SASTRA

First CIA Exam – Feb 2024

Course Code: CSE318

Course Name: Algorithm Design Strategies & Analysis

Duration: 90 minutes   Max Marks: 50

PART A

Answer all the questions   **10 x 2 = 20 Marks**

1. How to quantify the efficiency of an algorithm?
2. Define Theta notation.
3. Find the complexity of below codes.

```
function(int n) {
    for (int i=1; i<=n; i++) {
        for (int j=1; j*j<=n; j++) {
            printf("*");
            break;
        }
    }
}
```

4. Compare the divide & conquer approach with dynamic programming approach.
5. Solve the following recurrence using Master theorem.

$$T(n) = 8T(n/2) + \Theta(n^3)$$

6. Prove that $(3n^2 + 7n)^2 \in O(n^4)$
7. Find the order of growth of the following sum.

$$\sum_{i=1}^{n}\sum_{j=1}^{i}(i + j)$$

8. Find the recurrence by analyzing the following simple algorithm.

Algorithm MyFun(n)
    If n<=2 ***Then***
        Return n
    Else
        Return 2*MyFun(n/3)*MyFun(2*n/3)
    End If
End MyFun

9. What is optimization problem? Which algorithm design strategy is used mostly for solving optimization problem?

10. Consider a set of unordered elements. Problem is to search an element from the list. Suggest a best searching algorithm and justify the reason.

PART B

Answer all the questions $3 \times 10 = 30$ **Marks**

11. By applying divide & conquer strategy algorithm, solve the following maximum sub array problem. Show the step-by-step results of algorithm.

Index	1	2	3	4	5	6	7	8	9	10	11	12	13
Array	-3	-8	1	-2	1	5	-3	-4	3	10	-2	4	-1

12. (a) Using recursion tree method, solve the following reccurence.

$$T(n) = T(n-1) + T(n-2) + O(1) \quad \text{if } n>2$$
$$T(n) = \Theta(1) \quad \text{if } n=1 \text{ or } n=2$$

(b) Illustrate the greedy algorithm to find a sequence of jobs, which is completed within their deadlines and gives maximum profit for the following input.

n=8	Jobs With Profit & Deadlines							
Jobs	1	2	3	4	5	6	7	8
Profits	18	31	24	5	53	42	67	39
Deadlines	3	2	1	2	5	5	4	3

13. Consider a modification of the rod-cutting problem in which, in addition to a price p_i, for each rod, each cut incurs a fixed cost of c. The revenue associated with a solution is now the sum of the prices of the pieces minus the costs of making the cuts. Give a dynamic programming algorithm to solve this modified problem. The algorithm should return the maximum revenue. Using this algorithm, find the maximum revenue for the 5-inch rod with the following price list and the fixed cut cost of Rs.5 per cut.

Length of Rod = 5					
Length	1	2	3	4	5
Price	2	3	7	8	9

SASTRA

School of Computing
Second CIA Exam – March 2024

Course Code: CSE318
Course Name: Algorithm Design Strategies & Analysis
Duration: 90 minutes Max Marks: 50

PART A

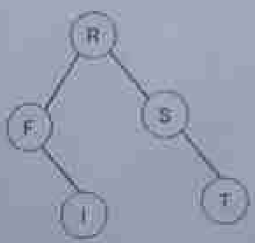
nswer all the questions **10 x 2 = 20 Marks**

1. Compare the backtracking strategy with brute-force approach.
2. Predict the algorithm design strategy used in the following algorithms. (a) 0/1 Knapsack Problem (b) Sum of Subset Problem (b) String Editing Problem (d) Kruskal's Algorithm
3. Relate the hamiltonian cycles problem with the Travelling Salesman Problem.
4. Mention the bounding conditions used for backtracking in sum of subset problem.
5. Say True or False
   (a) In the adjacency matrix representation of directed graph, the matrix is symmetric.
   (b) In the adjacency matrix representation of undirected graph, the number of 1's is twice the number of vertices.
6. Match the following.

Prim's Algorithm	Topological Order
BFS	Priority Queue
DFS	SET concept
Kruskal's Algorithm	Queue

7. Find the search cost for the following BST with the given probability of key elements.

n = 5	0	1	2	3	4	5
Keys[1..5]		F	I	R	S	T
P[1..5]		0.15	0.1	0.05	0.1	0.2
q[0..5]	0.05	0.1	0.05	0.05	0.05	0.1



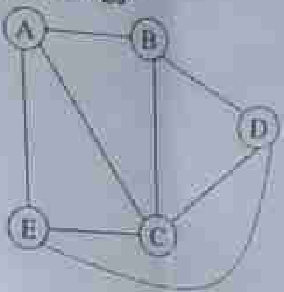
8. Write the recursive formula of optimal sub structure property for the 0/1 knapsack problem.
9. Describe the n-Queen problem.
10. What is the use of State Space Tree?

