AI LAB EXP – 6

IMPLEMENTATION OF MINIMAX ALGORITHM FOR AN APPLICATION

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AIM

To implement mini-max algorithm as a tic tac toe game using python.

ALGORITHM

Mini-max algorithm is a recursive or backtracking algorithm which is used in decision-making and game theory. It provides an optimal move for the player assuming that opponent is also playing optimally. Min-Max algorithm is mostly used for game playing in AI. Such as Chess, Checkers, tic-tac-toe, go, and various tow-players game. This Algorithm computes the minimax decision for the current state.

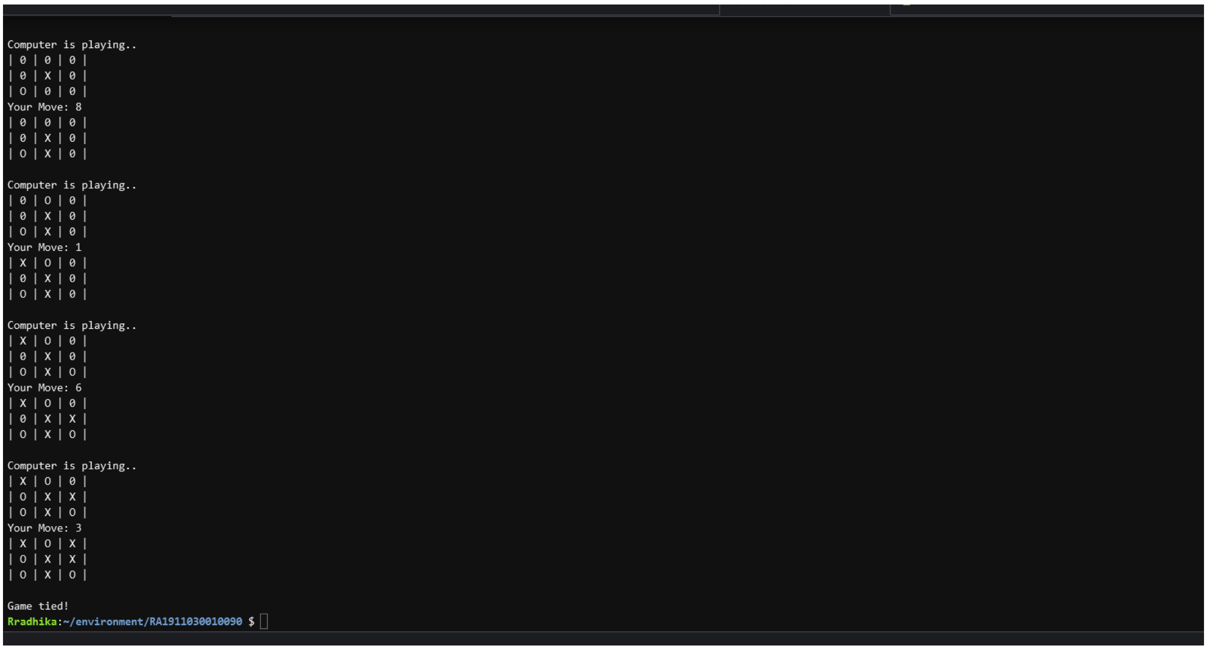
CODE

```
import random


class TicTacToe(object):
    winning_combos = (
        [0, 1, 2], [3, 4, 5], [6, 7, 8],
        [0, 3, 6], [1, 4, 7], [2, 5, 8],
        [0, 4, 8], [2, 4, 6]
    )

    winners = ('X-win', 'Draw', 'O-win')

    def __init__(self, board=[]):
        if len(board) == 0:
            self.board = [0 for i in range(9)]
```

```python
        else:
            self.board = board

    def print_board(self):
        for i in range(3):
            print(
                "| " + str(self.board[i * 3]) +
                " | " + str(self.board[i * 3 + 1]) +
                " | " + str(self.board[i * 3 + 2]) + " |"
            )

    def check_game_over(self):
        if 0 not in [element for element in self.board]:
            return True
        if self.winner() != 0:
            return True
        return False

    def available_moves(self):
        return [index for index, element in enumerate(self.board) if
element is 0]

    def available_combos(self, player):
        return self.available_moves() + self.get_acquired_places(player)

    def X_won(self):
        return self.winner() == 'X'

    def O_won(self):
        return self.winner() == 'O'

    def is_tie(self):
        return self.winner() == 0 and self.check_game_over()


    def winner(self):
        for player in ('X', 'O'):
            positions = self.get_acquired_places(player)
            for combo in self.winning_combos:
                win = True
                for pos in combo:
                    if pos not in positions:
                        win = False
                if win:
                    return player
        return 0


    def get_acquired_places(self, player):
        return [index for index, element in enumerate(self.board) if
element == player]


    def make_move(self, position, player):
        self.board[position] = player


    def minimax(self, node, player):
        if node.check_game_over():
            if node.X_won():
                return -1
            elif node.is_tie():
                return 0
            elif node.O_won():
                return 1
        best = 0
