Total No. of printed pages = 3

CSE 181502

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2023

B.Tech. 5th Semester End-Term Examination

CSE

DESIGN AND ANALYSIS OF ALGORITHM

Full Marks – 70 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer Question No. 1 and any *four* from the rest.

1. Answer the following : (10 × 1 = 10)

(i) The ———— is also known as an escape clause which is used to terminate the algorithm.

(a) Recursive case (b) Recursive function

(c) Iterative step (d) Base case

(ii) Which of the following algorithms is the best approach for solving Huffman codes?

(a) exhaustive search (b) greedy algorithm

(c) brute force algorithm (d) divide and conquer algorithm

(iii) How many comparisons will be made to sort the array arr = {1, 5, 3, 8, 2} using counting sort?

(a) 5 (b) 8

(c) 3 (d) 0

(iv) Prim's algorithm starts constructing a minimum spanning tree from ————.

(a) An arbitrary root vertex (b) The shortest edge

(c) The left most vertex (d) The right most vertex

(v) What is the typical running time of a heap sort algorithm?

(a) $O(N)$ (b) $O(N \log N)$

(c) $O(\log N)$ (d) $O(N2)$

(vi) Which of the problems cannot be solved by backtracking method?

(a) n-queen problem (b) subset sum problem

(c) hamiltonian circuit problem (d) travelling salesman problem

(vii) Subset sum problem is an example of NP-complete problem.

(a) true (b) false

(viii) Hamiltonian path problem is ————.

(a) P class problem (b) NP problem

(c) N class problem (d) NP complete problem

(ix) The time complexity to find the longest common subsequence fo two strings of length M and N is?

(a) $O(N)$ (b) $O(M * N)$

(c) $O(M)$ (d) $O(\log N)$

(x) If for an algorithm time complexity is given by $O(\log_2 n)$ then complexity will be ————.

(a) constant (b) polynomial

(c) exponential (d) none of the above

2. (a) Define algorithm. List the desirable properties of an algorithm. (2+5=7)

(b) Describe asymptotic notations. Prove that $T(n) = n^3 + 5n + 1$ is $O(n^4)$. (4+4=8)

3. (a) Solve the recurrence relation using substitution method. (4)

$T(n) = 8T(n/2) + n^2$ for $n > 1$

$T(n) = 1$ for $n = 1$

(b) Solve the following recurrence relations using recurrence tree method. (5)

$T(n) = 2T(n/2) + n^2$ for $n > 1$

$T(n) = 1$ for $n = 1$

(c) Solve the following recurrence relations using Master's theorem. (6)

(i) $T(n) = \sqrt{2}T(n/2) + \log n$

(ii) $T(n) = 6T(n/3) + n^2 \log n$

(iii) $T(n) = 2T(n/2) + n \log n$

4. (a) What is principle difference between dynamic programming and divide and conquer techniques? (4)

(b) Define greedy knapsack. If the capacity of the Knapsack is 15, find out optimal profit. (5)

Objects (n_i)	n_1	n_2	n_3	n_4	n_5	n_6	n_7
Profit	10	5	15	7	6	18	3
Weight	2	3	5	7	1	4	1

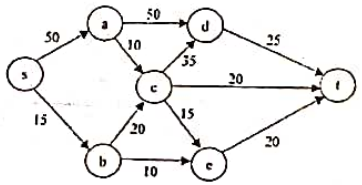
(c) Evaluate the subset sum problem with set as {3, 5, 6, 7, 2} and the sum = 15. Derive all the subsets using backtracking strategy. (6)

5. (a) Define amortized time complexity. (3)

(b) Mention the properties of Red-Black Trees. (4)

(c) Construct a Binomial Heap using the following keys: 7, 2, 4, 17, 1, 11, 6, 8, 15, 10, 20. (8)

6. (a) Use the Ford-Fulkerson Algorithm to find the maximum possible flow in the given network below, having the capacities as shown. Calculate the total flow that results. List the augmenting paths. (7)

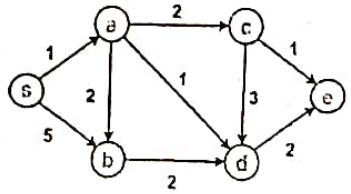


(b) Explain the traversal algorithm DFS and BFS with example. (4+4=8)

7. (a) State Cook's theorem. (2)

(b) Explain the class of P and NP with example. (4)

(c) Find the shortest distance from source vertex 'S' to remaining vertices in the following graph. (4)



(d) Explain Approximation algorithm with the help of Bin Packing problem. (5)

Total No. of printed pages = 4

CSE 181502

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2022

B.Tech. 5th Semester End-Term Examination

CSE

DESIGN AND ANALYSIS OF ALGORITHM

(New Regulation & New Syllabus)

Full Marks – 70 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1. Choose the most appropriate choice to answer the following : (10 × 1 = 10)

(i) Which of the following is a Divide and Conquer algorithm?

