Batch: B2	**Roll No.: 16010121110**
Experiment No._____5__	
Grade: AA / AB / BB / BC / CC / CD /DD	
Signature of the Staff In-charge with date	

Title: Implementation of Knapsack Problem using Greedy strategy

Objective: To learn the Greedy strategy of solving the problems for different types of problems

CO to be achieved:

CO 2 Describe various algorithm design strategies to solve different problems and analyse Complexity.

Books/ Journals/ Websites referred:

1. **Ellis horowitz, Sarataj Sahni, S.Rajasekaran," Fundamentals of computer algorithm", University Press**
2. **T.H.Cormen ,C.E.Leiserson,R.L.Rivest and C.Stein," Introduction to algorithms",2nd Edition ,MIT press/McGraw Hill,2001**
3. **http://lcm.csa.iisc.ernet.in/dsa/node184.htm**
4. **http://students.ceid.upatras.gr/~papagel/project/kruskal.htm**
5. **http://www.personal.kent.edu/~rmuhamma/Algorithms/MyAlgorithms/GraphAlgor/kruskalAlgor.html**
6. **http://lcm.csa.iisc.ernet.in/dsa/node183.html**
7. **http://students.ceid.upatras.gr/~papagel/project/prim.htm**
8. **http://www.cse.ust.hk/~dekai/271/notes/L07/L07.pdf**

Pre Lab/ Prior Concepts:

Data structures, Concepts of algorithm analysis

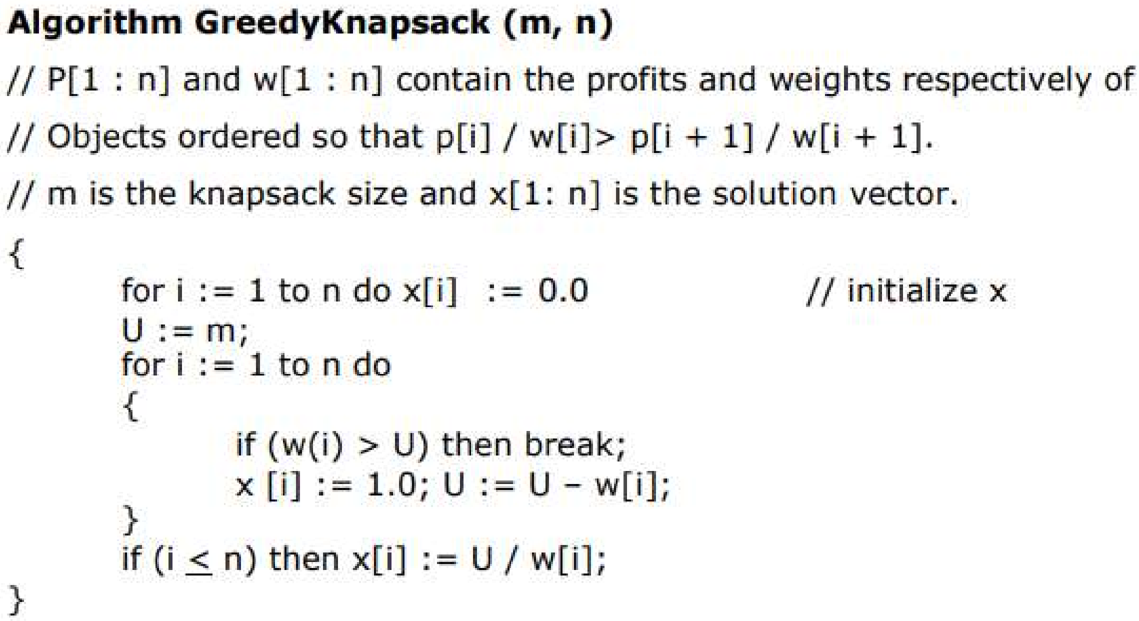
Historical Profile:

The knapsack problem represents constraint satisfaction optimization problems' family. Based on the nature of constraints, the knapsack problem can be solved with various problem solving strategies. Typically, these problems represent resource optimization solutions.

