DEPARTMENT OF
COMPUTER SCIENCE & ENGINEERING
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NAME – RAJDEEP JAISWAL

UID – 20BCS2761

BRANCH – CSE BTECH

SEC – WM 902 B

Subject Name: DAA Lab

Subject Code: 20ITP-312

Worksheet Experiment – 2.3

Name: Anant Kumar Mathur **UID: 20BET1071**
Branch: BE-IT **Section/Group: 20BET_WM-601-B**
Semester: 5th **Subject: DAA Lab**

1. **Aim/Overview of the practical:**

   Code to implement 0-1 Knapsack using Dynamic Programming.

2. **Task to be done/ Which logistics used:**

   Dynamic-0-1-knapsack Problem.

3. Algorithm/Steps:

1. Calculate the profit-weight ratio for each item or product.
2. Arrange the items on the basis of ratio in descending order.
3. Take the product having the highest ratio and put it in the sack.
4. Reduce the sack capacity by the weight of that product.
5. Add the profit value of that product to the total profit.
6. Repeat the above three steps till the capacity of sack becomes 0 i.e. until the sack is full.

for w = 0 to W do

c[0, w] = 0 for i = 1 to

n do c[i, 0] = 0 for w

= 1 to W do if wi ≤ w

then if vi + c[i-1, w-

wi] then c[i, w] = vi +

c[i-1, w-wi] else c[i,

w] = c[i-1, w]

else c[i, w] = c[i-1, w]

4. Steps for experiment/practical/Code:

```
#include<iostream>
#define MAX 10 using
namespace std; struct
product
{   int product_num;
int profit;   int
weight;   float ratio;
float take_quantity;
```

```
}; int
main() {
  product P[MAX],temp;
  int i,j,total_product,capacity;
float value=0;
  cout<<"ENTER NUMBER OF ITEMS : ";
  cin>>total_product;
  cout<<"ENTER CAPACITY OF SACK : ";
cin>>capacity;   cout<<"\n";
  for(i=0;i<total_product;++i)
  {
    P[i].product_num=i+1;
    cout<<"ENTER PROFIT AND WEIGHT OF PRODUCT "<<i+1<<" : ";
cin>>P[i].profit>>P[i].weight;

    P[i].ratio=(float)P[i].profit/P[i].weight;
    P[i].take_quantity=0;
  }

  //HIGHEST RATIO BASED SORTING
  for(i=0;i<total_product;++i)
  {
    for(j=i+1;j<total_product;++j)
    {
     if(P[i].ratio<P[j].ratio)
     {
temp=P[i];
        P[i]=P[j];
        P[j]=temp;
     }
    }
  }
  for(i=0;i<total_product;++i)
  {
    if(capacity==0)
break;
    else if(P[i].weight<capacity)
```

