CPS 130: Homework III (Due October 17)

1 More on sorting and searching

1. [2 points] Why do we analyze the average case performance of a randomized algorithm and not its worst-case performance?

2. [3 points] What is the running time of quick sort when all the elements are of the same value?

3. [6 + 4 points] Which of the following algorithms are stable: insertion sort, bubble sort, selection sort, merge sort, heapsort and quicksort? Give a simple scheme that makes any sorting algorithm stable. How much additional time and space does your scheme entail?

4. [5 points] Use induction to prove radix sort works. Where does your proof need the assumption that the intermediate sort is stable.


2 Medians and order statistics

1. [5 points] Suppose we use RANDOMIZED-SELECT (see page 186 of CLRS) to select minimum element of the array \( A = \langle 3, 2, 9, 0, 7, 5, 8, 6, 1 \rangle \). Describe a sequence of partitions that results in a worst-case performance of RANDOMIZED-SELECT.

2. [3 × 5 = 15 points] CLRS Problem 9-2 (page number 194) on weighted median.

3. [5 points] Let \( X[1…n] \) and \( Y[1…n] \) be two array, each containing \( n \) numbers already in sorted order. Give an \( O(\lg n) \)-time algorithm to find the median of all \( 2n \) elements in arrays \( X \) and \( Y \).