# Artificial Intelligence LAB-6

Min-Max Algorithms

Date:8-2-22

-Source Code:

```
from math import inf as infinity
from random import choice
import platform
import time
from os import system
HUMAN = -1
COMP = +1
board = [
 [0, 0, 0],
 [0, 0, 0],
 [0, 0, 0],
]
def evaluate(state):
 if wins(state, COMP):
 score = +1
 elif wins(state, HUMAN):

 score = -1
 else:
 score = 0
 return score
def wins(state, player):

 win_state = [
 [state[0][0], state[0][1], state[0][2]],
 [state[1][0], state[1][1], state[1][2]],
 [state[2][0], state[2][1], state[2][2]],
 [state[0][0], state[1][0], state[2][0]],
 [state[0][1], state[1][1], state[2][1]],
 [state[0][2], state[1][2], state[2][2]],
```

```
 [state[0][0], state[1][1], state[2][2]],
 [state[2][0], state[1][1], state[0][2]],
 ]
 if [player, player, player] in win_state:
 return True
 else:
 return False
def game_over(state):

 return wins(state, HUMAN) or wins(state, COMP)
def empty_cells(state):

 cells = []
 for x, row in enumerate(state):
 for y, cell in enumerate(row):
 if cell == 0:
 cells.append([x, y])
 return cells
def valid_move(x, y):

 if [x, y] in empty_cells(board):
 return True
 else:
 return False
def set_move(x, y, player):

 if valid_move(x, y):
 board[x][y] = player
 return True
 else:
 return False
def minimax(state, depth, player):

 if player == COMP:
 best = [-1, -1, -infinity]
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 else:
 best = [-1, -1, +infinity]
 if depth == 0 or game_over(state):
 score = evaluate(state)
 return [-1, -1, score]
 for cell in empty_cells(state):
 x, y = cell[0], cell[1]
 state[x][y] = player
 score = minimax(state, depth - 1, -player)
 state[x][y] = 0
 score[0], score[1] = x, y
 if player == COMP:
 if score[2] > best[2]:
 best = score # max value
 else:
 if score[2] < best[2]:
 best = score # min value
 return best
def clean():
 """
 Clears the console
 """
 os_name = platform.system().lower()
 if 'windows' in os_name:
 system('cls')
 else:
 system('clear')
def render(state, c_choice, h_choice):
 """
 Print the board on console
 :param state: current state of the board
 """
 chars = {
 -1: h_choice,
 +1: c_choice,
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 0: ' '
 }
 str_line = '---------------'
 print('\n' + str_line)
 for row in state:
 for cell in row:
 symbol = chars[cell]
 print(f'| {symbol} |', end='')
 print('\n' + str_line)
def ai_turn(c_choice, h_choice):
 """
 It calls the minimax function if the depth < 9,
 else it choices a random coordinate.
 :param c_choice: computer's choice X or O
 :param h_choice: human's choice X or O
 :return:
 """
 depth = len(empty_cells(board))
 if depth == 0 or game_over(board):
 return
 clean()
 print(f'Computer turn [{c_choice}]')
