

Difference between Merge Sort and Quick Sort

Merge Sort and Quick Sort are two popular algorithms for sorting an array or a list of elements. Although both algorithms are efficient and have a similar time complexity, there are some significant differences between them. In this section, we will discuss the differences between Merge Sort and Quick Sort.

Merge Sort

Merge Sort is a divide-and-conquer algorithm that recursively splits an array into halves until each sub-array has only one element. Then, it merges the sub-arrays in a sorted order until the entire array is sorted. The merge operation is the most critical part of the Merge Sort algorithm. The merge operation combines two sorted sub-arrays into a single sorted array.

- Merge Sort has a time complexity of $O(n \log n)$ in the worst case, average case, and best case.
- Merge Sort is a stable sorting algorithm, meaning that it maintains the relative order of equal elements in the sorted output.
- Merge Sort requires additional memory to store the sub-arrays during the sorting process. It needs $O(n)$ extra space in the worst case.

Quick Sort

Quick Sort is also a divide-and-conquer algorithm that recursively partitions an array into two sub-arrays based on a pivot element. The pivot element is an arbitrary element in the array that is used to partition the array into two sub-arrays: one with elements smaller than the pivot and another with elements greater than the pivot. Then, it recursively sorts the sub-arrays using the same process.

- Quick Sort has an average-case time complexity of $O(n \log n)$, but in the worst case, it has a time complexity of $O(n^2)$.
- Quick Sort is not a stable sorting algorithm, meaning that it may change the relative order of equal elements in the sorted output.
- Quick Sort does not require additional memory to store the sub-arrays during the sorting process. It sorts the array in place.

Comparison

The following are the main differences between Merge Sort and Quick Sort:

- Merge Sort is a stable sorting algorithm, while Quick Sort is not.
- Merge Sort requires extra memory to store the sub-arrays during the sorting process, while Quick Sort sorts the array in place.
- Merge Sort has a worst-case time complexity of $O(n \log n)$, while Quick Sort has a worst-case time complexity of $O(n^2)$.
- Merge Sort is suitable for sorting linked lists, while Quick Sort is not.

In conclusion, both algorithms have their advantages and disadvantages. Merge Sort is a better choice when stability is required, and additional memory is not an issue. Quick Sort is a better choice when in-place sorting is required, and average-case performance is more important than worst-case performance.