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HERITAGE INSTITUTE OF TECHNOLOGY

Class test I / II / III Examination 2017 Session : 2016 – 2017

Discipline : Computer Science & Engineering

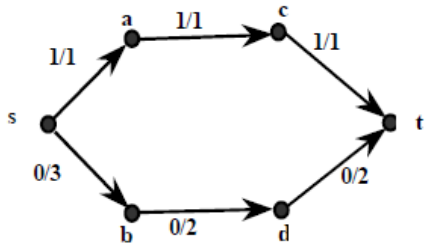
Paper Code : CSEN 2201 Paper Name : Design & Analysis of Algorithms

Time Allotted : 1 hr Full Marks : 30

Figures out of the right margin indicate full marks.

Answer all the questions.

Candidates are required to give answer in their own words as far as practicable.

1	Choose the correct alternatives for the following:	5 x 1 = 5
(a)	The residual capacity of the augmenting path for the flow network shown below is  (i) 1 (ii) 2 (iii) 3 (iv) 7	
(b)	In the algorithm for pattern matching using Finite Automata, the suffix function σ(x) is the _____est _____ of the pattern P that is also a _____ of x. (i) large, prefix, suffix (ii) small, prefix, suffix (iii) large, suffix, prefix (iv) large, suffix, prefix	
(c)	A negative weight cycle can be correctly detected by (i) Topological Sorting Algorithm (ii) Dijkstra's Algortihm (iii) Bellman-Ford Algorithm (iv) Prim's Algorithm	
(d)	A student proved that the longest path problem is NP-complete by reducing it to another already known NP-complete problem named set-cover problem. His teacher said the proof is not correct and did not give him any marks. (i) The teacher does not understand NP-completeness as it is a difficult chapter. (ii) The student got a wrong answer about the hardness of longest path problem. (iii) The method of proof given by the student was wrong. (iv) None of the above is true	
(e)	If the following 4 operations are defined on a data structure – push, pop, multi-push and multi-pop, the amortized cost per operation is – (i) O(1) (ii) O(log n) (iii) O(n) (iv) O(n log n)	
2 (a)	A sequence of n operations is performed on a data structure. The cost of ith operation is C(i) = i^2, if i is an exact power of 3	(5 + 1) + (2 + 4) = 12

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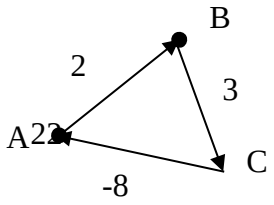
	= 3, otherwise. Calculate the exact expression for finding the cost for n successive operations using Aggregate Analysis. Determine the asymptotic amortized cost per operation. To make things simple, let us assume that n is an exact power of 3. This will get rid of some Hint to start: $\sum C(i)_{\,i=1 \text{ to } n} = 3^2 + 9^2 + 27^2 + \ldots\ldots..(n)^2 + X$ ANS: $\sum C(i)_{,\ i=1 \text{ to } n} = 3^2 + 9^2 + 27^2 + \ldots\ldots..(n)^2 + X$ $= 3^2 + (3^2)^2 + (3^3)^2 + \ldots\ldots..(3^{\log_3 n})^2 + 3(n - \log_3 n)$ $= 9(9^{\log_3 n} - 1)/(9 - 1) + 3(n - \log_3 n)$ (Using GP Series sum for the 1st portion) $= (9/8)\, n^2 + 3(n - \log_3 n) = O(n^2)$ (5 marks) So amortized cost per operation is O(n). (1 mark)	
(b)	Show that Shortest Path algorithms follow optimal substructure property. What problem do you face when you are going to apply Bellman Ford algorithm on the following graph? Justify your answer.  	
3 (a)	Define maximum-flow problem. What do you mean by an augmenting path in a residual network? A flow in G is a real valued function f: V x V → R that satisfies 3 properties. What are they and also state each of them in one sentence.	(2+2+3) + (4+4) =15
(b)	Give a 2-approximation algorithm for the Vertex-cover algorithm and give a correctness proof to show that it indeed achieves that factor.	

N. B. Though the total marks add up to 32, the maximum you can get is 30.