

Competitive Programming

Lab Assignment 01

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Question 1: Fractional Knapsack (Greedy)

Problem Statement:

You are given N items. Item i has value V_i and weight W_i . 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 V_i and W_i .

Output Format:

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

Constraints:

- $1 \leq T \leq 20$
- $1 \leq N \leq 200000$ (sum of N over all test cases ≤ 200000)
- $1 \leq V_i, W_i, W \leq 10^9$

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}")

```

```

main.py
2 input = sys.stdin.readline
3 t = int(input())
4
5 for _ in range(t):
6     n, W = map(int, input().split())
7     items = []
8
9     for _ in range(n):
10         v, w = map(int, input().split())
11         items.append((v / w, v, w))
12
13     items.sort(reverse=True)
14
15     total_value = 0.0
16     remaining = W
17
18     for ratio, value, weight in items:
19         if remaining == 0:
20             break
21
22         if weight <= remaining:
23             total_value += value
24             remaining -= weight
25         else:
26             total_value += ratio * remaining
27             remaining = 0
28
29     print(f"{total_value:.6f}")

```

input

```

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:

- $1 \leq T \leq 20$
- $1 \leq N \leq 200000$ (sum of N over all test cases ≤ 200000)
- $-10^9 \leq A_i \leq 10^9$

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)))

```

The screenshot shows a Python IDE with a dark theme. The top toolbar includes icons for Run, Debug, Stop, Share, Saved, and Beautify. The language is set to Python 3. The editor displays the merge sort code from the previous block. The console at the bottom shows the program's execution with two test cases: [4, 1, 6, 2, 5, 3, 2] and [1, 2, 2, 3, 4, 5, 6], both of which are sorted correctly. The program ends with the message '...Program finished with exit code 0' and a prompt to press ENTER to exit the console.

```

main.py
1 def merge_sort(arr):
2     if len(arr) <= 1:
3         return arr
4
5     mid = len(arr) // 2
6     left = merge_sort(arr[:mid])
7     right = merge_sort(arr[mid:])
8
9     return merge(left, right)
10
11 def merge(left, right):
12     i = j = 0
13     result = []
14
15     while i < len(left) and j < len(right):
16         if left[i] <= right[j]:
17             result.append(left[i])
18             i += 1
19         else:
20             result.append(right[j])
21             j += 1
22
23     result.extend(left[i:])
24     result.extend(right[j:])
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26     return result
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28 T = int(input())
29 for _ in range(T):
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