CS 401 Homework 2

State all necessary assumptions clearly.
Show all the steps and give complete answers.
Please write legibly or type your answers.

Submit via Gradescope. Remember to associate page numbers of your solution PDF file to question numbers.

1. Consider a sorted array A of n distinct numbers. $rotate(A)$ is any circular shift of the array by some value from 0 to $n-1$. For example, if $A = [2, 5, 7, 8, 10, 12, 16]$, a possible value of $rotate(A)$ is $[7, 8, 10, 12, 16, 2, 5]$, obtained a 2-left rotation.

   Given any number x, give a $O(\log n)$ algorithm to determine whether x is a member of $rotate(A)$. Your algorithm should have as low time complexity as possible. Can you solve in $O(\log n)$?

2. Consider the heap implementation of a priority queue. Let H be a heap on n elements. $Delete(H, i)$ deletes the element in position i.

   Construct an example heap with at least 15 elements, and identify a position i with the property that $Delete(H, i)$ results in the execution of calls to `Heapify-up`.

   You must draw your example heap as a binary tree and identify the element at position i. Then justify that your example satisfies the required property.

3. Chapter 3, Exercise 1

4. Chapter 3, Exercise 2

5. Give an implementation pseudocode of a depth-first search (DFS) of a graph that also prints out the edges of the DFS tree. Make sure to specify the data structures.

6. Chapter 3, Exercise 5

7. Chapter 3, Exercise 7

8. Chapter 3, Exercise 10