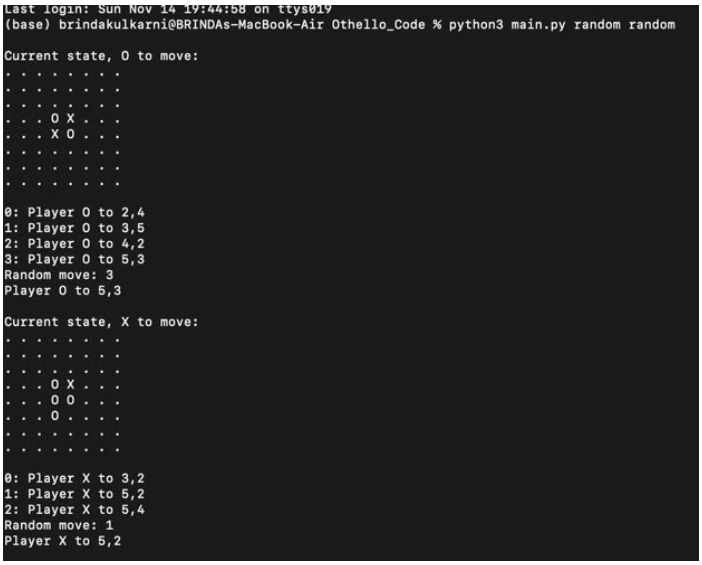
CS510 -Assignment 4

1) Random Agent

The Othello game is initially designed for 2 Human players, when we use the random function the player's move gets picked at random and the game continues. Here I have stored the possible moves for the particular state in a list, and used the random.choice function to pick a move.

Output for 2 random players:



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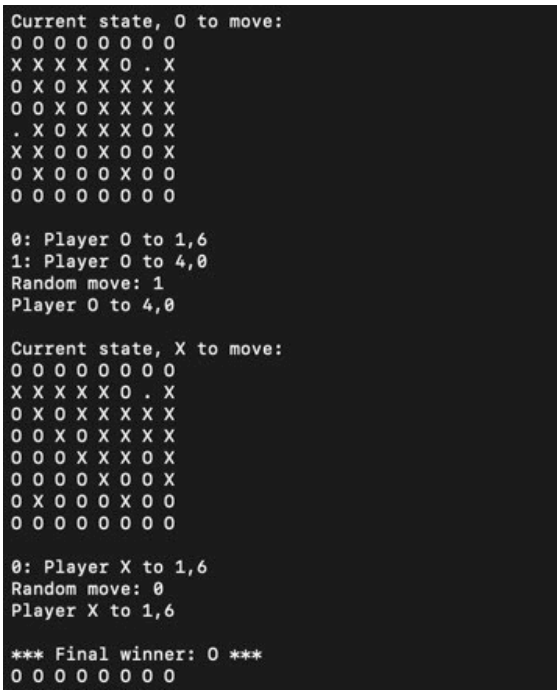

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(base) brindakulkarni@BRINDAs-MacBook-Air Othello_Code % python3 main.py random random

Current state, O to move:
. . . . . .
. . . . . .
. . . . . .
. . . O X . .
. . . X O . .
. . . . . .
. . . . . .
. . . . . .

0: Player O to 2,4
1: Player O to 3,5
2: Player O to 4,2
3: Player O to 5,3
Random move: 0
Player O to 2,4

Current state, X to move:
. . . . . .
. . . . . .
. . . O . . .
. . . O O . .
. . . X O . .
. . . . . .
. . . . . .
. . . . . .

0: Player X to 2,3
1: Player X to 2,5
2: Player X to 4,5
Random move: 2
Player X to 4,5
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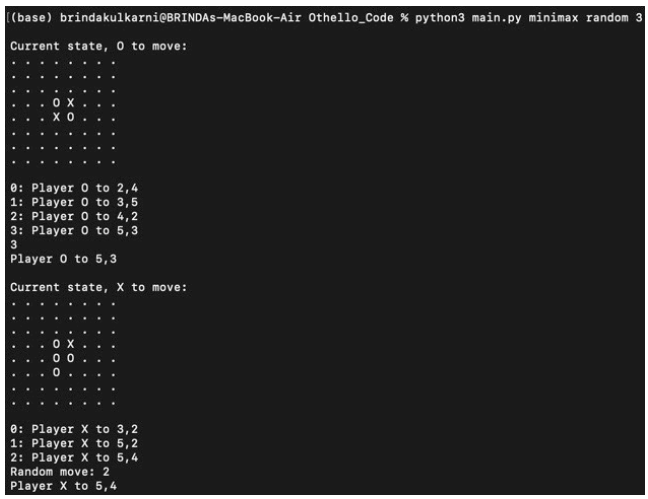
```
Current state, O to move:
X X X X X X X X
. X X X X X X O
X X X X X X O O
X O O O X X X X
X O O O O X O X
O O O O O X O X
O O X O X O O X
O . O O O O O X

0: Player O to 1,0
1: Player O to 7,1
Random move: 0
Player O to 1,0

Current state, X to move:
X X X X X X X X
O O O O O O O O
O O X X X X O O
O O O O X X X X
O O O O O X O X
O O O O O X O X
O O X O X O O X
O . O O O O O X

0: Player X to 7,1
Random move: 0
Player X to 7,1

*** Final winner: X ***
X X X X X X X X
O X O O O O O O
O X X X X X O O
O X O O X X X X
O X O O O X O X
O X O O O X O X
O X X O X O O X
O X X X X X X X
```

