**In-place and Out-place**

Q1. What is the difference between in-place and out-place sorting algorithms?

Ans. **In-place**

In-Place Algorithms mean that the algorithm doesn't use extra space for input manipulation. As the algorithm executes, the input is usually overwritten by the output, and no additional space is needed for this operation. Thus, It saves additional memory consumption.

An in-place algorithm transforms the input without using any extra memory. It may require a small amount of extra memory for its operation. However, the amount of memory required must not be dependent on the input size and should be constant. An in-place sorting algorithm sorts the elements in place: that is, it needs only O(1) extra space. It writes output in write-only memory, so it’s become more appropriate to consider only the working part of the algorithm.

**Out-place**

Out-of Place algorithm is Opposite to the In-place algorithm, it is also called an Out-in-place algorithm. Unlike an in-place algorithm, the extra space used by an out-of-place algorithm depends on the input size.

The merging can be done in-place, but it increases the time complexity of the sorting routine. An out-of-place sorting algorithm needs extra space to put the elements in as it's sorting them, this means O(n) extra space.

The standard merge sort algorithm is an example of out-of-place algorithm as it requires O(n) extra space for merging.

Q3. Suggest some practical examples of using in-place and out-place techniques.

Ans. Quick sort, heap sort, and insertion sort are in-place sorting algorithms. These algorithms require only a few pointers, so their space complexity is O(log n). Quicksort operates in-place on the data to be sorted. for example, (1) how tailors arrange shirts in a cupboard, they always keep them in sorted order of size and thus insert new shirts at the right position very quickly by moving other shirts forward to keep the right place for a new shirt. (2) Arranging a pack of playing cards. (3) It can be applied to a sim card store where there are many customers in line.

The standard merge sort algorithm is an example of out-of-place algorithm as it requires O(n) extra space for merging. (1) Used in database scenarios. (2) Useful in distributed scenarios where additional data arrive during or after sorting.