

Branch and Bound \Rightarrow Factors

State space tree

Bound funcⁿ

Upper bound
(Maximization)

Lower bound
(Minimization)

1) FIFO BB \rightarrow First in first out BB approach

\rightarrow Queue

2) LIFO BB \rightarrow Last in first out BB approach

\rightarrow Stack

3) Least Count BB approach

\rightarrow Priority queue

Q Sum of Subset = $\{w_1, w_2, w_3, w_4\} = \{7, 9, 9, 6\}$

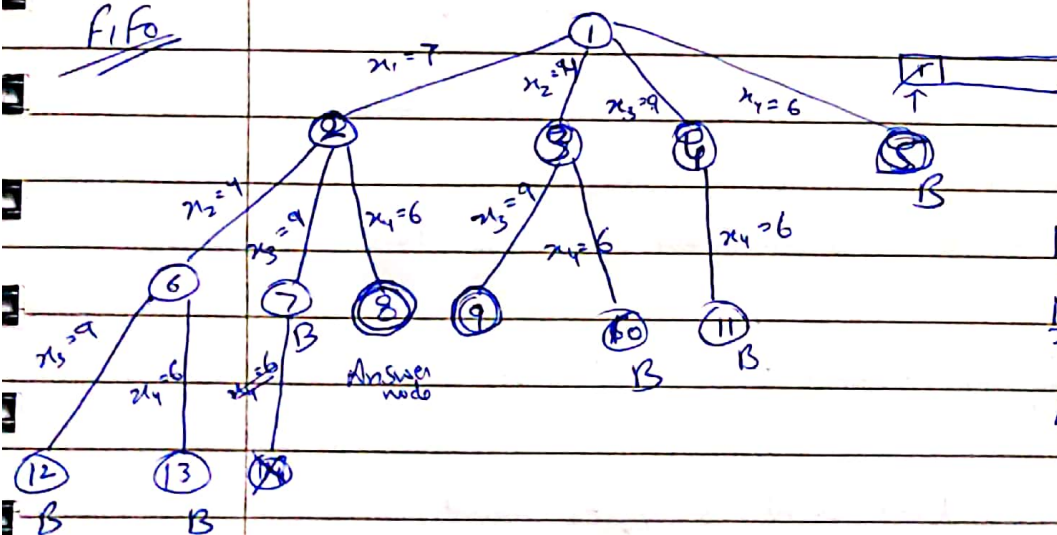
$$\{x_1, x_4\} = 13$$

$$\{x_1, x_3\} = 13$$

$$\{x_2, x_3\} = 13$$

$$\{x_3, x_2\} = 13$$

FIFO



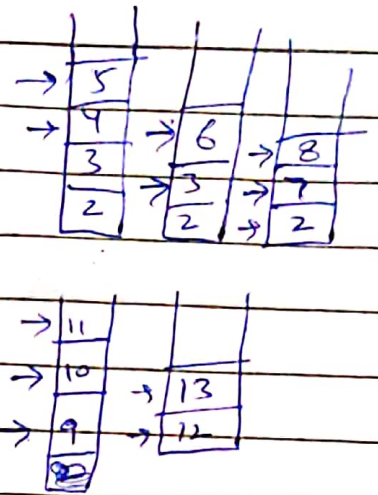
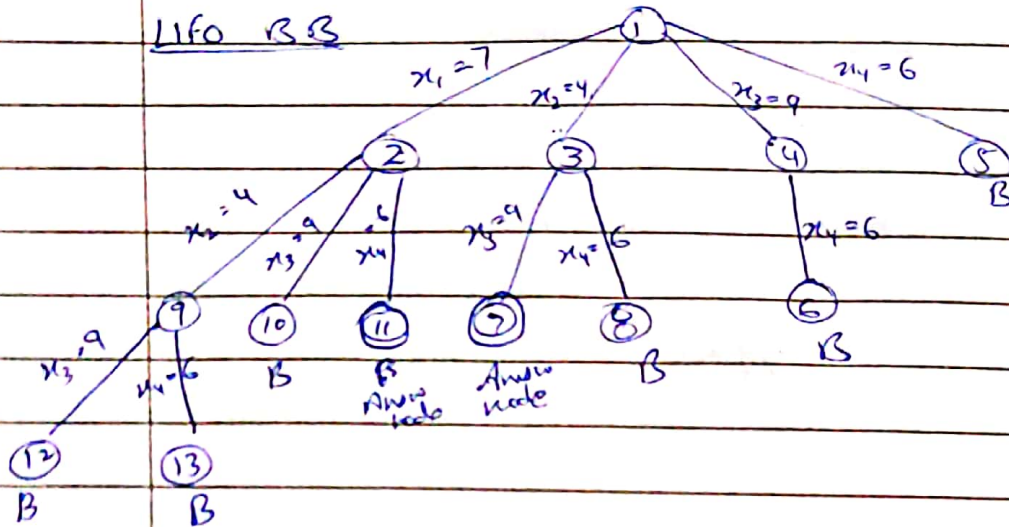
1) live node

