CSCI 4041, Fall 2018, Written Assignment 2

Due Thursday, 9/20/18, 10:30 AM (submission link on Canvas)

This is a collaborative assignment; you may work in a group of 1-3 students. However, you may not consult or discuss the solutions with anyone other than the course instructor, the TAs, or the other members of your group, nor may you use material found from outside sources as part of your solutions. In addition, if you do choose to work in a group, each group member must participate in coming up with the solution to each problem, and must be able to explain the group's answer if asked: dividing the problems amongst the group members is not acceptable.

Complete the following problems and submit your solutions in a single pdf file to the Written Assignment 2 submission link on Canvas. If you're working in a group, only one person should submit your answers, but make sure that you include the name and x500 of each group member at the top of the file, and that you are all in one of the WA2 Groups in Canvas. Typed solutions are preferred, but pictures or scans of a handwritten assignment in pdf form are acceptable so long as your solutions are clearly legible.

This assignment contains 3 problems, and each is worth 10 points, for a total of 30 points.

Your solutions to these problems must be clearly explained in a step-by-step manner; for most problems, the explanation will be worth far more points than the actual answer.

1. (Adapted from Exercise 2.3-7 in the textbook) Write pseudocode for a $\Theta(n \lg n)$-time algorithm that, given an array A of n integers and another integer x, determines whether or not there exist two elements in A whose sum is exactly x. Explain informally why your algorithm is $\Theta(n \lg n)$-time. You may use calls to the Merge-Sort algorithm in the textbook as part of your pseudocode.

   (Hint: Let p be the smallest element of A, r be the largest element of A, and z be any other element. If $p + r < x$, what does that say about $p + z$? If $p + r > x$, what does that say about $z + r$?)

2. (Exercise 7.2-3 in the textbook) Explain why the running time of the Quicksort algorithm in Section 7.1 in the textbook is $\Theta(n^2)$ in the case that the initial array contains distinct elements and is sorted in decreasing order.

   (Hint: Be careful here - while the first pivot chosen is the smallest value in the array, the second pivot will not be the second smallest value in the array)

3. For each of the following arrays, could the array represent a min heap? If no, explain why not.

   a. A = [2, 15, 2, 1, 6, 5, 20, 20]

b. B = [4, 5, 7, 18, 5, 15]

c. C = [1, 8, 14, 19, 15, 12, 15]

d. D = [42, 42, 42, 42, 42, 42, 42, 42, 42, 42]