2) Minimax agent

The Minimax algorithm is used to find the best possible value according to the heuristic provided. It is a recursive algorithm that searches all the possible moves to find the one with the best outcome. It uses the Depth First Search technique. I have considered the number of coloured disks as the heuristic for the minimax algorithm.



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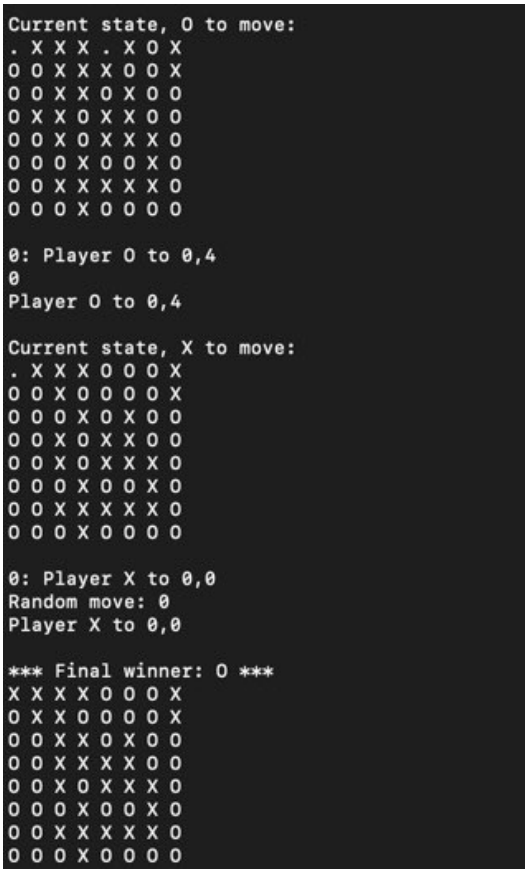


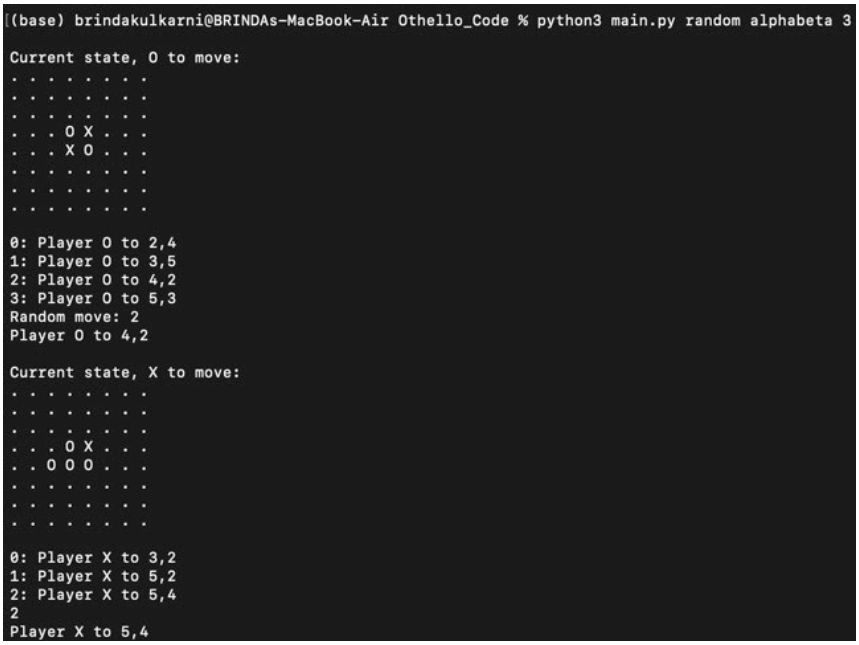
```
(base) brindakulkarni@BRINDAs-MacBook-Air Othello_Code % python3 main.py random minimax 3

Current state, O to move:
. . . . . .
. . . . . .
. . . . . .
. . . O X . .
. . . X O . .
. . . . . .
. . . . . .
. . . . . .

0: Player O to 2,4
1: Player O to 3,5
2: Player O to 4,2
3: Player O to 5,3
Random move: 0
Player O to 2,4

Current state, X to move:
. . . . . .
. . . . . .
. . . O . . .
. . . O O . .
. . . X O . .
. . . . . .
. . . . . .
. . . . . .

0: Player X to 2,3
1: Player X to 2,5
2: Player X to 4,5
2
Player X to 4,5
```

