CSE 5311 Design and Analysis of Algorithms

SPRING 2007

Department of Computer Science

The University of Texas at Arlington

SAMPLE QUESTIONS AND INSTRUCTIONS FOR REFERENCE SHEET

Note: The Quiz will have 4 questions - you will be require to answer all

1) Answer questions 1a to 1c pertaining to the STOOGE_SORT Algorithm given below.

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STOOGE_SORT(A,i,j)

1       if A[i] > A[j]
2           then exchange A[i] ↔ A[j]
3       if i+1 ≥ j
4           then return
5       k ← ⌊(j-i+1)/3⌋
6       STOOGE_SORT(A,i,j-k)
7       STOOGE_SORT(A,i+k,j)
8       STOOGE_SORT(A,i,j-k)
```

   a. Argue that STOOGE_SORT (A,1,length[A]) correctly sorts the input array $A[1 .. n]$, where n = length[A].
   b. Give a recurrence for the worst-case running time of STOOGE_SORT and a tight asymptotic bound on the worst-case running time.
   c. Compare the worst-case running time of STOOGE_SORT with that of insertion sort, merge sort, heapsort, and quicksort.

2) You are given a collection of n bolts of different widths and n corresponding nuts. You are allowed to try a nut and bolt together, from which you can determine whether the nut is larger than the bolt, smaller than the bolt, or matches the bolt exactly. However there is no way to compare two nuts together or two bolts together. The problem is to match each bolt to its nut. Design an algorithm for this problem with average case efficiency of $\Theta(n \log n)$.

3) Explain how we can check a graph's a cyclicity by using Bredth-first search. Does either of the two traversals – DFS or BFS –always find a cycle faster than the other? If your answer is yes, indicate which of them is better and explain why it is the case; if you answer no, give two examples supporting your answer.

4) You are given a list of numbers for which you need to construct a min-heap. (A Min-heap is a complete binary tree in which every key is less than or equal to the keys in its children.) Write a min-heap algorithm and analyze its complexity.

5) Modify Dijkstra's single source shortest path algorithm so that it checks if a directed graph has a cycle. Analyze your algorithm.

6) Design an algorithm to find a vertex in a connected undirected graph whose removal does not disconnect the graph. The algorithm should run in linear time.

GUIDELINEs for 1-pg Reference Sheet

- Printed on only one side of the Sheet
- One inch (or 2.5 cms) Margin on all four sides
- Single Column format
- Font Type: Times Roman or Times New Roman or Aerial
- Minimum Font Size : 11
- Your full name should be written on the sheet