158.

1. Implement the Merge Sort algorithm in a programming language of your choice and test it on the array 12,4,78,23,45,67,89,1. Modify your implementation to count the number of comparisons made during the sorting process. Print this count along with the sorted array.

Test Cases :
Input : N= 8, a[] = {12,4,78,23,45,67,89,1}
Output : 1,4,12,23,45,67,78,89
Code:

```
def merge_sort(arr):
    comparison_count = 0

    def merge_sort_recursive(arr):
        nonlocal comparison_count
        if len(arr) > 1:
            mid = len(arr) // 2
            L = arr[:mid]
            R = arr[mid:]

            merge_sort_recursive(L)
            merge_sort_recursive(R)
            i = j = k = 0

            while i < len(L) and j < len(R):
                comparison_count += 1
                if L[i] < R[j]:
                    arr[k] = L[i]
                    i += 1
                else:
                    arr[k] = R[j]
                    j += 1
                k += 1


            while i < len(L):
                arr[k] = L[i]
                i += 1
                k += 1

            while j < len(R):
                arr[k] = R[j]
                j += 1
                k += 1

    merge_sort_recursive(arr)
    return comparison_count

def print_array(arr):
    return " ".join(map(str, arr))

N = 8
a = [12, 4, 78, 23, 45, 67, 89, 1]

print("Given array is:")
given_array = print_array(a)
```

```
comparison_count = merge_sort(a)

print("Sorted array is:")
sorted_array = print_array(a)

print("Number of comparisons:", comparison_count)

given_array, sorted_array, comparison_count
```

output:

```
PS C:\Users\karth>
PS C:\Users\karth> & C:/Users/karth/AppData/Local/Programs/Python/Python312/python.exe c:/Users/karth/OneDrive/Desktop/csa0863_karthik/PROBLEM.py
Given array is:
Sorted array is:
Number of comparisons: 16
PS C:\Users\karth>
```

Time complexity:f(n)=o(nlogn)