2) E-node

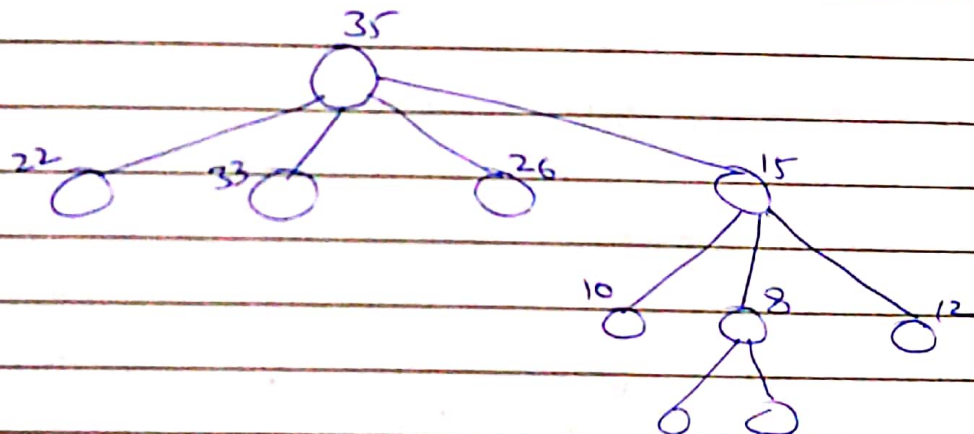
3) Dead node

4) Answer node

LIFO BBS



Least Cost BBS



0/1 Knapsack Problem using LCBB

Least Cost aim to minimization so we take objective function as

$$C(n) = - \sum p_i x_i \text{ subject to } \sum c_i x_i \leq m$$

$$\text{Lower Bound } (n) \leq C(n) \leq \text{Upper bound } (n)$$

$$U, \text{ Upper Bound} = \sum_{i=1}^n p_i x_i \text{ (without fraction)}$$

$$C, \text{ Lower Bound} = \sum_{i=1}^n p_i x_i \text{ (with fraction)}$$

Q

$$p_1, p_2, p_3, p_4 = (10, 10, 12, 18)$$

$$m=15$$

$$\omega_1, \omega_2, \omega_3, \omega_4 = (2, 4, 6, 9)$$

$$i) \quad u = -32$$

$$C = -38$$

$$u = 10 + 10 + 12 = 32$$

$$= 2 + 4 + 6 =$$

$$C = 10 + 10 + 12 + 18 \times \frac{3}{9}$$

$$= 2 + 4 + 6 + 8 \times \frac{3}{9} = 15$$

$$= 38$$

$$u = -32$$

$$C = -38$$

$$u = -22$$

$$C = -32$$

$$u = 10 + 12 = 22$$

$$= 4 + 6 =$$

$$C = 10 + 12 + \frac{5 \times 8}{9} = 32$$

