

Computer Science 673
Midterm 1 Review
Fall 2016

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 $0 \dots k$, preprocesses the input and then answers any query about how many of the n integers fall into a range $[a \dots b]$ 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