CMPUT 204 — Problem Set 3

Topics covered in Part I are heapsort and priority queues; in Part II are quicksort and lower bounds for comparison based sorting.

It is highly recommended that you read pages **135–168** very carefully and do **all** the exercises. The following are some of them that you are **REQUIRED** to practice on.

Quiz questions are mostly based on this list, with some minor modifications necessary. Consult your instructor and TAs if you have any problem with this list.

Part I

1. P136, Ex 6.4-1.
2. P136, Ex 6.4-2.
3. P136, Ex 6.4-3.
4. P140, Ex 6.5-1.
5. P140, Ex 6.5-2.
6. P142, Ex 6.5-5.
7. P142, Ex 6.5-6.
8. P142, Ex 6.5-8.

Part II

1. Consider a Quick-sort of n distinct keys.
   (a) What does "equiprobable input distribution" mean?
   (b) Assuming an equiprobable input distribution, what is the probability that the initial splitter is the k'th largest key (among the n possible keys)? Justify your answer.
2. Suppose Quick-sort is called on a sorted array with n distinct keys. How many
   (a) key comparisons
   (b) interchanges

   are performed?
3. Give a permutation of $\{1, 2, 3, \ldots, 14, 15\}$, such that for a Quick-sort of this input, every partition splits the list into two equal size sublists.
4. P148, Ex 7.1-1.
5. P149, Ex 7.1-4.
6. P153, Ex 7.2-1.
7. P153, Ex 7.2-2.
   Hint: $\Theta(n^2)$ (trace partition).
8. P153, Ex 7.2-3.
9. P153, Ex 7.2-4.
   Hint: how does the best case of Insertion-sort compare to the best case of Quick-sort?
10. P159, Ex 7.4-2.
    Hint: consider the binary search tree associated with the Quick-sort recursion tree (see course lecture slides); notice that the number of key comparisons is equal to the sum of the depths of the nodes; the sum of depths of nodes of an n-node binary tree is in $\Omega(n \lg n)$; also, there are cases where Quick-sort does $\Theta(n \lg n)$ key comparisons (see course lecture slides).
11. P159, Ex 7.4-5.
12. P161, Prob 7-3.
13. P167, Ex 8.1-1.
14. P167, Ex 8.1-3.
15. P167, Ex 8.1-4.