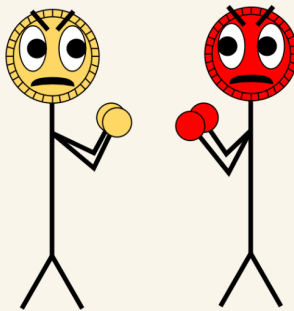


Adham Niazi

–CONNECT 4–

–REGIONAL CHAMPIONSHIP–



I physically cannot connect to CSIF. I connect to the library VPN and then use putty or command line to SSH, however it does not accept my password. and the Library VPN does not allow me to access Library articles on CSIF information, any time I try to access anything it says that I need to log out, and I cannot access any Library sites on the Library VPN.

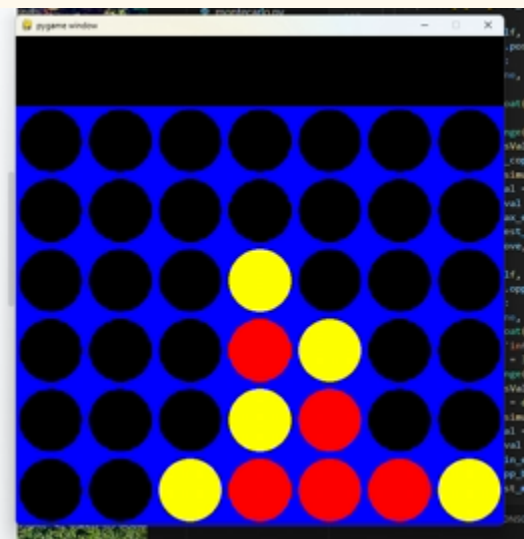
THUS none of this code has been tested on the CSIF Machines.

Part I: Evaluation Function (7pts)

My evaluation function had the following, It started out by adding points based on the locations of the pieces. This corresponded to a 2d matrix stored as a global variable. It was then followed by searching all possible 4 in a row segments of the board matrix, and in doing so, would add the value for 2 in a row, and the value for 3 in a row, if and only if the remaining part of the 4 were empty. If they were not then the score would not be affected by this. If it was 4 in a row then it would return a large value (10000). Then the opponent's score will be calculated in the same way and subtracted from our current score.

The motivation of this is to ensure that we deal with the threat of a win and ensure that we focus moves that will get our own win, while still accounting for moves that will not necessarily give us a victory, however we still need to choose good locations if that is the case to help with the goal of winning or drawing the game. That is why the score function gets incremented by every possible location of 4 in a row to ensure that the algorithm also prioritizes connecting pieces towards the win instead of just random places.

EVALUATING MID GAME_BOARD



Score of yellow

Position Scores: $20 + 14 + 13 + 8 + 1 = 56$

Horizontal scores: 0

Vertical scores: 0

Diagonal scores: THREE_VAL (=100) + TWO_VAL (=26)

↳ + THREE_VAL (=100) + TWO_VAL

Total ↳ = 250

Total ^{yellow} score = 306

Score of Red

Position Scores: $30 + 20 + 11 + 13 + 9 = 83$

Horizontal Scores: 0

Vertical scores: 0

Diagonal scores: TWO_VAL + THREE_VAL + TWO_VAL

= 160

Total ^{red} score = 233

Board score = $233 - 306 = \boxed{-73}$

Part III: Testing (20 pts)

BENCHMARK AGENTS VS ALPHA_BETA

	Wins	Ties	Losses
Vs stupidAI	10	0	0
Vs randomAI	10	0	0
Vs monteCarloAI	5	1	4

40 GAME ALPHA BETA VS MONTE CARLO

	Wins	Ties	Losses
P1 = ALPHA	4	1	15
P2 = ALPHA	7	1	12

SCREENSHOTS OF 40 MONTE CARLO VS ALPHA

ALPHA_BETA = PLAYER 1

GAME 1: LOSS

```
[[2 0 1 1 2 0 2]
 [2 0 1 2 1 0 1]
 [1 0 1 1 1 0 2]
 [2 0 2 2 2 2 1]
 [2 0 2 1 2 1 2]
 [2 1 1 1 2 1 1]]
```

