Genetic Algorithms for Evolving Computer Shogi

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CPSC 490 - Fall 2020

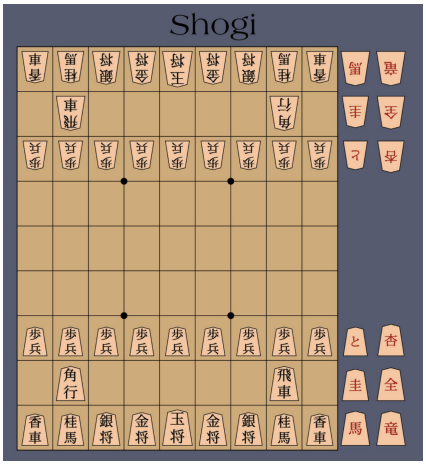

Figure 1: Traditional Shogi Board

1 Abstract

Shogi, also known as Japanese chess, is a two-player strategy board game that sees origins of play as early as 1210. The game is played on a 9x9 grid (as opposed to an $8x8$ grid for standard chess) with 8 types of starting pieces (*King, Rook, Bishop, Gold General, Silver General, Knight, Lance, and Pawn*) as shown above. The aspects that separate shogi from chess are the ability to promote multiple piece types (indicated by a red character on the reverse side of the piece) and the ability to drop captured pieces back into play. These rules result in a significantly larger branching factor than chess, meaning that there are a total of 10^{226} possible playouts of a shogi game, compared to just 10^{123} for chess.[1] This project approaches the problem by trying to use genetic algorithms to evolve a set of weights used in a heuristic function to evaluate board positions. The methodology follows a paper that used similar approaches to achieve a grandmaster level play for a chess program: Genetic Algorithms for Evolving Computer Chess. Based on the game features I implemented, I was able to find some success in tuning the parameters of a heuristic function, with my best organisms correctly matching the grandmaster move over 17 percent of the time in a 1-ply search. The target achieved in the paper mentioned above was 30 percent; however, given that state-space complexity of shogi is orders of magnitude larger than chess, 17 percent accuracy in a depth one search is still a success. This is

also the case when considering that the top performing shogi agents use heuristics comprised of millions of features, compared to just the roughly 60 I used for this project.

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2 Background

2.1 History

2.2 Complexity

3 Introduction

There is a theory which states that if ever anyone discovers exactly what the Universe is for and why it is here, it will instantly disappear and be replaced by something even more bizarre and inexplicable. There is another theory which states that this has already happened.

4 Methodology

5 Results

6 Conclusion

"I always thought something was fundamentally wrong with the universe" [2]

A Board Features

A.1 Material

A.1.1 In hand

A.2 King Safety

A.3 Controlled Squares

A.4 Castle

A.5 Shape

A.5.1 Bad Shape Penalty

Gold Ahead

Gold Ahead Silver

Gold Adjacent Rook

Boxed in Bishop

Piece Ahead of Pawn

A.5.2 Good Shape Bonuses

Bishop Heads

Reclining Silver

Vanguard Pawns

Adjacent Silvers

Adjacent Golds

A.6 Mobility

A.6.1 Bishop

A.6.2 Rook

A.7 Rook Enemy Camp

A.8 Rook Attack King File

A.9 Rook Attack King Adjacent File

A.10 Rook Attack King Adjacent File 9/8/2/1

A.11 Rook Open Semi Open File

A.12 Blocked Flow

A.13 Aggression Balance

A.14 King Attack

A.15 Total Attacking

A.16 Distance to Kings

References

[1] Computer shogi.

[2] D. Adams. *The Hitchhiker's Guide to the Galaxy.* San Val, 1995.