

## Homework 2 (5pt.)

Submission instruction:

Submit one single pdf file for this homework including both coding problems and analysis problems.

For coding problems, copy and paste your codes. Report your results.

For analysis problems, either type or hand-write and scan.

**Question 1.a (1 pt.) Quicksort and Randomized Quicksort:** Write codes for partition subroutine, quicksort and randomized quicksort. You may need `rand()` to generate random numbers. Run the randomized quicksort 5 times for input array  $A = \{1, 2, 3, \dots, 99, 100\}$  and report the 5 running times.

**Question 1.b (1 pt.)** The quicksort algorithms taught may not work well with repeated elements. Revise your codes to solve the problem. Briefly describe your revisions first. Report results on a couple of example inputs that have repeated elements.

**Question 2 (1pt.) Heapsort:** Write codes for heapsort. The input array is a random permutation of  $A = \{1, 2, 3, \dots, 99, 100\}$ . You should write codes to generate and print the random permutation first.

**Question 3 (1pt.) Counting Sort:** Write codes for counting sort. The input array is  $A = \{20, 18, 5, 7, 16, 10, 9, 3, 12, 14, 0\}$ .

**Question 4 (1pt.) Radix Sort:** Write codes for radix sort: use counting sort for decimal digits from the low order to high order. The input array is  $A = \{329, 457, 657, 839, 436, 720, 353\}$ .