Assignment 3:

Due Date: Friday February 11, 11:59 p.m.

Objectives:

- Divide-and-Conquer Algorithms
- Lower-bound proof
- Greedy Algorithms

Submission Instruction

- **Start early**
- You are allowed to work in groups of at most two students. It is okay if you want to work on your own.
- Write your answers in a file named **`A3_username.pdf.`**
- **Make sure to have one submission per group**
- **Make sure that you are typing or your writing is neat.**
- **Have your name(s) at the top of the pdf file**

Problems

Q1. Is the following True or False? Justify your answer:
For every n > 1, there are n-element arrays that are sorted faster by insertion sort than by quicksort?

Q2. Design an algorithm to rearrange elements of a given array of n numbers so that all its negative elements precede all its positive elements. Analyze the time complexity of your algorithm and prove the correctness of your algorithm. **Hint:** You can use a partitioning technique similar to that of quicksort.

Q3. Prove that the problem of finding an element in an array having n element has a lower bound of Ω(log n). You can use a technique similar to what we have done in class for proving the lower bound for sorting algorithms.

Q4. Suppose there is a road and the houses are scattered along the road.
The position of each house is specified by its distance from the western endpoint. We want to place cell-phone towers on the road so that all houses are covered by at least one tower. Design a greedy algorithm to find the minimum number of towers required. You need to write the pseudocode for the problem, the proof of optimality, and proof of correctness for the algorithm. Note: this is a one-dimensional problem. The houses and towers are all place on one line.