PRINCIPLES OF ARTIFICIAL INTELLIGENCE
ASSIGNMENT -3
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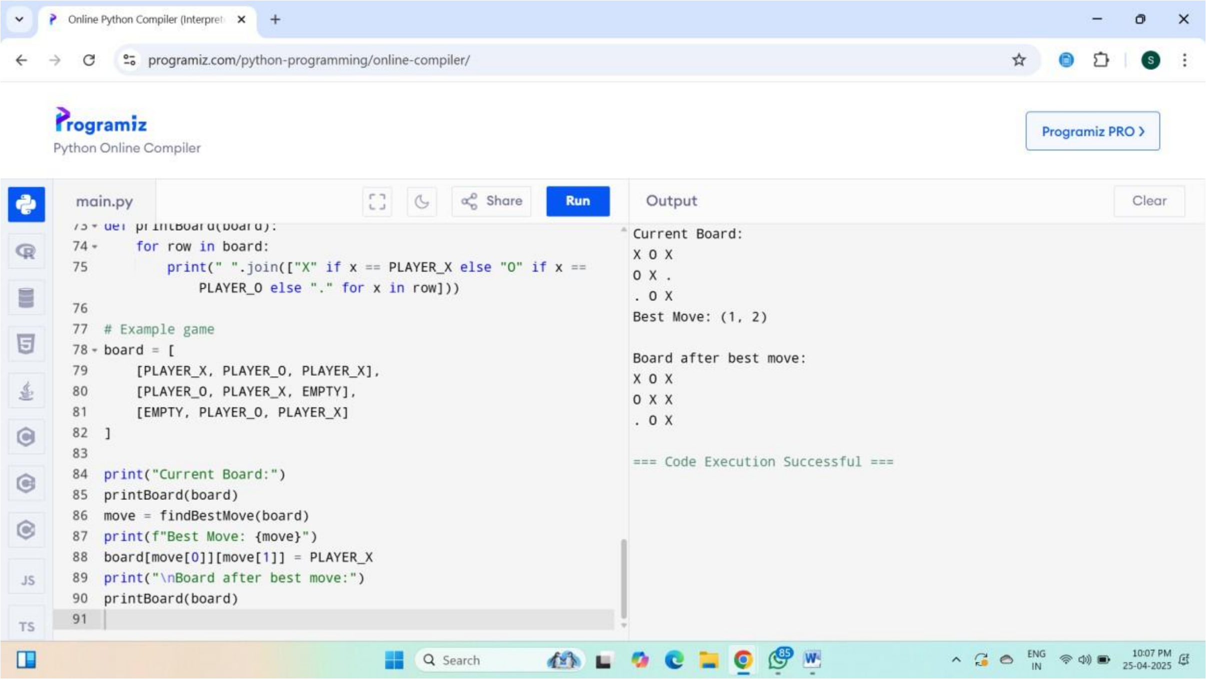
```
# Constants for players PLAYER_X = 1
PLAYER_O = -1

EMPTY = 0


# Evaluate the board

def evaluate(board):

    for row in range(3):

        if board[row][0] == board[row][1] == board[row][2] != EMPTY:

            return board[row][0]

    for col in range(3):

        if board[0][col] == board[1][col] == board[2][col] != EMPTY:

            return board[0][col]

    if board[0][0] == board[1][1] == board[2][2] != EMPTY:

        return board[0][0]

    if board[0][2] == board[1][1] == board[2][0] != EMPTY:

        return board[0][2]

    return 0


# Check if moves are left

def isMovesLeft(board):

    for row in range(3):

        for col in range(3):

            if board[row][col] == EMPTY:

                return True

    return False
```

```
# Minimax function
def minimax(board, isMax):
    score = evaluate(board)
    if score == PLAYER_X:
        return score
    if score == PLAYER_O:
        return score
    if not isMovesLeft(board):
        return 0

    if isMax:
        best = -float('inf')
        for row in range(3):
            for col in range(3):
                if board[row][col] == EMPTY:
                    board[row][col] = PLAYER_X
                    best = max(best, minimax(board, not isMax))
                    board[row][col] = EMPTY
        return best
    else:
        best = float('inf')
        for row in range(3):
            for col in range(3):
                if board[row][col] == EMPTY:
                    board[row][col] = PLAYER_O
                    best = min(best, minimax(board, not isMax))
                    board[row][col] = EMPTY
        return best


# Find the best move for PLAYER_X
def findBestMove(board):
    bestVal = -float('inf')
    bestMove = (-1, -1)
    for row in range(3):
        for col in range(3):
            if board[row][col] == EMPTY:
                board[row][col] = PLAYER_X
                moveVal = minimax(board, False)
                board[row][col] = EMPTY
                if moveVal > bestVal:
                    bestMove = (row, col)
                    bestVal = moveVal
    return bestMove


# Print the board
def printBoard(board):
    for row in board:
        print(" ".join(["X" if x == PLAYER_X else "O" if x == PLAYER_O else "." for x in row]))


# Example game
board = [
    [PLAYER_X, PLAYER_O, PLAYER_X],
    [PLAYER_O, PLAYER_X, EMPTY],
    [EMPTY, PLAYER_O, PLAYER_X]
]

print("Current Board:")

printBoard(board)

move = findBestMove(board)

print(f"Best Move: {move}")

board[move[0]][move[1]] = PLAYER_X

print("\nBoard after best move:")

printBoard(board)
```



```python
def printBoard(board):
    for row in board:
        print(" ".join(["X" if x == PLAYER_X else "O" if x ==
            PLAYER_O else "." for x in row]))

# Example game
board = [
    [PLAYER_X, PLAYER_O, PLAYER_X],
    [PLAYER_O, PLAYER_X, EMPTY],
    [EMPTY, PLAYER_O, PLAYER_X]
]

print("Current Board:")
printBoard(board)
move = findBestMove(board)
print(f"Best Move: {move}")
board[move[0]][move[1]] = PLAYER_X
print("\nBoard after best move:")
printBoard(board)
```

```
Current Board:
X O X
O X .
. O X
Best Move: (1, 2)

Board after best move:
X O X
O X X
. O X

=== Code Execution Successful ===
```