In greedy technique most of problem are having n inputs and our object is to find the subset of given input which will ~~sta~~ satisfy our requirement.

n- input	condition or constreont	max profit or min cost

- Problem Defination
understanding the problem clearly
- Find solution space
all possible solution for a given n inputs

- It is one of the solution from solution space. which will satisfy the condition
- Optimal solution
It is the solution from solution which will give max. profit or min cost.

Application of greedy technique
- greedy Knapsack
- Job sequencing / scheduling problem with deadline
- optimal merge pattern
- Haffman coding
- min cost spaning tree

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- signal source shortest path

Problem $= \sum_{i=1}^{\infty} w_i > M$

Feasible $= \sum_{n=1}^{\infty} w_i * x_i \leq M$

Optimal $= x_i * P_i$

Eg:- $n = 3$, $M = 20$

obj	obj-1	obj-2	obj-3
Profit	25	24	15
weight	18	15	10

greedy about profit

$M - 18 = 2$

	obj-1	obj-2	obj-3
Profit	1	2/15	0
weight	1×25	$2/15 \times 24$	0

$= 25 + 3.2 = 28.2$

greedy about weight

$M - 10 = 10$

	obj-1	obj-2	obj-3
weight	0	10/15	1
Profit	0	$\frac{10}{15} \times 24$	$+ 1 \times 15$

$= 16 + 15 = 31$

greedy about both

obj - 1	P/w	$= 25/18$	$= 1.4$
obj - 2	P/w	$= 24/15$	$= 1.6$
obj - 3	P/w	$= 15/10$	$= 1.5$

obj - 2 > obj - 3 > obj - 1

1.6 > 1.5 > 1.4 $\quad$ m - 15 - 5

1 $\quad$ 5/10 $\quad$ 0

$24 \times 1 + 5/10 \times 15 + 0 = 31.5$

Eg:- $\quad n = 5, \quad m = 12$

object	obj-1	obj-2	obj-3	obj-4	obj-5
profit	5	2	2	4	5
weight	5	4	6	2	1

greedy about profit $\quad$ m - 6 = 6

6 - 2 = 4

4 - 4 = 0

	obj - 1	obj - 2	obj - 3	obj - 4	obj - 5
profit	1	1	0	1	1
weight	1 x 5	1 x 4	0	1 x 2	1 x 1

= 5 + 4 * 2 + 1 = 12

greedy about weight

m - 1 = 11

11 - 2 = 9

9 - 4 = 5

	obj - 1	obj - 2	obj - 3	obj - 4	obj - 5
weight	1	1	0	1	1
profit	1 x 5	1 x 2		1 x 4	1 x 5

= 5 + 2 + 4 + 5

= 16

greedy about both

obj-1 $P/w = 5/5 = 1$

obj-2 $P/w = 2/4 = 0.5$

obj-3 $P/w = 2/6 = 0.3$

obj-4 $P/w = 4/2 = 2$

obj-5 $P/w = 5/1 = 5$

$M-1=11$ $11-2=9$ $9-5=4$ $4-4=0$

obj-5 > obj-4 > obj-1 > obj-2 > obj-3

5 > 2 > 1 > 0.5 > 0.3

1 1 1 1 0

$1\times5 + 1\times4 + 1\times5 + 1\times2 + 0$

$5 + 4 + 5 + 2 = 16$

g:- $n = 7$ $M = 15$

object	0-1	0-2	0-3	0-4	0-5	0-6	0-7
profit	10	5	15	7	6	18	3
weight	2	3	5	7	1	4	1

greedy about profit

	0-1 ($6-2=4$)	0-2	0-3 ($11-5=6$)	0-4	0-5	0-6 ($M-4=11$)	0-7
profit	1	0	1	4/7	0	1	0
weight	1×2	0	1×5	$\frac{4}{7}\times7$	0	1×4	0

$2 + 5 + 4 + 4 = 15$

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greedy about weight

$13-2=11$ $11-3=8$ $14-1=13$ $8-4=4$ $m-1=14$

	0-1	0-2	0-3	0-4	0-5	0-6	0-7
profit	1	1	4/5	0	1	1	1
weight	1 x 20	1x5	$\frac{4}{5}$x15	0	1x6	1x18	1x3

$20+5+12+6+18+3$
$= 54$

greedy about both

obj-1 $P/w = 10/2 = 5$
obj-2 $P/w = 5/3 = 1.6$
obj-3 $P/w = 15/5 = 3$
obj-4 $P/w = 7/7 = 1$
obj-5 $P/w = 6/1 = 6$
obj-6 $P/w = 18/4 = 4.5$
obj-7 $P/w = 3/1 = 3$

$m-1=11$ $11-2=9$ $9-4=5$ $5-5=0$

obj-5 > obj-1 > obj-6 > obj-3 > obj-7 > obj-2 > obj-4
6 > 5 > 4.5 > 3 > 3 > 1.6 > 1
1 > 1 > 1 > 1   0   0   0

$1\times6 + 1\times10 + 1\times18 + 1\times15 + 0$
$= 6 + 10 + 18 + 15 = 49$

18
15
6

49

$m-1=11$ $11-2=9$ $9-4=5$ $5-1=4$

obj-5 > obj-1 > obj-6 > obj-7 > obj-3 > obj-2 > obj-4
6 > 5 > 4.5 > 3 > 3 > 1.6 > 1
1   1   1 > 1 > 4/5 > 0 > 0

$1\times6 + 1\times10 + 1\times18 + 1\times3 + 4/5\times15$
$= 6 + 10 + 18 + 3 + 12 = 49$

Algorithm of greedy technique

(i) Calculate the Profit/Weight (P/W) ratio for each object.

for (i = 1 to n)
    a[i] = P_i / W_i $\Rightarrow O(n)$

(ii) Arrange the P/W ratio in descending order
$\Rightarrow O(n \log n)$

(iii) Take the object one by one from the descending array until capacity of Knapsack becomes 0.

while (m ≠ 0)
{
    M = M - $W_i X_i$
    P = P + $P_i X_i$ $\Rightarrow O(n)$

∴ Time Complexity = $O(n) + O(n \log n) + O(n)$
= $2O(n) + O(n \log n)$
= $O(n \log n)$

Minimum Cost Spanning Tree

Spanning Tree

$$G(V, E) = S(V, |V|-1)$$

A connected sub graph (S) of a graph G (V, E) is called as a spanning tree if and only if

i) It should consist V vertex

ii) It should consist $|V|-1$ edges

Complete graph ⇒ no. of vertices $= n^{n-2}$