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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), MAY 2019

		Course Code: CS302	
		Course Name: DESIGN AND ANALYSIS OF ALGORITHMS	
Ma	x. M	Tarks: 100 Duration: 3	Hours
		PART A Answer all questions, each carries3 marks.	Mark
1	De	fine the terms Best case, Worst case and Average case time complexities.	(3)
2	Wh	nat is the smallest value of n such that an algorithm whose running times is $100n^2$ runs faster	(3)
	tha	n an algorithm whose running time is 2 ⁿ on the same machine?	
3	Sta	ate Master Theorem.	(3)
4	Exp	plain the UNION and FIND-SET operations in the linked-list representation of disjoint sets.	(3)
	Dis	scuss the complexity.	
		PART B Answer any two full questions, each carries9 marks.	
5	a)	Determine the time complexities of the following two functions fun1() and fun2():	(2)
		<pre>int fun1(int n) { if (n <= 1) return n; return 2*fun1(n-1); } int fun2(int n) { if (n <= 1) return n; return fun2(n-1) + fun2(n-1); }</pre>	
	b)	Find the solution to the recurrence equation using iteration method: $T(2^k) = 3 \ T(2^{k-1}) + 1,$ $T(1) = 1$	(3)
	c)	Solve the recurrence using recursion tree method: $T(1) = 1$ $T(n) = 3T(n/4) + cn^2$	(4)
6	a)	Determine the best case and worst-case time complexity of the following function: void fun(int n, int arr[]) { int i = 0, i = 0:	(3)

for(; i < n; ++i)

j++;

 $while(j < n \ \&\& \ arr[i] < arr[j])$

- b) Explain the advantages of using height Balanced Trees? Explain AVL Rotations. (4)
- c) Find the minimum and maximum height of any AVL-tree with 7 nodes? Assume that the height of a (2) tree with a single node is 0.
- 7 a) List the Properties of B-Trees. (2)
 - b) A 2-3-4 tree is defined as a B-Tree with minimum degree t=2. Create a 2-3-4 tree by successively inserting the inserting the elements (in the given order) 42,56, 24, 89, 1, 5, 87, 8. 61. 6, 78, 7, 12, 34.
 - c) Delete the elements 89, 78. 12 and 8 from the above resultant tree.

PART C

Answer all questions, each carries3 marks.

(3)

(4)

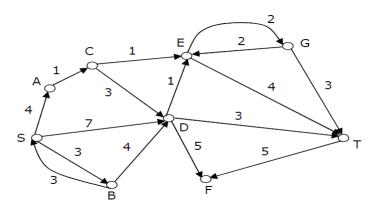
- 8 In a weighted graph, assume that the shortest path from a source 's' to a destination 't' is correctly calculated using a shortest path algorithm. Is the following statement true?

 If we increase weight of every edge by 1, the shortest path always remains same. Justify your answer with proper example.
- Define Strongly Connected Components of a graph.
 Write the algorithm to find Strongly Connected Components in a graph.
- 10 Write an algorithm to merge two sorted arrays and analyse the complexity. (3)
- Write notes on Dynamic Programming Approach. List the sequence of steps to be followed in Dynamic Programming. (3)

PART D

Answer any two full questions, each carries9 marks.

- 12 a) State Shortest Path Problem and Optimal substructure of Shortest Path. (2)
 - b) Write Dijkstra's Single Source Shortest path algorithm. Analyse the complexity. (4)
 - c) Find the shortest path from s to all other vertices in the following graph using Dijkstra's Algorithm. (3)



- 13 a) Write the algorithm for DFS and analyse its complexity.
 - b) Multiply the following two matrices using Strassen's Matrix Multiplication Algorithm. (5)

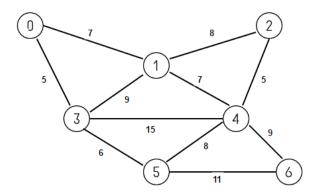
$$A = \begin{bmatrix} 6 & 8 \\ 9 & 7 \end{bmatrix} \qquad B = \begin{bmatrix} 2 & 5 \\ 3 & 6 \end{bmatrix}$$

- 14 a) State Matrix Chain Multiplication Problem. Write Dynamic Programming Algorithm for (4) Matrix Chain Multiplication Problem.
 - b) Using Dynamic Programming, find the fully parenthesized matrix product for multiplying (5) the chain of matrices< A1 A2 A3 A4 A5 A6 > whose dimensions are <30X35>, <35X15>, <15X5>, <5X10>, <10X20> and <20X25> respectively.

PART E

Answer any four full questions, each carries 10 marks.

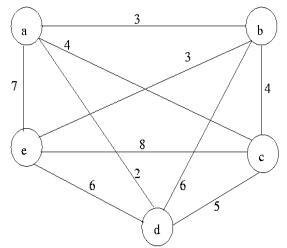
- 15 a) Explain Greedy Approach. Write the general greedy algorithm. (3)
 - b) Formulate Fractional Knapsack Problem. Write Greedy Algorithm for fractional Knapsack (4) Problem.
 - c) Find the optimal solution for the following fractional Knapsack problem. (3) $n=4, m=60, W=\{40, 10, 20, 24\}$ and $P=\{280, 100, 120, 120\}$
- 16 a) Write the Kruskal's algorithm for Minimum Spanning Tree. Analyse its complexity. (6)
 - b) Compute the Minimum Spanning Tree and its cost for the following graph using Kruskal's (4) Algorithm. Indicate each step clearly.



- 17 a) An undirected graph G=(V,E) contains n (n>2) nodes named v_1 , v_2 ,.... v_n . Two vertices v_i , v_j are connected if and only if 0<|i-j|<=2. Each edge (v_i,v_j) is assigned a weight i+j. What will be the cost of the minimum spanning tree (as a function of n) of such a graph with n nodes?
 - b) Consider a complete undirected graph with vertex set {0, 1, 2, 3, 4}. Entry wij in the matrix W (6) below is the weight of the edge {i, j}. What is the Cost of the Minimum Spanning Tree T using Prim's Algorithm in this graph such that vertex 0 is a leaf node in the tree T?

$$W = \begin{pmatrix} 0 & 1 & 8 & 1 & 4 \\ 1 & 0 & 12 & 4 & 9 \\ 8 & 12 & 0 & 7 & 3 \\ 1 & 4 & 7 & 0 & 2 \\ 4 & 9 & 3 & 2 & 0 \end{pmatrix}$$

- 18 a) State and Explain N Queens Problem. Write the backtracking algorithm for solving N (5) Queens problem.
 - b) Show the state space tree for 4 Queens problem. Show the steps in solving 4 Queens (5) problem using backtracking method to print all the solutions.
- 19 a) Explain Branch and Bound method for solving Travelling Salesman Problem. (5)
 - b) Solve Travelling Salesman problem for the following graph using Branch and Bound (5) Technique.



- 20 a) Define NP- Hard and NP Complete Problems.
 - b) What are the steps used to show a given problem is NP-Complete? (4)

(2)

c) Write notes on polynomial time reducibility. Give Examples. (4)
