Printed Pages : 4 MCA-302

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 1430 Roll No.

M.C.A.

(SEM. III) EXAMINATION, 2008-09
DESIGN AND ANALYSIS OF ALGORITHMS

Time : 3 Hours] *[Total Marks : 100*

Note : *Attempt **all** questions.*

1 Attempt any four parts of the following : 4×5=20

(a) Explain how 'analyzing a problem' help us in developing an algorithm to solve the problem.

(b) For the function, $f(x) = 7x^4 - 5x^2 + 11$ show that

(i) $f(x) = O(x^5)$

(ii) $x^5 \neq O(f(x))$.

(c) Sort the following sequence in ascending order using Heap sort

28, 13, 12, 25, 38, 11, 15, 9, 36

(d) State the master method for solving the recurrences. Why we can't solve the recurrences ?

$T(n) = 2T\left(n/2\right) + n \lg n$ using master method ?

(e) Prove that counting sort is stable.

(f) Give an algorithm to find the k^{th} smallest element in a sequence of n elements. Your algorithm must run in linear time.

Attempt any four parts of the following : **4×5=20**

(a) Explain with necessary algorithms, the Implementation of stack using linked list.

(b) What is the difference between binary search-tree and min. heap ? Explain.

(c) Show that a red-black tree with n internal nodes has height at most $2 \lg (n+1)$.

(d) Demonstrate the insertion of the keys 5, 28, 19, 15, 20, 33, 12, 17, 10 into a hash table with collisions resolved by chaining. Let the table have 9 slots, and let the hash function be h(k)=k mod 9.

(e) Discuss the various properties of B-tree.

(f) Explain how disjoint-set data structure used in determining the connected component of an undirected graph.

Attempt any two parts of the following : **2×10=20**

(a) Explain different constraints used to solve a problem by Backtracking. Solve sum of subset problem using backtracking.

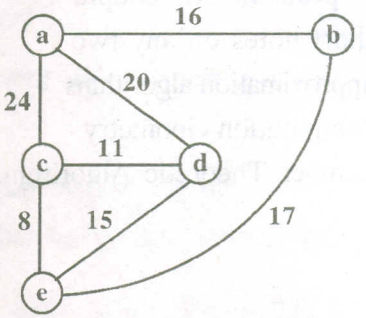
(b) What is an optimal Huffman code for the following set of frequencies, based on the first 8 Fibonacci numbers ? a:1 b:1 c:2 d:3 e:5 f:8 g:13 h:21 Can you generalise your answer to find the

optimal code when the frequencies are the first n Fibonacci number ?

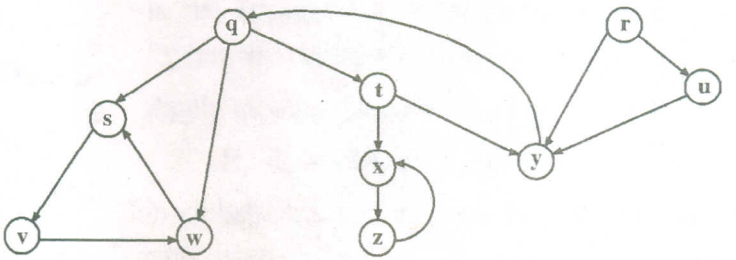
(c) Give the dynamic programming solution to the matrix chain multiplication problem.

Attempt any two parts of the following : **10×2=20**

(a) Using Dijkstra's Algorithm, find the minimum distances of all the nodes from the node C which is taken as the source node for the following graph.



(b) Show how depth search work on the following graph. Consider the vertices are in alphabetical order and assume that each adjacency list is ordered alphabetically.



(c) Define minimum spanning tree. Explain the method for generating a BFS based minimum spanning tree of a graph.

5 Attempt any two parts of the following : **10×2=20**

(a) What are the string matching problems ? Consider working module $q = 11$, how many spurious hits does the Rapin-Karp matcher counter in the tent $T = 31415926535897 93$ when looking for the pattern $P = 26$?

(b) Define the classes problems P, NP and NPC. How are they related to each other ? Is every decision problem NP couple ?

