

Code No: R09220505

R09**Set No. 2**

II B.Tech II Semester Examinations, APRIL 2011

DESIGN AND ANALYSIS OF ALGORITHMS

Common to Mechanical Engineering, Information Technology, Production Engineering, Computer Science And Engineering

Time: 3 hours

Max Marks: 75

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Modify the Binary search of the text so that in the case of unsuccessful search it returns the index i such that $k(i) < key < k(i+1)$.
(b) Is Quick sort a stable sorting method? Justify your answer. [7+8]
2. (a) Explain the Prim's algorithm with the appropriate example.
(b) Write the Prim's algorithm to find the minimum spanning tree. [7+8]
3. Define the following terms:
state space, explicit constraints, implicit constraints, problem state, solution states, answer states, live node, E-node, dead node, bounding functions. [15]
4. (a) Explain how to implement Warshall's algorithm without using extra memory for storing elements of the algorithm's intermediate matrices.
(b) Give an example of a graph or a digraph with negative weights for which Floyd's algorithm does not yield the correct result. [7+8]
5. Suppose there are n jobs to be executed but only k processors that can work in parallel. The time required by job i is t_i . Write an algorithm that determines which jobs are to be run on which processors and the order in which they should be run so that the finish time of the last job is minimized. [15]
6. Prove that every connected graph G on n vertices is the union of at most $\lfloor (n+1)/2 \rfloor$ edge-disjoint paths. [15]
7. Show that the reduction of the CNF satisfiability problem to the Clique Decision problem can be done in polynomial time. [15]
8. Suppose you are choosing between the following three algorithms:
 - (a) Algorithm A solves problems by dividing them into five subproblems of half the size, recursively solving each subproblem, and then combining the solutions in linear time.
 - (b) Algorithm B solves problems of size n by recursively solving two subproblems of size $(n-1)$ and then combining the solutions in constant time.
 - (c) Algorithm C solves problems of size n by dividing them into nine subproblems of size $n=3$, recursively solving each subproblem, and then combining the solutions in $O(n^2)$ time. What are the running times of each of these algorithms (in big-O notation), and which would you choose? [5+5+5]

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R09**Set No. 4**

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1. Given an array of n elements, (possibly with some of the elements are duplicates), write an algorithm to remove all duplicates from the array in time $O(n \log n)$. [15]
2. (a) What is Dynamic Programming? Explain with suitable illustration.
(b) You are given a list of words, $W_1, W_2, W_3, \dots, W_n$ and their corresponding probabilities of occurrence $p_1, p_2, p_3, \dots, p_n$. The problem is to arrange these words in a binary search tree in a way that minimizes the expected total access time. Suggest a good algorithm to implement it. Also prove the complexity of the algorithm derived by you. [7+8]
3. (a) Give an algorithm to find the minimum number of edges that need to be removed from an undirected graph so that the resulting graph is acyclic.
(b) Does either Prim's or Kruskal's algorithm work if there are negative edge weights. [7+8]
4. Suppose you implement the disjoint-sets data structure using union-by-rank but not path compression. Give a sequence of m union and find operations on n elements that take $(m \log n)$ time. [15]
5. (a) Given a sequence of n numbers, the distinct elements problem is to check if there are equal numbers. Give an $O(1)$ time non-deterministic algorithm for this problem.
(b) Obtain a nondeterministic algorithm of complexity $O(n)$ to determine whether there is a subset of n numbers $a_i, 1 \leq i \leq n$, that sums to n . [7+8]
6. (a) Is Quick sort a stable sorting method? Justify your answer.
(b) Derive the time complexity of Strassen's Matrix multiplication. [7+8]
7. Write a branch- and - bound algorithm for the job sequencing with deadlines problem. [15]
8. Write the algorithm BKnap for solving 0/1 Knapsack Problem using Back Tracking method. [15]

