0-1 Knapsack Problem using Branch & Bound :-

Ex:-

	1	2	3	4
Profit	10	10	12	18
weight	2	4	6	9

$M = 15$

$n = 4$

LC — Least Cost BB — Branch & Bound. method ⟹ gives faster result

(upper bound) $\Rightarrow U = \sum_{i=1}^{n} P_i x_i \leq m$

Cost $\Rightarrow C = \sum_{i=1}^{n} P_i x_i$ (with fraction)

(only for calculation but not include in the real)

Note:- One more method to solve this Problem :-
FIFO Branch & Bound. Best LC - Branch & Bound gives faster result

for Example:-

$S = \{x_1, x_3\}$ → Variable size solution i.e. x_1 & x_3 Item is included.

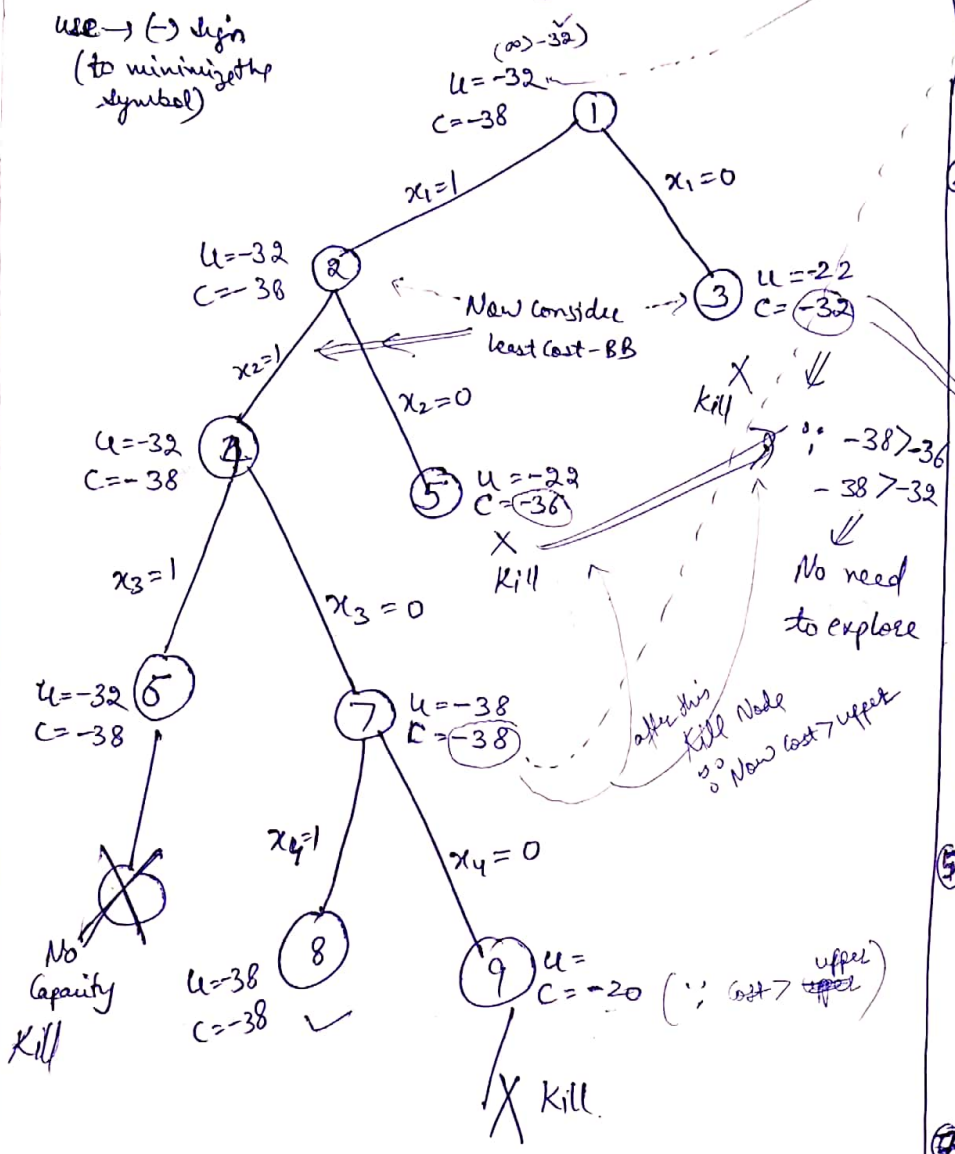
OR

$S = \{1\ 0\ 1\ 0\}$ ⟹ fixed Size Solution.

we use this type of solution.

