Lab 3 Exercise 3

1. For an array of length n, the formula for the number of comparisons in bubble sort is

$$c = \frac{n(n-1)}{2} = \frac{n^2 - n}{2} \to O(n^2)$$

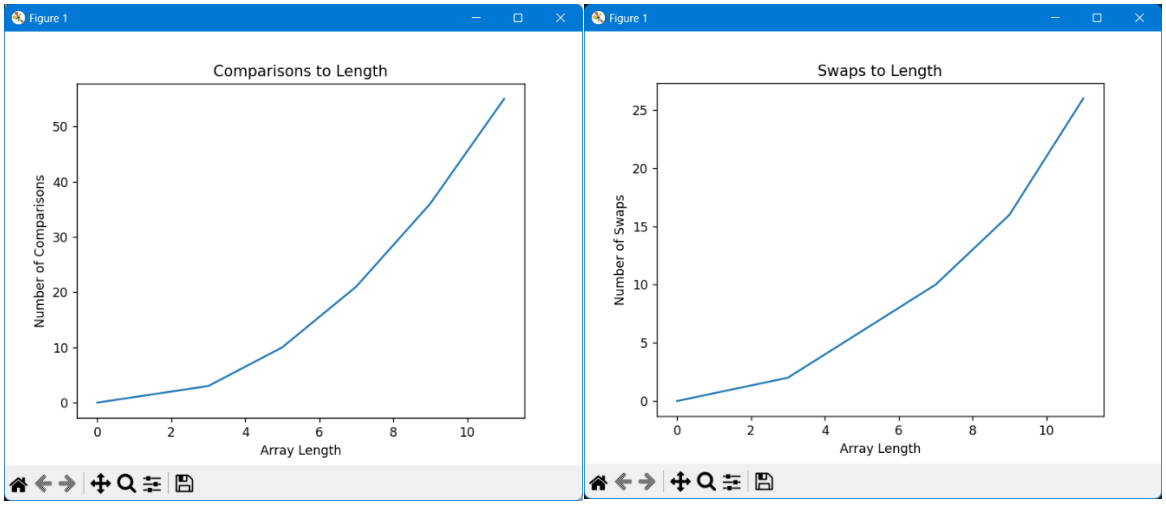
   The average number of swaps can be estimated to be about half the number of comparisons made, so we divide the number of comparisons by 2

$$s = \frac{c}{2} = \frac{n(n-1)}{4} = \frac{n^2 - n}{4} \to O(n^2)$$

2. (as ex3.py)

3. (as outputs of ex3.py)

4.



These graphs do match up with the complexity analyses because the number of comparisons and swaps are growing in a quadratic matter compared to the length of the arrays, which matches our conclusions of the complexity analyses.