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1. Write an algorithm in pseudocode to count the number of capital letters in a file of text. How many comparisons does it do? What is fewest number of increments it might do? What is the largest number? Assume that N is number of characters in a file. [15]
2. Explain the problem of All Pairs Shortest Path Problem and write its algorithm using Dynamic Programming. Prove that it is working with a numerical example. [15]
3. (a) What puts a problem into class NP.
(b) Explain the differences between decision and optimization problems. [7+8]
4. Write an algorithm schema FifoBB for a FIFO branch-and-bound search for a least-cost answer node. [15]
5. (a) Explain the merge sort with the example. Write the algorithm of merge sort, and the running time of the algorithm.
(b) Compute the product of the following matrices of 4 x4 size, using Strassen's matrix multiplication method. $A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 1 & 2 & 3 \\ 4 & 5 & 6 & 7 \end{bmatrix}$ $B = \begin{bmatrix} 8 & 9 & 1 & 2 \\ 3 & 4 & 5 & 6 \\ 7 & 8 & 9 & 1 \\ 2 & 3 & 4 & 5 \end{bmatrix}$ [7 + 8]
6. Define an articulation point in a graph. Write algorithm for find articulation point. Write the time complexity of your algorithm. [15]
7. Suppose you are given n men and n women and two of (n x n) arrays P and Q such that P(i,j) is the preference of man i for women j and Q(i,j) is the preference of woman i for man j. Design an algorithm that finds a pairing of men and women such that the sum of the product of the preferences is maximized. [15]
8. (a) Compute the time complexity of deriving minimum spanning tree from the weighted connected graph using Kruskal's algorithm
(b) Prove that if $p_1/w_1 \geq p_2/w_2 \geq \dots \geq p_n/w_n$, then FractionalGreedyKnapsack algorithm generates an optimal solution to the given instance of the fractional Knapsack problem. [7+8]

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- Write a Backtracking algorithm for the sum of subsets problem using the state space tree corresponding to the variable tuple size formulation. [15]
- Explain 0/1 Knapsack problem and explain the approach to solve it using Dynamic Programming. Explain with an example. [15]
- Explain the divide and conquer strategy. How it can be useful in the problem solving.
 - Assuming that quick sort uses the first item in the list as the pivot item:
 - Give a list of n items (for example, an array of 10 integers) representing the worst-case scenario.
 - Give a list of n items (for example, an array of 10 integers) representing in the best-case scenario. [7+8]
- How do you reduce/relate Job Scheduling Problem with Traveling Sales Person Problem. [15]
- Write an algorithm schema LifoBB for a LIFO branch-and-bound search for a least-cost answer node. [15]
- Explain the terms feasible solution, optimal solution and objective function.
 - Show that in a complete graph with n vertices, the number of spanning trees generated can not be greater than $(2^{n-1}-2)$. [7+8]
- Suppose we want to find the minimum spanning tree of the following graph in figure 1.

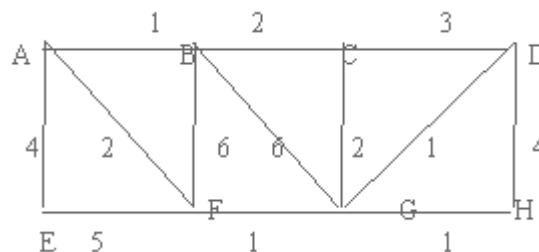


Figure 1:

- Run Prim's algorithm; whenever there is a choice of nodes, always use alphabetic ordering (e.g., start from node A). Draw a table showing the intermediate values of the cost array.

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- (b) Run Kruskal's algorithm on the same graph. Show how the disjoint-sets data structure looks at every intermediate stage (including the structure of the directed trees), assuming path compression is used. [7+8]
8. Let a, b, c be numbers such that $0 \leq a, b < 1$, and $c > 0$. Let $T(n)$ be defined by $T(n) = T(an) + T(bn) + cn$.
- (a) Show that if $(a+b) < 1$ then $T(n)$ is bounded by linear function.
- (b) Does there exist a d such that, for all a, b, c above, $T(n) = O(n^d)$? [15]

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