(c) Write short notes on any two :

(i) Approximation algorithms

(ii) Computation Geometry

(iii) Number Theoretic Algorithm.

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PAPER ID : 1430 Roll No.

M.C.A.

(SEM. III) EXAMINATION, 2007-08

DESIGN AND ANALYSIS OF ALGORITHMS

Time : 3 Hours] *[Total Marks : 100*

Note : Attempt all questions.

1 Attempt any **four** questions : 4×5

(a) Define algorithm. Describe its various characteristics.

(b) The recurrence $T(n) = 7T\left(\frac{n}{2}\right) + n^2$ describes the running time of an algorithm A, a competing algorithm A' has a running time $T'(n) = aT'\left(\frac{n}{4}\right) + n^2$ what is the largest integer value for a such that A' is asymptotically faster than A.

(c) Apply quicksort to sort the list

E, X, A, M, P, L, E

in alphabetical order, draw the tree of the recursive calls made.

(d) Prove that the height of a heap with n nodes is equal to $\lfloor \log_2 n \rfloor$.

(e) Describe the insertion sort algorithm and analyse its time complexity.

(f) What is the worst-case running time for the bucket-sort algorithm and explain the order of data set ?

2 Attempt any **four** questions : **4×5=20**

(a) Describe the algorithm to delete an element in double ended queue.

(b) What does a splay tree look like if it's items are accessed in increasing order by their keys ?

(c) Describe insertion and deletion algorithms in red black trees.

(d) Define the various structural properties of a binomial heap.

(e) Draw the 11-item hash table resulting from hashing the keys 12, 44, 13, 88, 23, 94, 11, 39, 20, 16 and 5. Using the hash function

$h(i) = (2i + 5)$ mod 11 and assuming collisions are handled by chaining. 4

(f) How many binary search trees are possible with n number of nodes ?

3 Attempt any **two** parts of the following : **10×2=20**

(a) Given an $O(n^2)$ time dynamic programming algorithm to find the longest monotonically increasing subsequence of a sequence of n numbers for example if the input sequence is $\langle 5, 24, 8, 17, 12, 45 \rangle$. The output sequence should be either $\langle 5, 8, 12, 45 \rangle$ or $\langle 5, 8, 17, 45 \rangle$.

(b) Consider the problem of scheduling n jobs of known duration $t_1, t_2 \ldots\ldots, t_n$ for execution by a single processor. The jobs can be executed in any order, one job at a time. Find a schedule that minimizes the total time spent by all the jobs in the system (the time spent by one job in the system is the sum of the time spent by this job in waiting plus the time spent on its execution).

(1) Design a greedy algorithm for this problem.

(2) Does the greedy algorithm always yield an optimal solution ?

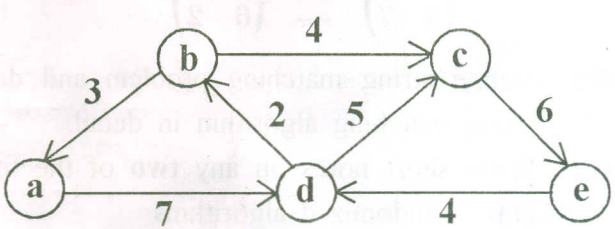
(c) Write short notes on the following :

(1) Branch and bound

(2) Amertized analysis.

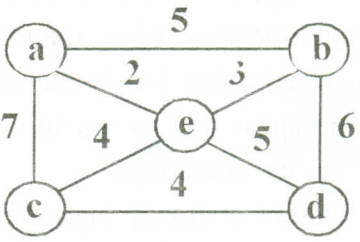
Attempt any **two** parts of the following : **10×2**

(a) Solve the following instance of the single source shortest path problem with vertex a as the source



Give a counter example that shows that Dijkstra's algorithm may not work for a weighted connected graph with negative weights.

(b) apply Prim's algorithm to the following graph. Include in the priority queue all the vertices not already in the tree



(c) What is the worst-case running time of the Ford-Fulkerson algorithm if all edge capacities are bounded by a constant ?