(a) Buble sort (b) Selection sort

(c) Merge sort (d) All above

(ii) What is the worst case time complexity of a quick sort algorithm on n elements?

(a) O(n) (b) O(n log n)

(c) $O(n^2)$ (d) O(log n)

(iii) What is the worst case time complexity of linear search on n elements?

(a) O(nlogn) (b) O(logn)

(c) O(n) (d) O(1)

(iv) Which of the following data structure helps to implement recursion?

(a) Stack (b) Queue

(c) Binary Tree (d) None above

[Turn over

(v) O-notation provides an asymptotic

(a) upper bound

(b) lower bound

(c) both upper and lower bound

(d) none of above

(vi) Optimal substructure property is required in which of the following?

(a) Greedy Technique

(b) Dynamic programming

(c) Divide and Conquer Technique

(d) All above

(vii) A sorting technique is called stable if

(a) It takes O(n) space

(b) It takes O(nlogn) time

(c) It maintains the relative order of occurrence of non-distinct elements

(d) None of above

(viii) To merger two sorted lists of sizes m and n into a sorted list of size m+n, we require comparisons of

(a) O(m) (b) O(n)

(c) O(m-n) (d) O(m+n)

(ix) The concatenation of two lists is to be performed in O(1) time. Which of the following implementations of a list should be used?

(a) Singly linked linear List

(b) Doubly linked linear list

(c) Circular doubly linked list

(d) None of above

(x) Consider following array of elements (89, 19, 50, 17, 12, 15, 2, 5, 7, 11, 6, 9, 100). The minimum number of interchanges needed to convert it into a max binary heap is

(a) 4 (b) 5

(c) 2 (d) 3

2. (a) For each of the following recurrences, derive an expression for the runtime T (n) if the recurrence can be solved with the Master Theorem. Otherwise, indicate why Master Theorem does not apply. (5+5=10)

(i) $T(n)=16T(n/4)+n$

(ii) $T(n)=2T(n/2)+n\log n$

(b) Analyses the time complexity of Binary Search on a sorted sequence of numbers stored in an array [No need to write algorithm] (5)

3. (a) Explain divide and conquer method of Problem solving. Discuss its merits. (5)

(b) Consider the following array of numbers (10)

(10, 2, 18, 5, 20, 6, 15, 25, 5, 40, 50, 30). Use quick sort to apply divide and conquer method to sort it in ascending order. Analyses the time complexity

4. Consider the following array of numbers: (10, 2, 18, 5, 20, 6, 15, 25,5, 40, 50, 30).

(a) Construct a max binary heap from this array. (5)

(b) Explain how you can implement the max heap as a priority queue on the heap constructed in question 4 (a). Also analyse the time complexity of the insertion and deletion operations on the priority queue. (5+5=10)

5. (a) What is the benefit of using Binomial Heap? Construct a binomial heap (min) if the following keys are inserted one after another in the given sequence. 16,9,30,26,8,20,22,5, 12. (5)

(b) Analyse the complexities of Breadth First and Depth First search with example. (10)

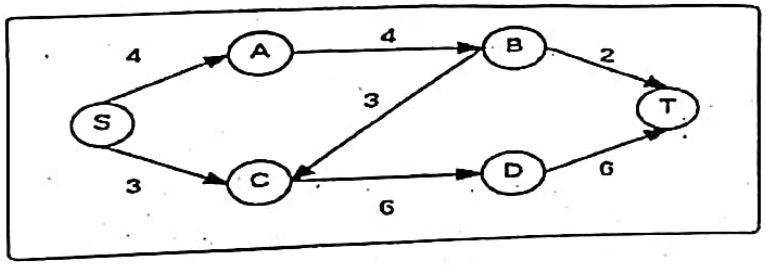
6. (a) Explain with an example how greedy strategies are applied in PRIM's algorithm to find minimum spanning tree. (5)

(b) Apply dynamic programming technique to find the optimal parenthesis for the matrix chain multiplication of the following matrix chain : A1 × A2 × A3 × A4, where the dimensions are as follows : (10)

Matrix	Dimension
A1	8 × 4
A2	4 × 2
A3	2 × 6
A4	6 × 5

7. (a) What is travelling salesman problem? State a few applications of Travelling salesman problem. (5)

(b) Following is a flow network, with source S and sink T. The numbers assigned to the edges are the flow capacities of the edges. Apply Ford and Fulkerson algorithm and explain how much "flow"(maximum) can the network process at a time? (No need to write any algorithm). (10)



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2021

B.Tech. 5th Semester (R) End-Term Examination

CSE

DESIGN AND ANALYSIS OF ALGORITHM

(New Regulation & New Syllabus)

Full Marks – 70 Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer Q.No. 1 and any *four* questions from the rest.

