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ASSIGNMENT 3

➢ Question 1:

Implementation of Merge sort.

TC: O(n Log n)

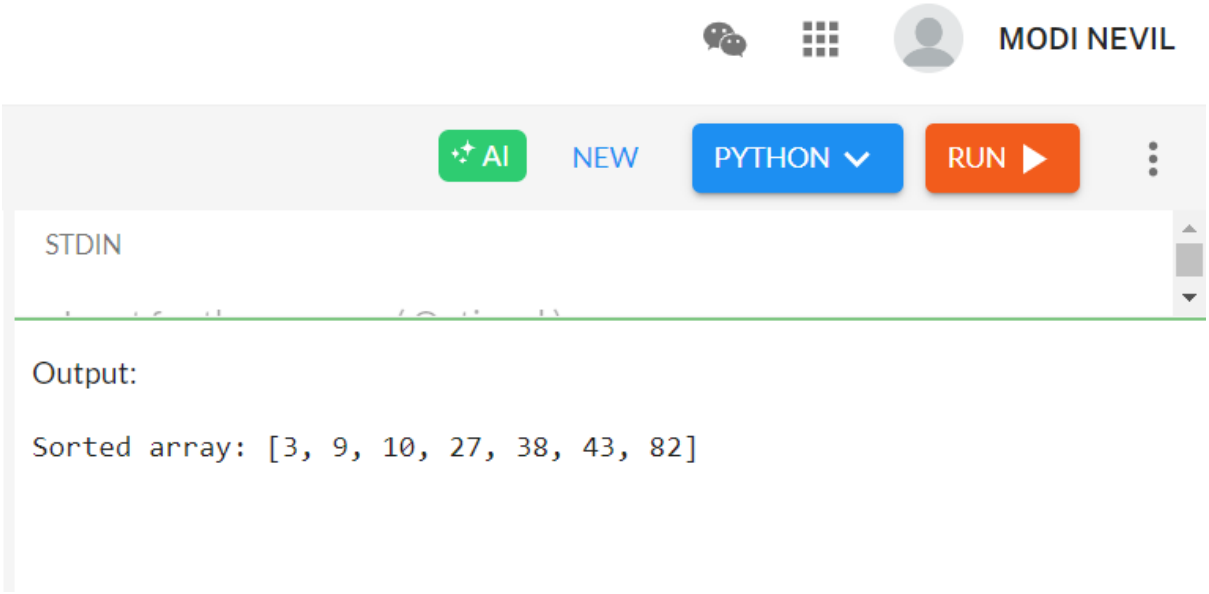
➢ Solution:

- Source Code:

```
def merge(left, right):
    merged = []
    i = j = 0
    while i < len(left) and j < len(right):
        if left[i] <= right[j]:
            merged.append(left[i])
            i += 1
        else:
            merged.append(right[j])
            j += 1
    while i < len(left):
        merged.append(left[i])
        i += 1
    while j < len(right):
        merged.append(right[j])
        j += 1
    return merged
def merge_sort(arr):
    if len(arr) <= 1:
        return arr
    mid = len(arr) // 2
    left_half = merge_sort(arr[:mid])
    right_half = merge_sort(arr[mid:])
    return merge(left_half, right_half)
arr = [38, 27, 43, 3, 9, 82, 10]
```

```
sorted_arr = merge_sort(arr)
print("Sorted array:", sorted_arr)
```

- Output:



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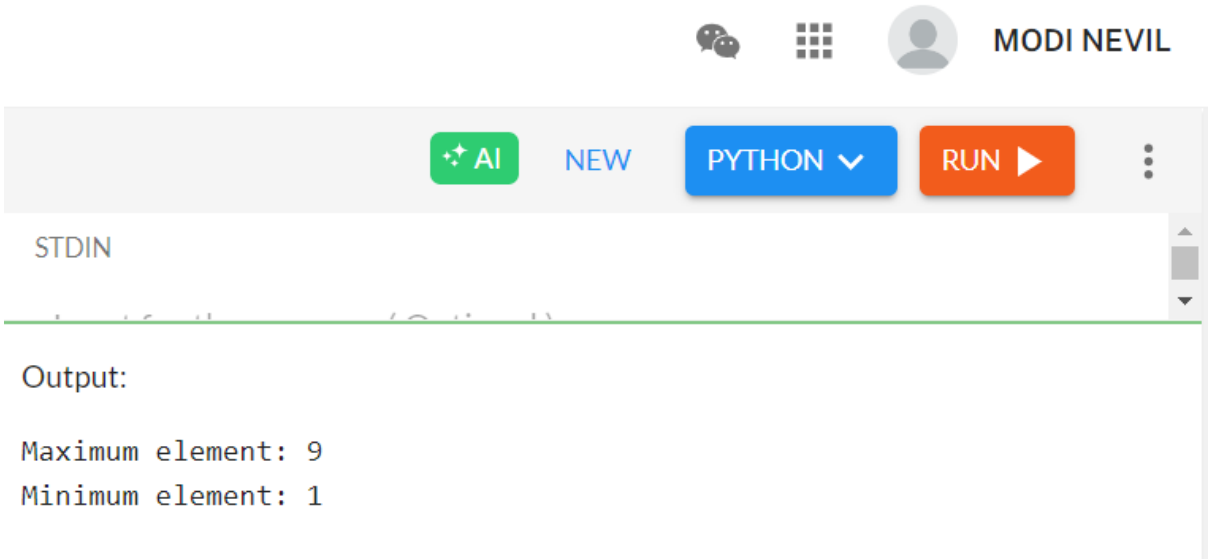
- Question 2:
  Implementation of Max-Min by using Divide and Conquer principal
  TC: O(n)
- Solution:
  - Source code:

```
def find_max_min(arr, low, high):
    if low == high:
        return arr[low], arr[low]

    elif high == low + 1:
        if arr[low] > arr[high]:
            return arr[low], arr[high]
        else:
            return arr[high], arr[low]

    mid = (low + high) // 2
    max1, min1 = find_max_min(arr, low, mid)
    max2, min2 = find_max_min(arr, mid + 1, high)

    overall_max = max(max1, max2)
    overall_min = min(min1, min2)

    return overall_max, overall_min

arr = [3, 5, 1, 8, 9, 2, 7, 6]
n = len(arr)
maximum, minimum = find_max_min(arr, 0, n - 1)
print(f"Maximum element: {maximum}")
print(f"Minimum element: {minimum}")
```

  - Output:



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- Question 3:
  Fractional Knapsack GeeksForGeeks Implementation of Fractional KnapSack TC: O(n log n) (Problem Statement: The weight of N items and their corresponding values are given. We have to put these items in a knapsack of weight W such that the total value obtained is maximized.)
- Solution:
  - Source code:

```
class Item:
    def __init__(self,val,w):
        self.value = val
        self.weight = w
class Solution:
    def fractionalknapsack(self, w,arr,n):
        prof = [arr[i].value / arr[i].weight for i in range(n)]
        items = [[prof[i], arr[i].value, arr[i].weight] for i in range(n)]
        items.sort(key=lambda x: x[0], reverse=True)
        profit = 0
        i = 0
        while w > 0 and i < n:
            if items[i][2] <= w:
                profit += items[i][1]
                w -= items[i][2]
            else:
                profit += items[i][0] * w
                w = 0
            i += 1
        return profit
```

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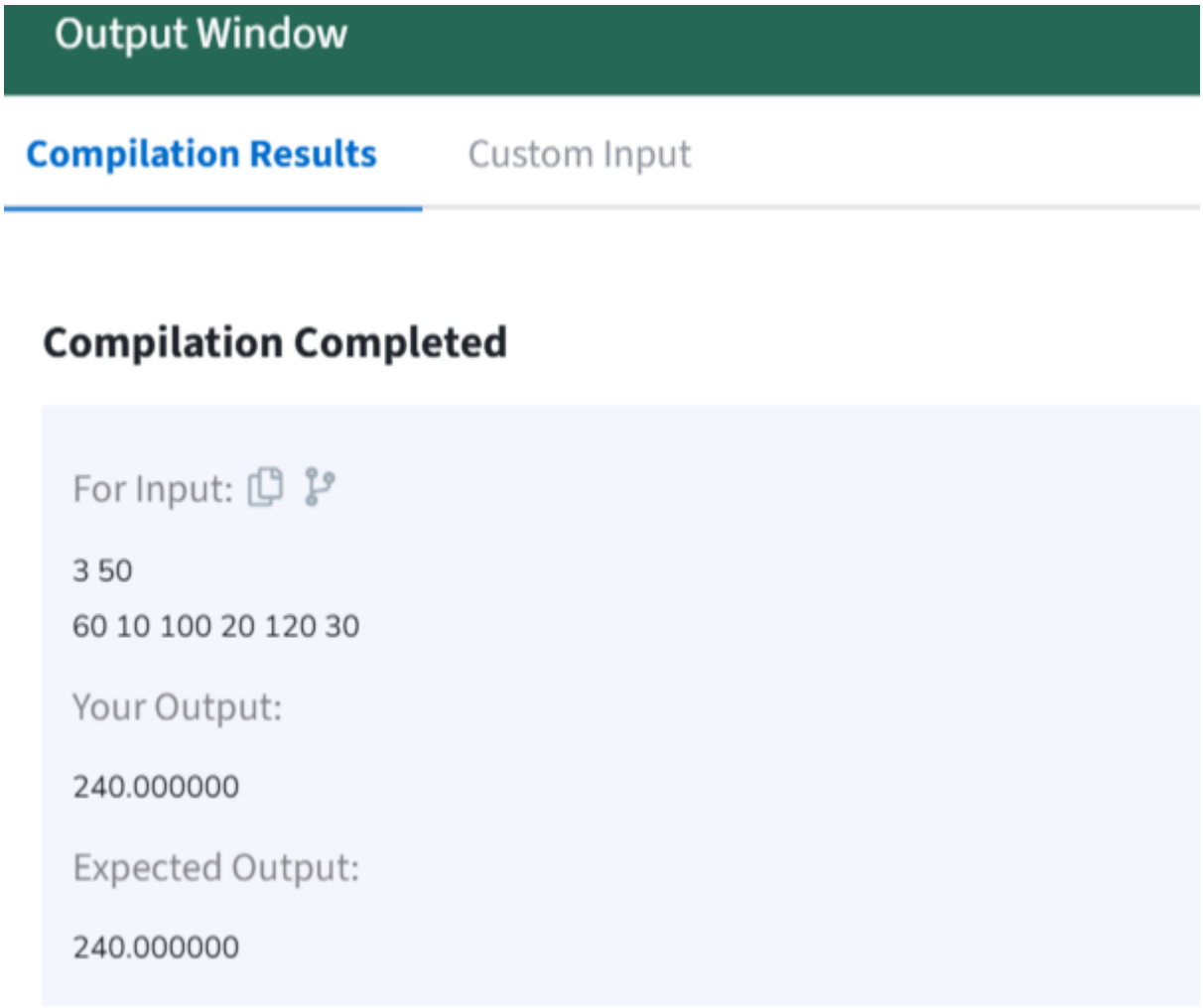
- Output:



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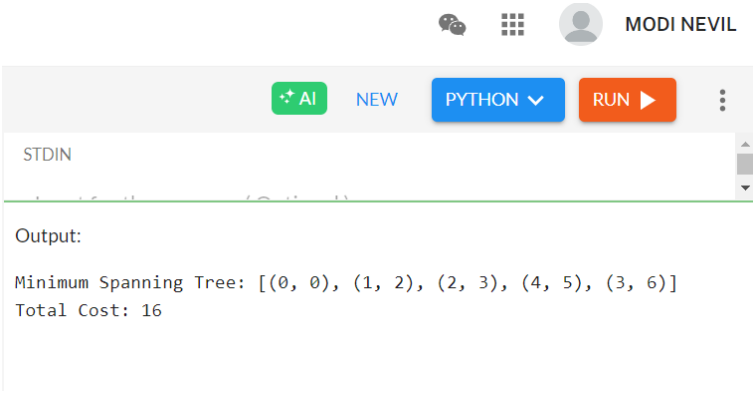
- Question 4:
  Implementation of Prim's Algorithm.
- Solution:
  - Source code:

```
import heapq

def prim(graph, start):
    mst = []
    visited = set()
    min_heap = [(0, start)]
    total_cost = 0

    while min_heap:
        cost, node = heapq.heappop(min_heap)
        if node in visited:
            continue
        visited.add(node)
        total_cost += cost
        mst.append((node, cost))

        for neighbor, weight in graph[node]:
            if neighbor not in visited:
                heapq.heappush(min_heap, (weight, neighbor))

    return mst, total_cost

graph = {
    0: [(1, 2), (3, 6)],
    1: [(0, 2), (2, 3), (3, 8), (4, 5)],
    2: [(1, 3), (4, 7)],
    3: [(0, 6), (1, 8)],
    4: [(1, 5), (2, 7)]
}
mst, total_cost = prim(graph, 0)
print("Minimum Spanning Tree:", mst)
print("Total Cost:", total_cost)
```

  - Output:



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- Question 5:

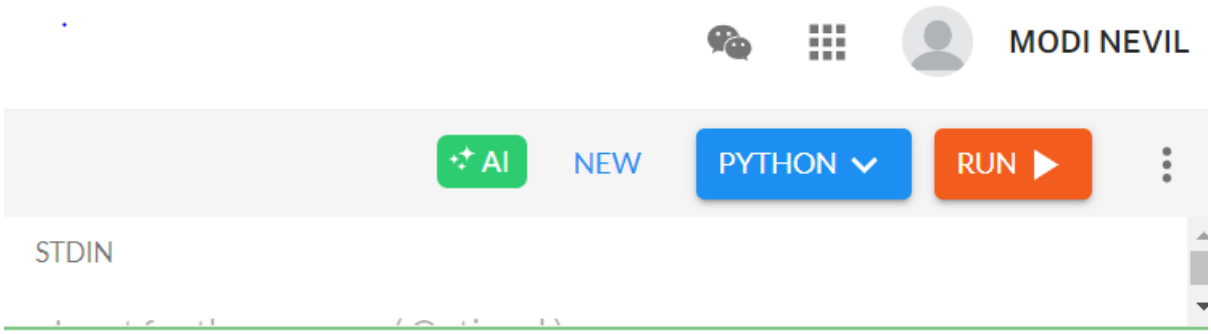
Assign Cookies. (Assume you are an awesome parent and want to give your children some cookies. But, you should give each child at most one cookie.) Leetcode problem number: 455

