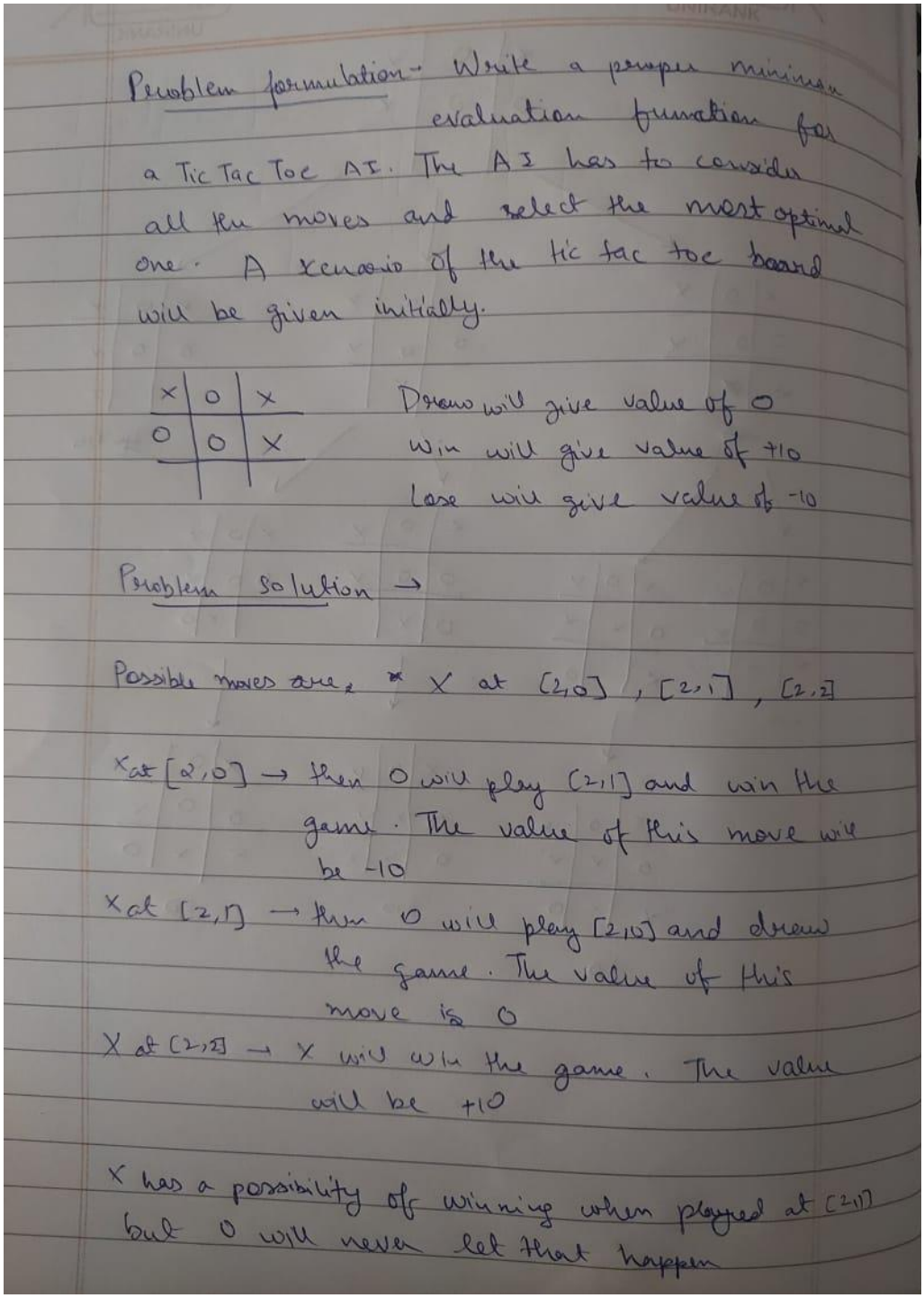
Prajwal Gupta

RA1911003010660

AI LAB 6

Aim- Implementation of minimax algorithm for an application



Problem formulation - Write a proper minimax evaluation function for a Tic Tac Toe AI. The AI has to consider all the moves and select the most optimal one. A scenario of the tic tac toe board will be given initially.

