These questions do not need to be turned in! They are only for your own benefit. These are questions that have appeared on previous midterms. We will go over the solutions on Friday, 10/2.

1. (10 points) Describe how to implement all of the following operations, within the specified time bounds. For full credit, give pseudo-code for all of your operations. You may use any data structures/algorithms described in the text without rewriting them.

   - Insert(k): Time $O(\lg n)$
   - Delete(k): Time $O(\lg n)$
   - Find(k): Time $O(\lg n)$
   - Min(): Time $O(1)$
   - Median(): Time $O(1)$

2. Give tight ($\Theta()$) bounds for each of the following recurrence relations. Justify your answers by either the master method or substitution method. You can assume that $T(a) = C$ for any constant $a$.

   (a) $T(n) = T(n - 2) + n^2$
   (b) $T(n) = 4T(n/4) + n \lg n$
   (c) $T(n) = 3T(n - 1) + n^3$

3. Give an algorithm that, given $n$ unsorted elements in the range $0\ldots k$, preprocesses the input and then answers any query about how many of the $n$ integers fall into a range $[a\ldots b]$ in $O(1)$ time. Your algorithm should use $\Theta(n + k)$ preprocessing time.

   HINT be sure your algorithm works correctly on duplicate elements! For the list [1,2,2,3,2,2,3,3,3,4] the query NumInRange(2,3) should return 8