

1. Derive the formulas for (i) number of comparisons, and (ii) average-case number of swaps for bubble sort [0.4 pts]

(i) We will demonstrate through an example:

Consider an array of length k .

In the first pass, the largest element in the array will be bubbled up to the end of the array. In order to do this, we need $k-1$ comparisons since the last element is not compared with any of the other elements.

Then, in the second pass, the second largest element will be bubbled-up to the second last position.

Consequently, for this to work, we will need $k-2$ comparisons since now, the last two elements won't need to be compared with any other element. (because they're already in their correct positions.)

This pattern will continue with each pass until the end, where the smallest element will already be in its correct index.

Thus, the total number of comparisons in a bubble sort is given by:

$$\text{Total Number of Comparisons} = (n*(n-1))/2 = (n^2-n)/2$$