- Solution:
  - Source code:

```
def find_content_children(g, s):
    g.sort()
    s.sort()
    i = j = 0
    while i < len(g) and j < len(s):
        if s[j] >= g[i]:
            i += 1
        j += 1
    return i

g = [1, 2, 3]
s = [1, 1]
result = find_content_children(g, s)
print(result)
```

  - Output:



Output:

1

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- Question 6:
  Maximum Units on a Truck. Leetcode problem number: 1710
- Solution:
  - Source Code:

```
class Solution:
    def maximumUnits(self, boxTypes: List[List[int]], truckSize: int) -> int:
        boxTypes.sort(key=lambda x: x[1], reverse=True)
        total_units = 0
        for box_count, units in boxTypes:
            if truckSize == 0:
                break
            if box_count <= truckSize:
                total_units += box_count * units
                truckSize -= box_count
            else:
                total_units += truckSize * units
                truckSize = 0
        return total_units
```

  - Solution:

Input

boxTypes =

```
[[1,3],[2,2],[3,1]]
```

truckSize =

```
4
```

Output

```
8
```

Expected

```
8
```

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- Question 7:
  Lemonade Change. Leetcode problem number: 860
- Solution:
  - Source Code:

```
class Solution:
    def lemonadeChange(self, bills: List[int]) -> bool:
        five, ten = 0, 0
        for bill in bills:
            if bill == 5:
                five += 1
            elif bill == 10:
                if five > 0:
                    five -= 1
                    ten += 1
                else:
                    return False
            elif bill == 20:
                if ten > 0 and five > 0:
                    ten -= 1
                    five -= 1
                elif five >= 3:
                    five -= 3
                else:
                    return False
        return True
```

  - Solution:

Input

bills =

```
[5,5,5,10,20]
```

Output

```
true
```

Expected

```
true
```

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- Question 8:
  Merge Intervals Leetcode problem number: 56
- Solution:
  - Source Code:

```
class Solution:
    def merge(self, intervals: List[List[int]]) -> List[List[int]]:
        intervals.sort(key=lambda x: x[0])
        merged = []

        for interval in intervals:
            if not merged or merged[-1][1] < interval[0]:
                merged.append(interval)
            else:
                merged[-1][1] = max(merged[-1][1], interval[1])

        return merged
```

  - Output:

Input

intervals =

```
[[1,3],[2,6],[8,10],[15,18]]
```

Output

```
[[1,6],[8,10],[15,18]]
```

Expected

```
[[1,6],[8,10],[15,18]]
```

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- Question 9:
  LCS LeetCode problem number 1143
- Solution:
  - Source Code:

```
class Solution:
    def longestCommonSubsequence(self, text1: str, text2: str) -> int:
        m, n = len(text1), len(text2)
        dp = [[0] * (n + 1) for _ in range(m + 1)]
        for i in range(1, m + 1):
            for j in range(1, n + 1):
                if text1[i - 1] == text2[j - 1]:
                    dp[i][j] = dp[i - 1][j - 1] + 1
                else:
                    dp[i][j] = max(dp[i - 1][j], dp[i][j - 1])
        return dp[m][n]
```

  - Output:

Input

text1 =

"abcde"

text2 =

"ace"

Output

3

Expected

3

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- Question 10:
  Numberof Coins GeeksForGeeks
- Solution:
  - Source Code:

```
class Solution:
    def minCoins(self, coins, M, sum):
        k = float("inf")
        dp = [[k for _ in range(sum + 1)] for _ in range(M + 1)]
        dp[0][0] = 0
        for i in range(1, M + 1):
            for j in range(1, sum + 1):
                if coins[i - 1] <= j:
                    dp[i][j] = min(dp[i][j - coins[i - 1]] + 1, dp[i - 1][j])
                else:
                    dp[i][j] = dp[i - 1][j]
        if dp[M][sum] == k:
            return -1
        return dp[M][sum]

    # Driver code
    if __name__ == "__main__":
        T = int(input())
        for i in range(T):
            v, m = input().split()
            v, m = int(v), int(m)
            coins = [int(x) for x in input().split()]
            ob = Solution()
            ans = ob.minCoins(coins, m, v)
            print(ans)
```

  - Output: