Exp-3.4

Title:

Merge Sort Algorithm for Sorting an Unsorted Array

Aim:

To implement the Merge Sort algorithm and modify it to count the number of comparisons made during the sorting process, and print the count along with the sorted array.

Algorithm

1. Start.
2. If the array length is 1 or 0, return the array and zero comparisons.
3. Split the array into two halves.
4. Recursively apply Merge Sort on both halves, accumulating comparison counts.
5. Merge the two sorted halves while counting comparisons during merging.
6. Return the merged sorted array along with the total comparison count.
7. Stop.

Input:

Sorted array: 1,4,12,23,45,67,78,89

Number of comparisons: 15

Output:

Sorted array: 1,4,12,23,45,67,78,89

Number of comparisons: 15

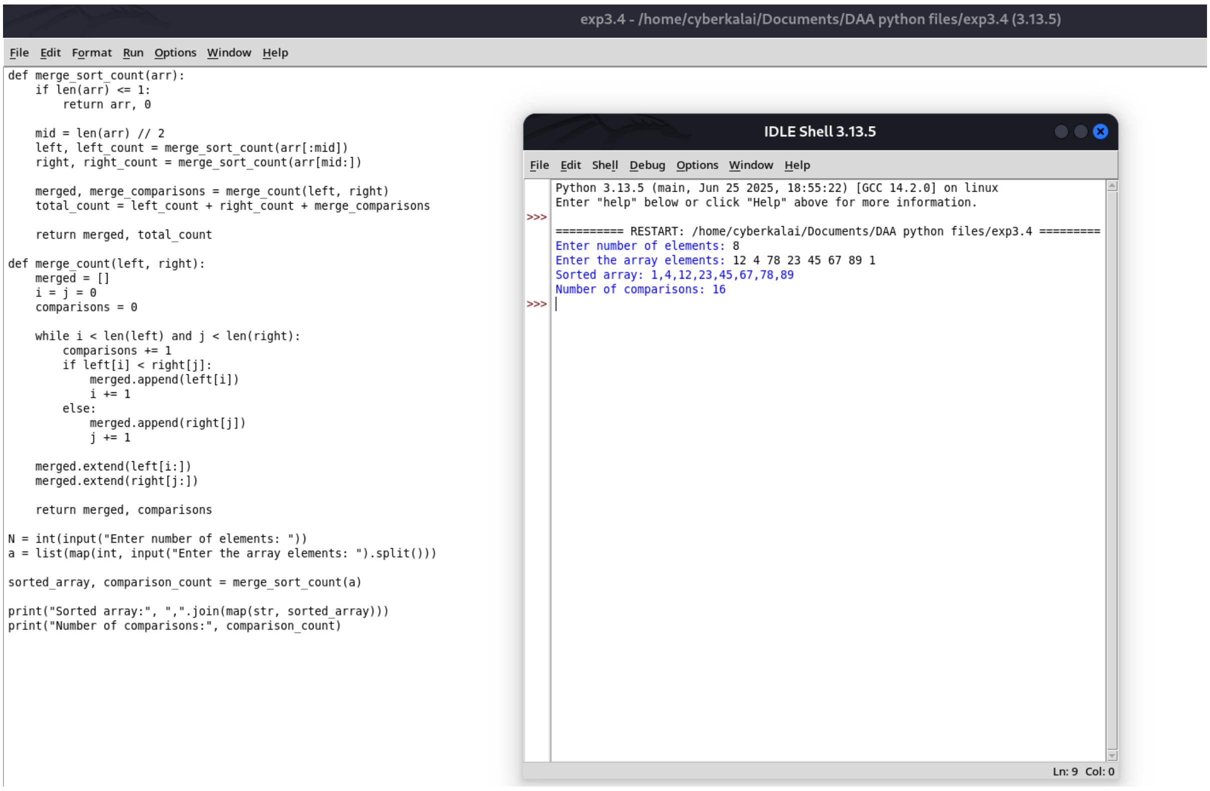
Program:

```
def merge_sort_count(arr):
    if len(arr) <= 1:
        return arr, 0

    mid = len(arr) // 2
    left, left_count = merge_sort_count(arr[:mid])
    right, right_count = merge_sort_count(arr[mid:])

    merged, merge_comparisons = merge_count(left, right)  # Renamed to avoid conflict
    total_count = left_count + right_count + merge_comparisons

    return merged, total_count

def merge_count(left, right):
    merged = []
    i = j = 0
    comparisons = 0

    while i < len(left) and j < len(right):
        comparisons += 1
        if left[i] < right[j]:
            merged.append(left[i])
            i += 1
        else:
            merged.append(right[j])
            j += 1
    merged.extend(left[i:])
    merged.extend(right[j:])

    return merged, comparisons

N = int(input("Enter number of elements: "))
a = list(map(int, input("Enter the array elements: ").split()))

sorted_array, comparison_count = merge_sort_count(a)

print("Sorted array:", ",".join(map(str, sorted_array)))
print("Number of comparisons:", comparison_count)
```

Performance Analysis:

- **Time Complexity: O(n log n)**
- **Space Complexity: O(n)**

Program Output:



exp3.4 - /home/cyberkalai/Documents/DAA python files/exp3.4 (3.13.5)
File Edit Format Run Options Window Help
IDLE Shell 3.13.5
File Edit Shell Debug Options Window Help
Ln: 9 Col: 0

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    merged.extend(left[i:])
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```
Python 3.13.5 (main, Jun 25 2025, 18:55:22) [GCC 14.2.0] on linux
Enter "help" below or click "Help" above for more information.
>>>
========== RESTART: /home/cyberkalai/Documents/DAA python files/exp3.4 =========
Enter number of elements: 8
Enter the array elements: 12 4 78 23 45 67 89 1
Sorted array: 1,4,12,23,45,67,78,89
Number of comparisons: 16
>>>
```

Result:

Thus, the modified Merge Sort program executed successfully with comparison counting.