GAME 2 : LOSS

```
[[2 0 1 1 2 0 2]
 [2 0 1 2 1 0 1]
 [1 0 1 1 1 0 2]
 [2 0 2 2 2 2 1]
 [2 0 2 1 2 1 2]
 [2 1 1 1 2 1 1]]
```

GAME 3: WIN

```
[[0 0 0 2 0 0 0]
 [2 0 0 1 0 0 0]
 [1 0 2 1 0 0 0]
 [2 1 1 1 1 0 0]
 [2 1 2 2 1 0 0]
 [2 2 1 1 2 0 0]]
```

GAME 4: WIN

```
[[1 2 1 2 1 0 1]
 [2 2 1 1 1 0 1]
 [2 1 2 1 1 0 2]
 [2 2 1 2 2 1 2]
 [1 2 2 2 1 2 1]
 [2 2 1 1 1 2 1]]
```

GAME 5: LOSS

```
[[0 0 0 1 0 0 0]
 [0 0 2 1 0 0 0]
 [0 0 1 2 0 1 0]
 [2 0 2 2 2 2 0]
 [1 0 1 2 1 1 0]
 [2 0 2 1 1 1 2]]
```

GAME 6: LOSS

```

[[0 2 1 1 1 2 0]]
[[0 0 0 0 0 0 0]
 [0 0 0 2 0 0 0]
 [0 0 0 2 2 0 0]
 [0 0 1 2 1 0 0]
 [0 0 1 2 1 0 0]
 [0 2 1 1 1 2 0]]

```

GAME 7: LOSS

```

[[0 0 0 0 0 0 0]]
[[0 0 1 0 1 0 0]
 [0 0 1 0 2 2 0]
 [0 0 2 2 1 1 0]
 [0 1 2 2 2 1 0]
 [0 2 2 1 1 1 2]]

```

GAME 8: WIN

```

[[2 2 1 2 1 0 0]
 [1 1 2 1 1 0 0]
 [2 1 2 2 2 1 0]
 [2 2 2 1 1 2 0]
 [2 2 1 1 2 1 0]
 [1 2 1 1 2 1 1]]

```

GAME 9: LOSS

```

[[0 0 1 2 2 0 0]
 [0 1 2 1 1 1 0]
 [0 2 2 1 2 1 0]
 [2 1 2 2 1 2 1]
 [1 2 1 2 2 1 2]
 [1 2 2 1 1 1 2]]

```

GAME 10: TIED

```

[[2 2 2 2 1 2 2]
 [1 1 1 2 2 2 1]
 [2 2 2 1 2 1 1]
 [2 1 2 1 1 1 2]
 [1 1 1 2 2 2 1]
 [2 1 1 2 1 1 1]]
The game has tied

```

GAME 11: LOSS

```

[[0 0 2 2 1 0 1]
 [0 0 1 1 1 0 1]
 [0 0 2 1 1 0 2]
 [0 0 2 1 2 0 1]
 [0 2 1 2 2 2 2]
 [0 2 1 2 1 2 1]]
Player 2 has won

```

GAME 12: WIN

```

[[0 0 1 2 1 1 0]]
[[0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0]
 [0 0 1 2 2 0 0]
 [0 0 2 1 1 0 0]
 [0 0 2 2 1 0 0]
 [0 0 1 2 1 1 0]]
Player 1 has won

```

GAME 13: LOSS

```

[[0 0 2 2 1 0 1]
 [0 0 1 1 1 0 1]
 [0 0 2 1 1 0 2]
 [0 0 2 1 2 0 1]
 [0 2 1 2 2 2 2]
 [0 2 1 2 1 2 1]]
Player 2 has won

```

GAME 14: LOSS

```

[[2 1 1 2 1 1 1]]
[[2 0 0 0 1 0 1]
 [2 0 0 1 1 0 1]
 [1 2 0 2 2 2 2]
 [2 1 0 1 2 1 2]
 [2 1 0 2 1 2 2]
 [2 1 1 2 1 1 1]]
Player 2 has won

