Competitive Programming

Lab Assignment 01

Name : **R Govardhan Sai Ganesh**

Hall Ticket No : **2303A54044**

Batch : **48**

Question 1: Fractional Knapsack (Greedy)

Problem Statement

You are given N items. Item i has value Vi and weight Wi. You have a knapsack of capacity W. You may take any fraction of an item (including the whole item). Your goal is to maximize the total value in the knapsack without exceeding the capacity. For each test case, output the maximum total value achievable. The result must be printed with exactly 6 digits after the decimal point.

Input Format

The first line contains an integer T, the number of test cases. For each test case: - The first line contains two integers N and W. - The next N lines each contain two integers Vi and Wi.

Output Format

For each test case, print one number: the maximum value, formatted to 6 decimal places.

Constraints

- 1 ≤ T ≤ 20

- 1 ≤ N ≤ 200000 (sum of N over all test cases ≤ 200000)

- 1 ≤ Vi, Wi, W ≤ 10^9

Sample Input

```
1
3 50
60 10
100 20
120 30
```

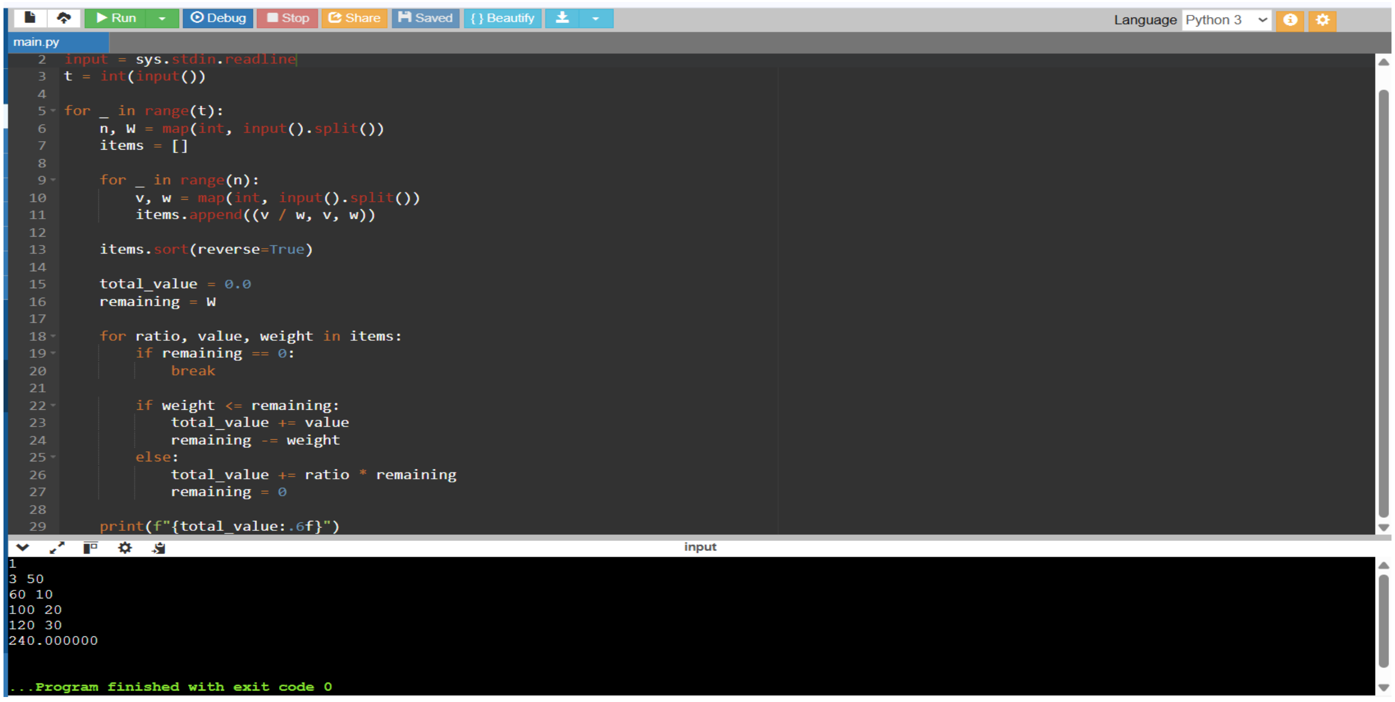
Expected Output: **240.000000**

Code:

```
import sys
input = sys.stdin.readline
```

```
t = int(input())
for _ in range(t):
    n, W = map(int, input().split())
    items = []
    for _ in range(n):
        v, w = map(int, input().split())
        items.append((v / w, v, w))
    items.sort(reverse=True)
    total_value = 0.0
    remaining = W

    for ratio, value, weight in items:
        if remaining == 0:
            break
        if weight <= remaining:
            total_value += value
            remaining -= weight
        else:
            total_value += ratio * remaining
            remaining = 0
    print(f"{total_value:.6f}")
```



Language Python 3

```
input = sys.stdin.readline
t = int(input())

for _ in range(t):
    n, W = map(int, input().split())
    items = []

    for _ in range(n):
        v, w = map(int, input().split())
        items.append((v / w, v, w))

    items.sort(reverse=True)

    total_value = 0.0
    remaining = W

    for ratio, value, weight in items:
        if remaining == 0:
            break

        if weight <= remaining:
            total_value += value
            remaining -= weight
        else:
            total_value += ratio * remaining
            remaining = 0

    print(f"{total_value:.6f}")
```

```
1
3 50
60 10
100 20
120 30
240.000000


...Program finished with exit code 0
```

Question 2: Package Priority Sorting (Divide and Conquer)

Problem Statement

A warehouse records package priority scores as integers. To dispatch efficiently, you must sort the scores in non-decreasing order using merge sort (divide and conquer). For each test case, output the sorted list.

Input Format

The first line contains integer T.For each test case:

- First line: N

- Second line: N integers (priority scores)

Output Format

For each test case, print the sorted array in one line (space-separated).

Constraints

- 1 ≤ T ≤ 20

- 1 ≤ N ≤ 200000 (sum of N over all test cases ≤ 200000)

- -10^9 ≤ Ai ≤ 10^9

Sample Input

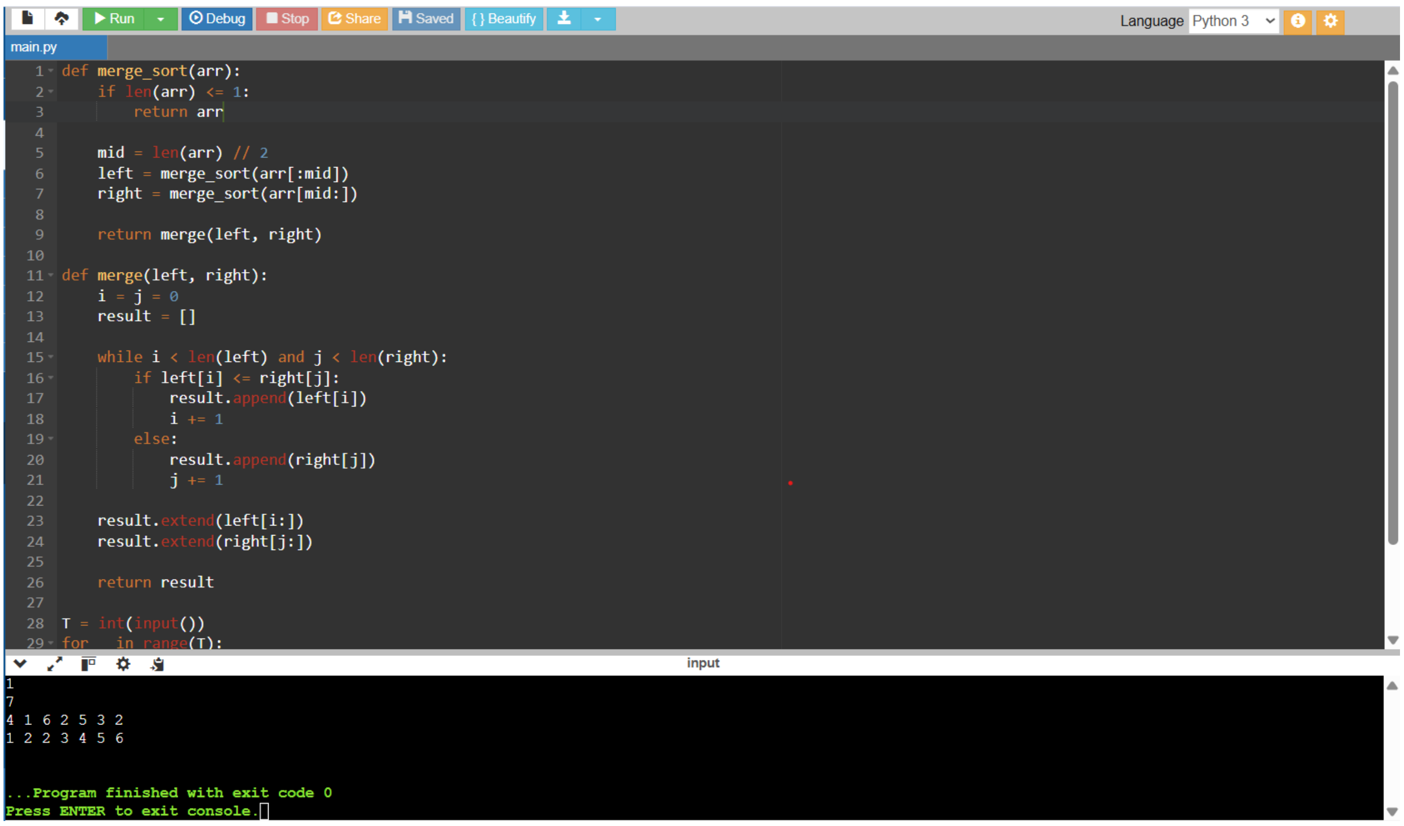
```
1
7
4 1 6 2 5 3 2
```

Expected Output

```
1 2 2 3 4 5 6
```

Code:

```
def merge_sort(arr):
    if len(arr) <= 1:
        return arr
    mid = len(arr) // 2
    left = merge_sort(arr[:mid])
    right = merge_sort(arr[mid:])
    return merge(left, right)
def merge(left, right):
    i = j = 0
    result = []
    while i < len(left) and j < len(right):
        if left[i] <= right[j]:
            result.append(left[i])
            i += 1
        else:
            result.append(right[j])
            j += 1
    result.extend(left[i:])
    result.extend(right[j:])
    return result
T = int(input())
for _ in range(T):
    N = int(input())
    arr = list(map(int, input().split()))
    sorted_arr = merge_sort(arr)
    print(" ".join(map(str, sorted_arr)))
```



```
def merge_sort(arr):
    if len(arr) <= 1:
        return arr

    mid = len(arr) // 2
    left = merge_sort(arr[:mid])
    right = merge_sort(arr[mid:])

    return merge(left, right)

def merge(left, right):
    i = j = 0
    result = []

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

    result.extend(left[i:])
    result.extend(right[j:])

    return result

T = int(input())
for _ in range(T):
```

```
1
7
4 1 6 2 5 3 2
1 2 2 3 4 5 6


...Program finished with exit code 0
Press ENTER to exit console.
```