Given a set of n inputs. · Find a subset, called feasible solution, of the n inputs subject to some constraints, and satisfying a given objective function. · If the objective function is maximized or minimized, the feasible solution is optimal. · It is a locally optimal method.

New Concepts to be learned:
Application of algorithmic design strategy to any problem, Greedy method of problem solving Vs other methods of problem solving, optimality of the solution, knapsack problem and their applications

Knapsack Problem Algorithm

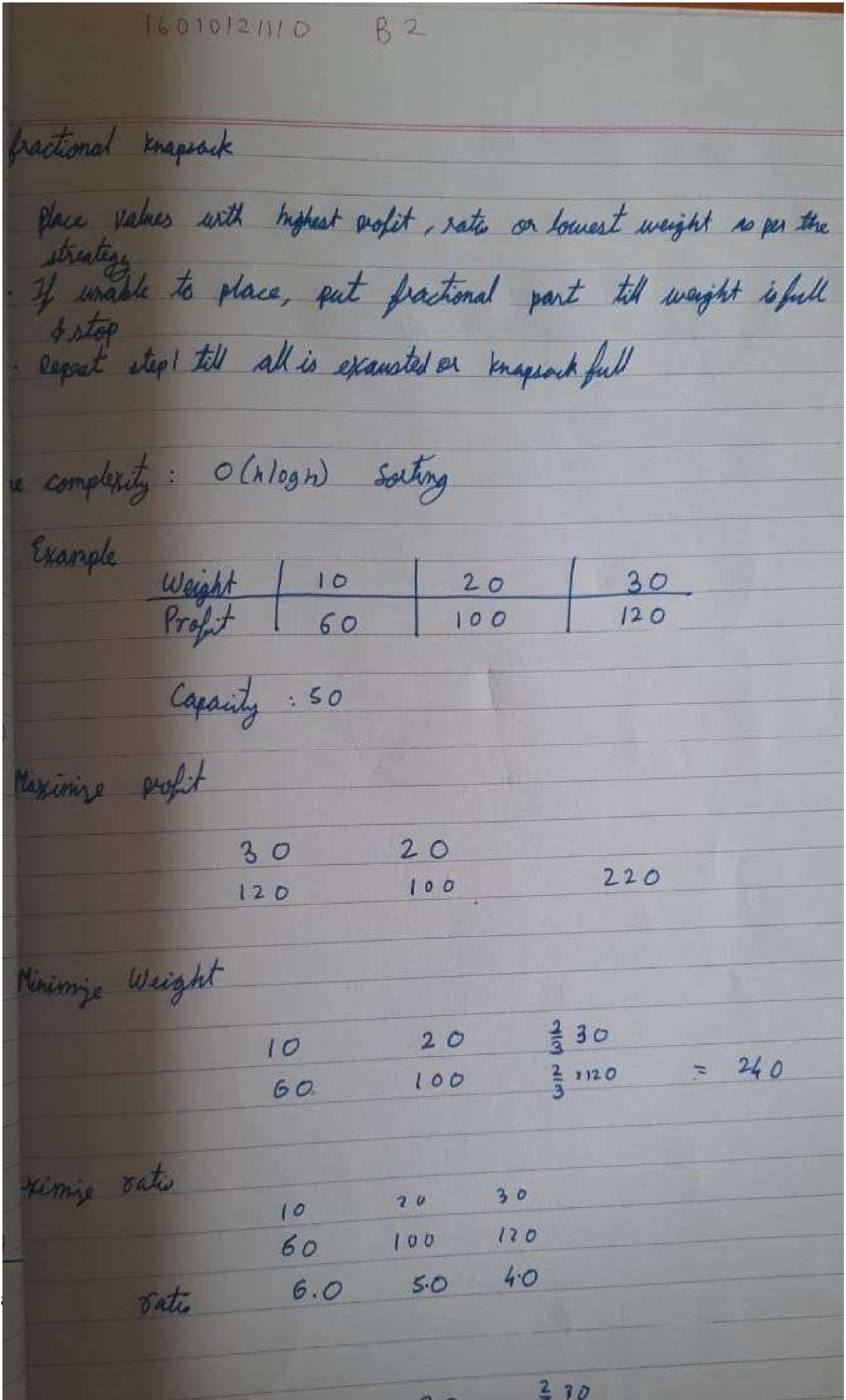


```
Algorithm GreedyKnapsack (m, n)
// P[1 : n] and w[1 : n] contain the profits and weights respectively of
// Objects ordered so that p[i] / w[i]> p[i + 1] / w[i + 1].
// m is the knapsack size and x[1: n] is the solution vector.
{
        for i := 1 to n do x[i]  := 0.0                    // initialize x
        U := m;
        for i := 1 to n do
        {
                if (w(i) > U) then break;
                x [i] := 1.0; U := U – w[i];
        }
        if (i ≤ n) then x[i] := U / w[i];
}
```