```

GAME 15: LOSS

```

[[0 0 0 0 0 0 0]
 [0 0 0 2 0 0 0]
 [0 0 0 1 2 0 0]
 [0 0 2 1 1 0 1]
 [0 0 1 2 2 2 2]
 [0 2 1 2 1 1 1]]
Player 2 has won

```

GAME 16: LOSS

```

[[1 2 1 2 1 2 1]]
[[0 0 0 1 0 0 0]
 [0 0 0 2 1 0 0]
 [2 0 1 2 2 0 0]
 [1 0 2 1 1 0 0]
 [2 2 2 2 1 0 1]
 [1 2 1 2 1 2 1]]
Player 2 has won

```


GAME 17: LOSS

```

[[0 0 2 2 2 1 0]
 [2 0 2 1 1 1 0]
 [2 0 1 2 2 1 0]
 [1 0 2 1 1 2 1]
 [2 2 2 2 2 1 1]
 [1 2 1 2 1 1 1]]
Player 2 has won

```

GAME 18: LOSS

```

[[0 0 1 2 0 0 0]
 [0 0 2 1 1 0 1]
 [0 0 2 2 1 0 2]
 [0 0 1 1 2 0 2]
 [0 0 2 2 1 2 2]
 [0 0 1 2 1 1 1]]
Player 2 has won

```

GAME 19: LOSS

```

[[1 2 1 2 1 1 1]
 [[0 0 2 2 2 1 0]
 [2 0 2 1 1 1 0]
 [2 0 1 2 2 1 0]
 [1 0 2 1 1 2 1]
 [2 2 2 2 2 1 1]
 [1 2 1 2 1 1 1]]
Player 2 has won

```

GAME 20: LOSS

```
[[1 2 1 2 1 2 1]]
[[0 0 0 1 0 0 0]
 [0 0 0 2 1 0 0]
 [2 0 1 2 2 0 0]
 [1 0 2 1 1 0 0]
 [2 2 2 2 1 0 1]
 [1 2 1 2 1 2 1]]
Player 2 has won
□
```

ALPHA_BETA = PLAYER 2

GAME 1: WIN

```
MADE: IT
[[0 0 0 0 0 0 0]
 [0 0 2 1 0 0 0]
 [0 2 2 2 2 0 0]
 [0 1 1 2 1 0 0]
 [1 2 1 2 1 0 0]
 [2 1 1 1 2 2 1]]
Player 2 has won
```

GAME 2: WIN

```
[[0 0 0 0 0 0 0]
 [0 0 0 1 2 0 0]
 [0 0 1 2 1 0 0]
 [0 0 2 2 1 0 0]
 [0 2 2 2 1 0 0]
 [0 1 2 1 2 1 1]]
Player 2 has won
```

GAME 3: WIN

```
MADE: IT
[[2 2 0 1 1 0 1]
 [2 1 0 2 1 0 2]
 [1 1 0 2 2 2 1]
 [2 1 0 2 1 1 2]
 [1 2 2 1 2 2 1]
 [1 2 1 1 2 2 1]]
Player 2 has won
```

GAME 4: LOSS

```

[[2 2 2 1 2 1 1]]
[[2 2 0 2 2 1 1]
 [1 2 0 1 1 2 2]
 [2 2 0 2 1 1 1]
 [1 1 1 1 1 2 2]
 [2 1 2 1 2 1 1]
 [2 2 2 1 2 1 1]]
Player 1 has won

```

GAME 5: WIN

```

[[2 0 0 2 0 0 0]
 [1 0 1 1 0 0 0]
 [2 0 1 2 0 0 0]
 [1 0 2 1 1 0 0]
 [2 2 1 2 2 2 2]
 [1 2 1 1 2 1 1]]

```

GAME 6: LOSS

```

[[0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0]
 [0 0 0 2 0 0 0]
 [2 2 1 1 1 1 0]]

