

Artificial Intelligence Morris Game Variant-B

Project Report

This is the output my program produced for several positions. I had given depth 6 for all the programs except in improvement. In improvement, depth is 2.

MiniMaxOpening

Input Board: xxxxxxxxxxxxxxxxxxxx
Output Board: Wxxxxxxxxxxxxxxxxx
Positions evaluated by static estimation: 40254840
MINIMAX estimate: 0

MiniMaxOpeningBlack

Input Board: Wxxxxxxxxxxxxxxxxx
Output Board: WBxxxxxxxxxxxxxxxxx
Positions evaluated by static estimation: 30549672
MINIMAX estimate: -1

MiniMaxOpening

Input Board: WBWBxxxxxxxxxxxxxxxxx
Output Board: WxWBWxxxxxxxxxxxxxxxxx
Positions evaluated by static estimation: 16382256
MINIMAX estimate: 1

MiniMaxOpeningBlack

Input Board: WxWBWxxxxxxxxxxxxxxxxx
Output Board: WxWBWxBxxxxxxxxxxxxxxxxx
Positions evaluated by static estimation: 11107044
MINIMAX estimate: -2

MiniMaxOpening vs ABOpening:

MiniMaxOpening

Input Board: WWWBWBxxxxxxxxxxxxxxxxx
Output Board: WWWBWBWxxxxxxxxxxxxxxxxx
Positions evaluated by static estimation: 3907368
MINIMAX estimate: 1

ABOpening

Input Board: WWWBWBxxxxxxxxxxxxxxxxx
Output Board: WWWBWBWxxxxxxxxxxxxxxxxx
Positions evaluated by static estimation: 18532
MINIMAX estimate: 1

MiniMaxOpening

Input Board: WWWBWBWBWxxxxxxxxBxxxxx
Output Board: WWWBWBWBWxxxxxxxxBxxxxx
Positions evaluated by static estimation: 1566700
MINIMAX estimate: 1

ABOpening

Input Board: WWWBWBWBWxxxxxxxxBxxxxx
Output Board: WWWBWBWBWxxxxxxxxBxxxxx
Positions evaluated by static estimation: 11768
MINIMAX estimate: 1

MiniMaxGame vs ABGame:

MiniMaxGame

Input Board: WWWBWBWBWBWBxWBxWxxB
Output Board: WWWBWBWBWBWBxWBWxxxB
Positions evaluated by static estimation: 14648
MINIMAX estimate: 987

ABGame

Input Board: WWWBWBWBWBWBxWBxWxxB
Output Board: WWWBWBWBWBWBxWBWxxxB
Positions evaluated by static estimation: 1200
MINIMAX estimate: 987

MiniMaxGame

Input Board: WWWBWBWBWBWBxWBWxxBx
Output Board: WWWBWBWBWBWBxWBxWxxBx
Positions evaluated by static estimation: 37234
MINIMAX estimate: -6

ABGame

Input Board: WWWBWBWBWBWBxWBWxxBx
Output Board: WWWBWBWBWBWBxWBxWxxBx
Positions evaluated by static estimation: 2494
MINIMAX estimate: -6

Conclusion: We observe from the above results that Alpha beta pruning reduces number of nodes evaluated. The output Board and minimax estimates remain the same.

MiniMaxGameBlack

Input Board: WWWBWBWBWBWBxWBWxxxB
Output Board: WWWBWBWBWBWBxWBWxxBx

Positions evaluated by static estimation: 89266
MINIMAX estimate: -1004

MiniMaxGameBlack

Input Board: WWWBWBBWWBBWBxWBxWxBx
Output Board: WWWBWBBWWBBWBxWxBWxBx
Positions evaluated by static estimation: 88595
MINIMAX estimate: -8

Improvement:

MiniMaxOpening

Input Board: xxWBxBxWxxxxWBxxWBxxx
Output Board: xxWxxBxWxxxxWBxWWBxxx
Positions evaluated by static estimation: 242
MINIMAX estimate: 1

MiniMaxOpeningImproved

Input Board: xxWBxBxWxxxxWBxxWBxxx
Output Board: xxWBxxxWxxxxWBxWWBxxx
Positions evaluated by static estimation: 242
MINIMAX estimate: 8

MiniMaxGame

Input Board: xxWBxBxWxxWBxxxxxxWBx
Output Board: xxWBxBxxxxWBxxxWxxWBx
Positions evaluated by static estimation: 53
MINIMAX estimate: -9

MiniMaxOpeningImproved

Input Board: xxWBxBxWxxWBxxxxxxWBx
Output Board: xxWBxBWxxWBxxxxxxBx
Positions evaluated by static estimation: 53
MINIMAX estimate: 7991

In the improved staticEstimation function, I had calculated number of potential mills W has and added it before returning the value.