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Question Paper Code : X 10314

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020 AND
APRIL/MAY 2021
Fourth Semester
Computer Science and Engineering
CS 8451 – DESIGN AND ANALYSIS OF ALGORITHMS
(Common to Computer and Communication Engineering/Information Technology)
(Regulations 2017)

Time : Three Hours   Maximum : 100 Marks

Answer ALL questions

PART – A   (10×2=20 Marks)

1. Define algorithm with its properties.

2. List the reasons for choosing an approximate algorithm.

3. Write an example problem that cannot be solved by brute-force algorithm. Justify your answer.

4. Write the general divide and conquer approach to solve a problem.

5. What is meant by optimal substructure property of a dynamic programming problem.

6. Write the control abstraction for greedy method.

7. What are the essential properties of a flow graph ?

8. What is meant by iterative improvement technique ?

9. Differentiate between NP hard and NP complete problems.

10. What is LC search and how it is efficient from other search methods in branch and bound algorithms ?

PART – B **(5×13=65 Marks)**

11. a) i) Consider the problem of counting, in a given text the number of substrings that start with an A and end with a B. For example, there are four such substrings in CABAAXBYA. Design a brute-force algorithm for this problem and determine its efficiency class. **(8)**

    ii) "The best-case analysis is not as important as the worst-case analysis of an algorithm". Yes or No ? Justify your answer with the help of an example. **(5)**

(OR)

  b) i) Solve : $T(n) = 2T(n/2) + n^3$. **(4)**

    ii) Explain the importance of asymptotic analysis for running time of an algorithm with an example. **(4)**

   iii) Write and explain recursive algorithm to find the factorial of any given number $n >= 0$. Find the time complexity. **(5)**

12. a) i) Let $x_1 < x_2 < ... < x_n$ be real numbers representing coordinates of n villages located along a straight road. A post office needs to be built in one of these villages. Design an efficient algorithm to find the post-office location minimizing the average distance between the villages and the post-office. **(8)**

    ii) Explain how exhaustive search can be applied to the sorting problem and determine the efficiency class of such an algorithm. **(5)**

(OR)

  b) i) Write an algorithm using divide and conquer to search an element in a list of numbers. If the number is not present, the algorithm returns the closest number of the searches number. **(8)**

    ii) What is Strassen's matrix multiplication and explain how it is solves the problem using divide and conquer technique. **(5)**

13. a) i) Compare and contrast dynamic programming and greedy method. **(5)**

    ii) Write the algorithm for optimal binary search tree and solve the following problem instance to construct the optimal binary search tree. Keys are a, b, c, d and the probabilities are 0.1, 0.2, 0.4 and 0.3. **(8)**

(OR)

b) i) Write the prim's algorithm to find the minimum spanning tree and illustrate the algorithm for the following graph. Where a, b, c, d and e are nodes and each edges are weighted by numbers. **(8)**
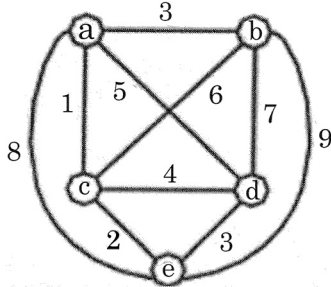
ii) What is multistage graph ? List any three applications of multistage graph. **(5)**

14. a) i) Find a stable marriage matching for the instance defined by the following ranking matrix : **(8)**

	A	B	C	D
α	1, 3	2, 3	3, 2	4,3
β	1, 4	4, 1	3, 4	2, 2
γ	2, 2	1, 4	3, 3	4, 1
δ	4, 1	2, 2	3, 1	1, 4

ii) Determine the time efficiency of the above algorithm in the worst case. **(5)**

(OR)

b) Advertising alternatives for a company include television, radio and newspaper. The table below shows the costs and estimates of audience coverage for each types of media.

	Cost per advertisement	Audience per advertisement
Television	$2000	100,000
Newspaper	$600	40,000
Radio	$300	18,000

The newspaper limits the number of weekly advertisements form a single company to ten. Moreover to balance the advertising among the three types of media, no more than half of the total number of advertisements should occur on the radio, and at least 10% should occur on television. The weekly advertising budget is $ 18,200. How many advertisements should run in each of the three types of media to maximize the total audience ? Solve the problem using simplex method. **(13)**

15. a) i) What are the general approaches exit for branch and bound algorithms ? Also explain the data structure need for storing live nodes in each approach with suitable example. **(5)**

    ii) Write the algorithm for solving 0/1 knapsack problem using LC branch and bound and solve the knapsack instance ; n = 4; (p1, p2, p3, p4) = (10, 10, 12, 18); (w1, w2, w3, w4) = (2, 4, 6, 9) and M = 15, using LCBB, Draw the state space tree. **(8)**

(OR)

    b) i) Write the algorithm for sum of subsets problem using backtracking technique. **(8)**

    ii) Illustrate the algorithm for the instance n = 6, M = 30 and W = (5, 10, 12, 13, 15, 18). Draw possible state space tree. **(5)**

PART – C   **(1×15=15 Marks)**

16. a) i) Assume {500, 100, 50, 20, 10, 5} currency of denominations is available in a bank. Devise a greedy algorithm to obtain the minimum number of denominations for any amount which is a multiple of 5. Find the time complexity of your algorithm. **(5)**

    ii) Explain the maximum-bipartite-matching problem with an illustration. **(5)**

    iii) Prove that TSP problem is NP complete, assuming that Hamiltonian problem is NP complete. **(5)**

(OR)

    b) i) Solve the TSP using branch and bound technique. **(10)**

$$\begin{array}{c c} & \begin{array}{cccc} A & B & C & D \end{array} \\ \begin{array}{c} A \\ B \\ C \\ D \end{array} & \left[\begin{array}{cccc} \infty & 12 & 5 & 7 \\ 11 & \infty & 13 & 6 \\ 4 & 9 & \infty & 18 \\ 10 & 3 & 2 & \infty \end{array} \right] \end{array}$$

    ii) Explain the operations of approximate vertex cover and Give an example of a graph for which APPROX-VERTEX-COVER always yields a suboptimal solution. **(5)**

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