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| *Cairo University**Faculty of Computers and Information*Subject: AlgorithmsSubject Code: NCS316Examiner(s): Sherif Khattab |  | Mid-term examSemester: 1stDate: 20/11/2016Duration: 1 hour |

***Answer as much as you can. Max. grade is 30. Open book and notes.***

***Question 1 [10 marks]*** For each of the following recurrences, produce an example algorithm whose running time satisfies the recurrence, determine the running-time of the algorithm, and explain your analysis.

* + ***T(n) = T(n/2) + O(1)***

*a=1, b=2, d=0 => Case 1 of the Master method (slide 183). O(log n). Binary search.*

* + ***T(n) = T(n/5) + O(1)***

***a=1, b=5, d=0 => Case 1 of the Master method. O(log n)***

***MyAlgo(n){***

 ***//O(1) processing***

***MyAlgo(n/5)***

***}***

* + ***T(n) = T(n/5) + T(n/3) + O(n)***

***O(n)***

***MyAlgo(n){***

 ***//O(n) processing***

***MyAlgo(n/5)***

***MyAlgo(n/3)***

 ***}***

 ***Same analysis as deterministic selection (Slide 211-212)***

***Question 2 [5 marks]*** Modify the Quicksort algorithm so that its worst-case running-time is O(n log n).

Replace ChoosePivot by DSelect(A, n, n/2) //Compute the median and use it as a pivot.

***Question 3 [5 marks]*** Analyze the running-time of Karger’s min-cut algorithm.

***Slide 288.***

***n-2 iterations and m per loop = O(nm)***

***Question 4 [5 marks]*** Write a recursive algorithm to compute a topological sort of a Directed Acyclic Graph.

***Slide 308***

***Question 5 [10 marks]***

 ***a. [5 marks]*** Re-write Kosaraju’s strongly-connected components algorithm so that it calls a topological sort algorithm.

**Replace step 2 by a call to Topological sort on the reverse graph.**

 ***b***. ***[5 marks]*** Draw a directed graph of size: n=10, m=15 and trace Kosaraju’s strongly-connected components algorithm on your graph.

Check slides 316 and 317.