Initially, upper = ∞ (-32) (-38)

use → (-) sign (to minimize the symbol)



Cost ⇒ Include fraction ∴ (38)

ub ⇒ Don't ∴ ∴ 10+10+12 = 32

(Upper bound)

(2) $C = 10 + 10 + 12 + \frac{18}{9} \times 3 = 38$

2 + 4 + 6

15 - 12 = (3) more require.

(3) $C = 10 + 10 + 12 + \frac{18}{9} \times 5 = 32$

2 + 4 + 6

10

(x_1 Not include)

(5) $C = 10 + 10 + 12 + \frac{18}{9} \times 7 = 36$

2 + 4 + 6

$x_2 = 0$

(7) $C = 10 + 10 + 12 + \frac{18}{9} = -38$

2 + 4 + 6 + 9 = 15

$S = \{1, 1, 0, \phi\}$

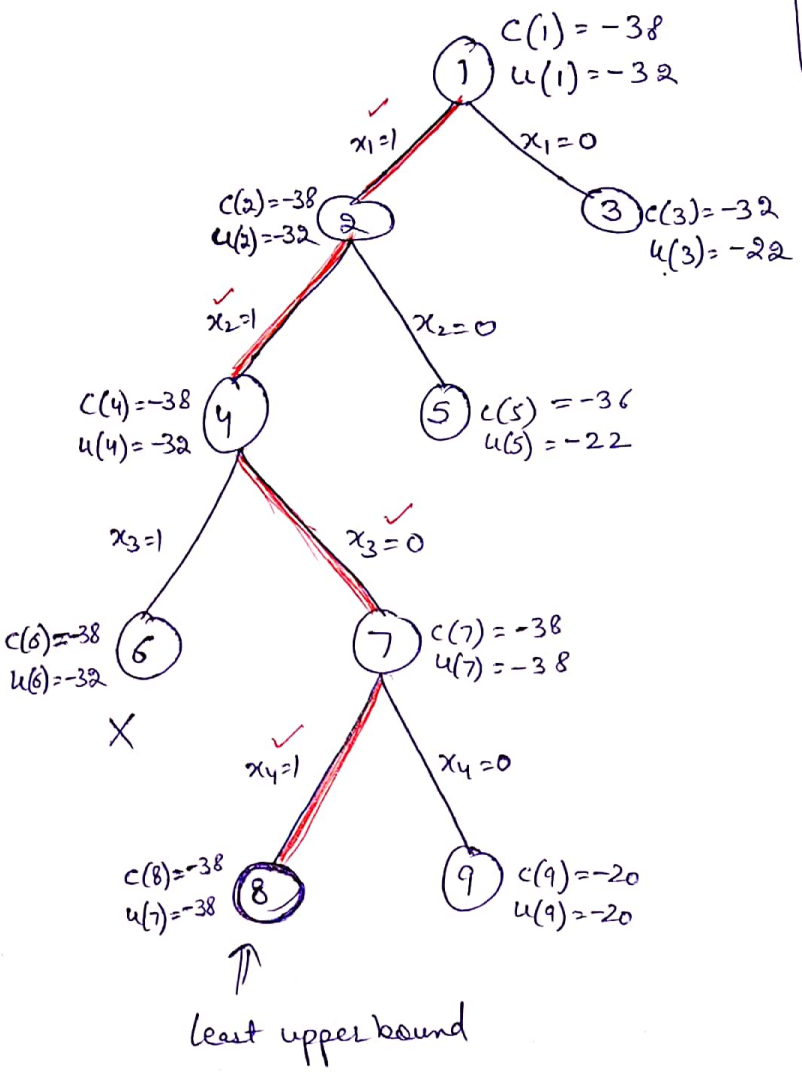
or

$S = \{x_1, x_2, x_4\}$ included.

Profit ⇒ 10 + 10 + 18 = (38) Ans.

weights ⇒ 2 + 4 + 9 ⇒ 15

OR



$S = \{ x_1 \; x_2 \; x_3 \; x_4 \}$

$= \{ 1 \; 1 \; 0 \; 1 \}$

$\Rightarrow$ 10 + 10 + 0 + 18 (Profit)

$\Rightarrow$ 38 Max. Profit.

Node (1) $\Rightarrow$

Item		
4	$\frac{18}{9} \times 3$	
3	12	
2	10	
1	10	32

38

Capacity 2 → 1 → 0 → 3

Remaining Capacity.

Node (3) $\Rightarrow$ (x_1 Not Include) or First Item Not Include

Item		
4	$\frac{18}{9} \times 5$	
3	12	
2	10	22

32

* For branching $\Rightarrow$ Upper Bound value is Less $\longrightarrow$ follow path.

$u(2) < u(3)$

$-32 < -22$

Node (5)

4	$\frac{18}{9} \times 7$	
3	12	
1	10	22

36

Node (7)

4	18 (Full Take)	
2	10	
1	10	38

38

Node (9)

2	12	
1	10	22