X	O	X
O	O	X

Draw will give value of 0
Win will give value of +10
Lose will give value of -10

Problem solution →

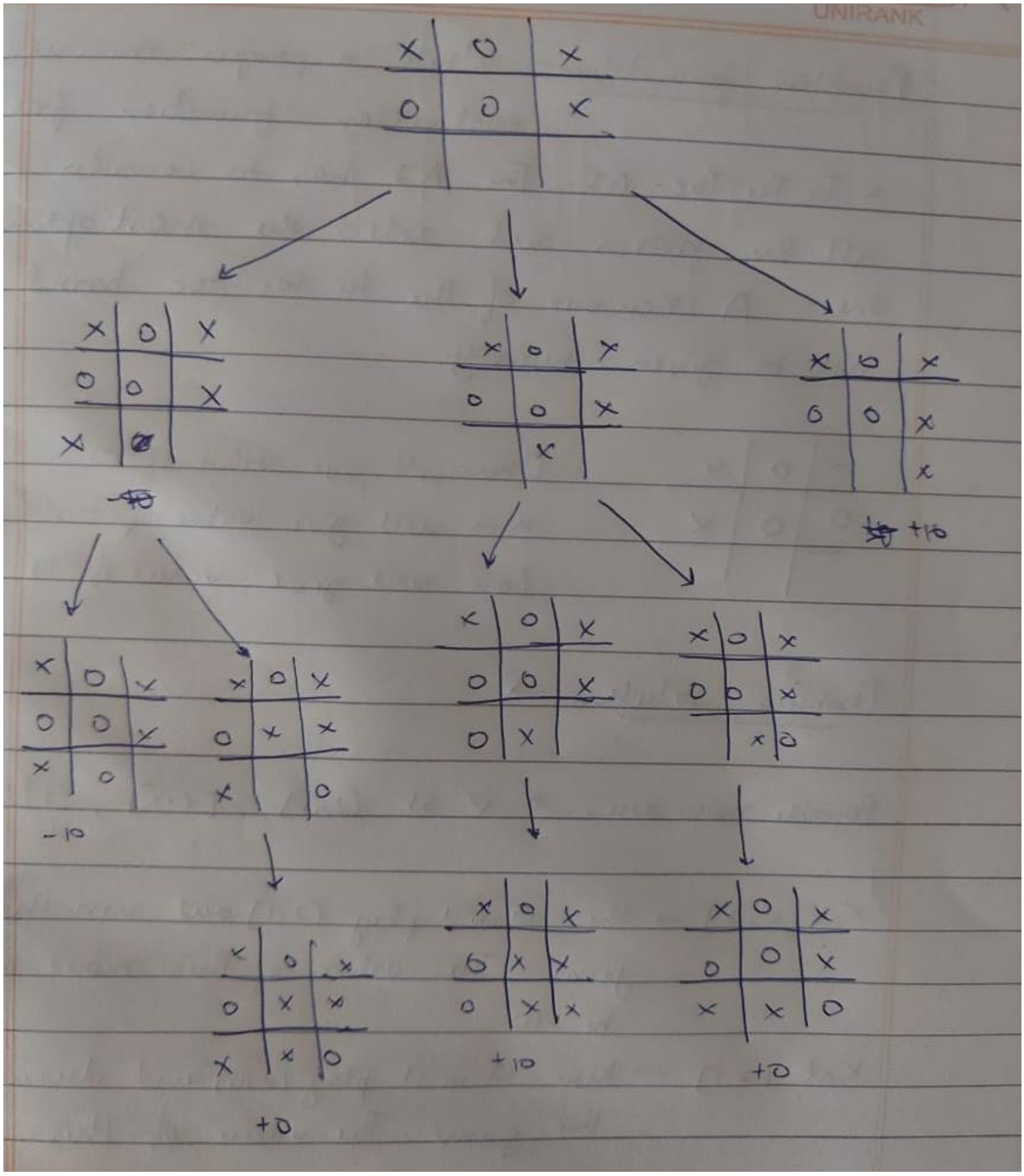
Possible moves are, X at [2,0], [2,1], [2,2]

