Greedy Method :- (is a Technique)

- Simplest & straight forward approach.
- The decision is taken on basis of current available infor.ⁿ. without worrying about the effect of current decision in future.
- Feasible Sol.ⁿ that may or may not be optimal.

Feasible Sol.ⁿ → any subset that satisfy the condition.

optimal Sol.ⁿ ⇒ Best & most favorable Sol.ⁿ.

Characteristic & Features :-

(1) To Construct the Sol.ⁿ in an optimal way, Algorithm maintains 2 sets :-
   - one contains chosen items &
   - other " rejected items.

(2) Greedy algorithm make good local choices.
   - an optimal Sol.ⁿ
   - feasible Sol.ⁿ

Components of Greedy Algorithm :-

(1) A Candidate Set :-
A sol.^{n} is created from this set.

(2) A selection fun.^{c} :-
used to choose the best candidate to be added to the sol.^{n}.

(3) A feasibility fun.^{c} :-
Used to determine whether a candidate can be used to contribute to the sol.^{n}.

(4) A objective fun.^{c} :-
used to assign value to a solution or partial sol.^{n}

(5) A solution fun.^{c} :-
used to indicate whether a complete sol.^{n} has been reached.

Applications of Greedy :-

(1) finding shortest Path
(2) finding Minimum Spanning Tree
(3) Job sequencing with deadline / activity-selection problem.
(4) fractional knapsack problem

(5) Huffman coding.

Pseudocode for Greedy Algorithm;-

```
Algorithm Greedy (a, n)
{
    solution := 0;
    for i=1 to n do
    {
        x := select(a);
        if feasible ( solution, x) then
            solution := Union(solution, x) ;
    }
    return solution ;
}
```

for those Problem which are divisible.

Example :- Fractional Knapsack using Greedy Method.

$n=7$

$W=15$

Object (O) ⇒	1	2	3	4	5	6	7
Profit (P) ⇒	10	5	15	7	6	18	3
Weights (W) ⇒	2	(3)	5	7	1	4	1

Right selection Procedure for the object.

$\frac{P}{W}$ ⇒

5	(1.3)	3	1	6	4.5	3

x (1 x_1 | 2/3 x_2 | 1 x_3 | 0 x_4 | 1 x_5 | 1 x_6 | 1 x_7)

$(0 \le x \le 1)$

4th object Not Included :. zero

How to include object/ITEM in Bag to get Max. Profit :-

Idea 1) Those Element/object give take that object first.

Eg :- (18) → Profit take Complete object

Idea 2) Or we may fill the bag with smaller things. So that I can add more & more things in the bag & can make more Profit.

i.e. More Thing we carry more will be the Profit

Right Method 3) → $\frac{P}{W}$ Then add item accordingly :-

15 − 1 = 14 (x_5)

14 − 2 = 12 (x_6)

12 − 4 = 8 (x_4)

8 − 5 = 3 (x_3)

3 − 1 = 2 (x_7)

2 − 2 = 0 (x_2) Take only 2 Kg

$\sum x_i w_i = 1\times2 + \frac{2}{3}\times3 + 1\times5 + 0\times7 + 1\times1 + 1\times4 + 1\times1$

$= 2+2+5+0+1+4+1 = (15)$ Kg

$\sum x_i p_i = 1\times10 + \frac{2}{3}\times5 + 1\times15 + 1\times6 + 1\times18 + 1\times3$

~~$10+1.3$~~

$= 10 + 2\times1.3 + 15 + 6 + 18 + 3$

$= (54.6)$ Total Profit

Fractional Knapsack (Array V, Array W, int W)

```
1) for i=1 to Size(V)
2)     do P[i] = V[i]/W[i]
3) Sort-Descending (P)
4) i ← 1
5) while (W>0)
6)     do amount = min (W, W[i])
7)     Solution [i] = amount
8)     W = W - amount
9)     i ← i+1
10 return solution.
```

Constraint :-

$\sum x_i w_i \leq m$ ← Capacity of Bag

objective :-

$\max \sum x_i P_i$

$O(n \log n)$

Q= Consider 5 items along their respective weights and values.

$I = (I_1, I_2, I_3, I_4, I_5)$

$W = (5, 10, 20, 30, 40)$

$V = (30, 20, 100, 90, 160)$

The Capacity of Knapsack $W=60$. Find the solution to the fractional knapsack problem.

Sol.ⁿ ⇒

→ Initially,

Item	w_i (kg) weight	v_i (Price)
I_1	5	30
I_2	10	20
I_3	20	100
I_4	30	90
I_5	40	160
~~I_6~~		

Taking value per weight ratio i.e. $p_i = v_i/w_i$

Item	w_i	v_i	$p_i = v_i/w_i$
I_1	5	30	6.0
I_2	10	20	2.0
I_3	20	100	5.0
I_4	30	90	3.0
I_5	40	160	4.0

Now arrange the value of 'p_i' in descreasing order.

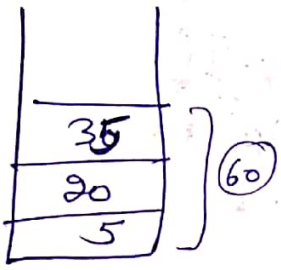
Item	w_i	v_i	$p_i = v_i/w_i$
I_1	5	30	6.0
I_3	20	100	5.0
I_5	40	160	4.0
I_6	30	90	3.0
I_2	10	20	2.0

Now, fill the knapsack acc. to the descreasing value of p_i.

first, we choose item I_1 whose weight is 5, then choose Item I_3 whose weight is 20. Now the total weight

in Knapsack is $5+20=25$.

Now, the next item is I_5 & its weight is 40, but we want only 35. So we choose fractional part of it i.e.



The value of fractional part of I_5 is

$$\frac{160}{40} \times 35 = 140$$

The max. value is $\Rightarrow 30+100+140$

$= 270$ Rs.