ENSF 338 Lab 3 Exercise 3

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Lecture no: 03

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Question 1

Let:

- n be the number of elements in the array,
- C be the number of comparisons,
- S be the number of swaps.

(i) Number of comparisons (C):

In each pass through the list, each pair of adjacent elements is compared. There are $n-1$ pairs of adjacent elements in a list of n elements. Since bubble sort repeatedly goes through the list until it is sorted, the number of comparisons (C) can be expressed as:

$C = (n-1) + (n-2) + \ldots + 1$

This is a sum of the first $n-1$ natural numbers, which can be expressed as the formula for the sum of an arithmetic series:

$C = (n \cdot (n-1))/2$

(ii) Average-case number of swaps (S):

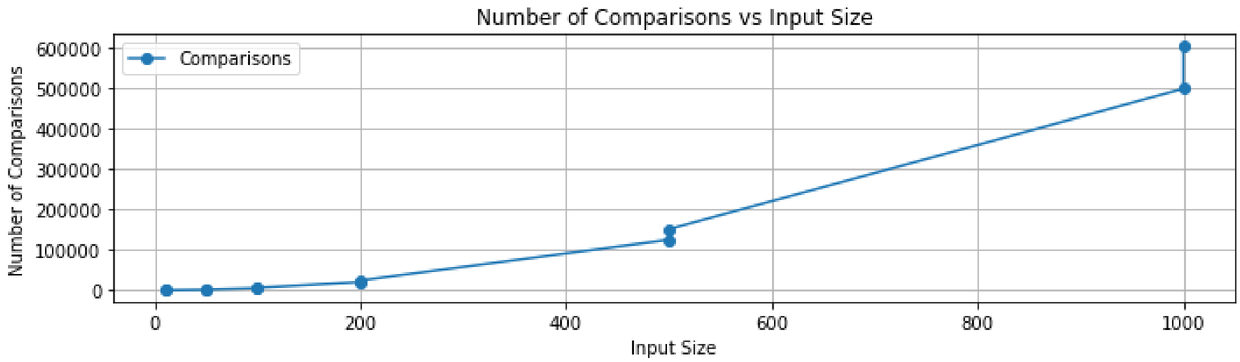
The average-case analysis assumes that all possible input permutations are equally likely. In the average case, bubble sort's performance improves when there are fewer inversions (pairs of elements out of order). The average-case number of swaps (S) can be approximated as a fraction of the number of inversions in the input.

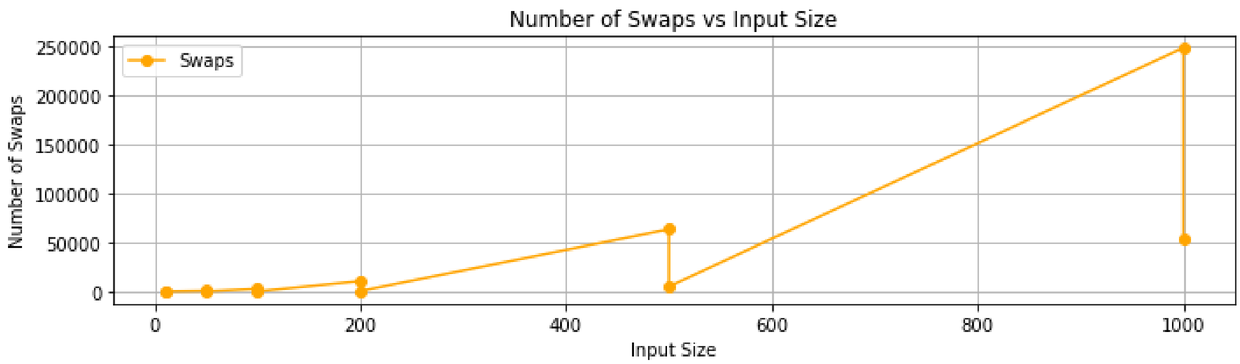
Let I be the number of inversions in the input array. The average-case number of swaps (S) is approximately given by:

$S \approx I/2$

This is because, on average, a swap corrects two elements that are out of order, and I represents the total number of inversions that need to be corrected.

<u>Exercise 4</u>





The results in the two graphs are very different. The first graph which shows the number of comparisons vs input size seems to follow a quadratic shape but not entirely. This means that the results most likely match the complexity analysis, but further investigation is needed to confirm. The second graph on the other hand does not follow the quadratic shape that is being looked for therefore it can be concluded that the results do not match the complexity analysis and more work is needed to get them to match.