....

```
Current state, O to move:
. . O X X X X X
O O X X X X X O
X X O X O X X O
X X O X O O X O
X X X O O X X O
X O X O O X X O
X X O O X O X O
X O O O O O O O

0: Player O to 0,1
Random move: 0
Player O to 0,1

Current state, X to move:
. O O X X X X X
O O O X X X X O
X X O O O X X O
X X O X O O X O
X X X O O X X O
X O X O O X X O
X X O O X O X O
X O O O O O O O

0: Player X to 0,0
0
Player X to 0,0

*** Final winner: X ***
X X X X X X X X
X X O X X X X O
X X X O O X X O
X X O X O O X O
X X X O O X X O
X O X O O X X O
X X O O X O X O
X O O O O O O O
```

3) Alpha Beta Pruning

The Alpha- Beta-Pruning algorithm is an optimization that improves the MiniMax algorithm. Alpha-Beta-Pruning is a strategy for pruning nodes that aren't needed to analyze the alternative moves instead of exploring the complete tree. The best position value that Max player can reach using a pessimistic evaluation is Alpha, while the best position value that Max player can reach using an optimistic evaluation is Beta. In the beginning of the search, alpha is -9999, while beta is +9999. At each depth, the program evaluates the nodes using optimistic and pessimistic criteria, then compares alpha and beta.



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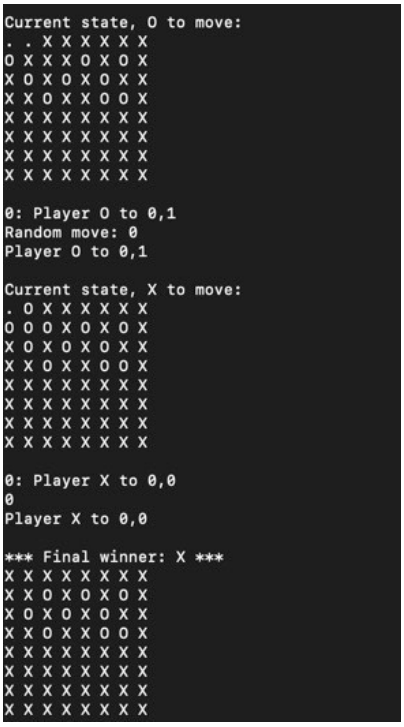

```
(base) brindakulkarni@BRINDAs-MacBook-Air Othello_Code % python3 main.py alphabeta random 3

Current state, O to move:
. . . . . .
. . . . . .
. . . . . .
. . . O X . . .
. . . X O . . .
. . . . . .
. . . . . .
. . . . . .

0: Player O to 2,4
1: Player O to 3,5
2: Player O to 4,2
3: Player O to 5,3
3
Player O to 5,3

Current state, X to move:
. . . . . .
. . . . . .
. . . . . .
. . . O X . . .
. . . O O . . .
. . . O . . . .
. . . . . .
. . . . . .

0: Player X to 3,2
1: Player X to 5,2
2: Player X to 5,4
Random move: 0
Player X to 3,2
```

```
Current state, O to move:
X X . O X X X .
X X O O O X X X
X O X X X O X O
X X O X X X O O
X X O O X X X O
X O O O O O X O
X X X O X O X O
X O O O O O O O

0: Player O to 0,7
0
Player O to 0,7

Current state, X to move:
X X . O O O O O
X X O O O X O O
X O X X X O X O
X X O X X X O O
X X O O X X X O
X O O O O O X O
X X X O X O X O
X O O O O O O O

0: Player X to 0,2
Random move: 0
Player X to 0,2

*** Final winner: O ***
X X X O O O O O
X X X X O X O O
X O X X X O X O
X X O X X X O O
X X O O X X X O
X O O O O O X O
X X X O X O X O
X O O O O O O O
```

Alphabeta Pruning computes the result faster than minimax algorithm at the same depth.