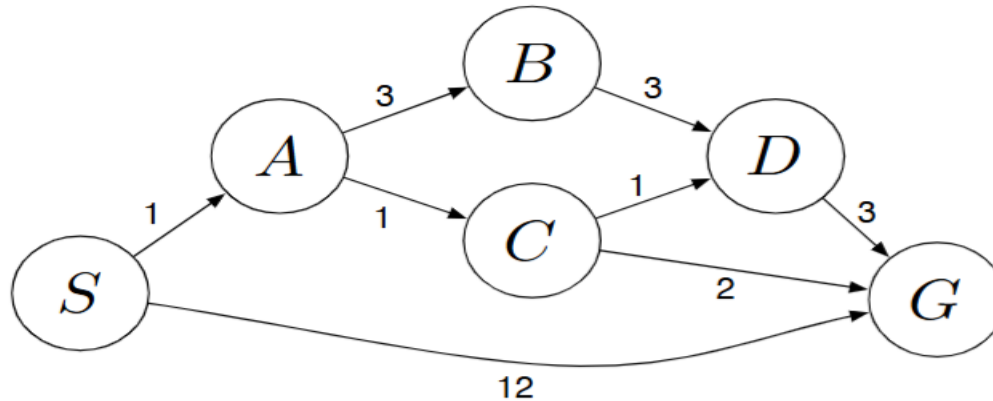
A spanning tree of a graph is a subgraph that includes all the vertices of the graph and is a tree (i.e., it has no cycles). A graph can have multiple spanning trees, and finding a minimum spanning tree (MST) is a common problem in graph theory.

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

ANS:

- Data Collection
- Data processing
- Choosing a Model
- Model Training
- Evaluating models
- Fine-tuning
- Prediction or Inference

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



Answer the following questions (a-b) 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.

- a. What path would breadth-first graph search return for this search problem? **Ans:** S – G
- b. What path would uniform cost graph search return for this search problem? **Ans:** S – A – C – G
- c. What path would depth-first graph search return for this search problem? **Ans:** S – A – B – D – G
- d. What path would A* graph search, using a consistent heuristic, return for this search problem? **Ans:** S – A – C – G

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