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# GUJARAT TECHNOLOGICAL UNIVERSITY 

## MCA. Sem-IV Examination May- 2011 <br> Subject code: 640010

Subject Name: Analysis and Design of Algorithm (ADA)
Date:26/05/2011

Time: 02.30 pm - 05.00 pm
Total Marks:

## 70Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
Q. 1 (a) Write a recursive algorithm for Binary search of a sorted array of n elements. Derive the time complexity of this algorithm?
Does this algorithm use Divide and Conquer (D\&C) strategy? Whether D\&C always leads to balanced splitting of the problem or it may lead to imbalanced (or unequal) splitting also?
(b) (i) State the functional algorithmic specification of factorial function:
factorial (n). Establish the correctness of this functional algorithm using the Principles of Mathematical Induction.
(ii) Write an efficient version of the following algorithm:
$\mathrm{x}=0$;
for $\mathrm{i}=1$ to N do
begin

$$
\begin{aligned}
& \mathrm{x}=\mathrm{x}+0.01 ; \\
& \mathrm{y}=(\mathrm{a} * \mathrm{a} * \mathrm{a}+\mathrm{c}) * \mathrm{x} * \mathrm{x}+\mathrm{b} * \mathrm{~b} * \mathrm{x} \\
& \text { writeln ('x } \left.=\text { ', } \mathrm{x},{ }^{\prime} \mathrm{y}={ }^{\prime}, \mathrm{y}\right)
\end{aligned}
$$

end
(iii) $\mathrm{p}=0$;
for $(\mathrm{i}=1 ; \mathrm{i}<\mathrm{n} ; \mathrm{i}++)$ \{ if $(\mathrm{a}[\mathrm{i}]>\mathrm{a}[\mathrm{p}])$ \{
$\mathrm{p}=\mathrm{i}$;
\}
\}
$\max =\mathrm{a}[\mathrm{p}] ; \quad / * \mathrm{p}$ is the position of $\max * /$
Q. 2 (a) (i) Write an algorithm for multiplying two matrices A and B of size $\mathrm{N} \times \mathrm{N}$ and store result in matrix C.
(ii) Show that the time of this algorithm is proportional to $\mathrm{N}+3 * \mathrm{~N}^{2}+2 *$ $\mathrm{N}^{3}$. Write down its worst case time complexity.
(b) (i) Briefly describe Pigeonhole Principle (or Dirichlet Drawer Principle)
(ii) State Chinese Remainder theorem
(iii) Describe Big-oh Notation and Theta Notation and write their salient (main) characteristics.
(b) (i) What is Latin square?
(ii) What is Convex Hulls problem? Give an example of a 2-D Convex Hull, and illustrate it with respect to the definition of Convex Hull.
Q. 3 (a) (i) What is the general structure of problems solved by Greedy algorithm?
(ii) Write down basic steps for solving Knapsack problem using greedy algorithm approach.
Knapsack problem is stated as follows:
There are n objects numbered $\mathrm{i}, \mathrm{o} \leq \mathrm{i} \leq \mathrm{n}-1$, having weights $\mathrm{w}_{\mathrm{i}}$ and contribution to profit $p_{i}$. There is a sack having a capacity of M. If a fraction $x_{i}$ of the object $i$ is put in the sack, then it increases its weight by $w_{i} x_{i}$ and contributes $p_{i} x_{i}$ to the profits. Find the filling that maximizes the profits.
(b) Write the dynamic programming algorithm for finding the longest common sub-sequence in a given sequence.

## OR

Q. 3 (a) (i) What is spanning tree? Show examples of some of spanning trees 07
including
a minimum spanning tree of an undirected graph.
(ii) Write the basic steps of Kruskal's algorithm for finding minimum spanning tree.
(b) Write down four basic steps used in a dynamic programming solution. Briefly describe Travelling Salesman Problem and write down the basic solution methodology using dynamic programming approach.
Q. 4 (a) Describe backtracking strategy. Write down Depth-First Search (DFS) 0707 and $\begin{aligned} & \text { algorithm using Backtracking Strategy. You can simply write a backtrack } \\ & \text { statement without giving its details. }\end{aligned}$
(b) (i) Derive complexity of Quick-Sort algorithm.
(ii) Briefly describe Splay Trees.

## OR

## Q. 4 (a) (i) Describe Backtracking framework and write down the four factors on <br> 07 which the efficiency of backtracking depends.

(ii) What is Hamiltonian Circuit (Cycle)? Can it be used to solve Travelling Salesman Problem? Briefly Explain.
(b) (i) Derive Complexity of Merge-Sort algorithm. 07
(ii) Briefly describe Binomial Heap.
Q. 5 (a) (i) Write a brief description of sequential search for unsorted list with n entries under the following headings:

- Problem
- Best Case
- Worst Case
- Average Case
- Space Efficiency
(ii) What is meant by NP problems? Write down the salient (main) characteristics of these problems.
(b) Briefly describe NP-Complete problems. What is the significance of NP Complete problems? Give an example of NP-Complete problem.


## OR

Q. 5 (a) (i) Write a brief description of matching a given pattern string of length $m$ in a text string of length $n$ under the following headings:

- Problem
- Best Case
- Worst Case
- Average Case
- Space Efficiency
(ii) Briefly describe the term Reductions (in the context of NP and NPComplete Problems). What are its advantages? As a corollary of Reductions, whether the converse is also true?
(b) (i) Write a short note on Approximate Solutions to NP-Complete problems.
(ii) Give examples to show that the assumption that " P means 'easy"" and "'not in P' means 'hard'" is not always true in practice.

