

Total number of printed pages – 8

MCA
PCS 3001

32C
Third Semester Examination – 2006

ANALYSIS AND DESIGN 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) Define max-flow problem as optimization problem.
- (b) Solve the recurrence relation
 $T(N) = 4T(N/3) + N$, for $N \geq 2$ with $T(1) = 1$,
when N is a power of two.

P.T.O.

- (c) What do you mean by connected component of a directed graph ?
- (d) Explain why we expect the average case for mergesort to be almost the same as the worst case.
- (e) What is the lower bound for finding both the maximum and minimum key in an array containing n keys ? Briefly describe a strategy that yields this lower bound for any n .
- (f) Describe an **optimal** method for finding the two largest keys in an array. How many comparisons are done in the worst case ?
- (g) What are the general characteristic of divide and conquer algorithm ?
- (h) How the forward and backward approach differs under dynamic programming paradigm ?

- (i) Explain the role of data structure in computing amortized complexity.
- (j) Define P, NP and NP-complete problems with examples. Which of the problem family seeks the help of approximation algorithm for finding a solution ?
2. (a) Describe the method of divide and conquer that used to design Algorithms. State the control Abstraction for Divide-and-Conquer. Solve the general recurrence form of complexity $T(n)$ with $a=5$, $b=4$, and $f(n) = cn^2$; for some constant c

$$T(n) = \begin{cases} T(1) & n=1 \\ aT(n/b) + f(n) & n>1 \end{cases} \quad 5$$

- (b) Discuss the problem model of a multi-stage graph. State an algorithm to find a minimum-cost path from source to sink using forward approach using **dynamic programming** paradigm. 5

- (b) boosting up the priority of a process in multilevel queues without feedback
 - (c) gradually increasing the priority of jobs that wait in the system for a long time to recover from indefinite blocking
 - (d) letting jobs reside in memory for a certain amount of time so that the number of pages required can be estimated accurately.
- (viii) Bit vector or bit-map is used in connection with disk space management in order to
- (a) keep track of the allocated space when contiguous allocation method is used
 - (b) specify the bad sectors on the disk
 - (c) optimize the disk space occupied by files when indexed allocation method is used

- (d) keep track of the free space in the disk.
- (ix) Imposing a linear order on all resource types and letting processes request resources in increasing order is an example of
- (a) Deadlock avoidance
 - (b) Deadlock prevention using hold and wait
 - (c) recovery
 - (d) Prevention using breaking circular wait.
- (x) Dirty bit helps in
- (a) Cleaning the RAM
 - (b) Improving the memory speed
 - (c) Dirts the page table
 - (d) None of the above

(iv) Find out the shortest path from A to E using DFS.

(v) What are the time complexity and space complexity of Bellman-Ford algorithm on different representation of graph ?

2x5

6. (a) Which process determines the amount of work done by Kruskal's algorithm ? How much work is done in the worst case? Explain. In Kruskal's method for finding a minimum spanning tree, how does the algorithm know when the addition of an edge will generate a cycle ?

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(b) Discuss the mechanism of Branch and bound algorithm as "all state space search method". Considering Traveling Sales Man (TSP) problem, explain the application of *Least cost Branch and*

bound search and FIFO branch and Bound search to found an optimal solution.

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7. (a) Write an algorithm that takes any 3 elements $a(i)$, $a(j)$, and $a(k)$ of an array and rearranges them in the array so that $a(i) \leq a(j) \leq a(k)$. Analyze the time complexity of your algorithm.

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(b) State the different constraints to be satisfied while solving a problem using backtracking. Discuss how BACKTRACKING is used to solve ? Explain the role of constraints in 0/1 knapsack problem.

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8. (a) What is the time complexity of the QUICK SORT ALGORITHM, if the pivot is chosen from the center of the list rather than from one end ?



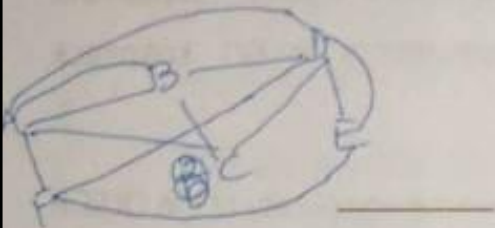
(b) Consider an undirected graph with V vertices and E weighted edges. How would you (simply!) modify the Floyd-Warshall algorithm to require $O(V^2)$ memory?

(c) In the backtracking formulation of the 8-queens problem, what are the explicit and implicit constraints?

(d) Solve for $T(n)$:

$$T(N) = \alpha n T(\alpha N) + N, \text{ for } N \geq 2 \text{ with } T(1) = 1.$$

2.5x4



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