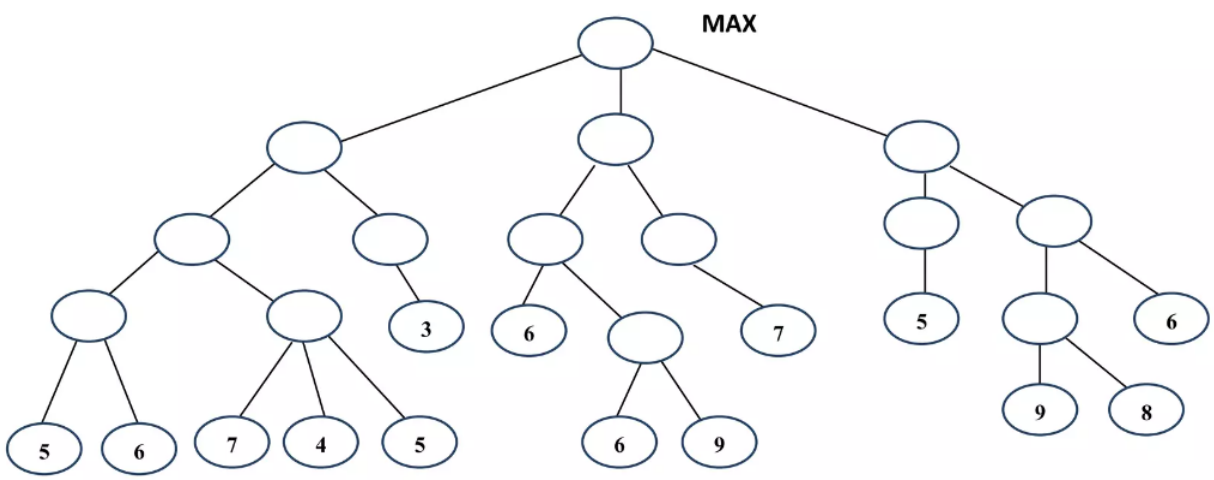
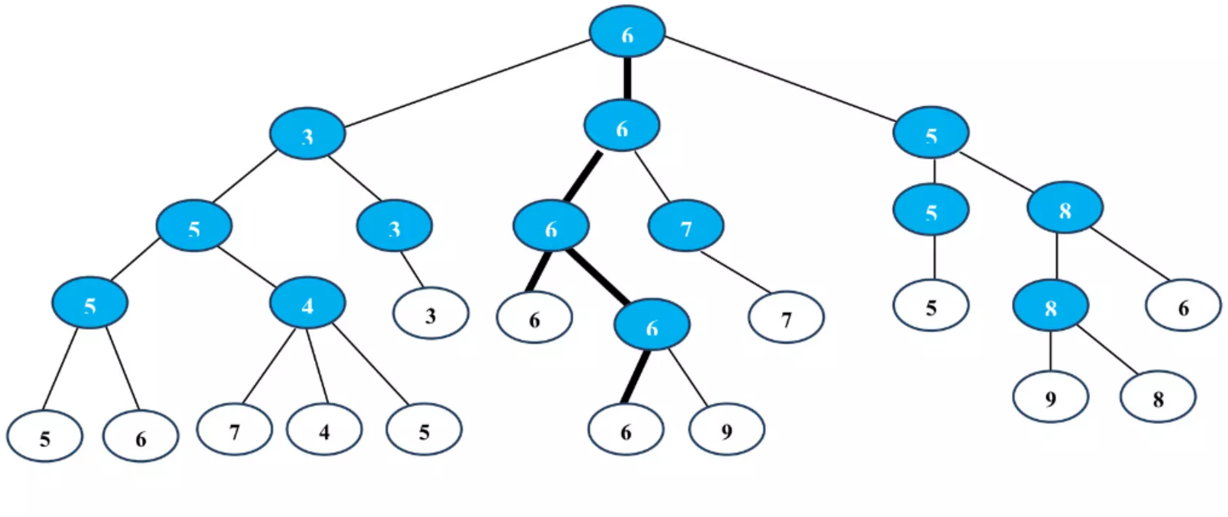
Practice Problems :
Topic: Min Max algo and CSP

1. Apply the **minimax** algorithm to the game tree in Figure 1, where it is the MAXIMIZER's turn to play. The values estimated by the evaluation function are indicated at the leaf nodes. Assume that the search always visits children in a left-to-right order.
   i) Compute the backed-up values computed by the **minimax** algorithm. Show your answer by writing values at the appropriate nodes in the above tree.
   ii) Indicate the proper move for the MAXIMIZER by marking the line with bold indicator(——) to the root's outgoing edges.



Solution :

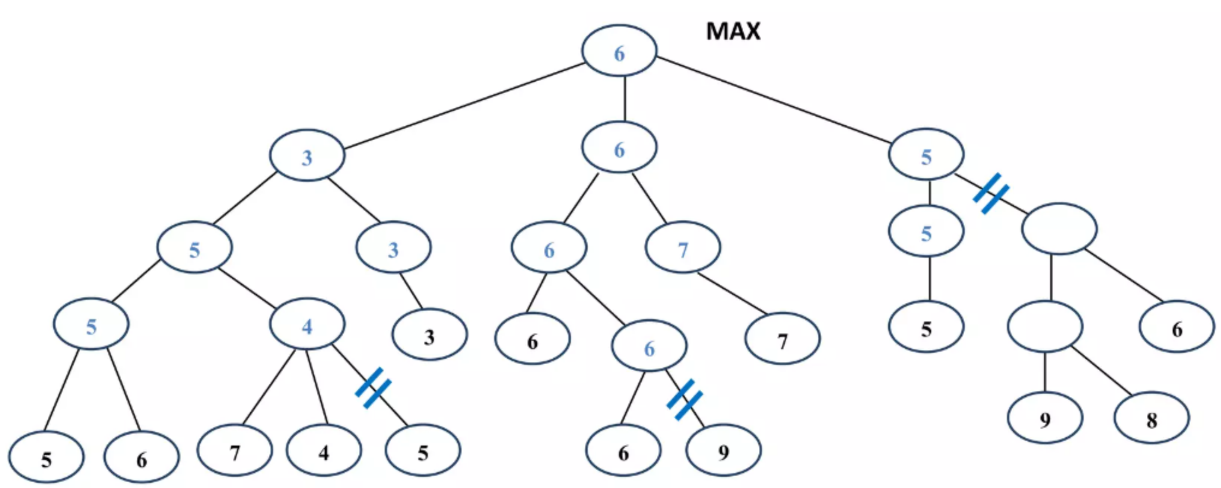


2. Apply alpha beta pruning to the game tree in Figure 1.
i) Using the alpha-beta pruning procedure (and standard left-to-right evaluation of nodes), how many of the nodes and leaves will get evaluated?

ii) Indicate all parts of the tree that are pruned / cut off.

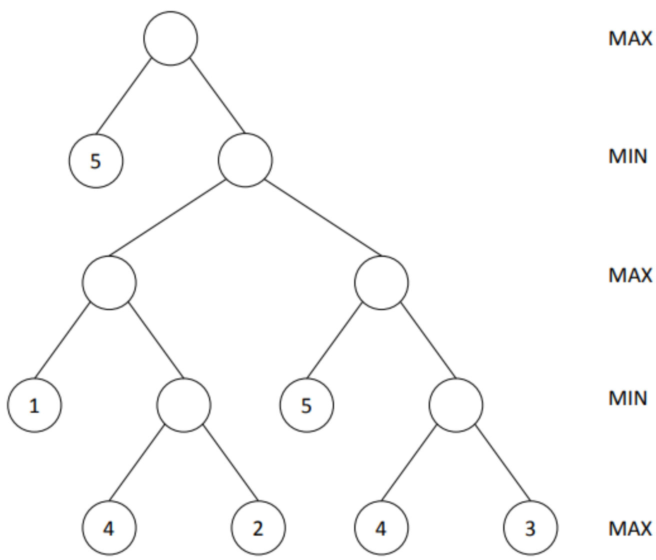
Answer:

i) 21 nodes (nodes with cut-off are not included and 12 nodes (nodes with cut-off are not included and not including leaf nodes)

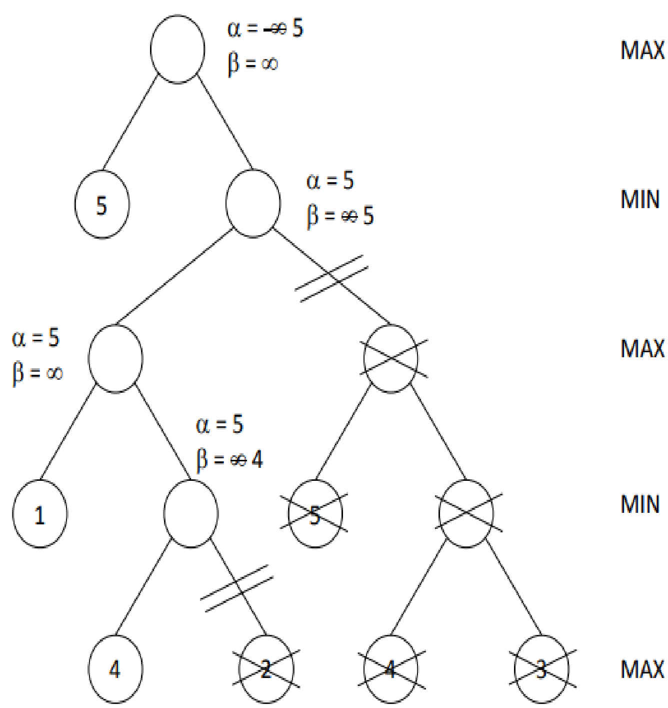


Q2

What is the minimax value of the root node for the game tree below? Cross out the node(s) whose value(s) the alpha-beta method never determines, assuming that it performs a depth-first search that always generates the leftmost child node first and a loss (and win) of MAX (and MIN) corresponds to a value of −∞ (and ∞, respectively). Determine the alpha and beta values of the remaining node(s).



Answer: The minimax value is 5.



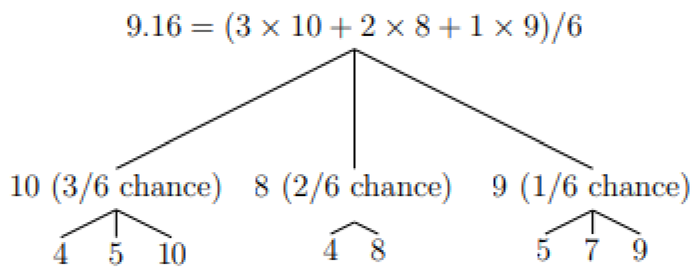
Q3. In order to perform a move in the game a player has to roll a die. If the outcome is odd (1,3 or 5) the player has three possible moves that will reach states with utilities: 4, 5 and 10. If the outcome of the die is 2 or 4, the player has two possible moves that will reach states with utilities: 4, and 8. Finally, if the outcome of the die is 6, there are three moves that reach states with utilities 5, 7 and 9. Draw the expectiminimax tree and calculate the expectiminimax value of the root node given that:

a) The player is a maximum player.

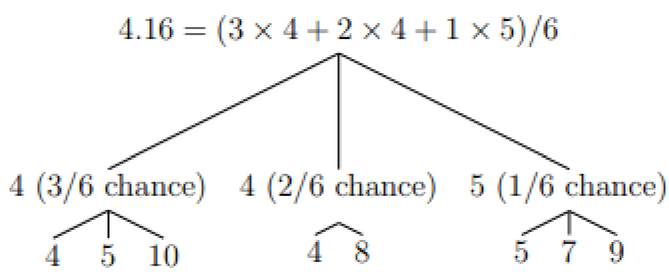
b) The player is a minimum player.

Solution

a)



b)



Q5. The minimax algorithm returns the best move for MAX under the assumption that MIN plays optimally. What happens if MIN plays suboptimally? Is it still a good idea to use the minimax algorithm?

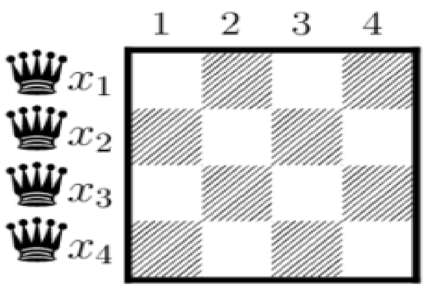
Ans: The outcome of MAX can only be the same or better if MIN plays suboptimally compared to MIN playing optimally. So, in general, it seems like a good idea to use minimax. However, suppose MAX assumes MIN plays optimally and minimax determines that MIN will win. In such cases, all moves are losing and are “equally good,” including those that lose immediately. A better algorithm would make moves for which it is more difficult for MIN to find the winning line.

CSP

Q1

Given problem : N - Queens problem

N - Queens problem is to place n - queens in such a manner on an n x n chessboard that no queens attack each other by being in the same row, column or diagonal.



Formulate (Basic CSP Formulation) the following terms with respect to given problem

1.Variables

2.Domains

3.Satisfaction Constraints

4. Optimization Criteria (if any)

5. Solution

Solve the above given CSP using Constraint Propagation, Backtracking

Q2

Given problem : CRYPTARITHMETIC PUZZLE problem

(Cryptarithmetic Problem is a type of constraint satisfaction problem where the game is about digits and its unique replacement either with alphabets or other symbols. In cryptarithmetic problems, the digits (0-9) get substituted by some possible alphabets or symbols. The task in cryptarithmetic problems is to substitute each digit with an alphabet to get the result arithmetically correct.)

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  B A S E
+ B A L L
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G A M E S
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→

B	7
A	4
S	8
E	3
L	5
G	1
M	9

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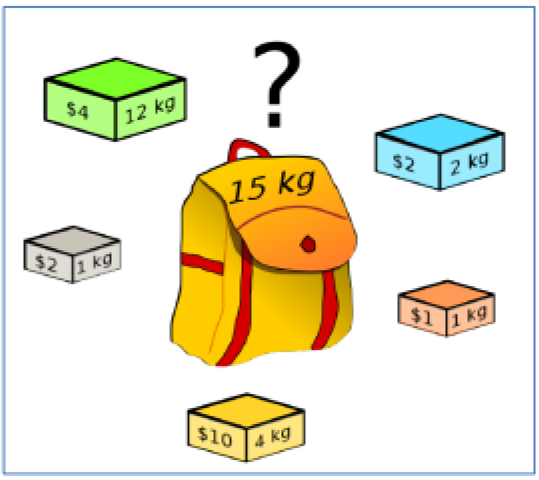
4. Optimization Criteria (if any)
5. Solution
Solve the above given CSP using Constraint Propagation, Backtracking

Q3
Given problem : knapsack problem
A knapsack problem is a problem faced by someone who is constrained by a fixed-size knapsack and must fill it with the most valuable items.



Formulate (Basic CSP Formulation) the following terms with respect to given problem
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5. Solution
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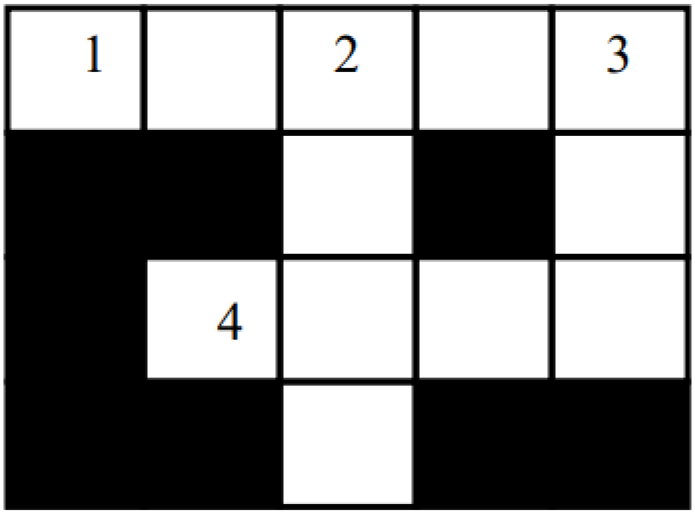
Q4

Given problem : Crossword problem



Word List:

astar, happy, hello, hoses, live, load, loom, peal, peel, save, talk, ant, oak, old

Formulate (Basic CSP Formulation) the following terms with respect to given problem

1.Variables

2.Domains

3.Satisfaction Constraints

4. Optimization Criteria (if any)

5. Solution

Solve the above given CSP using Constraint Propagation, Backtracking