

ABBOTABAD UNIVERSITY OF SCIENCE AND TECHNOLOGY



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SECTION : C

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SUBJECT : DSA

Question 1:

```
assq1.py > merge_sort
1  def merge_sort(arr):
2      if len(arr) <= 1:
3          return arr, 0
4      mid = len(arr) // 2
5      left, left_inversions = merge_sort(arr[:mid])
6      right, right_inversions = merge_sort(arr[mid:])
7      merged, split_inversions = merge(left, right)
8      total_inversions = left_inversions + right_inversions + split_inversions
9      return merged, total_inversions
10 def merge(left, right):
11     merged = []
12     inversions = 0
13     i = j = 0
14     while i < len(left) and j < len(right):
15         if left[i] <= right[j]:
16             merged.append(left[i])
17             i += 1
18         else:
19             merged.append(right[j])
20             j += 1
21             inversions += len(left) - i
22     merged.extend(left[i:])
23     merged.extend(right[j:])
24     return merged, inversions
25 arr = [5, 2, 6, 1]
26 sorted_arr, inversions = merge_sort(arr)
27 print("Sorted Array:", sorted_arr)
28 print("Number of Inversions:", inversions)
29
```

Out put:

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

PS C:\Users\hp\OneDrive\Desktop\pyto> python -u "c:\Users\hp\OneDrive\Desktop\pyto\assq1.py"
Sorted Array: [1, 2, 5, 6]
Number of Inversions: 4
PS C:\Users\hp\OneDrive\Desktop\pyto>
```

Question 2:

```
ms q2.py > ...
1 class ListNode:
2     def __init__(self, value=0, next=None):
3         self.value = value
4         self.next = next
5 def merge_sort_linked_list(head):
6     if head is None or head.next is None:
7         return head
8     mid = find_middle(head)
9     left_half = head
10    right_half = mid.next
11    mid.next = None
12    left_half = merge_sort_linked_list(left_half)
13    right_half = merge_sort_linked_list(right_half)
14    return merge(left_half, right_half)
15
16 def find_middle(head):
17     slow_ptr = head
18     fast_ptr = head
19
20     while fast_ptr.next is not None and fast_ptr.next.next is not None:
21         slow_ptr = slow_ptr.next
22         fast_ptr = fast_ptr.next.next
23
24     return slow_ptr
25 def merge(left, right):
26     dummy = ListNode()
27     current = dummy
28     while left is not None and right is not None:
29         if left.value < right.value:
30             current.next = left
31             left = left.next
32         else:
33             current.next = right
34             right = right.next
35
36         current = current.next
37     if left is not None:
38         current.next = left
39     else:
40         current.next = right
41
42     return dummy.next
43 def print_linked_list(head):
44     current = head
45     while current:
46         print(current.value, end=" -> ")
47         current = current.next
48     print("None")
49 head = ListNode(5, ListNode(2, ListNode(6, ListNode(1))))
50 sorted_head = merge_sort_linked_list(head)
51 print("Sorted Linked List:")
52 print_linked_list(sorted_head)
53
```

Output:

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
PS C:\Users\hp\OneDrive\Desktop\pyto> python -u "c:\Users\hp\OneDrive\Desktop\pyto\ass q2.py"
Sorted Linked List:
1 -> 2 -> 5 -> 6 -> None
PS C:\Users\hp\OneDrive\Desktop\pyto>
```

Question 3:

```
assq3.py > merge_descending
1  def merge_sort_descending(arr):
2      if len(arr) <= 1:
3          return arr
4
5      mid = len(arr) // 2
6      left = arr[:mid]
7      right = arr[mid:]
8
9      left = merge_sort_descending(left)
10     right = merge_sort_descending(right)
11
12     return merge_descending(left, right)
13
14  def merge_descending(left, right):
15      merged = []
16      i = j = 0
17
18      while i < len(left) and j < len(right):
19          if left[i] >= right[j]:
20              merged.append(left[i])
21              i += 1
22          else:
23              merged.append(right[j])
24              j += 1
25      merged.extend(left[i:])
26      merged.extend(right[j:])
27      return merged
28
29  arr = [5, 2, 6, 1, 9, 3]
30  sorted_arr_descending = merge_sort_descending(arr)
31  print("Sorted Array in Descending Order:", sorted_arr_descending)
```

Out put:

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS
PS C:\Users\hp\OneDrive\Desktop\pyto> python -u "c:\Users\hp\OneDrive\Desktop\pyto\assq3.py"
Sorted Array in Descending Order: [9, 6, 5, 3, 2, 1]
PS C:\Users\hp\OneDrive\Desktop\pyto>
```


Question 4:

```
1  def multiway_merge_sort(arr):
2      if len(arr) <= 1:
3          return arr
4      mid = len(arr) // 2
5      left = arr[:mid]
6      right = arr[mid:]
7      left = multiway_merge_sort(left)
8      right = multiway_merge_sort(right)
9      return multiway_merge(left, right)
10 def multiway_merge(left, right):
11     merged = []
12     i = j = 0
13     while i < len(left) and j < len(right):
14         if left[i] <= right[j]:
15             merged.append(left[i])
16             i += 1
17         else:
18             merged.append(right[j])
19             j += 1
20     merged.extend(left[i:])
21     merged.extend(right[j:])
22     return merged
23 arr = [5, 2, 6, 1, 9, 3, 4, 7]
24 sorted_arr = multiway_merge_sort(arr)
25 print("Sorted Array:", sorted_arr)
26
```

Output:

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS

PS C:\Users\hp\OneDrive\Desktop\pyto> python -u "c:\Users\hp\OneDrive\Desktop\pyto\assq4.py"
Sorted Array: [1, 2, 3, 4, 5, 6, 7, 9]
PS C:\Users\hp\OneDrive\Desktop\pyto>
```

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