PART B

Answer any three questions **3 x 10 = 30 Marks**

11. (a) Write the algorithm using backtracking strategy for the sum of subset problem. *(5 Marks)*

(b) Find all the hamiltonian cycles present in the following graph by applying backtracking strategy. *(5 Marks)*

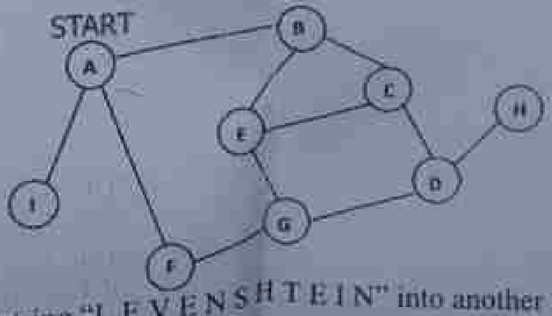


12. (a) Write dynamic programming algorithm for constructing optimal binary search tree. *(5 Marks)*

(b) Construct the optimal binary search tree for the following root table (r) which is obtained by applying dynamic programming approach for the key elements: Keys[1..5] = {F, I, R, S, T}. *(5 Marks)*

0	1	2	3	4	5	r
0	1	1	2	2	2	0
	0	2	2	2	4	1
		0	3	4	5	2
			0	4	5	3
				0	5	4
					0	5

13. Which traversal algorithm used for finding shortest distance from the given starting vertex to all other vertices in a unweighted graph. Write the algorithm and find the shortest distance from 'A' to all other vertices by tracing algorithm.



14. Tranform a string "L E V E N S H T E I N" into another string "M E I L E N S T E I N" by using minimum numbers of editing operations by applying dynamic programming approach.

SASTRA

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Third CIA Exam – April 2024

Course Code: CSE318

Course Name: Algorithm Design Strategies & Analysis

Duration: 90 minutes Max Marks: 50

PART A

Answer all the questions **10 x 2 = 20 Marks**

1. List out any six algorithm-design strategies.
2. Backtracking approach uses _______ search, whereas Branch & Bound approach uses _______ search.
3. What are the four different types of approximation algorithms available for solving Bin-Packing Problem?
4. Predict the algorithm design strategy used in the following algorithms. (a) Bin Packing Problem (b) Dijkstra's Shortest Path Problem (c) Job Sequencing Problem (d) Sum of Subsets Problem
5. Compare deterministic and non-deterministic algorithms.
6. Relate decision problems with optimization problems.
7. What is negative weight cycle in a graph? Which algorithm is used to check whether a graph containing negative weigh cycle or not?
8. State Boolean Satisfiability Problem. Give an example.
9. What is Clique in graph? Describe Clique Decision Problem.
10. Differentiate NP-Hard and NP-Complete problems.

PART B

Answer any two questions **2 x 10 = 20 Marks**

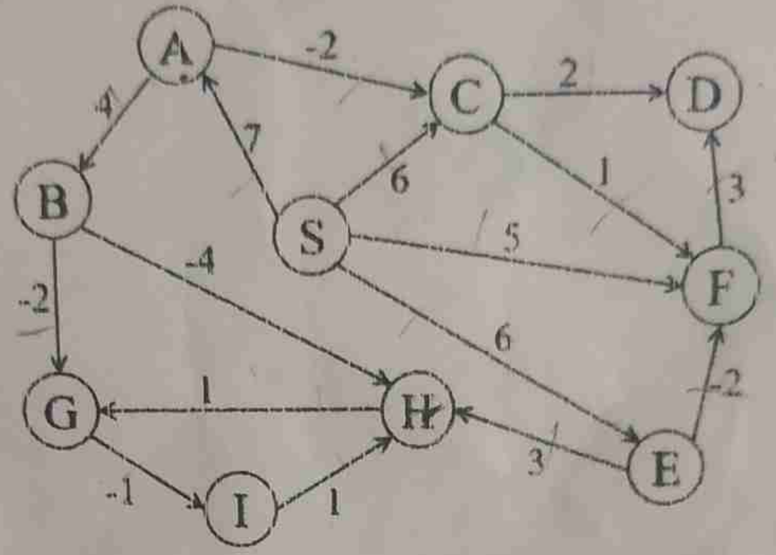
11. How to prove a problem belongs to NP-Complete? Prove that Travelling Salesperson Problem is NP-Complete.
12. Given a set of (n=5) items with their profits and wieghts. Apply the branch and bound strategy to solve the 0/1 Knapsack Problem.

    Profit[1..5] = {10, 10, 12, 18, 5}

    Weight[1..5] = {2, 4, 6, 9, 3}

    Knapsack Capacity = 15

13. Find the shortest distance from the vertex 'S' to all other vertices by applying Bellman-Ford algorithm for the following weighted graph.



PART C

Answer all questions **1 x 10 = 10 Marks**

14. Discuss on approximation algorithms, scheduling independent tasks problem and LPT schedule. Consider n=7 independent tasks with processing times (in hours) given by 1, 4, 5, 7, 8, 9 and 10. (a) Schedule these tasks with, m=2 processors using LPT schedule algorithm. Show the timeline and give the tasks finishing time. (b) Find the optimal finishing time for m=2 processors. (c) Compute the relative error of LPT schedule found in (a) expressed as percent.