Total number of printed pages – 7

B. Tech

BCSE 3301

Fifth Semester Examination – 2008

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) Briefly discuss the Algorithm Analysis Framework ?

   (b) What are different ways of measuring the running time of an algorithm ?

P.T.O.

(c) Using big-O notation, state the average time and space complexity of QUICK SORT ?

(d) Define Worst case, Average case and Best case efficiencies.

(e) For problem P, if we are given an input I and a possible answer A, and we find a way to verify whether or not A really is a valid answer to P given I, then what kind of problem is P ?

(f) What is the lower bound of an algorithm ?

(g) What are the three properties of NP-complete problems ?

(h) Which function grows at the faster rate e^n or 2^n ? Justify your answer.

(i) Solve the following recurrence relation :

$$T(n) = 4\,T(n-1) - 3\,T(n-2) + 4n\,3^n$$

$$T(0) = 1,\ T(1) = 12$$

(j) Define approximation algorithm. What are the key characteristic of a approximation algorithm ?

2. (a) Write an recursive algorithm for merge sort. Show that running time is O(n log n). Can we say the time for merge sort is θ (log n) ? 5

(b) Design a divide-and-conquer algorithm for finding the minimum and the maximum element of n numbers using no more than 3n/2 comparisons. 5

3. (a) What is the basic objective of Robin Crap pattern-matching algorithm. Write the Robin

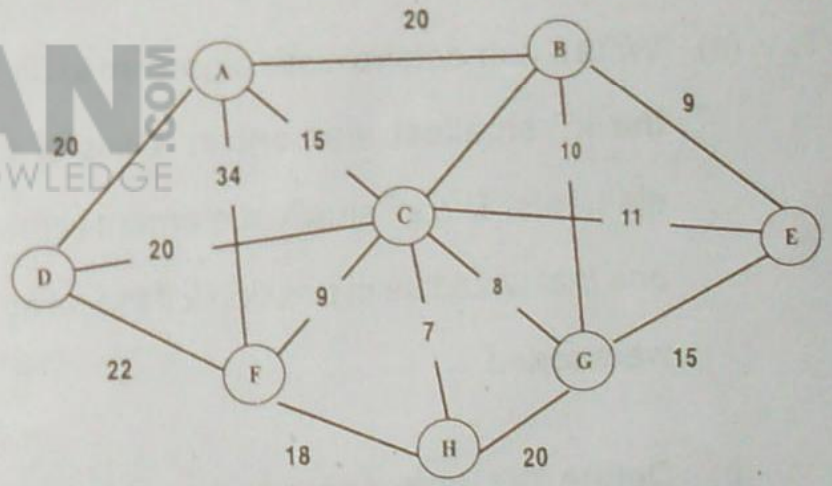
Crap pattern-matching algorithm. Comment on the time complexity of the algorithm. 5

(b) Design Huffman codes for the following symbols : a, b, c, d, e, f, and l having relative frequency 2, 4, 6, 8, 10, 16 respectively. Discuss on the time complexity of the Huffman algorithm with binary heap. 5

4. (a) Write a dynamic programming algorithm to find solution to Longest common sub-sequence problem with time complexity O(mn). Explain principle of optimality hold for the above algorithm. 5

(b) Define approximation algorithm. Why solution to TSP is possible using an approximation algorithm. Suggest an approximation algorithm to solve TSP problem. 5

5. (a) Trace Prim's algorithm for the following graph. Assume the start vertex is A. Compare the MST produced by Prim's algorithm with the MST produced by Kruskal's. What is the time complexity of these algorithms ? 8



(b) Define NP-hard and NP-complete problems with examples ? 2

6. (a) What is Single Source Shortest Path Problem? Suggest the greedy algorithm to find shortest paths from the designated vertex start to all of the other vertices in a connected weighted, n vertex graph. 5

(b) Write down the recurrence relation for the work done by the Fast Fourier Transform and explain the origin of the terms. 5

7. (a) Write a non-deterministic algorithm to find the k^{th} smallest element in a list of n elements. The k^{th} smallest element is the one that would be in position k if the array were sorted. 5

(b) Define 0/1 knapsack problem as an optimization problem. Give an algorithm to solve the 0/1 knapsack problem. 5

8. (a) Define NP Complete problem with example.

(b) Give an algorithm to check whether all the elements in a list are unique or not and analyze the efficiency.

(c) Solve the following recurrence relation :

$$T(n) = \begin{cases} 1 & n \leq 4 \\ 2T(\sqrt{n}) + \log n & n > 4 \end{cases}$$

3+3+4