Sameer Khan

sxk190245

**Part 1:**

MinMaxOpening:

Case1:

Input: xxxxxxxxxxWxxWxxxxBxB

Output: xxxxxxxxxxWxxWxxxxBWB

Depth: 5

Positions Evaluated: 1219368

Static Estimate: 1

Case2:

Input: xxxxxxxxxxxxWxWxxxBxB

Output: xxxxxxxxxxxxWWWxxxxxB

Depth: 5

Positions Evaluated: 1399404

Static Estimate: 2

MinMaxMidgameEndgame:

Case1:

Input: WBWxBxBWWWBxBxxBWBWxx

Output: WBxWBxBWWWBxBxxBWBWxx

Depth: 5

Positions Evaluated: 13553

Static Estimate: -6

Case2:

Input: BBxWBxBWWBWxBxxWWBWxx

Output: BBWxBxBWWBWxBxxWWxWxx

Depth: 5

Positions Evaluated: 45577

Static Estimate: 1994

**Part 2:**

ABOpening:

Case1:

Input: xxxxxxxxxxWxxWxxxxBxB

Output: xxxxxxxxxxWxxWxxxxBWB

Depth: 5

Positions Evaluated: 133590 (90% savings over MinMaxOpening)

Static Estimate: 1

Case2:

Input: xxxxxxxxxxxxWxWxxxBxB

Output: xxxxxxxxxxxxWWWxxxxxB

Depth: 5

Positions Evaluated: 135597 (90% savings over MinMaxOpening)

Static Estimate: 2

ABMidgameEndgame:

Case1:

Input: WBWxBxBWWWBxBxxBWBWxx

Output: WBxWBxBWWWBxBxxBWBWxx

Depth: 5

Positions Evaluated: 1374 (90% savings over MinMaxMidgameEndgame)

Static Estimate: -6

Case2:

Input: BBxWBxBWWBWxBxxWWBWxx

Output: BBWxBxBWWBWxBxxWWxWxx

Depth: 5

Positions Evaluated: 1509 (95% savings over MinMaxMidgameEndgame)

Static Estimate: 1994

**Part 3:**

MinMaxOpeningBlack:

Case1:

Input: xxxxxxxxxxBxxBxxxxWxW

Output: xxxxxxxxxxBxxBxxxxWBW

Depth: 5

Positions Evaluated: 1219368

Static Estimate: 1

Case2:

Input: xxxxxxxxxxxxBxBxxxWxW

Output: xxxxxxxxxxxxBBBxxxxxW

Depth: 5

Positions Evaluated: 1399404

Static Estimate: 2

MinMaxMidgameEndgameBlack:

Case1:

Input: BWBxWxWBBBWxWxxWBWBxx

Output: BWxBWxWBBBWxWxxWBWBxx

Depth: 5

Positions Evaluated: 13553

Static Estimate: -6

Case2:

Input: WWxBWxWBBWBxWxxBBWBxx

Output: WWBxWxWBBWBxWxxBBxBxx

Depth: 5

Positions Evaluated: 45577

Static Estimate: 1994

**Part 4:**

MinMaxOpeningImproved:

Case1:

Input: BxWBxBWxBxxxxBBxWxxBW

Improved Static Output: BxWBxBWxBWxxxBBxWxxBW

Normal Static Output: BxWBxBWxBxxxWBBxWxxBW

Depth: 5

Positions Evaluated: 248720

Static Estimate: 296

With Normal Static: With Improved Static:

Shape, arrow

Description automatically generated Shape, arrow

Description automatically generated

Normal static output, in this example could not close the mill for a potential mill.

Normal static function is at times missing the closing of the black mill, as it only directly compares (White-Black) without making sense of where the pieces are.

But with improvised static, we have successfully stopped a Black mill from forming, by assigning credits for stopping a mill from closing and for finding out potential mills which can be formed using millCount(), potentialMill(), potentialCloseMill() functions.

MinMaxMidgameEndgameImproved:

Case1:

Input: WBxBxWxWWWBBxxxxxxxxB

Improved Static Output: xBxxxWWWWWBBxxxxxxxxB

Normal Static Output: WBxBWxxWWWBBxxxxxxxxB

Depth: 5

Positions Evaluated: 23860

Static Estimate: 1960

With Normal Static: With Improved Static:

Shape, arrow, rectangle

Description automatically generated Shape, arrow

Description automatically generated

In the above example, we can see that the Normal MiniMax Midgame Endgame is not closing the mill, instead it is moving the ‘W’ piece from ‘5’ to ‘4’ location, where a mill can be formed but it needs another move to form the mill. But it is not evaluating the case, where there are already 2 W’s waiting to form a mill.

Now with the new improved static, we are closing the mill and removing a black piece.