2011N769

Candidate's Seat No :_____

IM.Sc AIML & DS Sem.-7 Examination

CC 401

Advanced Algorithms

November-2024

Time : 2-30 Hours] **[Max. Marks : 70**

Instructions: All questions are compulsory. Use of non-programmable scientific calculator is allowed.

Q.1 **(a)** Define Growth of Functions. Define the Asymptotic Notations: Big-oh (O), Big-Omega (ω), Big-Theta (θ) with its graphical representation. (07)

(b) Calculate the time Complexity of Selection Sort and Quick Sort with suitable example. (07)

OR

(a) Calculate the time Complexity of Insertion Sort and Merge Sort with suitable example. (07)

(b) Define Complexity of an Algorithm. Explain the comparison of various Time Complexities with its graphical representation. (07)

Q.2 **(a)** Explain the concept of a greedy Bellman-Ford algorithm. Also, discuss the worst time complexity of the algorithm. (07)

(b) Explain the concept of Matrix Chain Multiplication algorithm. Consider the following array and give the suitable output: (07)

(i) Input: arr[ ] = {2, 1, 3, 4}, Output: ?

(ii) Input: arr[ ] = {2, 1, 3}, Output: ?

(iii) Input: arr[ ] = {3, 4}, Output: ?

OR

(a) Discuss in brief: the difference between Divide and Conquer method and Dynamic Programming algorithm approach. (07)

(b) What is Huffman Coding? (07)

Consider the message with 100 characters in which characters a, b, c, d, e and f are used with frequency 50,10,30,5,3 and 2 respectively. Find the number of bits required for Huffman encoding the above message. Also, find the average bits required to represent each character.

Q.3 **(a)** Discuss the time complexity of Traditional and Strassen method with suitable example. (07)

(P.T.O)

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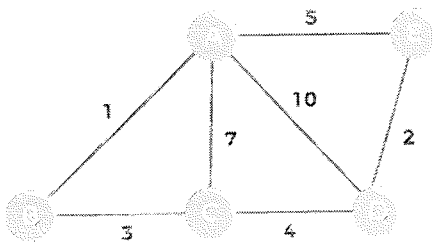
Find the matrix multiplication using Strassen method

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \quad B = \begin{bmatrix} 5 & 6 \\ 7 & 8 \end{bmatrix}$$

(b) Define: Spanning tree. **(07)**

Consider the graph, find the minimum cost of the spanning tree by using Kruskal Algorithm.

State one important difference while applying Kruskal and Prim's algorithm. What is the time complexity of Kruskal Algorithm.



OR

(a) Explain the concept of Dijkstra's algorithm. Write the application of Dijkstra's algorithm in real-world scenarios. **(07)**

(b) Consider the array **(07)**

6	5	3	1	8	7	2	4

Using Bubble sorting algorithm, answer the following questions:

(i) It depends on the structure or content.

(ii) Internal/External sorting algorithm?

(iii) Stable/Unstable sorting algorithm?

(iv) Best-case and worst-case time complexity?

(v) State the algorithm approach?

Q.4 (a) State Master method for solving recurrences. Using Master's method find the worst time complexity of the recurrence $T(n) = 7T\left(\frac{n}{2}\right) + 18n^2$ **(07)**

(b) Define NP-Complete and NP-Hard problems. Explain with diagram the concept of P, NP, NP-Complete and NP-Hard. **(07)**

OR

(a) What is Clique? Prove that Clique decision problem is NP-complete. **(07)**

(b) What is Travelling Salesman Problem? Why it is NP hard Problem? **(07)**

Q.5 Attempt any **SEVEN** out of **TWELVE:** (14)

(1) Which of the following asymptotic notations holds the property of Reflexivity, Symmetry and Transitivity?

A. Big Oh notations

B. Big Theta notations

C. Big Omega notations

D. Small Oh notations

(2) Define the Longest Common Subsequence (LCS) problem in algorithm design.

(3) What is the number of spanning tree possible if G is complete Graph?

(4) Write the concept of "pivot" in the quicksort algorithm.

(5) What are the advantages and disadvantages of heap sort as a sorting algorithm?

(6) What is the time complexity of the following code:

```
def func(n):
    for i in range (n):
        for j in range (n):
            print (i, j)
```

A. $O(n)$

B. $O(n \log n)$

C. $O(n^2)$

D. $O(n^3)$

(7) What are the applications of Huffman coding in real scenarios.

(8) What is the time complexity of the recurrence relation $T(n) = T\left(\frac{n}{4}\right) + T\left(\frac{n}{2}\right) + n$.

(9) Which of the following sorting algorithms is based on Divide and Conquer algorithmic approach?

A. Bubble sort

B. Selection Sort

C. Insertion sort

D. Quick sort

(10) State (only) Cook's Theorem.

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(11) What is the worst-case time complexity of Strassen method?

A. $O(n^3)$

B. $O(n \log n)$

C. $O(n^{ln7})$

D. $O(\log n)$

(12) State (only) Vertex Covering Problem?

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