

Ques) Compare Branch and Bound design paradigm with Backtracking Method.

### Branch and Bound

1. An algorithm for finding discrete and combinational optimization problems of mathematical optimization.
2. Solves a given problem by dividing it into at least 2 new restricted subproblems.
3. Less efficient.
4. It may traverse tree in any manner (DFS or BFS)

### Backtracking

1. An algorithm for finding all solutions to some computational problems that incrementally builds candidates to soln.
2. Finds the soln to overall issue by finding a solution to the first subproblem & then recursively solving other problems based on soln of first issue.  
More efficient.
3. It traverse tree by DFS.

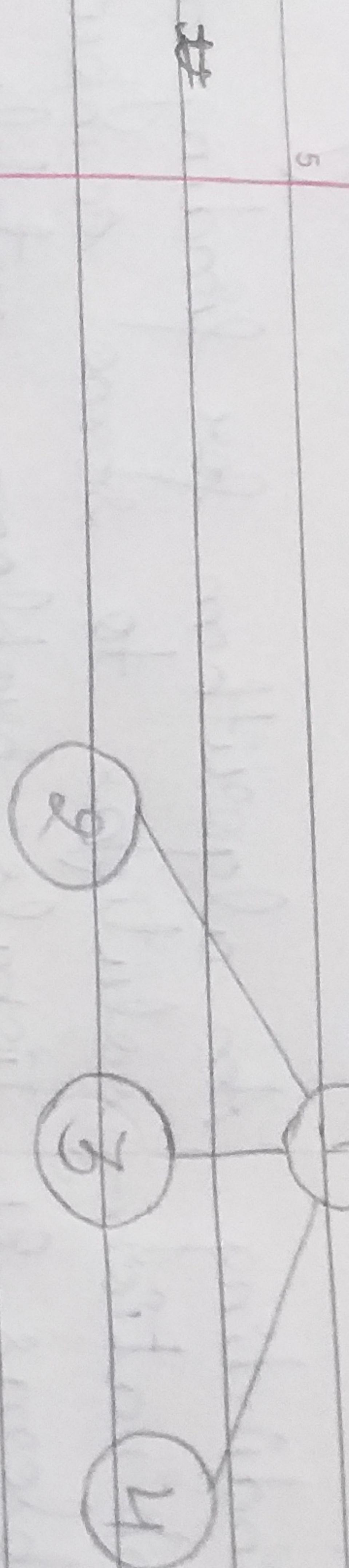
Ques) Explain in detail about state space tree.

1. A state space tree is constructed from all the possible states of the problem as nodes, connected via state transitions from some initial state as root to some terminal state as leaf. Actions are represented by operators or moves applied to each state. The number of operators are problem dependant and specific to a particular state space representation. The more operators the larger the branching factor of the state space. Thus, the number of operators should kept to a minimum. e.g. 8-puzzle : operations are defined in terms of moving the space instead of the tiles.

Ques 5) Describe :

Live Node

It is a node that has been generated but whose children have not yet been generated.



ii) Dead Node

It is a generated node that is not to be expanded or explored any further. All children of a dead node have already been expanded

Ques 4) What is best case and worst case scenario of 0/1 Knapsack problem using branch and bound?

In the best case scenario we only need to fully calculate the path through the tree and leave the rest of it.

Whereas in worst case scenario we need to fully calculate the entire tree and we have to explore all possible permutations.

12 Marks:

Ques 1) Solve the 0/1 knapsack problem using Branch and Bound. Generate the state space tree. Total capacity of Knapsack,  $W = 12$ .

Items	Weight	Profit
Item 1	5	24
Item 2	4	16
Item 3	3	9
Item 4	2	8

$$VB \text{ (Without fraction)} = -(24 + 16 + 9) = -49$$

$$(C) \text{ (With fraction)} = -(24 + 16 + 9 + \frac{2}{4} \times 8) = -53$$

$$\begin{aligned}\hat{C} &= -53 \\ \hat{D} &= -49\end{aligned}$$

$$x_1 = 0 \Rightarrow \text{Item } 9$$

$\therefore$  not taken  
 $16 + 9 + 8 = 33$

$$\begin{aligned}\hat{A} &= -53 \\ \hat{B} &= -49 \\ \hat{C} &= -41 \\ \hat{D} &= -33\end{aligned}$$

$$x_1 = 1$$

$$x_2 = 1$$

$$\begin{aligned}\hat{A} &= -53 \\ \hat{B} &= -49\end{aligned}$$

10

$$x_3 = 0$$

10

$$x_4 = 0$$

10

$$[24 + 16 + 9 = 49]$$

$$x_1 = 1, x_2 = 1, x_3 = 0, x_4 = 1$$

$$[24 + 16 + 9 = 49]$$

$$\begin{aligned}\hat{A} &= -53 \\ \hat{B} &= -49 \\ \hat{C} &= -41 \\ \hat{D} &= -33\end{aligned}$$

$$AB = -49$$

$$\text{Ans} = \{1, 1, 1, 0\}$$