1. Answer the following : (10 × 1 = 10)

(a) What are P and NP class problems?

(b) State Master's Theorem.

(c) What are randomized algorithms?

(d) What are the different algorithm strategies?

(e) What is amortized analysis?

(f) What is a Minimum spanning tree?

(g) What is a Network Flow? Give some algorithms to solve it.

(h) What will the number of comparisons needed to simultaneously find minimum and maximum.

(i) State Ω - notation.

(j) What are the different approaches to solve Knap Sack problem using greedy method?

2. (a) What is dynamic programming? What are the various steps involved in the solution of a dynamic programming problem? (1 + 2 = 3)

(b) With working modulo q = 11, how many spurious hits does the Rabin Karp algorithm encounters in the text, T = 314152692 when looking for the pattern, P = 26. (8)

(c) Differentiate between comparison sort and non-comparison sort. (4)

[Turn over

3. (a) State the Cook's theorem. (2)

(b) Insert the following keys in a red black tree and a Binomial heap and show the steps of construction too. (7 + 6 = 13)

14, 17, 11, 7, 53, 4, 13, 12, 8, 60, 19, 16, 20

4. (a) Create a Fibonacci heap from the following keys : H, I, J, B, A, E, C, F, D, G, K, L. (5)

(b) What are the different operations on heaps and their complexities too? (4)

(c) Sort the following keys using counting sort :

3, 6, 4, 1, 3, 4, 1, 4 (6)

5. (a) Solve the following recurrences : (2 + 2 + 3 = 7)

(i) $T(n) = 2T\left(\frac{n}{4}\right) + \sqrt{n}$. (Master Theorem)

(ii) $T(n) = 2T(\sqrt{n})$. (Changing variable)

(iii) $T(n) = 2T(n/2) + \sqrt{n}$. (Recursion tree)

(b) Show that Master's Theorem cannot be applied on the following recurrence :

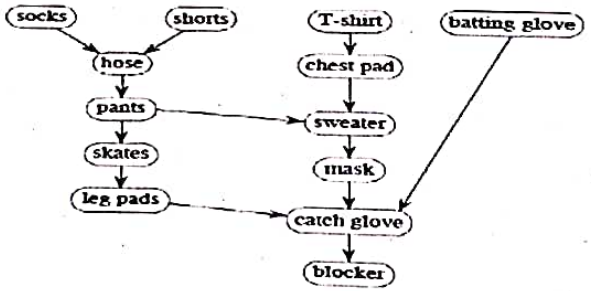
$T(n) = 4T(n/2) + n^2 \log n$.

Give the solution of the above recurrence too. (3 + 5 = 8)

6. (a) Given a sequence of matrices, a = 10 × 100, b = 100 × 20, c = 20 × 5 and d = 5 × 80. Insert parenthesis so that the product of the matrices, in order, is unambiguous and needs the minimal number of multiplication. (7)

(b) Write the algorithm for Q.No. 6 (a). (3)

(c) Give a linear ordering for the vertices of the graph and write the algorithm too. (5)



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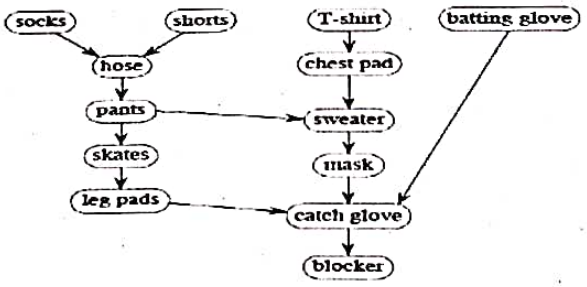
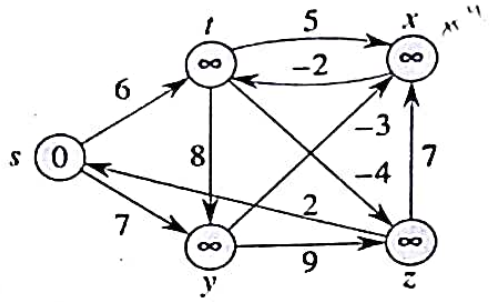


7. (a) Solve the single - source shortest path problem in the given graph from the source vertex. (8)



(b) Write the algorithm for Q.No.7 (a) and find its complexity too. (4)

(c) Differentiate between Breadth First Search (BFS) and Depth First Search (DFS). (3)