Analysis of Knapsack Problem algorithm:

Time complexity- only for sorting so O(n log(n))

Example: Knapsack Problem



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fractional knapsack

Place values with highest profit, ratio or lowest weight as per the strategy

- If unable to place, put fractional part till weight is full & stop
- Repeat step1 till all is exausted or knapsack full

e complexity : O(nlogn) Sorting

Example

Weight	10	20	30
Profit	60	100	120

Capacity : 50

Maximize profit

30	20	
120	100	220

Minimize Weight

10	20	$\frac{2}{3}$ 30	
60	100	$\frac{2}{3} \times 120$	= 240

ximize ratio

	10	20	30
	60	100	120
ratio	6.0	5.0	4.0

$\frac{2}{3}$ 30

```
import java.util.*;
public class Main
{
        public static void main(String[] args) {
                double [] profit ={1,2,4,3,5};
                double [] weight = {2,1,4,5,7};
                double capacity=7;
                double[][] ratio = new double[5][5];
                for(int i=profit.length-1;i>=0;i--){

                  ratio[i][0]=profit[i]/weight[i];
                  ratio[i][1]=weight[i];
                }

                //sort ArrayList


                ratio=insetionSort(ratio);



                int i=0;
                while(capacity>0){

                   capacity=capacity-ratio[i][1];
                   if(capacity>0){
                   System.out.println("chosen object with weight "+ratio[i][1] +" with profit "
+ profit[i]);

                   }
                   else{
                        System.out.println("chosen object with weight "+ratio[i][1] +" with
fraction "+(double)(capacity+ratio[i][1])+"/"+ratio[i][1] +" with profit " + profit[i]);
                   }
                  i++;
                   if(i==5){//on capacity less than objects
                      break;
                   }
                }

        }
        public static double[][]                insetionSort(double[][] arr1){
           for(int i=1;i<arr1.length;i++){
              double key=arr1[i][0];
              int j=i-1;
              while(arr1[j][0]<key){
                    //swap ratio
                    double temp=arr1[j+1][1];
                    arr1[j+1][1]=arr1[j][1];
                    arr1[j][1]=temp;
                    //swap weight
                     temp=arr1[j+1][0];
                    arr1[j+1][0]=arr1[j][0];
                    arr1[j][0]=temp;

                    j--;
                    if(j<0){
                        break;
                    }
                }
             }
          //   for(int i=0;i<arr1.length;i++){
    //     System.out.print(arr1[i]+",");
    //   }
             return arr1;

         }

}
```

Output-

```
chosen object with weight 1.0 with profit 1.0
chosen object with weight 4.0 with profit 2.0
chosen object with weight 7.0 with fraction 2.0/7.0 with profit 4.0
```

Conclusion:

Thus we have understood how to implement fractional knapsack using greedy strategy. We used the p/w ratio to implement the best possible profit. This has many applicaiotns including thread scheduling policies