```

GAME 7: LOSS

```

[[1 0 1 2 0 1 2]
 [2 0 2 1 0 2 1]
 [2 0 2 2 0 1 2]
 [1 0 2 2 1 2 1]
 [1 0 1 1 2 1 2]
 [1 0 2 1 1 1 2]]

```

GAME 8: LOSS

```

[[2 2 0 1 2 2 2]]
[[0 0 0 2 1 0 0]
[0 0 0 2 2 0 0]
[0 2 0 1 1 0 1]
[1 1 0 2 1 0 1]
[2 2 0 1 1 1 1]
[2 2 0 1 2 2 2]]
Player 1 has won

```

GAME 9: LOSS

```

[[1 2 2 1 0 1 2]
[2 2 2 1 1 2 1]
[1 1 1 2 2 1 2]
[2 2 1 1 1 2 1]
[1 1 1 2 2 1 2]
[2 2 2 1 1 1 2]]

```

GAME 10: WIN

```

[[1 0 1 2 2 0 0]
[1 2 1 2 2 0 0]
[2 2 2 1 1 2 0]
[1 1 1 2 2 2 0]
[1 2 1 1 2 1 0]
[2 1 2 1 1 1 2]]

```

GAME 11: WIN

```

[[0 2 0 2 0 1 0]
[0 1 0 2 2 2 0]
[2 2 0 2 1 1 0]
[1 1 1 1 2 1 0]
[2 1 2 1 1 2 0]
[2 2 1 1 1 2 1]]

```

GAME 12: LOSS

```
[[0 0 0 1 0 0 0]
 [0 0 1 2 0 1 0]
 [1 0 2 1 0 2 0]
 [2 0 2 2 0 2 1]
 [1 1 1 1 0 1 2]
 [2 2 2 1 0 1 2]]
```

GAME 13: DRAW

```
[[2 1 2 2 2 1 2]]
[[1 2 2 2 1 1 2]
 [2 2 1 2 2 1 2]
 [1 2 1 1 1 2 2]
 [1 1 1 2 2 1 1]
 [2 1 2 1 1 2 1]
 [2 1 2 1 2 1 2]]
```

GAME 14: WIN

```
[[0 0 1 1 0 0 0]
 [0 2 2 2 0 0 0]
 [0 2 1 2 1 0 0]
 [0 2 1 2 2 0 1]
 [1 2 2 1 1 0 2]
 [2 1 1 1 2 0 1]]
```

GAME 15: LOSS

```
[[2 2 2 1 2 1 2]]
[[1 0 2 2 2 0 2]
 [2 0 1 2 2 0 2]
 [1 2 1 1 1 0 1]
 [1 1 1 2 1 1 1]
 [1 2 2 1 1 2 1]
 [2 2 2 1 2 1 2]]
```

GAME 16: LOSS

```
[[2 2 0 2 2 2 0]
 [1 1 0 1 2 1 0]
 [2 1 0 2 1 2 0]
 [1 1 1 2 1 1 0]
 [1 2 2 1 1 1 0]
 [2 2 1 1 2 2 0]]
```

GAME 17: LOSS

```
[[1 1 2 1 1 0 1]
 [2 1 2 1 2 1 2]
 [2 2 1 2 2 2 1]
 [1 2 2 1 1 2 2]
 [2 1 1 1 2 1 1]
 [1 2 2 1 2 2 1]]
```

GAME 18: LOSS

```
[[1 1 0 1 2 0 0]
 [2 2 0 1 2 0 0]
 [1 1 1 2 1 0 1]
 [2 2 2 1 1 1 2]
 [2 1 1 1 2 2 1]
 [1 2 2 1 2 2 2]]
```

GAME 19: LOSS

```
[[0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0]
 [0 0 0 0 0 0 0]
 [0 0 0 0 0 2 0]
 [1 1 1 1 2 2 0]]
Player 1 has won
```

GAME 20: LOSS

```
[[0 0 2 0 0 0 0]
 [0 0 2 2 0 0 0]
 [2 0 2 2 2 0 0]
 [1 0 1 1 1 0 0]
 [1 1 1 1 2 2 0]
 [1 1 2 1 2 1 0]]
```