AI PROJECT REPORT on 9 MEN MORRIS GAME

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1) Input - BBxWxxWBBxxWxxxxxxxxxxW

MiniMaxOpening

```
C:\Users\USER\Desktop\AI\Project\Final>MiniMaxOpening board1.txt board2.txt 2
Board Position: BBWWxxWBBxxWxxxxxxxxxW
Positions evaluated by static estimation: 322
MINIMAX estimate: -1
```

ABOpening

```
C:\Users\USER\Desktop\AI\Project\Final>ABOpening board1.txt board2.txt 2
Board Position: BBWWxxWBBxxWxxxxxxxxxW
Positions evaluated by static estimation: 32
MINIMAX estimate: -1
```

2) Input - xxxxxxxxxxWWxWWxBBBxxxx

MiniMaxGame

```
C:\Users\USER\Desktop\AI\Project\Final>MiniMaxGame board1.txt board2.txt 3
Board Position: xxxxxxWxxxxWxWWxBBBxxxx
Positions evaluated by static estimation: 5403
MINIMAX estimate: -51
```

ABGame

```
C:\Users\USER\Desktop\AI\Project\Final>ABGame board1.txt board2.txt 3
Board Position: xxxxxxWxxxxWxWWxBBBxxxx
Positions evaluated by static estimation: 897
MINIMAX estimate: -51
```

3) Input - xxxxxxxxxWxxWxxxBxxxxxx

MiniMaxOpening

```
C:\Users\USER\Desktop\AI\Project\Final>MiniMaxOpening board1.txt board2.txt 4
Board Position: WxxxxxxxxWxxWxxxBxxxxxx
Positions evaluated by static estimation: 124404
MINIMAX estimate: 1
```

ABOpening

```
C:\Users\USER\Desktop\AI\Project\Final>ABOpening board1.txt board2.txt 4
Board Position: WxxxxxxxxWxxWxxxBxxxxxx
Positions evaluated by static estimation: 3650
MINIMAX estimate: 1
```

4) Input - BxxBxxxxxWxxWxxxBxxWxxx

MiniMaxGame

```
C:\Users\USER\Desktop\AI\Project\Final>MiniMaxGame board1.txt board2.txt 2
Board Position: xxxBxWxxxxxxWxxxBxxWxxx
Positions evaluated by static estimation: 2698
MINIMAX estimate: 10000
```

ABGame

```
C:\Users\USER\Desktop\AI\Project\Final>ABGame board1.txt board2.txt 2
Board Position: xxxBxWxxxxxxWxxxBxxWxxx
Positions evaluated by static estimation: 230
MINIMAX estimate: 10000
```

I used the following estimators in addition to the ones proposed by the instructor. They were strung together with appropriate coefficients(weights) to form a good evaluation function.

Potential Close Mills – Number of pairs of pieces on a single line that can form a close mill by the addition of one more piece to the line.

Total Close Mills - Number of existing Closed mills.

Number of blocked opponent's pieces – Number of pieces of the opponent that are blocked.

These estimators were chosen on the basis of players' experience. They represent the strategies that a human player would consider when playing the game. So, they have been selected based on the common knowledge of the game and on strategies of experienced players. Hence I believe my function to be an improvement over the proposed one.

For the following two inputs, the results returned by my evaluation function were different from the standard evaluation function.

Input - BBxxxxxxxWxxWxxxBxxWxxx

MiniMaxOpening

```
C:\Users\USER\Desktop\AI\Project\Final>MiniMaxOpening board1.txt board2.txt 2
Board Position: xBxxxWxxxWxxWxxxBxxWxxx
Positions evaluated by static estimation: 352
MINIMAX estimate: 1
```

MiniMaxOpeningImproved

```
C:\Users\USER\Desktop\AI\Project\Final>MiniMaxOpeningImproved board1.txt board2.txt 2
Board Position: BBWxxxxxxWxxWxxxBxxWxxx
Positions evaluated by static estimation: 352
MINIMAX estimate: 179
```

For the above input, while the MiniMaxOpening (with the standard evaluation function) produced a move that created a close mill, the miniMaxOpeningImproved (with the improved evaluation function) blocked the 'black' from creating a close mill by placing the piece at location 2.) . The improved evaluation function focuses on strategically placing the pieces on the board rather than on closing a mill.

Input - BxBWBWWxxxBxxxxBBWWxxxW

MiniMaxGame

```
C:\Users\USER\Desktop\AI\Project\Final>MiniMaxGame board1.txt board2.txt 2
Board Position: BxBWBWWxxxxxxxxBBWWWxxx
Positions evaluated by static estimation: 295
MINIMAX estimate: -6
^Z
```

MiniMaxGameImproved

```
C:\Users\USER\Desktop\AI\Project\Final>MiniMaxGameImproved board1.txt board2.txt 2
Board Position: xxBWBWWxxxBxxxxBBWWWxxx
Positions evaluated by static estimation: 295
MINIMAX estimate: 10
```

For the above input, the MiniMaxGame (with the standard evaluation function) produced a different move than the miniMaxOpeningImproved (with the improved evaluation function). Both of them formed a closed mill by moving white piece from position 22 to position 19. But the black pieces that they removed afterwards were different.