 render(board, c_choice, h_choice)
 if depth == 9:
 x = choice([0, 1, 2])
 y = choice([0, 1, 2])
 else:
 move = minimax(board, depth, COMP)
 x, y = move[0], move[1]
 set_move(x, y, COMP)
 time.sleep(1)
def human_turn(c_choice, h_choice):

 depth = len(empty_cells(board))
 if depth == 0 or game_over(board):
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return
# Dictionary of valid moves
move = -1
moves = {
1: [0, 0], 2: [0, 1], 3: [0, 2],
4: [1, 0], 5: [1, 1], 6: [1, 2],
7: [2, 0], 8: [2, 1], 9: [2, 2],
}
clean()
print(f'Human turn [{h_choice}]')
render(board, c_choice, h_choice)
while move < 1 or move > 9:
try:
move = int(input('Use numpad (1..9): '))
coord = moves[move]
can_move = set_move(coord[0], coord[1], HUMAN)
if not can_move:
print('Bad move')
move = -1
except (EOFError, KeyboardInterrupt):
print('Bye')
exit()
except (KeyError, ValueError):
print('Bad choice')
def main():
"""
Main function that calls all functions
"""
clean()
h_choice = '' # X or O
c_choice = '' # X or O
first = '' # if human is the first
# Human chooses X or O to play
while h_choice != 'O' and h_choice != 'X':
try:
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print('')
h_choice = input('Choose X or O\nChosen: ').upper()
except (EOFError, KeyboardInterrupt):
print('Bye')
exit()
except (KeyError, ValueError):
print('Bad choice')
# Setting computer's choice
if h_choice == 'X':
c_choice = 'O'
else:
c_choice = 'X'

# Human may starts first
clean()
while first != 'Y' and first != 'N':
try:
first = input('First to start?[y/n]: ').upper()
except (EOFError, KeyboardInterrupt):
print('Bye')
exit()
except (KeyError, ValueError):
print('Bad choice')
# Main loop of this game
while len(empty_cells(board)) > 0 and not game_over(board):
if first == 'N':
ai_turn(c_choice, h_choice)
first = ''
human_turn(c_choice, h_choice)
ai_turn(c_choice, h_choice)
# Game over message
if wins(board, HUMAN):
clean()
print(f'Human turn [{h_choice}]')
render(board, c_choice, h_choice)
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 print('YOU WIN!')
 elif wins(board, COMP):
 clean()
 print(f'Computer turn [{c_choice}]')
 render(board, c_choice, h_choice)
 print('YOU LOSE!')
 else:
 clean()
 render(board, c_choice, h_choice)
 print('DRAW!')
 exit()
if _name_ == '_main_':
 main()
```
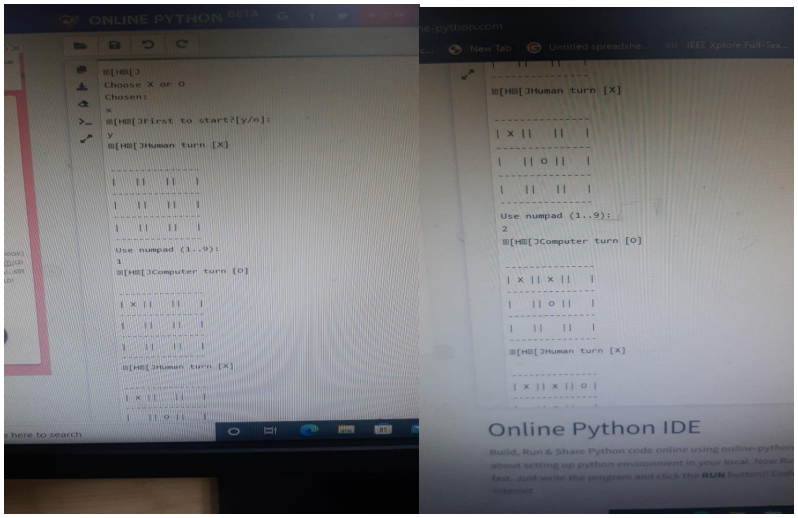
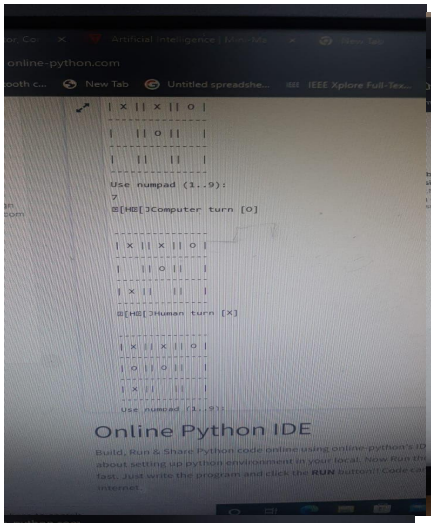
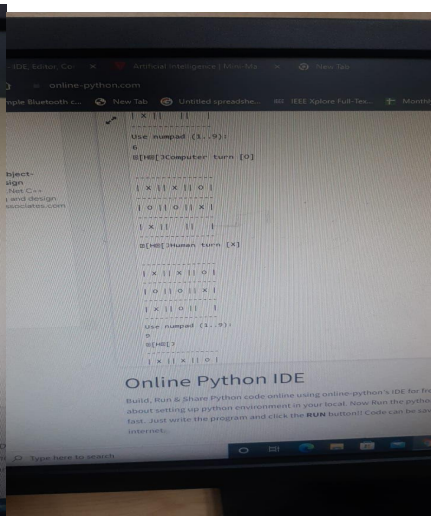
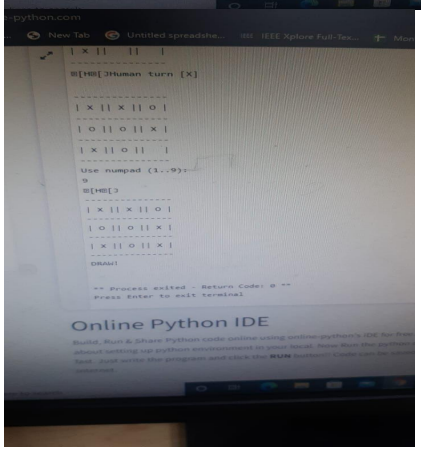

**Output**




Use numpad (1..9):
7
Computer turn [O]
Human turn [X]
Online Python IDE


Use numpad (1..9):
6
Computer turn [O]
Human turn [X]
Online Python IDE


Human turn [X]
Use numpad (1..9):
9
DRAW!
** Process exited - Return Code: 0 **
Press Enter to exit terminal
Online Python IDE