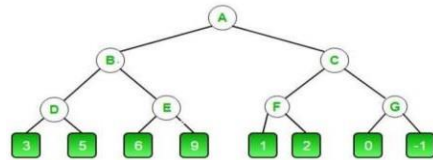


## TASK:4

Implementation of **Mini-Max algorithm** using recursion to search through the Game - tree using python by applying following constraints.

**Aim:** To create a program for searching problem using Mini-max algorithm with Alpha-Beta pruning approach.



### Algorithm:

**Step 1:** At the first step the, Max player will start first move from node A where  $\alpha = -\text{infinity}$  and  $\beta = +\text{infinity}$ , these values of alpha and beta passed down to node B. Node B transmitting the identical value to its off spring D.

**Step2:** As Max's turn at Node D approaches, the value of  $\alpha$  will be decided. when the value of  $\alpha$  is compared to 3 then 5 the value at node D is  $\max(3,5) = 5$ . Hence the node value is also 5

**Step 3:** The algorithm returns to node B, where the value of beta will change since this a turn of min

**Step 4:** Max will take over at node E and change alpha's value.

**Step 5:** We know traverse the tree backward, from node B to node A

**Step 6:** As a result, in this case, the ideal value for the maximizer is 5.

### Program:

# Initial values of Alpha and Beta

MAX, MIN = 1000, -1000

# Returns optimal value for current player

# (Initially called for root and maximizer)

```
def minimax(depth, nodeIndex, maximizingPlayer, values, alpha, beta):
```

```
    # Terminating condition. i.e. leaf node is reached
```

```
    if depth == 3:
```

```
        return values[nodeIndex]
```

```
    if maximizingPlayer:
```

```
        best = MIN
```

```
        # Recur for left and right children
```

```

for i in range(0, 2):
    val = minimax(depth + 1, nodeIndex * 2 + i, False, values, alpha, beta)
    best = max(best, val)
    alpha = max(alpha, best)

    # Alpha Beta Pruning
    if beta <= alpha:
        break

return best
else:
    best = MAX
    # Recur for left and right children
    for i in range(0, 2):
        val = minimax(depth + 1, nodeIndex * 2 + i, True, values, alpha, beta)
        best = min(best, val)
        beta = min(beta, best)

        # Alpha Beta Pruning
        if beta <= alpha:
            break

return best

# Driver Code
if __name__ == "__main__":
    values = [3, 5, 6, 9, 1, 2, 0, -1]
    print("The optimal value is:", minimax(0, 0, True, values, MIN, MAX))

```

### Sample output :

```

The optimal value is: 5

```

### Result:

Thus creating a program for searching problem using Mini-max algorithm with Alpha-Beta pruning approach was successfully executed and output was verified.