        for move in node.available_moves():
            node.make_move(move, player)
            val = self.minimax(node, get_enemy(player))
            node.make_move(move, 0)
            if player == 'O':
                if val > best:
                    best = val
            else:
                if val < best:
                    best = val
        return best



def determine(board, player):
    '''
    Driver function to apply minimax algorithm
    '''
    a = 0
    choices = []
    if len(board.available_moves()) == 9:
        return 4
    for move in board.available_moves():
        board.make_move(move, player)
        val = board.minimax(board, get_enemy(player))
        board.make_move(move, 0)
        if val > a:
            a = val
            choices = [move]
        elif val == a:
            choices.append(move)
    try:
        return random.choice(choices)
    except IndexError:
        return random.choice(board.available_moves())
```

```
def get_enemy(player):
    if player == 'X':
        return 'O'
    return 'X'


if __name__ == "__main__":
    board = TicTacToe()
    print('Board positions are like this: ')
    for i in range(3):
        print(
            "| " + str(i * 3 + 1) +
            " | " + str(i * 3 + 2) +
            " | " + str(i * 3 + 3) + " |"
        )
    print('Type in the position number you to make a move on..')
    while not board.check_game_over():
        player = 'X'
        player_move = int(input("Your Move: ")) - 1
        if player_move not in board.available_moves():
            print('Please check the input!')
            continue
        board.make_move(player_move, player)
        board.print_board()
        print()
        if board.check_game_over():
            break
        print('Computer is playing.. ')
        player = get_enemy(player)
        computer_move = determine(board, player)
        board.make_move(computer_move, player)
        board.print_board()
    if board.winner() != 0:
        if board.winner() == 'X':
            print("Congratulations you win!")
        else:
            print('Computer Wins!')
    else:
        print("Game tied!")
```

OUTPUT



```
Computer is playing..
| 0 | 0 | 0 |
| 0 | X | 0 |
| O | 0 | 0 |
Your Move: 8
| 0 | 0 | 0 |
| 0 | X | 0 |
| O | X | 0 |

Computer is playing..
| 0 | O | 0 |
| 0 | X | 0 |
| O | X | 0 |
Your Move: 1
| X | O | 0 |
| 0 | X | 0 |
| O | X | 0 |

Computer is playing..
| X | O | 0 |
| 0 | X | 0 |
| O | X | O |
Your Move: 6
| X | O | 0 |
| 0 | X | X |
| O | X | O |

Computer is playing..
| X | O | 0 |
| O | X | X |
| O | X | O |
Your Move: 3
| X | O | X |
| O | X | X |
| O | X | O |

Game tied!
Rradhika:~/environment/RA1911030010090 $ 
```

RESULT

Mini-Max algorithm has been successfully implemented using python.