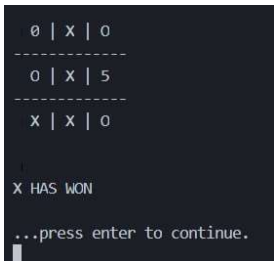
Thomas Mulvey

Project 1.A : TTT WITH MINIMAX

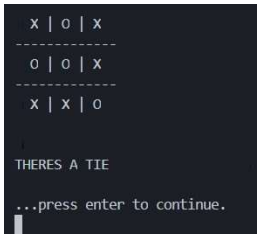
4/1/19

Analysis / Sample Outputs: “X” is COMPUTER and goes first

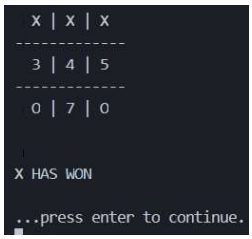
Game 1: HUMAN LOSS



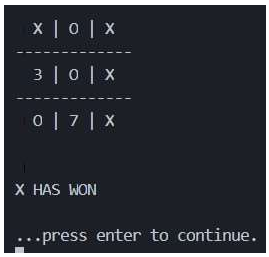
Game 2: TIE



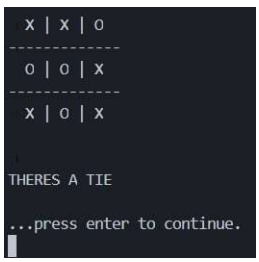
Game 3: HUMAN LOSS



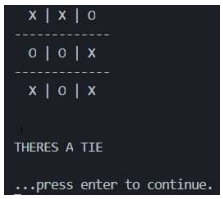
Game 4: HUMAN LOSS



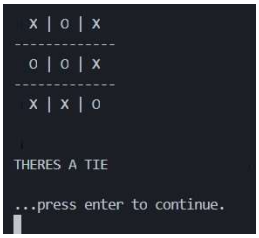
Game 5: TIE



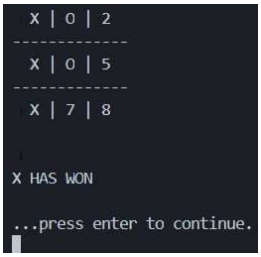
Game 6: TIE



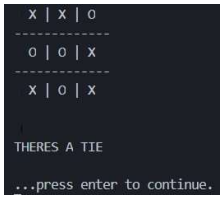
Game 7: TIE



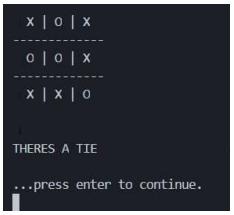
Game 8: HUMAN LOSS



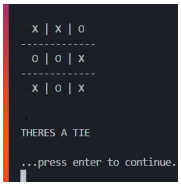
Game 9: TIE



Game 10: TIE



MINIMAX vs MINIMAX: TIE



Results:

Humans vs AI (Human Wins, AI Win, TIE) -- (0, 4, 6)

- Game 3 and 8: AI obviously sees optimal path
- Game 4 and 1: Starting a corner like the AI results in loss
- Starting in middle after corner move is only move that can result in a tie

AI vs AI: always a tie

== CODE ==

MINIMAX CLASS:

```
import random
from Player import *

# X IS MAX (computer) O IS MINS (human)
# we will return score based off of X's position
class MiniMax(Player):
    def __init__(self, char='X'):
        self.char = char
        self.kind = 'MiniMax'
        if self.char == 'X':
            self.opponent = 'O'
        else :
            self.opponent = 'X'

    '''
    is game done given board state?
    returns (TRUE, value of state [10 win, -10 lost] ) or FALSE
    '''
    def is_terminal_state(self, board):
        winning_states = ( [0,1,2],[3,4,5],[6,7,8],[0,3,6],[1,4,7],[2,5,8],[0,4,8],[2,4,6] )
        for a,b,c in winning_states:
            if board[a]==board[b]==board[c]==self.char:
                return (True, 10) #minimax won!
            elif board[a]==board[b]==board[c]==self.opponent:
                return (True, -10) #other player won

        space_counter = 0
        for spot in board:
            if spot==' ':
                space_counter+=1

        if space_counter==0: #TIE
            return (True, 0)

        return (False, 0) # aint over yet, chiefton

    def move(self, board): #acutal MINIMAX IMPLEMENTATION
        # in order to cut down brnaching factor a bit, IF ai
        #  is going first, just choose a corner.
        if len( self.available_positions(board) ) == 9:
            return random.choice( [0,2,6,8] ) , 10

        # ON THE MINIMAX TURN, YOU WANT THE BEST (MAX) OF THE OTHER PLAYERS TURNS(MIN)
        moves=[-10 for _ in range(9)] #move values
        for move in self.available_positions(board) : # for every child, is it a winner? is a
successor a winner? else play random
            board[int(move)] = str(self.char)
            if (self.is_terminal_state(board))[0] is True:
                return move, (self.is_terminal_state(board))[1]
            board_val = self.min_value(board)
            board[move] = ' '
            moves[move] = board_val

        # game would sometimes choose a slower win so this forces it to choose immediate win
        c=0
        for i in moves:
```

```
            if i == 0 and board[c] == ' ':
                board[c] = self.opponent
                res = (self.is_terminal_state(board))[1]
                if int(res) == int(-10):
                    return c,0 #stops win so tie for now
                board[c] = ' '
            c+=1

        # otherwise play random move
        return moves.index(max(moves)) , max(moves)

        # if cant find a move there, just take a tie from here.
        #   return random.choice(self.available_positions(board))

    def max_value(self, board):
        board_done, return_value = self.is_terminal_state(board)
        if board_done: # if current board is done, return -10, 0 , 10
            return return_value

        value = -100

        for moves in self.available_positions(board):
            board[moves] = self.char
            new_value = self.min_value(board)
            if new_value > value:
                value = new_value
            board[moves] = ' '

        return value

    def min_value(self, board):
        board_done, return_value = self.is_terminal_state(board)
        if board_done:
            return return_value

        value = 100

        for moves in self.available_positions(board):
            board[moves] = self.opponent
            new_value = self.max_value(board)
            if new_value < value:
                value = new_value
            board[moves] = ' '

        return value
```

PLAYER / HUMAN CLASS

```
class Player:
    def __init__(self, char='X'):
        self.kind = 'human'
        self.char = char

    def move(self, board):
        while True: #valid move
            move = int(input('Your move? '))
            if board[move] != "X" and board[move] != "O" and move >= 0 and move <= 9:
                return move

    def available_positions(self, board):
        return [i for i in range(0, 9) if board[i] == ' ']
```

FOOTNOTE: I forgot to add the values associated with each move in the screenshot so here is minimax vs minimax where it displays it.