Total number of printed pages – 7

B. Tech
BCSE 3301

Fifth Semester Examination – 2007

DESIGN AND ANALYSIS OF ALGORITHM

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which is compulsory and any ***five*** *from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10

   (a) Show that $(n + 1)^5$ is $O(n^5)$?

   (b) What is an absolute approximation algorithm ?

   (c) What do you mean by relaxation, while designing approximation algorithm for NP-Hard problem ?

P.T.O.

(d) What do you mean by time complexity and space complexity of an algorithm ?

(e) What is a feasible solution in activity selection problem ?

(f) Using big-O notation, state the average time and space complexity of merge-sort ?

(g) How the Greedy paradigm of Algorithm differs from that of DYNAMIC PROGRAMMING ?

(h) Solve the following recurrence relation :

$T(n) = T(n-2) + n, \quad n > 1$

$T(0) = c$

$T(1) = d.$

(i) Can the master method be applied to solve recurrence

$T(n) = 4T(n/2) + n^2 \log n$? Why or why not ?

(j) Differentiate, between performance analysis and performance measurement of an algorithm.

2. (a) Illustrate how you would develop a divide and conquer approach to find the **maximum** and **minimum** elements in an array. A full algorithm is not necessary. 5

(b) A Graph can be represented using *adjacency matrix and adjacency list* in memory. Discuss about the *time complexity* and *space complexity* of BFS algorithm with reference to the two said data structure. 5

3. (a) Write a dynamic programming algorithm for the **0-1** knapsack problem. Your algorithm should be able to take as parameters two arrays : one giving the size of each of the

n items and the second giving the value of each of the items, and the size of the knapsack ***W***. You are to maximize the value in your knapsack without exceeding the capacity ***W***. 5

(b) Write a divide and conquer algorithm for binary search. What is the recurrence relation for the algorithm ? Find the time complexity of the algorithm. 5

4. (a) Explain the process of Heap sort. Write an algorithm to construct a min heap. What is time complexity of the sorting process ? 5

(b) Write down the algorithm to compute Fast Fourier Transform (FFT). Hence write the recurrence relation for the work done by the Fast Fourier Transform and explain the origin of the terms. 5

5. (a) Given the following set of characters with their corresponding probabilities

a	0.32	e	0.08
b	0.24	l	0.08
c	0.16	o	0.02
d	0.09	n	0.01

Construct a Huffman code for the same source, and compute its weighted average code length. What is time complexity of the algorithm used ? 5

(b) Write down the recurrence relation for the work done by mergesort in the best case, explain the origin of the terms, and solve it. 5

6. (a) Discuss the relationship between the class P, NP, NP-complete and NP-Hard problem with suitable example. 5

(b) Explain how dynamic programming is used to solve matrix-chain multiplication problem. 5

7. (a) What is approximation ratio ? Approximate the Traveling Salesman problem with triangle inequality. 5

(b) Describe and justify Kruskal's algorithm for finding the minimum spanning tree of an undirected graph. 5

8. (a) Show how Strassen's algorithm computes the following multiplication ?

$$\begin{vmatrix} 3 & 1 \\ 4 & -1 \end{vmatrix} \quad \begin{vmatrix} 2 & -5 \\ 6 & -3 \end{vmatrix}$$

(b) Define NP hard problem with example.

(c) Arrange the following functions from the lowest asymptotic order to the highest asymptotic order :

$7n$, 2^n, $10n$, $\log n$, $4n^3$, $5n^2$, $2 \log n$, $10n - n^3 + 9a^5$, $7 \log n$

(d) Solve the following recurrence relation :

$T(N) = 2T(N-1) + 1$ with $T(1) = 1$ and $T(2) = 3$.

2.5×4