Attempt any **two** parts of the following : **10×2**

(a) Describe the Strassen's algorithm to compute the matrix product and apply the method on the following matrix

$$\begin{pmatrix} 1 & 3 \\ 5 & 7 \end{pmatrix} \; ad \; \begin{pmatrix} 8 & 4 \\ 6 & 2 \end{pmatrix}.$$

(b) Define string matching problem and describe any string matching algorithm in detail.

(c) Write short notes on any **two** of the following :

(1) Randomized algorithms

(2) Computation geometry

(3) Approximation algorithm.

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MCA

THIRD SEMESTER EXAMINATION, 2006-07

DESIGN AND ANALYSIS OF ALGORITHM

Time : 3 Hours *Total Marks : 100*

Note : *(i) Attempt **ALL** questions.*

(ii) All questions carry equal marks.

(iii) In case of numerical problems assume data wherever not provided.

(iv) Be precise in your answer.

1. Attempt ***any four*** parts of the following : **(5x4=20)**

(a) What do you mean by analysis of an algorithm ? Write an algorithm for Binary search and analyze it.

(b) Explain Heapsort and write algorithm for Heapsort and find out the time complexity of that algorithm.

(c) Write a short note on Asymptotic Notations.

(d) What are various tree traversal techniques ? Write an algorithm for any of them and analyze it.

(e) Explain divide and conquer approach and apply it on merge sort using the array : Sort A=<9, 16, 52, 5, 8, 25, 35, 50>, in increasing order.

(f) Define minimum cost spanning tree. Write any algorithm for finding spanning tree and find out order of complexity.

2. Attempt *any four* parts of the following : **(5x4=20)**

(a) What are Branch and Bound techniques ? Give the arrangement of 4 queens problem.

(b) Find out the worstcase running time of Merge sort and compare with Bubble sort.

(c) Write algorithm for knapsack problem and analyze it with suitable example.

(d) Explain and write algorithm for travelling salesman problems. Find out the order of complexity.

(e) Explain Binary search tree and analyze the algorithm of BST using suitable example.

(f) Devise a divide and conquer algorithm to evaluate a polynomial at a point. Analyze carefully the time for your algorithm.

3. Attempt *any four* parts of the following : **(5x4=20)**

(a) Design and test an algorithm which determines how long it takes your computer to execute $2^n, n^n$ and $\lfloor n$ additions for various values of n.

(b) What is the minimum number of edges in a strongly connected digraph on 'n' vertices ? What shape do such digraphs have ? Prove your answer.

(c) Prove the relationship E = I + 2n for a Binary tree with n internal nodes. E and I are the external and internal path length respectively.

(d) Show that how Quicksort sort the following array :

A = < 51, 25, 17, 72, 92, 5, 15, 20 >.

(e) Define growth of functions and various asymptotic notations used.

(f) What is the Bubble sort ? Explain it with suitable example and analyze it.

4. Attempt *any two* parts of the following : **(10x2=20)**

(a) Explain Greedy Method and write algorithm for Greedy method and define which types of problems are solved using this algorithm.

(b) Show that :

(i) The Inorder and Postorder sequences of a Binary tree uniquely define the Binary tree.

(ii) The Preorder and Postorder sequences of a Binary tree do not uniquely define the Binary tree.

(c) Explain NP-hard and NP-complete problems and also define the polynomial time problems and write a procedure to solve NP problems.

Attempt *any two* parts of the following : **(10x2=20)**

(a) Write short notes on any three :

(i) Approximation algorithms

(ii) DFT and FFT

(iii) Red-Black Trees

(iv) Linear Programming

(b) Draw the recursion tree for $T(n) = 4T(\lfloor n/2 \rfloor) + C_n$, where C is a constant and provide a tight asymptotic bound on its solution.

(c) Show the results of inserting the keys :

F, S, ,Q, K, C, L, H, T, V, W, M, R, N, P, A, B, X, Y, D, Z, E in order into an empty B-Tree of order-5. Only draw the configurations of the tree just before some node must split and also draw the final configuration

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