# Homework 1

1. Order the following functions by asymptotic growth rate. Identify which functions are asymptotically equivalent.

   - $10$
   - $4n \log n + 2n$
   - $2^{10}$
   - $2^{\log n}$
   - $3n + 100 \log n$
   - $4n$
   - $2^n$
   - $n^2 + 10n$
   - $n^3$
   - $n \log n$

2. Rewrite the InsertionSort procedure shown in class to sort in decreasing order instead of increasing order.

3. Prove that $5n^2 + n \log n + 7 = O(n^2)$ by finding $c$ and $n_0$.

4. Show that if $f = O(g(n))$ then $g = \Omega(f(n))$.

5. Show that $O(\max(f(n), g(n))) = O(f(n) + g(n))$.

6. Consider a function `Contains(A, k)`, which determines whether an *unsorted* list $A$ contains a specified search key $k$. Do not sort $A$.

   (a) Write pseudocode for `Contains`.

   (b) Write the cost time analysis next to each line of your pseudocode. You may use sigma notation to identify how many times a line is executed if necessary.

   (c) Compute $T(n)$, the total amount of time required to execute the function on a list of length $n$.

   (d) Find the running time in Big-Oh notation.

   The loop header and conditional will each run at most $n$ times and one or the other return statement will execute once. This makes the total running time $O(n)$.

7. Consider a function `Seek(A, k)`, which *quickly* determines whether a *sorted* list $A$ contains a specified search key $k$.

   (a) Write pseudocode for `Seek`.

   (b) Find the running time in Big-Oh notation. Justify your answer.