MCS-031 Ⓢ

MCA (Revised)

Term-End Examination

June, 2007

MCS-031 Ⓢ : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 3 hours *Maximum Marks : 100*

Note : *Question number 1 is* ***compulsory****. Attempt any* ***three*** *questions from the rest. All algorithms should be written nearer to C/C++ language. Parts of the same question should be attempted together.*

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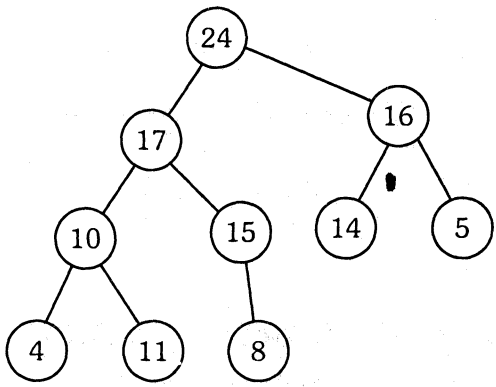
1. (a) (i) In case of heap sort algorithm, what are the minimum and maximum number of elements in a heap of height h ? *3*

(ii) Is the tree given below is a heap ? 2



(b) For a function $f(n) = 4n^3 + 3n$ check whether the equivalence $f(n) = \theta(n^3)$ is true or not. 5

(c) (i) How many recursive calls take place in a single pass of quicksort algorithm ? What is its best case efficiency ? 5

(ii) What do we mean by parenthesis structure in a depth first search algorithm ? How does it evolve ? 5

(d) (i) Suppose that we are given Indian currency notes of denominations 1, 2, 5, 10, 20, 50, 100 Rs. only. Describe the Greedy algorithm to find the minimum number of currency notes to make an amount of Rs. 289 (an informal discussion is sufficient). 6

(ii) What is the essential difference between a Kruskal's approach and Prim's approach for finding a minimum spanning tree ? 4

(e) Write short notes on : 10

(i) Church Turing Thesis

(ii) Undecidable Problems

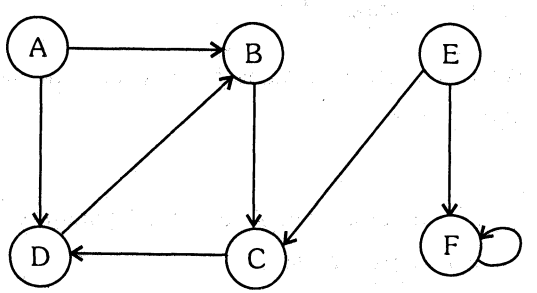
2. (a) Write a recursive algorithm to find the Greatest Common Divisor (GCD) of two numbers. 5

(b) Show how addition chain method can be used for exponentiation. Use an example. 5

(c) What is a 0-1 Knapsack problem ? Describe whether dynamic programming or greedy approach would be useful to solve this problem. You can use an example to explain. 7

(d) Define pumping lemma for regular grammar. 3

3. (a) Show the stepwise running of Breadth First Search on the following directed graph using vertex 'E' as the source vertex and vertex A as the goal node. 7



(b) What is the satisfiability problem ? Is the boolean expression $(A \vee \neg B) \wedge (\neg A \vee B)$ satisfiable ? 6

(c) What do you understand by the overlapping subproblem property of dynamic programming ? How is this property useful in matrix-chain order problem ? 7

4. (a) Design a FA (Finite Automata) over the alphabet $\Sigma = \{a, b\}$ that accepts all the words that have different first and last letters. 5

(b) Consider the CFG :

$$S \rightarrow XYX$$

$$X \rightarrow aX \mid bX \mid \Lambda$$

$$Y \rightarrow bbb$$

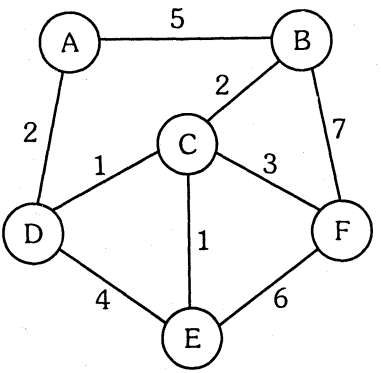
What is the language that this CFG generates ? 5

(c) Design a Turing Machine that recognizes all strings of even number of 1's. 6

(d) What do you understand by amortized analysis of an algorithm ? 4

5. (a) What is minimax principle ? Write minimax algorithm for a two player game. 8

(b) What is a minimum spanning tree ? Use Kruskal's algorithm to find the minimum spanning tree on the graph given below. (Assume that the graph is stored using adjacency list representation and each adjacency list is ordered alphabetically). *8*



(c) What are intractable or infeasible problems ? *4*