CS:5350 Homework 2, Spring 2016

Due in class on Thu, Feb 4

Collaboration: You are welcome to form groups of size 2 and work on your homeworks in groups. Of course, you are not required to work in groups. Every group should make one submission and names of both group members should appear on the submission and both students in a group will receive the same score. Other than the TA and the professor, you can only discuss homework problems with your group partner. Collaboration can be positive because talking to someone else about these problems can help to clarify your ideas and you will also (hopefully) get to hear about different ways of thinking about the problem. On the other hand, collaboration can be negative if one member of the group rides on work being done by the other member – please avoid this situation. If your solutions are (even partly) based on material other than what has been posted on the course website, you should clearly acknowledge your outside sources.
Late submissions: No late submissions are permitted. You will receive no points for your submission if your submission is not turned in at the beginning of class on the due date.
Evaluation: Your submissions will be evaluated on correctness *and* clarity. Correctness is of course crucial, but how clearly you communicate your ideas is also quite important.

1. Consider the following recurrence relation that arose from a discussion in class on Tuesday, Jan 26:
$$T(n) = 2T(2n/3) + n \quad \text{for} \quad n > 1$$
and $T(1) = 1$. Solve this recurrence by unrolling it.
Note: If I remember correctly, the discussion in class was initiated by the question "Is the solution to this recurrence $T(n) = O(n)$?" By solving this problem you can convince yourselves that this is not the case and $T(n) = \Theta(n^c)$ for a constant $c > 1$. You'll be able to figure out exactly what c is by solving this recurrence.

2. Problem 15(b) from Chapter 1 (Recursion) on Page 20 from Jeff Erickson's notes.
Another Hint: What is the solution of the recurrence $T(n) = 2T(n/2) + O(n \log n)$ for $n > 2$ and $T(n) = O(1)$ for $n \leq 2$?

3. Problems 28(a), (b), and (c) from Chapter 1 (Recursion) on Page 26 from Jeff Erickson's notes.

4. Consider the divide-and-conquer algorithm for the 2-dimensional *Closest Point Pair* problem discussed in class on Thu, Jan 28. Suppose that after the CONQUER step we see that $\delta_L = \delta_R = 1$. Recall that in the COMBINE step we focus on the strip defined by vertical lines H_L, which is δ units to the left of the median line H and H_R which is δ units to the right of the median line H. Illustrate a situation in which there are 8 points in this strip, with 4 of these being in L and 4 in R. Furthermore, for every point in the strip, it is required that there is at least one other point in the strip at distance less than 1 from it. To be specific, provide coordinates for all 8 points in your illustration and equations for the lines H, H_L, H_R.
