Solving Jungle Checkers

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1 Background

One of the most interesting recent results in the field of Artificial Intelligence was solving Checkers [2]. With the capabilities of current computer hardware, more games can be solved in a similar way. Within the Algorithms group, some people are interested in analyzing these games.

2 Research Question

We aim to solve, analogous to Checkers, a simplified version of the game Dou Shou Qi (or Jungle Chess), called Jungle Checkers (see Appendix A). The idea is to calculate the outcome for endgame positions by *retrograde* analysis. The first step is building an endgame tablebase up to at least six pieces. Calculating the complete endgame tablebase in main memory will prove a challenge. As well as choosing a suitable format of storing the tablebase. Next, we need to have an analyzing engine (or playing engine) that is able to calculate forwards from the initial position until a position in the endgame tablebase. By combining these two steps we are able to determine the winner of the game.

3 Context

A framework for playing the original game is available as well as a retrograde analysis tool. This can serve as a starting point for this project.

4 Required Background

As this seems to be a heavy computational task, we propose to develop the project in C/C++. A good knowledge of C/C++ is required. Good grades for "Algoritmiek" and "Kunstmatige Intelligentie" will be beneficial for this project.

5 Work plan

This project can start at any time. Deliverables:

- endgame tablebase including tooling for its construction;

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- analyzing engine using minimax search and the endgame tablebase;
- written thesis.

A Jungle Checkers

Dou Shou Qi [3] (meaning: "Game of Fighting Animals") is a Chinese board game. In the Western world it is often called *Jungle*, The Jungle Game, Jungle Chess, or Animal Chess. Here, we introduce a simplified version of this game called *Jungle Checkers* [1].

The Board

Jungle Checkers is played on a rectangular board consisting of 7×7 squares, see Figure 1. The columns are called *files* and are labeled a–g from left to right. The rows or *ranks* are numbered 1–7 from bottom to top (the board is viewed from the position of the white player).

```
. r . # . e .
. . t . d . .
. . . . . . .
. . . . . . .
. . . . . . .
. . D . T . .
. E . # . R .
```

Figure 1: The game board with the initial position.

There are two different kinds of squares. The *dens* (`#`) are located in the center of the first and the last rank ($d1$ and $d7$). The remaining squares are ordinary squares.

The Pieces

Each player has four different pieces representing different animals. Each animal has a certain *strength*, according to which they can *capture* other (opponent's) pieces. Only pieces with the same or a higher strength may capture an opponent's piece. The only exception to this rule regards the weakest (rat) and the strongest (elephant) pieces. Just like the spy in Stratego, the weakest piece may capture the strongest. The strength of the pieces, from weak to strong, is:

1. `R`, `r` — Rat (sometimes called mouse);
2. `D`, `d` — Dog;
3. `T`, `t` — Tiger;
4. `E`, `e` — Elephant.

The initial placement of the pieces is fixed, see Figure 1. The capital letters are used to denote the white pieces.

Movement

Players alternate turns with white moving first. Each turn one piece must be moved. Each piece can move one square either horizontally or vertically. A piece is forbidden to enter its own den ($d1$ for white, and $d7$ for black).

Objective

The objective of the game is to either place one of your pieces in the opponent's den or to eliminate all of the opponent's pieces.

References

[1] UNSW School of Computer Science and Engineering. `http://www.cse.unsw.edu.au/~cs3411/07s1/hw3/`, accessed November 2013.

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[3] J.N. van Rijn and J.K. Vis. Complexity and Retrograde Analysis of the Game Dou Shou Qi. In *25th Benelux Conference on Artificial Intelligence*, 2013.