CSCE-629 Analysis of Algorithms

Fall 2017

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Assignment # 1
(Due September 26, 2017)

1. Answer the following questions, and give a brief explanation for each of your answers.
   a) True or False: Quicksort takes time $O(n \log n)$;
   b) True or False: Quicksort takes time $O(n^2)$;
   c) True or False: Mergesort takes time $O(n \log n)$;
   b) True or False: Mergesort takes time $O(n^2)$;

2. Solve the following recurrence relations:
   a) $T(1) = O(1)$, and $T(n) = 2T(n/2) + O(n^2)$;
   b) $T(1) = O(1)$, and $T(n) = 2T(n-2) + O(n)$.

3. Use mathematical induction to prove that a 2-3 tree with n leaves has its height bounded by $\log_2 n$. The *height* of a 2-3 tree is defined to be the length of the path from its root to any of its leaves.

4. Let T_1 and T_2 be two 2-3 trees, where T_1 has n elements in its leaves, and T_2 has $n/\log n$ elements in its leaves. Develop a linear-time algorithm that places all the elements in T_1 and T_2 in a single sorted list.

5. Design algorithms for Min(S), Insert(S, a), and Delete(S, h), where the set S is stored in a heap, a is the element to be inserted into the heap S, and h is the index of the element in the heap S to be deleted. Analyze the complexity of your algorithms.