CMPS 102 Homework 4
3 problems, 25 points, due at the start of class, May 4, 2004

Reading: Chapter 8, and the reading from HW 3.

1. (10 pts) Consider a modification to the Select algorithm of section 9.3 that finds medians of groups of 3 (rather than groups of 5). First (2 pts), write pseudo-code for this version of Select. Next (3 pts), derive a recurrence underestimating its running time (don’t worry about floors and ceilings). Finally (5 pts), show that the running time of this version of Select is not linear in the number of elements (i.e. that your underestimate is not $O(n)$).

2. (10 pts) Consider a modification to MergeSort that recursively calls itself at most $k$ times and then uses Selection Sort (if needed) to sort the $2^k$ resulting sub-arrays (each of these sub-arrays has approximately $n/2^k$ elements). Thus the recursion tree for this algorithm has $k$ levels of MergeSort followed by a level of Selection Sort.

First (3 pts) Write pseudo-code for this algorithm. You may want to include the number of remaining recursions as a parameter to the recursive routine. Then (7 pts) determine the asymptotic running time of the algorithm as a function of both $k$ and $n$. You may assume that $n$ is a power of 2, and that running Selection Sort on $n$ elements takes $\Theta(n^2)$ time.

3. (5 pts) Prove the correctness of Radix Sort (pg 172 of text) by (finite) induction on $i$, the column being sorted. It should be clear from your proof why the sorting method for each digit must be stable, and why the digits must be sorted least to most significant.