CS4311 Design and Analysis of Algorithms

Homework 3 (Solution Sketch)

1. **Main idea:** Find the items in *reverse* order, each time using the linear-time selection algorithm to find the desired item, *and* reducing the problem size (by removing larger items) before we find the next item.

2. **Main idea:** Use linear-time selection algorithm to find the $\sqrt{n}$th smallest item. Then we can scan the whole array again and obtain all the $\sqrt{n}$ smallest items. Finally, we perform a sorting.

3. **Main idea:** Use linear-time selection algorithm to find the median m. Create an array D such that $D[i]$ stores the difference between $A[i]$ and m. That is, $D[i] = |A[i] - m|$. Use linear-time selection again to obtain the kth smallest entry of D, and by scanning D again, we can locate all k smallest entries of D. This in turn gives the k elements of A closest to the median m.

4. **Main idea:** Treat each integer as a 2-digit number in the n-ary system. Use radix sort to sort them. The total time is $O(d(n + k)) = O(n)$ as $d = 2$ and $k = n$. (Recall: k is the range of each digit, and it is the number of buckets used to sort each digit.)