

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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AI NEW PYTHON RUN

STDIN

Input for the program (Optional)

Output:

Sorted array: [3, 9, 10, 27, 38, 43, 82]

➤ 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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RUN ▶



STDIN

Input for the program (Optional)

Output:

```
Maximum element: 9  
Minimum element: 1
```

➤ 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
```

- Output:

```
Compilation Results Custom Input Y.O.G.I. (AI Bot)

Compilation Completed

For Input: [ 3 50 ]
60 10 100 20 120 30

Your Output:
240.000000

Expected Output:
240.000000
```

➤ 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))

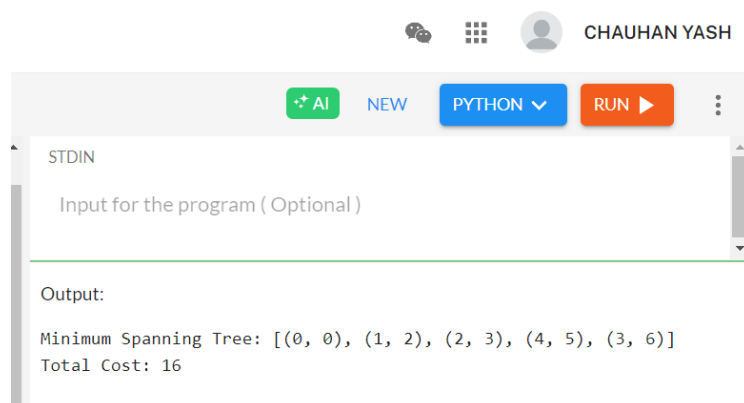
        for neighbor, weight in graph[node]:
            if neighbor not in visited:
                heapq.heappush(min_heap, (weight, neighbor))

    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:



The screenshot shows a code editor interface with a user profile 'CHAUHAN YASH' at the top right. The editor has a toolbar with 'AI', 'NEW', 'PYTHON', and 'RUN' buttons. The main area displays the output of the program, which is: 'Minimum Spanning Tree: [(0, 0), (1, 2), (2, 3), (4, 5), (3, 6)]' and 'Total Cost: 16'.

➤ 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:

The screenshot shows a LeetCode test result interface. At the top, there are tabs for 'Testcase' and 'Test Result'. The status 'Accepted' is displayed in green, along with the runtime 'Runtime: 29 ms'. Below this, there are two tabs for 'Case 1' and 'Case 2'. The 'Input' section shows two variables: 'g =' with the value '[1,2,3]' and 's =' with the value '[1,1]'. The 'Output' section shows the value '1'. The 'Expected' section also shows the value '1'. At the bottom, there is a link to 'Contribute a testcase'.

➤ 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:

The screenshot shows a LeetCode interface for the 'Maximum Units on a Truck' problem. At the top, there are tabs for 'Testcase' and 'Test Result'. The 'Test Result' tab is active, showing a green 'Accepted' status and a runtime of 33 ms. Below this, there are two tabs for 'Case 1' and 'Case 2', with 'Case 1' selected. The 'Input' section shows two variables: 'boxTypes' with the value '[[1,3],[2,2],[3,1]]' and 'truckSize' with the value '4'. The 'Output' section shows the result '8'. The 'Expected' section also shows '8', indicating the test case passed. At the bottom, there is a link to 'Contribute a testcase'.

Testcase | Test Result

Accepted Runtime: 33 ms

Case 1 Case 2

Input

boxTypes =
[[1,3],[2,2],[3,1]]

truckSize =
4

Output

8

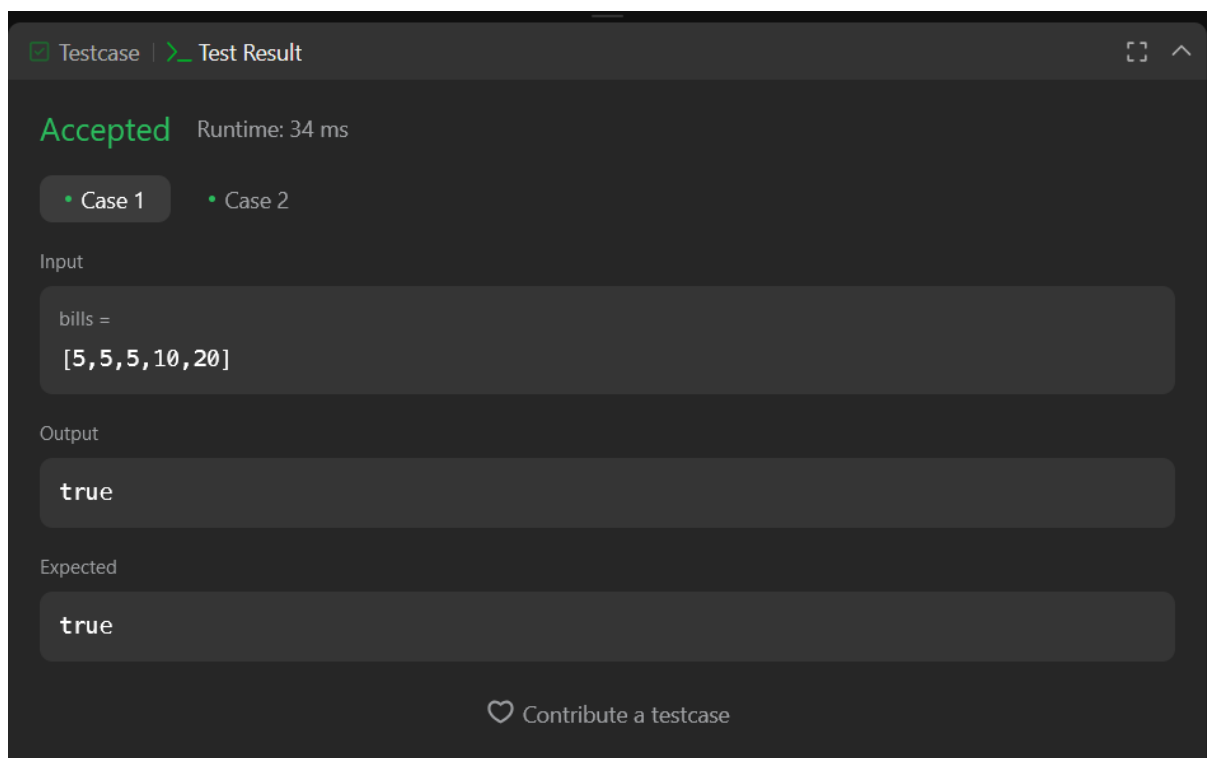
Expected

8

Contribute a testcase

➤ 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:

➤ 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:
```

