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Lab-6

Aim - Implementation of minimax algorithm for an application

Problem Formulation

Consider a board having nine element vector where each element will contain '_' for blank, X for indicating the move of player 1 and 0 for player 2's move

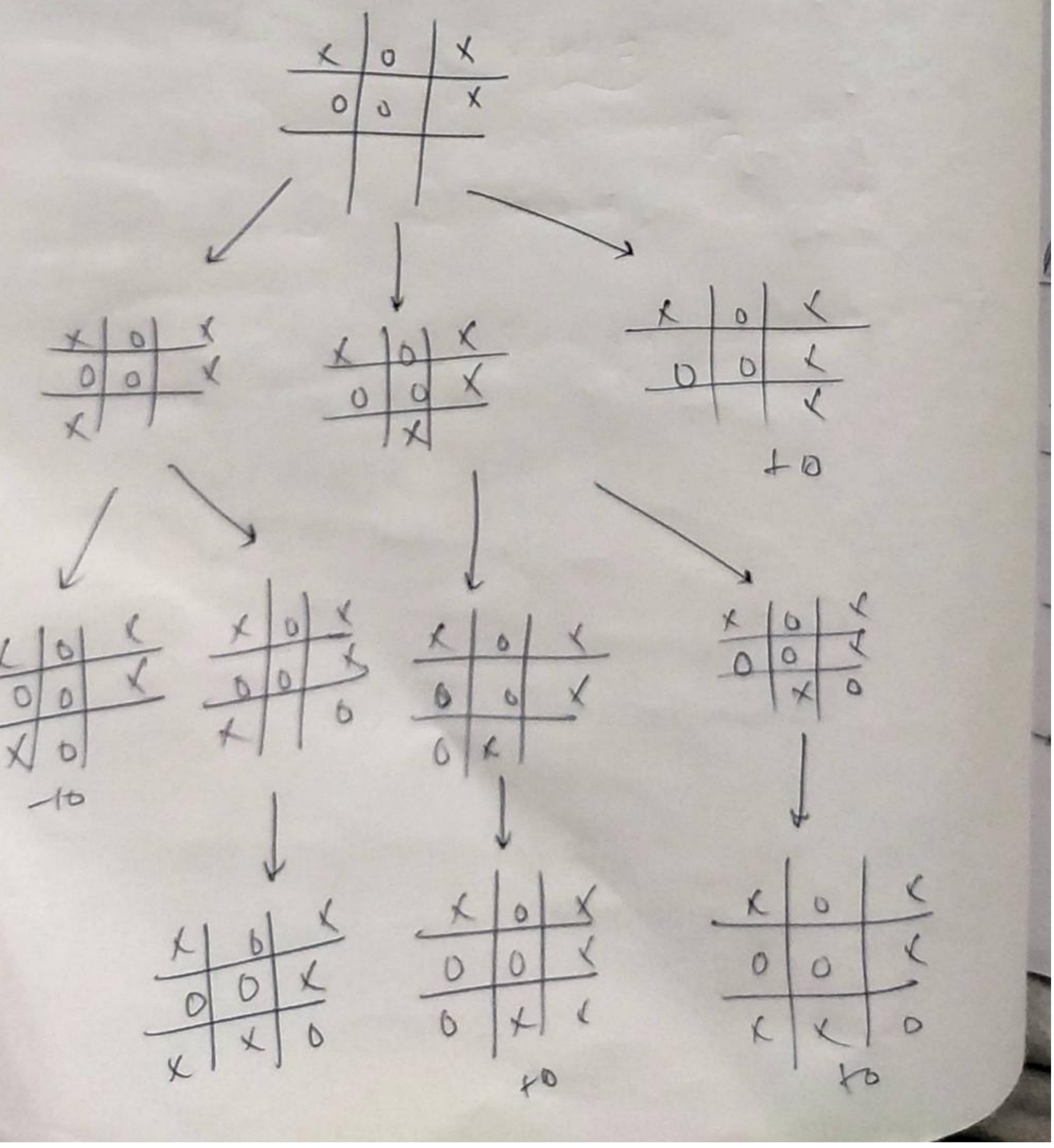
Initial State

X	0	X
0	0	X
_	_	_

Final State

X	0	X
0	0	X
0	X	X

+10



NAME – SHUBHAM SHARMA

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AI LAB 6

Implementation of minimax algorithm for an application

Algorithm:

Step-1: Start

Step-2: Construct the complete game tree

Step-3: Evaluate scores for leaves using the evaluation function

Step-4: Back-up scores from leaves to root, considering the player type:

• For max player, select the child with the maximum score

• For min player, select the child with the minimum score

Step-5: At the root node, choose the node with max value and perform

the corresponding move

Step-6: Stop

Source Code

```
# Python3 program to find the next optimal move for a player
player, opponent = 'x', 'o'

# This function returns true if there are moves
# remaining on the board. It returns false if
# there are no moves left to play.
def isMovesLeft(board) :

for i in range(3) :
for j in range(3) :
if (board[i][j] == '_'):

return True
```

```
return False

# This is the evaluation function as discussed
# in the previous article ( http://goo.gl/sJgv68 )
def evaluate(b) :

# Checking for Rows for X or O victory.
for row in range(3) :
if (b[row][0] == b[row][1] and b[row][1] == b[row][2]) :
if (b[row][0] == player) :
return 10
elif (b[row][0] == opponent) :
return -10

# Checking for Columns for X or O victory.
for col in range(3) :

if (b[0][col] == b[1][col] and b[1][col] == b[2][col]) :

if (b[0][col] == player) :
return 10
elif (b[0][col] == opponent) :
return -10

# Checking for Diagonals for X or O victory.
if (b[0][0] == b[1][1] and b[1][1] == b[2][2]) :

if (b[0][0] == player) :
return 10
elif (b[0][0] == opponent) :
```

```
return -10

if (b[0][2] == b[1][1] and b[1][1] == b[2][0]) :

if (b[0][2] == player) :
return 10
elif (b[0][2] == opponent) :
return -10

# Else if none of them have won then return 0
return 0

# This is the minimax function. It considers all
# the possible ways the game can go and returns
# the value of the board
def minimax(board, depth, isMax) :
score = evaluate(board)

# If Maximizer has won the game return his/her
# evaluated score
if (score == 10) :
return score

# If Minimizer has won the game return his/her
# evaluated score
if (score == -10) :
return score

# If there are no more moves and no winner then
# it is a tie
if (isMovesLeft(board) == False) :
```

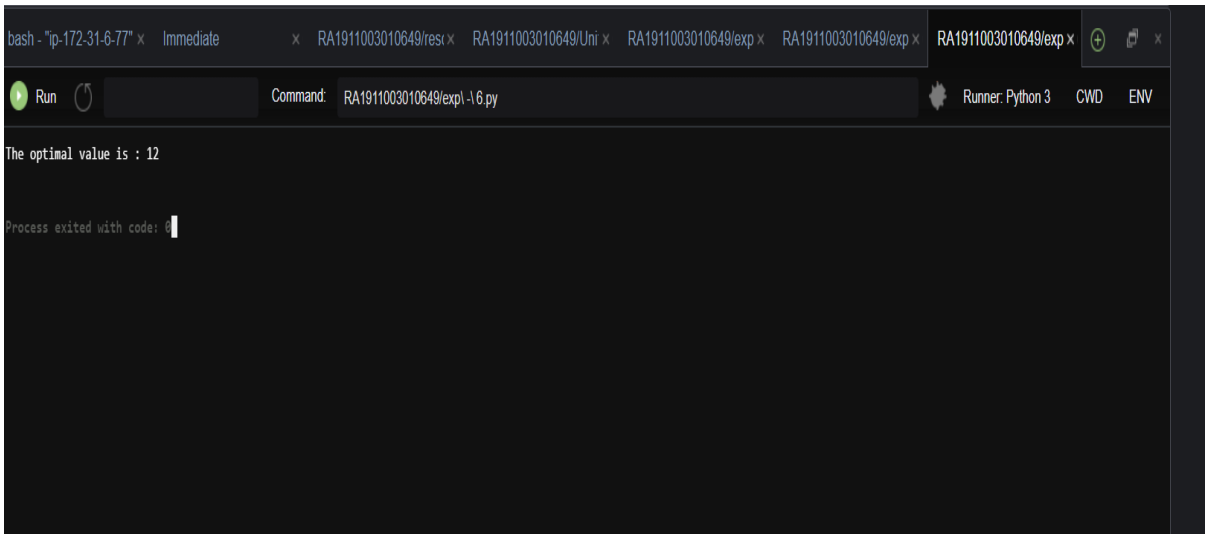
```
return 0

# If this maximizer's move
if (isMax) :
best = -1000

# Traverse all cells
for i in range(3) :
for j in range(3) :

# Check if cell is empty
if (board[i][j]=='_') :

# Make the move
board[i][j] = player

# Call minimax recursively and choose
# the maximum value
best = max( best, minimax(board,

depth + 1,
not isMax) )

# Undo the move
board[i][j] = '_'

return best

# If this minimizer's move
else :
```

```
best = 1000

# Traverse all cells

for i in range(3) :
for j in range(3) :

# Check if cell is empty
if (board[i][j] == '_') :

# Make the move
board[i][j] = opponent

# Call minimax recursively and choose
# the minimum value
best = min(best, minimax(board, depth + 1, not isMax))

# Undo the move
board[i][j] = '_'

return best

# This will return the best possible move for the player
def findBestMove(board) :
bestVal = -1000
bestMove = (-1, -1)

# Traverse all cells, evaluate minimax function for
# all empty cells. And return the cell with optimal
# value.
for i in range(3) :
```

```
for j in range(3) :

# Check if cell is empty
if (board[i][j] == '_') :

# Make the move
board[i][j] = player

# compute evaluation function for this
# move.
moveVal = minimax(board, 0, False)

# Undo the move
board[i][j] = '_'

# If the value of the current move is
# more than the best value, then update
# best/
if (moveVal > bestVal) :
bestMove = (i, j)
bestVal = moveVal

print("The value of the best Move is :", bestVal)
print()
return bestMove
# Driver code
board = [
[ 'x', 'o', 'x' ],
[ 'o', 'o', 'x' ],
[ '_', '_', '_' ]
]
```

```
bestMove = findBestMove(board)

print("The Optimal Move is :")
print("ROW:", bestMove[0], " COL:", bestMove[1])
```

Output-



Result:

Hence, the Implementation of minimax algorithm for TIC-TAC-TOE is done successfully.