$$= 4 + 6 + 8 \times \frac{5}{9}$$

$$u = 10 + 12 = 22$$

$$2 + 6$$

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

$$2 + 6 + 8 \times \frac{7}{9}$$

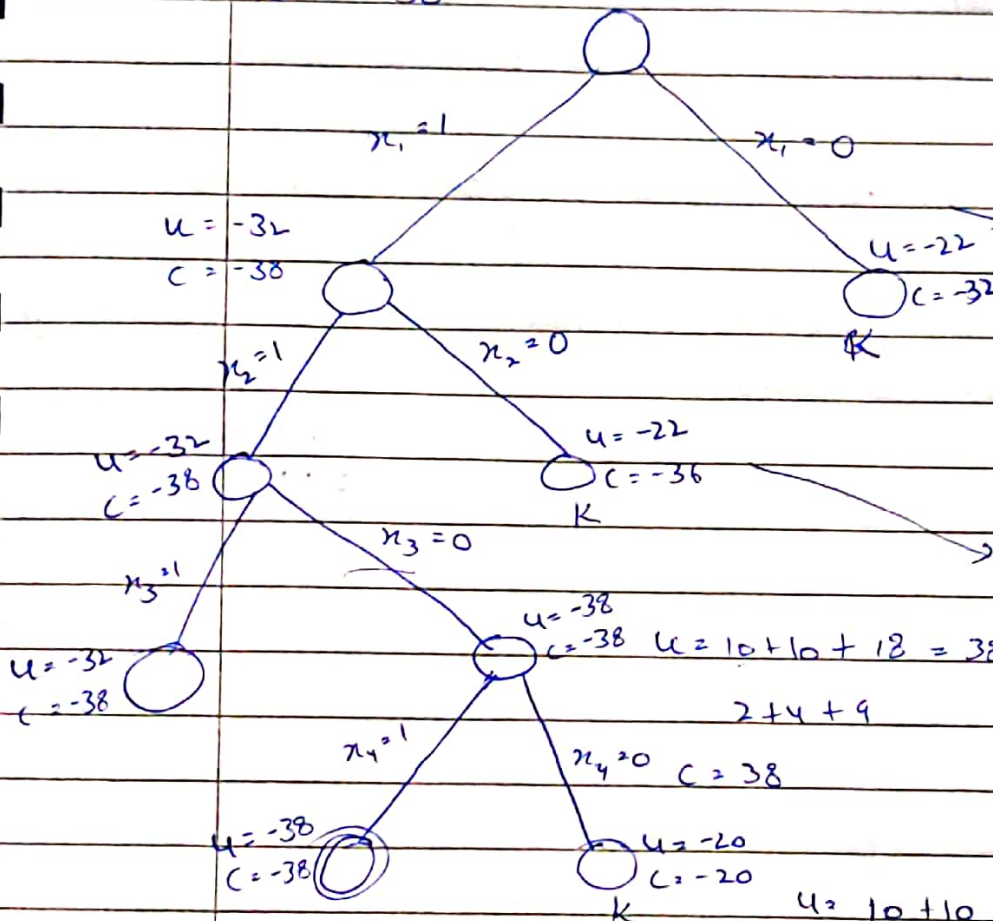
$$u = 10 + 10 = 20$$

$$2 + 4 = 6$$

$$C = 20$$

$$x_1, x_2, x_4$$

$$= \{1, 1, 0, 1\} \quad \text{Sol}$$



P and NP class

Class P: Problem solvable in polynomial time.

$$O(n^k) \quad k \rightarrow \text{const}$$

2CNF

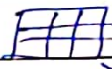
$a \in \Gamma \rightarrow \boxed{\text{LBA}}$ $\begin{cases} \rightarrow \text{found} \\ \rightarrow \text{not found} \end{cases}$
 $O(n)$

\Rightarrow tractable Problem

Class NP: It consists of those problems that are verifiable in polynomial time.

\rightarrow Decision problems solvable in non-deterministic polynomial time.

\downarrow
guess

 \rightarrow Sudoku
 \rightarrow use brute force

eg: 3-SAT

3-CNF

TSP

Knapsack Problem

$$P \subseteq NP$$