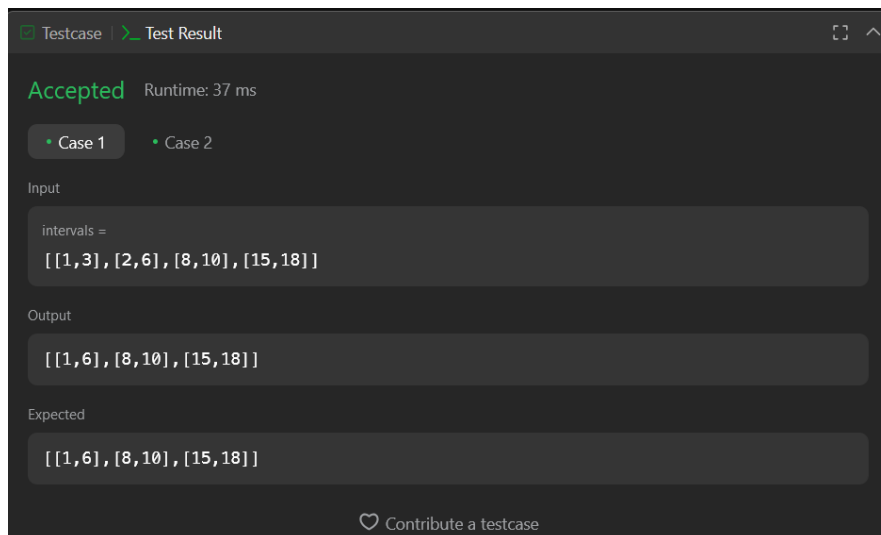
```
        if not merged or merged[-1][1] < interval[0]:
            merged.append(interval)
```

```
        else:
```

```
            merged[-1][1] = max(merged[-1][1], interval[1])
```

```
    return merged
```

- Output:



➤ 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]:

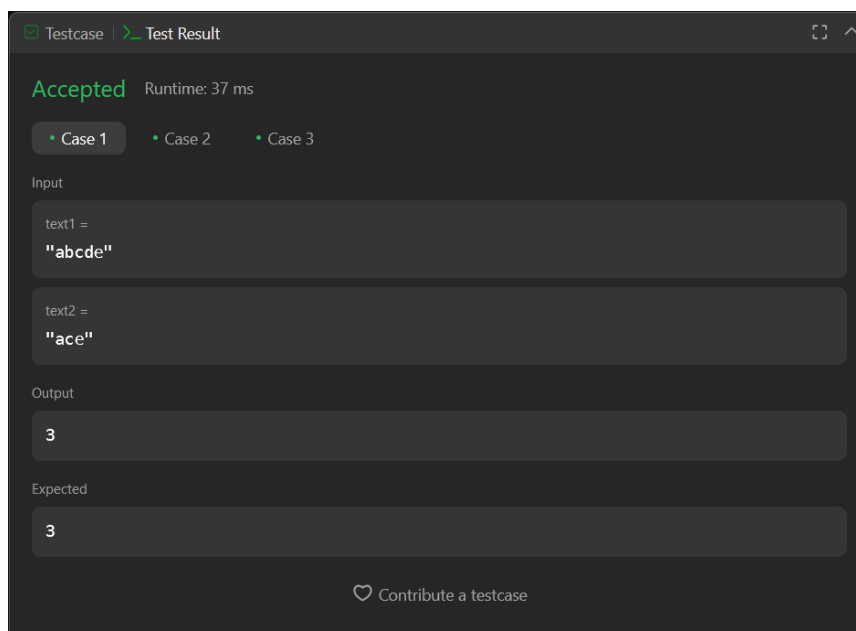
dp[i][j] = dp[i - 1][j - 1] + 1

else:

dp[i][j] = max(dp[i - 1][j], dp[i][j - 1])

return dp[m][n]

- Output:



➤ Question 10:**Number of 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:

The screenshot shows an IDE's Output Window with a dark theme. At the top, there are tabs for 'Compilation Results' (selected) and 'Custom Input'. Below the tabs, the text 'Compilation Completed' is displayed. Underneath, the input is shown as 'For Input: 30 3' followed by '25 10 5' on the next line. The output is shown as 'Your Output: 2'. At the bottom, the 'Expected Output:' is also shown as '2'. The window has standard OS controls (minimize, maximize, close) in the top right corner.