Experiment-3.3

Aim of the Experiment :

Write a program to solve the Knapsack Problem Using Greedy Technique

1. Problem Description :

Solve the Knapsack Problem Using Greedy Technique and understand its time complexity.

2. Algorithm :

```
for i in range(1,n):
    calculate p/w
    Sort objects in descending order of p/w ratio
    if M>0 and wi<=M:
        M = M-wi
        p = p + pi
    else:
        p = p + pi(M/wi)
```

3. Complexity Analysis:

The time complexity for the Knapsack Problem Using Greedy Technique is O(NlogN), where N is the number of items in the knapsack. This is because the algorithm first sorts the items in descending order of their value-to-weight ratio, which takes O(NlogN) time. Then, the algorithm iterates through the items in sorted order, adding each item to the knapsack if there is enough space. This takes O(N) time.

Therefore, the overall time complexity is O(NlogN) + O(N) = O(NlogN).

4. Pseudo Code :

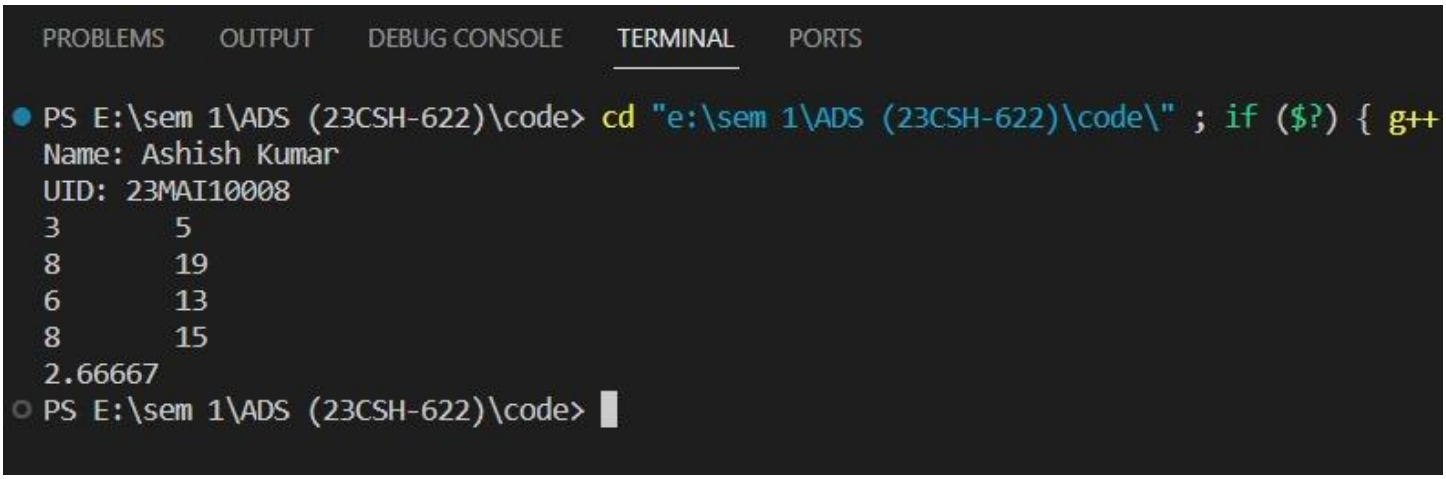
```
function knapsack(items, capacity):
  sort items by value-to-weight ratio in descending order
  current_weight = 0
  total_value = 0
  for item in items:
    if current_weight + item.weight <= capacity:
      current_weight += item.weight
      total_value += item.value
    else:
      fraction = (capacity - current_weight) / item.weight
      total_value += fraction * item.value
      current_weight += fraction * item.weight
      break
  return total_value
```

5. Source Code for Experiment :

```
#include <bits/stdc++.h>
using namespace std;

// Structure to represent an item
struct Item
{
   int value, weight;
};

// Function to compare two items
bool compare(Item a, Item b)
{
   double r1 = (double)a.value / (double)a.weight;
   double r2 = (double)b.value / (double)b.weight;
   return r1 > r2;
}

// Function to solve the knapsack problem
double fractionalKnapsack(Item items[], int n, int W)
{
   // Sort the items by value/weight ratio
   sort(items, items + n, compare);

   // Initialize the total value
   double totalValue = 0.0;

   // Iterate over the items
   for (int i = 0; i < n; i++)
   {
      // If the weight of the current item is less than the knapsack capacity
      if (items[i].weight <= W)
      {
         // Add the whole item to the knapsack
         totalValue += items[i].value;
```

```
            W -= items[i].weight;
        }
        else
        {
            // Add a fraction of the item to the knapsack
            double fraction = (double)W / (double)items[i].weight;
            totalValue += fraction * items[i].value;
            W = 0;
            break;
        }
    }

    // Return the total value
    return totalValue;
}

// Main function
int main() {
    // Get the number of items and the knapsack capacity
    int n, W;
    cin >> n >> W;

    // Create an array of items
    Item items[n];
    for (int i = 0; i < n; i++)
    {
        cin >> items[i].value >> items[i].weight;
    }

    // Solve the knapsack problem
    double totalValue = fractionalKnapsack(items, n, W);
    // Print the total value
    cout << totalValue << endl;

    return 0;
}
```

6. Result/Output :



Learning outcomes (What I have learnt):

1. I learnt about how to input elements in an array.

2. I learnt about how to solve the Knapsack problem.

3. I learnt about the concept of Greedy Technique.

4. I learnt about how to solve knapsack problem using Greedy Technique.

5. I learnt about time complexity of Knapsack Problem.