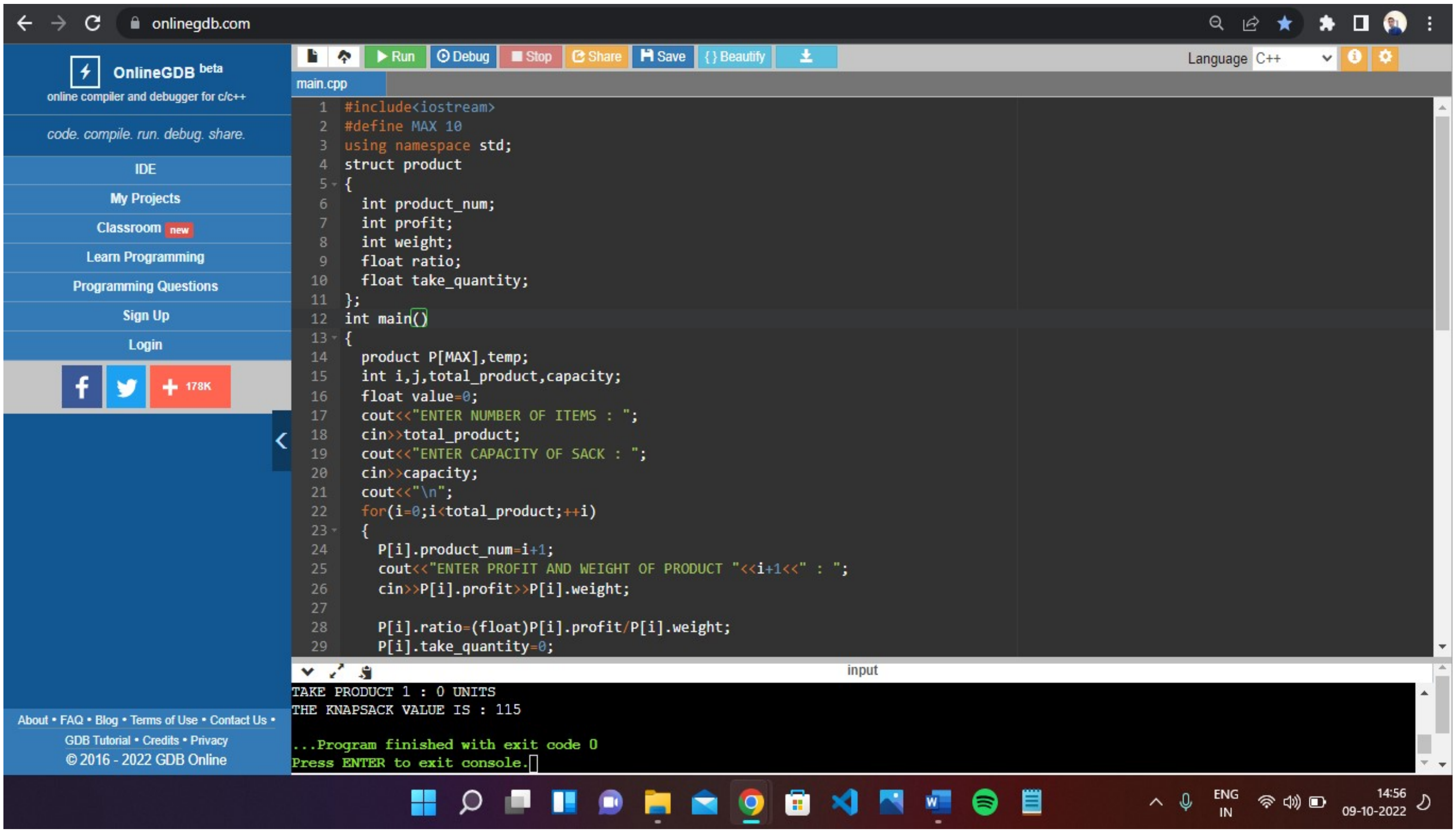
```
    {
      P[i].take_quantity=1;
      capacity-=P[i].weight;
    }
    else if(P[i].weight>capacity)
    {
      P[i].take_quantity=(float)capacity/P[i].weight;
capacity=0;
    }
  }

  cout<<"\n\nPRODUCTS TO BE TAKEN -";
  for(i=0;i<total_product;++i)
  {
    cout<<"\nTAKE PRODUCT "<<P[i].product_num<<" : "<<P[i].take_quantity*P[i].weight<<"
UNITS";
    value+=P[i].profit*P[i].take_quantity;
  }
  cout<<"\nTHE KNAPSACK VALUE IS : "<<value;
return 0;
}
```

5. **Observations/Discussions/ Complexity Analysis:**

This algorithm takes θ(n, w) times as table c has (n + 1).(w + 1) entries, where each entry requires θ(1) time to compute .

6. **Result/Output/Writing Summary:**



```cpp
#include<iostream>
#define MAX 10
using namespace std;
struct product
{
  int product_num;
  int profit;
  int weight;
  float ratio;
  float take_quantity;
};
int main()
{
  product P[MAX],temp;
  int i,j,total_product,capacity;
  float value=0;
  cout<<"ENTER NUMBER OF ITEMS : ";
  cin>>total_product;
  cout<<"ENTER CAPACITY OF SACK : ";
  cin>>capacity;
  cout<<"\n";
  for(i=0;i<total_product;++i)
  {
    P[i].product_num=i+1;
    cout<<"ENTER PROFIT AND WEIGHT OF PRODUCT "<<i+1<<" : ";
    cin>>P[i].profit>>P[i].weight;

    P[i].ratio=(float)P[i].profit/P[i].weight;
    P[i].take_quantity=0;
```

```
TAKE PRODUCT 1 : 0 UNITS
THE KNAPSACK VALUE IS : 115

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

main.cpp

```
#include<iostream>
#define MAX 10
using namespace std;
struct product
{
  int product_num;
  int profit;
  int weight;
  float ratio;
  float take_quantity;
};
int main()
{
```

```
ENTER NUMBER OF ITEMS : 4
ENTER CAPACITY OF SACK : 15

ENTER PROFIT AND WEIGHT OF PRODUCT 1 : 35 6
ENTER PROFIT AND WEIGHT OF PRODUCT 2 : 50 7
ENTER PROFIT AND WEIGHT OF PRODUCT 3 : 60 8
ENTER PROFIT AND WEIGHT OF PRODUCT 4 : 70 9


PRODUCTS TO BE TAKEN -
TAKE PRODUCT 4 : 9 UNITS
TAKE PRODUCT 3 : 6 UNITS
TAKE PRODUCT 2 : 0 UNITS
TAKE PRODUCT 1 : 0 UNITS
THE KNAPSACK VALUE IS : 115

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

Learning Outcomes:-

1. Create a program keeping in mind the time complexity
2. Create a program keeping in mind the space complexity
3. Steps to make optimal algorithm
4. Learnt about how to implement 0-1 Knapsack problem using dynamic programming.