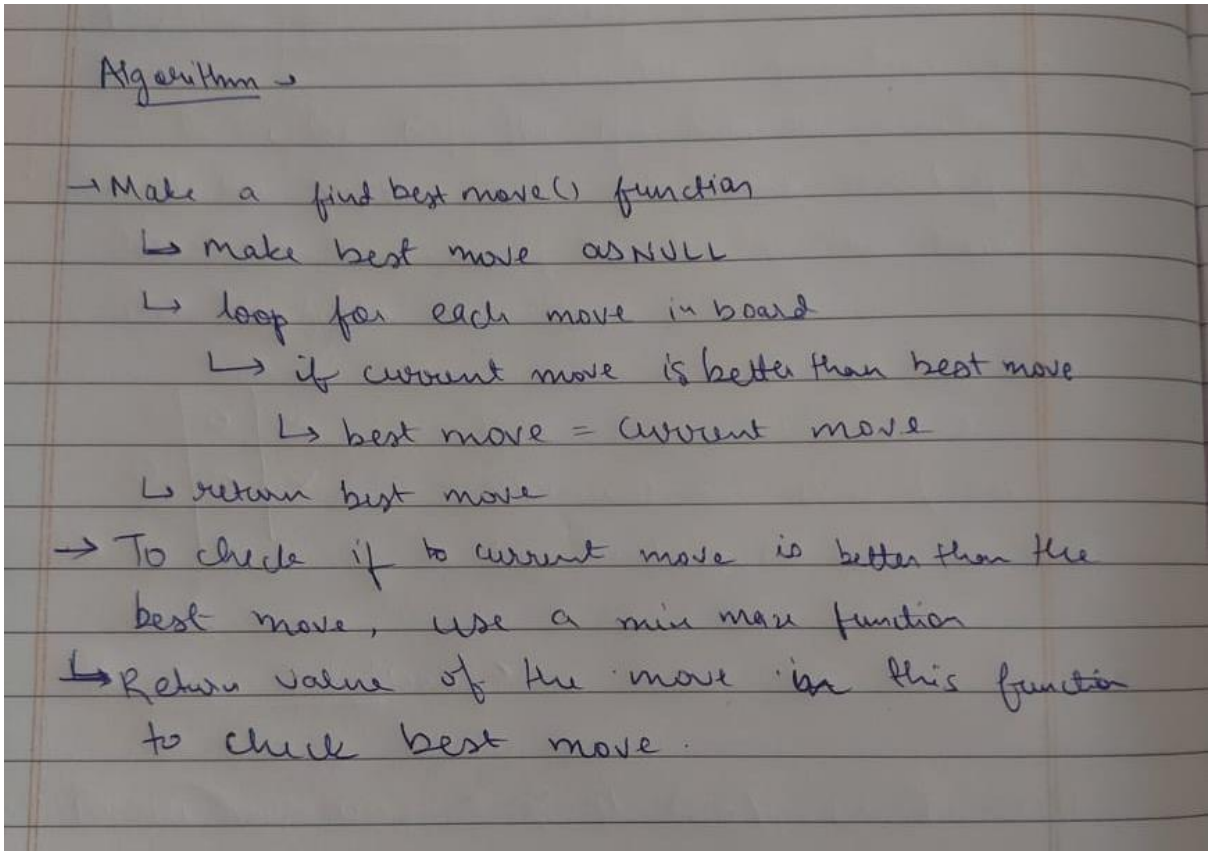
X at [2,0] → then O will play [2,1] and win the game. The value of this move will be -10

X at [2,1] → then O will play [2,0] and draw the game. The value of this move is 0

X at [2,2] → X will win the game. The value will be +10

X has a possibility of winning when played at [2,1] but O will never let that happen


UNIRANK
-10
+0
+10
+0
+10



Code-

```
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


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
```

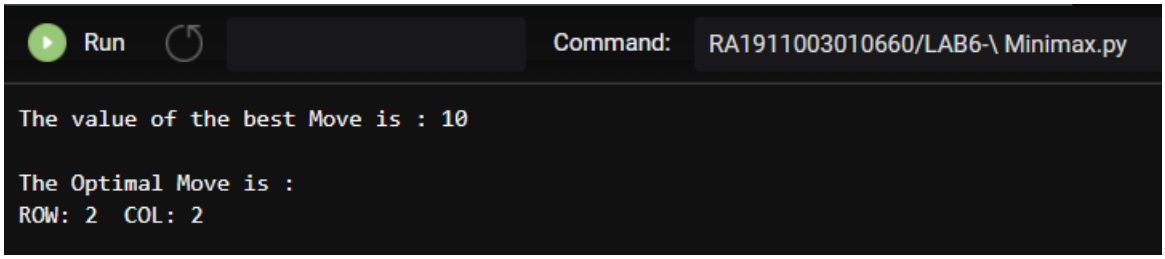
```
        elif (b[0][2] == opponent) :
            return -10

    # 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-


Run
Command:
RA1911003010660/LAB6-\ Minimax.py
The value of the best Move is : 10
The Optimal Move is :
ROW: 2 COL: 2