Please complete this worksheet by **November 12th, 2021 by 11:59pm**.

Once you upload a picture of your work [here], the solutions will become available so you can study for the weekly quizlet, which may draw one problem from this week’s worksheets.

**Problem 1**

Here’s an algorithm:

\[
\text{mystery\_algorithm}(x)
\]

1. \text{input}: a list of integers \(x\)
2. \text{output}: none, but \(x\) is modified in place
3. \(n \leftarrow \text{len}(x)\)
4. \text{for} \(i = 1 \rightarrow n\) # not including \(n\) (like \text{range} in Python)
5. \(v = x[i]\)
6. \(j = i\)
7. \text{while} \(j > 0 \text{ and } x[j-1] > v\)
8. \(x[j] = x[j-1]\)
9. \(j = j - 1\)
10. \(x[j] = v\)

(a) What does this algorithm do? Treat the list as you would in Python/Java, where the first item in the list is at index 0, and the last item is at index \text{len}(x) - 1. It might help to create a random list of integers of length 5 and step through the algorithm.

(b) Do a detailed analysis to count the number of operations performed by this algorithm in the worst case.

(c) Give a bound on the number of operations performed by this algorithm using big-oh notation.

**Problem 2**

Show that \(\log_3(n^2) = O(\log_2(n))\).

Logarithms come up often in computer science, so this is good practice! Recall that \(\log_b(c) = x\) means \(b^x = c\) and \(a = b^{\log_b(a)}\). Also, \(\log_b(a \cdot c) = \log_b(a) + \log_b(c)\). A logarithm in one base \(a\) can be converted to a logarithm in another base \(b\) using \(\log_b(x) = \frac{\log_a(x)}{\log_a(b)}\).