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PES University, Bangalore

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UE16CS251

MAY 2018: END SEMESTER ASSESSMENT (ESA) B.TECH. IV SEMESTER

UE16CS251- Design and Analysis of Algorithms

Time: 3 Hrs | Answer All Questions | Max Marks: 100

1.	a)	Algorithm Mystery(M, N)
		//Input: M and N are nonnegative integers
		if (M = 0) return N
		if (N = 0) return M
		Ans ← 0
		while (M > 0 OR N > 0)
		while (M > 0 AND N > 0)
		Ans ← Ans + 1
		if (M > N) M ← M - 1
		else N ← N - 1
		Ans ← Ans + 1
		M ← M - 1
		return Ans
		
		(i) What does the algorithm given above compute?
		(ii) Derive the worst-case asymptotic time complexity of the algorithm given above in terms of Θ - notation.
			6

	b)	What is a stable sorting algorithm? Is Selection sort stable? Explain with an example.	6
	c)	Using limits, compare the order of the growth of (i) n^2 and n(n-1)/2. (ii) $\log_2(n)$ and $\sqrt{(n)}$	8
2.	a)	Write Bruteforce string matching algorithm to match the pattern P[0..m-1] in a text T[0..n-1].	6
	b)	Design a divide and conquer algorithm to add two NxN matrices A[0..N-1, 0..N-1] and B[0..N-1, 0..N-1] where N is a power of 2.	6
	c)	Write an algorithm for merge sort. Sort the following elements using merge sort and write the recursion tree. 8, 3, 2, 9, 7, 1, 5, 4.	8
3.	a)	Design an algorithm for each of the following design strategies for the problem of finding the sum of all the elements of a non-empty array A[0..n-1] of 'n' numbers. (i) Brute-Force, (ii) Divide-and-Conquer, and (iii) Decrease-and-Conquer.	6
	b)	Design a DFS-based algorithm to count the number of connected components in an undirected graph.	6
	c)	Write Horspool's algorithm for string matching. Trace the algorithm to find the pattern "ELECTION" in the text "EDUCATION_ONLY_HELPS_IN_SELECTION"	8

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4.	a)	Using dynamic programming, solve the following knapsack instance. Number of items, N = 4. Knapsack capacity, W = 5. Weights (w1, w2, w3, w4) = (2, 1, 3, 2) Values (v1, v2, v3, v4) = (12, 10, 20, 15)	6
	b)	Consider an array A[1..n] of positive integers. Let the value of a subset of the array be the sum of the elements of the subset. Design an algorithm using dynamic programming strategy (write the memory function method) to find the most valuable subset of the array such that no two adjacent elements of the given array are included in the subset.	6
	c)	Write Floyd's algorithm to find all-pairs shortest-paths distances in a weighted directed graph. Trace the algorithm to find all-pairs shortest-paths for the graph given below in the form of a cost matrix. Let the result be a distance matrix. $\begin{bmatrix} 0 & \infty & 3 & \infty \\ 2 & 0 & \infty & \infty \\ \infty & 7 & 0 & 1 \\ 6 & \infty & \infty & 0 \end{bmatrix}$	8
5.	a)	Construct the Huffman tree for the following and find the compression ratio. (Character, Probability) = {(A, 0.35), (B, 0.1), (C, 0.2), (D, 0.2), (E, 0.15)}	6
	b)	Define NP and NP-complete problems. What is the significance of NP-complete problems?	6
	c)	Write the Dijkstra's single-source shortest-paths algorithm. Apply the algorithm on the graph shown below to obtain the shortest paths from the first vertex. The graph is represented as a cost matrix. Let the result be a rooted tree of shortest paths from the first vertex. $\begin{bmatrix} 0 & 50 & 45 & 10 & \infty & \infty \\ \infty & 0 & 10 & 15 & \infty & \infty \\ \infty & \infty & 0 & \infty & 30 & \infty \\ 20 & \infty & \infty & 0 & 15 & \infty \\ \infty & 15 & 35 & \infty & 0 & 3 \\ \infty & \infty & \infty & \infty & \infty & 0 \end{bmatrix}$	8