**Exercise 3: Sorting Customer Orders**

Q. Explain different sorting algorithms (Bubble Sort, Insertion Sort, Quick Sort, Merge Sort).

A.

**1. Bubble Sort** is the simplest [sorting algorithm](https://www.geeksforgeeks.org/sorting-algorithms/) that works by repeatedly swapping the adjacent elements if they are in the wrong order. This algorithm is not suitable for large data sets as its average and worst-case time complexity is quite high.

**2. Insertion Sort** is a simple sorting algorithm that works by iteratively inserting each element of an unsorted list into its correct position in a sorted portion of the list. It is a stable sorting algorithm, meaning that elements with equal values maintain their relative order in the sorted output.

**3. Quick Sort** is a sorting algorithm based on the Divide and Conquer algorithm that picks an element as a pivot and partitions the given array around the picked pivot by placing the pivot in its correct position in the sorted array.

**4. Merge Sort** is a sorting algorithm that follows the divide-and-conquer approach. It works by recursively dividing the input array into smaller subarrays and sorting those subarrays then merging them back together to obtain the sorted array.

Q. Compare the performance (time complexity) of Bubble Sort and Quick Sort.

A. **Bubble Sort- Time Complexity**:

* **Best Case**: O(n) (when the list is already sorted)
* **Average Case**: O(n²)
* **Worst Case**: O(n²) (when the list is sorted in reverse order)

**Quick Sort -Time Complexity**:

* **Best Case**: O(n log n) (when the pivot selection divides the list into nearly equal parts)
* **Average Case**: O(n log n) (when the pivot selection generally divides the list into balanced partitions)
* **Worst Case**: O(n²) (when the pivot selection consistently results in highly unbalanced partitions, such as always choosing the smallest or largest element as the pivot)

Q. Discuss why Quick Sort is generally preferred over Bubble Sort.

A. Quick Sort is preferred over Bubble Sort because:

1. **Time Complexity**: Quick Sort has an average time complexity of O(n log n), whereas Bubble Sort has O(n²). This makes Quick Sort faster for large datasets.
2. **Efficiency**: Quick Sort handles large lists more efficiently by dividing the problem into smaller subproblems, while Bubble Sort’s performance degrades significantly with larger lists.
3. **Algorithm Design**: Quick Sort uses a divide-and-conquer approach, which is generally more efficient than Bubble Sort’s repetitive comparisons and swaps.