Code No: 07A50506 **R07** **Set No. 2**

III B.Tech I Semester Examinations,November 2010
DESIGN AND ANALYSIS OF ALGORITHMS
Computer Science And Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the divide and conquer strategy. How it can be useful in the problem solving.
   (b) Assuming that quick sort uses the first item in the list as the pivot item: i)Give a list of n items (for example, an array of 10 integers) representing the worst-case scenario. ii)Give a list of n items (for example, an array of 10 integers) representing in the best-case scenario. [8+8]

2. (a) Describe some classic NP problems and why they are important.
   (b) Write about tractable and intractable problems. [8+8]

3. (a) Write the non recursive algorithm for finding the Fibonacci sequence and derive its time complexity.
   (b) Show that n^3logn is Ω (n^3). [16]

4. Let w = 5,7,10,12,15,18,20 and m=35. Find all possible subsets of w that sum to m. Do this using Sum-of-subsets algorithm. Clearly state the bounding functions used in the algorithm. Draw the portion of the state space tree that is generated. [16]

5. Write a branch- and - bound algorithm for the job sequencing with deadlines problem. [16]

6. (a) What is a minimum spanning tree? What are its applications?
   (b) Analyze precisely the computing time and space requirements of this new version of Prim's algorithm using adjacency lists. [8+8]

7. (a) Given a sequence of n real numbers A(1), ..., A(n), write a procedure to determine a contiguous subsequence A(i),,A(j) for which the sum of elements in the subsequence is maximized.
   (b) You are given n types of coin denominations of values v(1) < v(2) < ....v(n) (all integers). Assume v(1) = 1, so you can always make change for any amount of money C. Give an algorithm which makes change for an amount of money C with as few considerations as possible. [8+8]

8. The following statements may or may not be correct. In each case, either prove it (if it is correct) or give a counterexample (if it isn't correct). Always assume that the graph G = (V,E) is undirected. Do not assume that edge weights are distinct unless this is specifically stated.

(a) If G has a cycle with a unique lightest edge e, then e must be part of every MST.

(b) The shortest-path tree computed by Dijkstra's algorithm is necessarily an MST.

(c) The shortest path between two nodes is necessarily part of some MST.

(d) Prim's algorithm works correctly when there are negative edges. [16]

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1. (a) Differentiate between Dynamic Knapsack and Branch and Bound Knapsack problem.
   (b) Compare and contrast Backtracking and Branch-and-Bound. How Branch-and-Bound method efficient in implementation than Dynamic Programming. [8+8]

2. What is the value returned by each of the following functions? Express your answer as functions of n. Also, state the worst-case running times in big-O notation,
   (a) Function mystery(n)
   1. r:=0;
   2. for i:=1 to n-1 do
   3. for j:=i+1 to n do
   4. for k:=1 to j do
   5. r:=r+1;
   6. return(r).

   (b) Function pensy(n)
   1. r:=0;
   2. for i:=1 to n-1 do
   3. for j:=1 to i do
   4. for k:=j to i+j do
   5. r:=r+1;
   6. return (r) [16]

3. Write the Bellman-Ford algorithm to compute shortest paths and explain its working with a numerical example. [16]

4. Consider the following jobs, deadlines, and profits. Use the Scheduling with Deadlines algorithm to maximize the total profit.

Job	Deadline	Profit
1	2	40
2	4	15
3	3	60
4	2	20
5	3	10
6	1	45
7	1	55

[16]

5. Solve the recurrence for the number of additions required by Strassen's algorithm for matrix multiplication. [16]

6. How do you reduce/relate Job Scheduling Problem with Traveling Sales Person Problem. [16]

7. Given a 2-connected graph G, and two vertices u and v of G, how can one find a minimum length cycle through u and v in the graph G ? Can this be done in polynomial time? [16]

8. (a) Find at least two instances of the n-Queens problem that have no solutions?
   (b) Use the Backtracking algorithm for the m-Coloring problem to find all possible colorings of the graph 1 using the three colors red, green and white. Show the actions step by step. [8+8]

