

22C : 231 Design and Analysis of Algorithms
Spring 2006
Homework 1
Due on Tuesday, February 14

You are expected to do the homework assignments on your own without consulting human and non-human sources (like the web, books other than the textbook) for the solutions. You are welcome to discuss the homeworks with your classmates, but you are not allowed to take away from the discussion any written record, electronic or otherwise, of the discussion.

1. [12 points] Suppose that we change our deterministic linear time algorithm for selection as follows. Instead of computing our partitioning element by dividing into groups of 5 and choosing the median from the medians within each group, we divide into groups of 9 and choose the median from the medians within each group. Do we still obtain a linear time algorithm? Argue by setting up a recurrence for the running time and justifying informally whether this recurrence leads to an $O(n)$ bound on the running time.
2. [12 points] Solve the following recurrence, that is, express $T(n)$ as $\Theta(n^\alpha)$ for the appropriate α .

$$\begin{aligned}T(n) &= 7T(n/2) + n \text{ if } n \geq 2 \\T(n) &= 1 \text{ if } n < 2.\end{aligned}$$

You should derive your solution by expanding the recurrence, noticing a pattern, and adding up a series, just as we did in class. There is no need for a more formal derivation.

3. [13 points] Exercise 4 of chapter 5 of the book. For a hint, read the applications that are described in the book for convolutions.
4. [13 points] Exercise 6 of chapter 5 of the book. Review Solved Exercise 1 in Chapter 5 if needed. (You can assume your favorite representation for the complete binary tree.)