csce750 — Analysis of Algorithms
Fall 2019 — Homework 04

Assigned: October 3
Due: October 17

This assignment covers material from the lectures on Chapters 8, 9, 11, 12, and 13, in preparation for Quiz 4.

Not in textbook: In the **search problem**, the input is an array A of size n along with a search key k. The output is an integer i such that $A[i] = k$, or -1 if k is not in A. **Prove**, using the decision tree method, that any correct algorithm for this problem based on comparisons ($<, >, \leq, \geq$, and $=$) between elements takes $\Omega(\lg n)$ time.

Pages 219–220: Exercise 9.2-3, 9.2-4

Page 223: Exercise 9.3-3

Page 224: Problems 9.1 (express the run time of each solution in terms of both n and i), 9.2b, 9.2c

Page 261: Exercises 11.2-2, 11.2-5, 11.2-6

Pages 268–269: Exercise 11.3-1

Not in textbook: Write pseudocode for an algorithm that uses a hash table to solve the **element uniqueness** problem:

- Input: An array A of n elements.
- Output: "True" if the elements of A are all distinct, or "False" if A contains at least one pair of duplicate elements.

How efficient is your algorithm in the worst case? How efficient is it under the simple uniform hashing assumption? Can you design a different algorithm, not based on hashing, that performs better?

Page 289: Exercise 12.1-1

Page 293: Exercises 12.2-1, 12.2-4

Page 314: Exercise 13.2.3, 13.2-4

Not in book: Figure 13.10 shows a treap variant called a min-treap, which differs from the version in the notes only because the priorities from a min-heap rather than a max-heap. Show the result of inserting the key 'J', with priority 8, into the min-treap shown in Figure 13.10f. Then show the result of inserting the key 'J', with priority 1, into the min-treap shown in Figure 13.10f. In each case, list the rotations performed by the insertion.