Examples of program outputs (all at depth 2)

1. **MiniMaxOpening:**

```
G:\Anaconda\python.exe "G:\Graduate Program docs\AI\MiniMaxOpening.py" input.txt out.txt 2
Input board is: WWxxxxxWWWWBBBBxxBWBxB
New board is: WWWxxxxWWWWxBBBxxBWBxB
Positions Evaluated: 441
MiniMax evaluation: 0

Process finished with exit code 0
```

```
G:\Anaconda\python.exe "G:\Graduate Program docs\AI\MiniMaxOpening.py" input.txt out.txt 2
Input board is: xxxWWxWxWxBBxxBxxxxxBx
New board is: xxxWWWWxWxxBxxBxxxxxBx
Positions Evaluated: 388
MiniMax evaluation: 0

Process finished with exit code 0
```

2. **MiniMaxGame:**

```
G:\Anaconda\python.exe "G:\Graduate Program docs\AI\MinMaxGame.py" input.txt out.txt 2
Input board is: WWxxxxxWWWWBBBBxxBWBxB
New board is: WWxxxxxWWWWBBBBWxxxBxB
Positions Evaluated: 386
MiniMax evaluation: 981

Process finished with exit code 0
```

```
G:\Anaconda\python.exe "G:\Graduate Program docs\AI\MinMaxGame.py" input.txt out.txt 2
Input board is: xxxWWxWxWxBBxxBxxxxxBx
New board is: xxxWWxxWWxBBxxBxxxxxBx
Positions Evaluated: 75
MiniMax evaluation: -15

Process finished with exit code 0
```

3. ABOpening

```
G:\Anaconda\python.exe "G:\Graduate Program docs\AI\ABOpening.py" input.txt out.txt 2
Input board is: WWxxxxxWWWWBBBBxxBWBxB
New board is: WWWxxxxWWWWxBBBxxBWBxB
Positions Evaluated: 134
MiniMax evaluation: 0

Process finished with exit code 0
```

```
G:\Anaconda\python.exe "G:\Graduate Program docs\AI\ABOpening.py" input.txt out.txt 2
Input board is: xxxWWxWxWxBBxxBxxxxxBx
New board is: xxxWWWWxWxxBxxBxxxxxBx
Positions Evaluated: 167
MiniMax evaluation: 0

Process finished with exit code 0
```

(here we can see that the alpha-beta pruning gets the same result but in very less number of positions evaluated)

4. ABGame:

```
G:\Anaconda\python.exe "G:\Graduate Program docs\AI\ABGame.py" input.txt out.txt 2
Input board is: WWxxxxxWWWWBBBBxxBWBxB
New board is: WWxxxxxWWWWBBBBWxxxBxB
Positions Evaluated: 327
MiniMax evaluation: 981

Process finished with exit code 0
```

```
G:\Anaconda\python.exe "G:\Graduate Program docs\AI\ABGame.py" input.txt out.txt 2
Input board is: xxxWWxWxWxBBxxBxxxxxBx
New board is: xxxWWxxWWxBBxxBxxxxxBx
Positions Evaluated: 45
MiniMax evaluation: -15

Process finished with exit code 0
```

The MinimaxOpeningBlack and MiniMaxGameBlack are programs that play as the black coin.

5. MiniMaxOpeningBlack

```
G:\Anaconda\python.exe "G:\Graduate Program docs\AI\MiniMaxOpeningBlack.py" input.txt out.txt 2
Input board is: WWxxxxxWWWWBBBBxxBWBxB
New board is: WWBxxxxxWWWBBBBxxBWBxB
Positions Evaluated: 413
MiniMax evaluation: 1

Process finished with exit code 0
```

```
G:\Anaconda\python.exe "G:\Graduate Program docs\AI\MiniMaxOpeningBlack.py" input.txt out.txt 2
Input board is: xxxWWxWxWxBBxxBxxxxxBx
New board is: xxxxWxWxWxBBBxBxxxxxBx
Positions Evaluated: 388
MiniMax evaluation: 1

Process finished with exit code 0
```

6. MiniMaxGameBlack

```
G:\Anaconda\python.exe "G:\Graduate Program docs\AI\MiniMaxGameBlack.py" input.txt out.txt 2
Input board is: WWxxxxxWWWWBBBBxxBWBxB
New board is: WWxxxxxxWWWBBBBxxxWBBB
Positions Evaluated: 376
MiniMax evaluation: 987

Process finished with exit code 0
```

```
G:\Anaconda\python.exe "G:\Graduate Program docs\AI\MiniMaxGameBlack.py" input.txt out.txt 2
Input board is: xxxWWxWxWxBBxxBxxxxxBx
New board is: xxxWWxWBWxxBxxBxxxxxBx
Positions Evaluated: 75
MiniMax evaluation: -11

Process finished with exit code 0
```

The MinimaxOpeningImproved and MiniMaxGameimproved are programs where the static estimation function has been improved to account for few more factors and in turn provide better results.

7. MinimaxOpeningImproved

```
G:\Anaconda\python.exe "G:\Graduate Program docs\AI\MiniMaxOpeningImproved.py" input.txt out.txt 2
Input board is: WWxxxxxWWWWBBBBxxBWBxB
New board is: WWxxxxxWWWWBxBBWxBWBxB
Positions Evaluated: 441
MiniMax evaluation: 0

Process finished with exit code 0
```

```
G:\Anaconda\python.exe "G:\Graduate Program docs\AI\MiniMaxOpeningImproved.py" input.txt out.txt 2
Input board is: xxxWWxWxWxBBxxBxxxxxBx
New board is: xxxWWWWxWxxBxxBxxxxxBx
Positions Evaluated: 388
MiniMax evaluation: 200

Process finished with exit code 0
```

This output is better than the normal one because here the mill formed blocks a potential black mill and plus removes a black coin that could have formed a mill in the later rounds

8. MinimaxGameImproved

```
G:\Anaconda\python.exe "G:\Graduate Program docs\AI\MinMaxGameImproved.py" input.txt out.txt 2
Input board is: WWxxxxxWWWWBBBBxxBWBxB
New board is: WWxxxxxWWWWBBBBWxxxBxB
Positions Evaluated: 386
MiniMax evaluation: 1862

Process finished with exit code 0
```

```
G:\Anaconda\python.exe "G:\Graduate Program docs\AI\MinMaxGameImproved.py" input.txt out.txt 2
Input board is: xxxWWxWxWxBBxxBxxxxxBx
New board is: xxxWWxxxWWBBxxBxxxxxBx
Positions Evaluated: 75
MiniMax evaluation: -310

Process finished with exit code 0
```

These results produces are very better than the ones that were produces by the normal program which shows that this static estimation is superior than the normal one.

New Static Estimation function explanation:

Here I am using a score variable to store the score of each board.

It begins by going through the board one character at a time, if that character is ‘W’ then, check if it forms a close Mill, if it does the then I add 100 to score. Check if there are neighbors present for this position of W if yes then I add 50 to score. If the character is ‘B’ then, in this case I subtract 100 from score while doing this I am also keeping count of the White and Black pieces.

In the end I am adding the count of white if it is greater than Black pieces and subtracting the count of black if it is greater than count of white.

In this static estimation it considers 4 cases which in turn helps choose a better board position compared to the normal one in the handout.