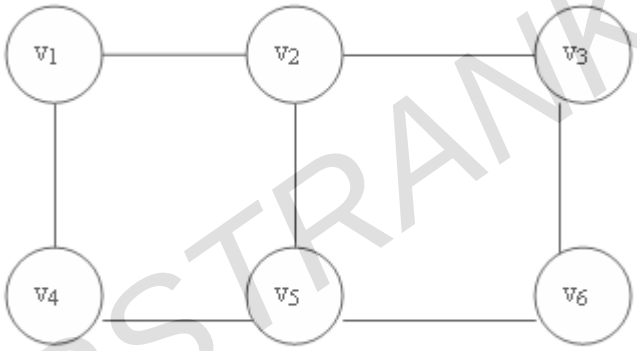

Figure 1:

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1. Write about Graph Colouring Problem and Subset Sum Problem. Are they NP problems. If yes, Justify your answer to include them in to NP Problems. [16]

2. Write an recursive algorithm for find GCD of two numbers and write the recurrence relation for the number of operations such as division and mod. [16]

3. (a) Investigate the amortized complexity of the disjoint sets ADT when path compression, but not union by size, is employed.
   (b) Write an algorithm to find the connected component of given graph. Also state the time complexity of the algorithm. [8+8]

4. (a) What is the essential difference between the greedy method and dynamic programming method?
   (b) Find the minimum number of operations required for the following chain matrix multiplication using dynamic programming : A(30,40) * B(40,5) *C(5,15) *D(15,6).
   [8+8]

5. Write an algorithm schema FifoBB for a FIFO branch-and-bound search for a least-cost answer node. [16]

6. Use the divide-and-conquer approach to write an algorithm that finds the largest item in a list of n items. Analyze your algorithm, and show the results inorder notation. [16]

7. (a) Compute the time complexity of deriving minimum spanning tree from the weighted connected graph using Kruskal's algorithm
   (b) Prove that if $p_1/w_1 \geq p_2/w_2 \geq .... \geq p_n/w_n$,, then FractionalGreedyKnapsack algorithm generates an optimal solution to the given instance of the fractional Knapsack problem. [8+8]

8. Given two strings X=x_1,x_2,x_3,....,x_n and Y=y_1,y_2,y_3,....,y_n. Now transform X into Y using a sequence of edit operation on X. The permissible edit operations are insert, delete, and change, and there is a cost associated with performing each operation. Draw an algorithm that will detect the minimum cost sequence of editing operation that will transform X to Y. [16]

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1. Write an algorithm to solve 0/1 Knapsack problem with FIFO Branch & Bound? [16]
2. Write an algorithm for 0/1 Knapsack Problem using Dynamic Programming. [16]
3. Write an algorithm to find the intersection of given two graphs G1, G2. Also find time complexity of the algorithm. [16]
4. Let x[1 : n] and y[1 : n] contain two sets of integers, each sorted in nondecreasing order. Write an algorithm that finds the median of the 2n combined elements. What is the time complexity of your algorithm? [16]
5. Design an algorithm for finding a maximum spanning tree (a spanning tree with the largest possible edge weight) of a weighted connected graph. [16]
6. Show that the reduction of the CNF satisfiability problem to the Clique Decision problem can be done in polynomial time. [16]
7. Suppose that if $f_1(n) = \Theta(g_1(n))$ and $f_2(n) = \Theta(g_2(n))$. Is this true that $f_1(n)+f_2(n) = \Theta(g_1(n)+g_2(n))$? Is this true that $f_1(n)+f_2(n) = \Theta(\max\{g_1(n), g_2(n)\})$? Is it true that $f_1(n)+f_2(n) = \Theta(\min\{ g_1(n)+g_2(n)\})$? Justify your answer. [16]
8. Suppose you are given n men and n women and two of (n x n) arrays P and Q such that P(i,j) is the preference of man i for women j and Q(i,j) is the preference of woman i for man j. Design an algorithm that finds a pairing of men and women such that the sum of the product of the preferences is maximized. [16]

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