CS 3343 Analysis of Algorithms – Fall 10

8/31/10

1. Homework

Due **9/7/10** before class

1. **Linear Search (12 points)**

   Consider the linear search algorithm which scans a set of numbers systematically to find a specific value. In this problem you will describe and analyze the algorithm similar to how we described and analyzed "insertion sort" in class.

   (a) (2 points) Give the problem definition (input, output).

   (b) (2 points) Give a verbal description of the algorithm (this may include a picture for illustrative purposes).

   (c) (2 points) Write pseudocode for this algorithm.

   (d) (1 points) What loop invariant does this algorithm maintain? Your loop invariant should eventually help prove the correctness of the algorithm. *(Hint: It should involve the value and the part of the set of numbers that has been scanned so far.)*

   (e) (3 points) Use the loop invariant to prove the correctness of the algorithm. For this you need to prove by induction that the loop invariant holds for all iterations of your loop ("base step" and "inductive step"), and then use the loop invariant in the "termination step" to prove the correctness of the algorithm.

   (f) (2 points) Give best-case and worst-case running times in asymptotic notation. Also give example inputs attaining these runtimes.

2. O, Ω, Θ **(8 points)**

   Show using the definitions of big-Oh, Ω, and Θ:

   (a) (1 point) $4n^3 + 7n - 3 \in O(n^3)$

   (b) (1 point) $3n^2 + 4n + 5 \in \Omega(24n^2)$

   (c) (2 points) $3n^4 + 2n^2 + 7 \in \Theta(n^4)$

   (d) (2 points) If $f(n) \in O(g(n))$ and $g(n) \in O(h(n))$ then $f(n) \in O(h(n))$.

   (e) (2 points) If $f(n) \in \Theta(g(n))$ and $g(n) \in \Theta(h(n))$ then $f(n) \in \Theta(h(n))$.