Homework 2 (due 4/24)

1. (10 pts.) Write a C++ program to run `insertion_sort` on all permutations of `1, 2, 3, .., 10` and output the permutation(s) that requires

   a. the most number of comparisons (counting only `A[j] < A[j-1]`);

   b. the most number of swaps.

   Generalize your observations to permutations of `1, 2, 3,..., n`.

   The answer when $n=5$ is

   ```
   Max number of comparisons = 10
   16 permutations requiring maximum number of comparisons:
   5 4 3 2 1
   4 5 3 2 1
   5 3 4 2 1
   3 5 4 2 1
   5 4 2 3 1
   4 5 2 3 1
   5 2 4 3 1
   2 5 4 3 1
   5 4 3 1 2
   4 5 3 1 2
   5 3 4 1 2
   3 5 4 1 2
   5 4 1 3 2
   4 5 1 3 2
   5 1 4 3 2
   1 5 4 3 2
   Max number of swaps = 10
   1 permutation requiring maximum number of swaps:
   5 4 3 2 1
   ```

2. (10 pts.) Write a C++ program to run `merge_sort` on all permutations of `1, 2, ..., n` where n is between 1 and 10 inclusive. For each n, record the average number of comparisons (counting only `A[j] < A[i]`) and the worst number of comparisons. Plot the result (using Excel for example) together with the curves $n \log_2 n$ and $\frac{1}{2} n \log_2 n$.

   The answer when $n=5$ is

   ```
   average = 7.16667
   worst = 8
   ```

You must turn in by noon of the due date:

- a hard copy of your code with sample output, your name, and your section; and

- send **one** email message with the subject line: `HW2 Your_last_name Your_section` to `cs61@math.scu.edu` with your code and graph attached. Please do **not** zip your file.