Theory of Computer Games (Fall 2021) Homework 1

NTU CSIE

Due: 14:20 (UTC+8), November 11, 2021

Outline

Chinese Dark Chess (CDC)

- The game rule could be found here

  `https://homepage.iis.sinica.edu.tw/~tshsu/tcg/2021/hwks/rules.pdf`

Chinese Dark Chess (CDC) Special Case

- All pieces have been flipped
- All cannons have been eaten

Chinese Dark Chess (CDC) - Score

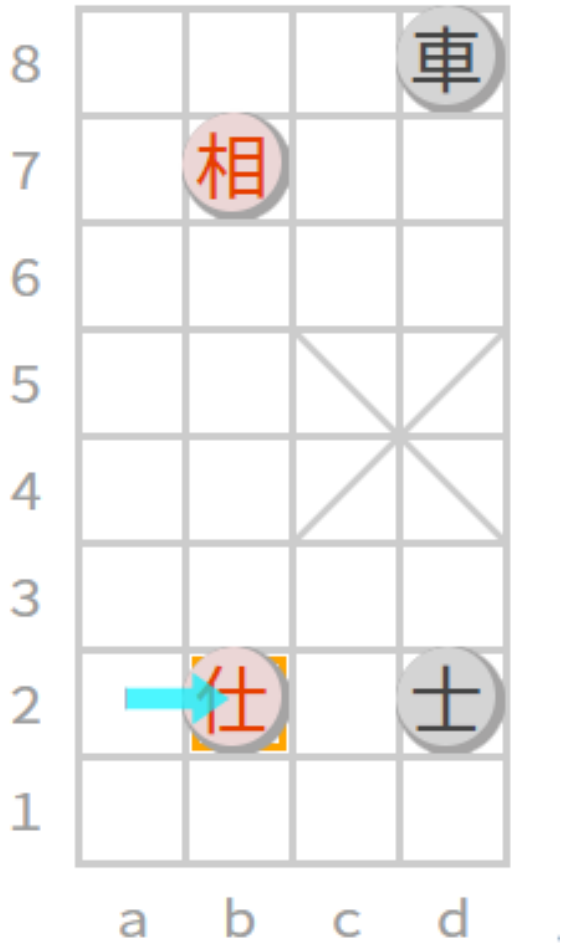
Score

- Win: 1.0 + Bonus
- Draw: 0.2 + Bonus
- Lose: 0

Bonus

- $Bonus = \min(\max(Diff \times \frac{0.3}{8}, 0), 0.3)$
- $Diff = \#\ of\ my\ alive\ piece - \#\ of\ opponent's\ alive\ piece$

Chinese Dark Chess (CDC) - Score



Draw

- Red Score
  $= 0.2 + \min(\max((5-6) \times \frac{0.3}{8}, 0), 0.3)$
  $= 0.2 + 0 = 0.2$
- Black Score
  $= 0.2 + \min(\max((6-5) \times \frac{0.3}{8}, 0), 0.3)$
  $= 0.2 + 0.0375 = 0.2375$

Requirements

HW Requirements

- Implement an agent of Chinese Dark Chess (CDC) using Alpha-Beta algorithm.
- Write a report.

Part I: CDC Agent

CDC Agent

In your CDC agent, you need to implement following requirements:

- Alpha-Beta algorithm (TA will trace your code)
- Iterative deepening (TA will trace your code)
- Evaluation function (TA will trace your code)
- Quiescent search (TA will trace your code)
- Move generator and ordering (TA will trace your code)
- Time limit: 10 seconds per ply (measured by server)
- Thread limit: 1 threads
- Memory limit: 4 GB
- Pre-processing time limit: 30 minutes

Part I: CDC Agent

Baseline

Provide the baseline's source code and executable file

Baseline's specification:

- Nega Max algorithm
- Iterative deepening
- 9.5 seconds per ply

Part I: CDC Agent

Testing

- Your CDC agent will be against the baseline on 10 specific boards.
- Take turns to move first.
- Your score is the sum of the scores of all games.

Target

Your CDC agent needs to get scores from baseline as much as possible.

Boards

- Sample boards: 10 boards (provided)
- Testing boards: 5 from sample boards and 5 hidden boards

(See the appendix for more detail information)

Part I: CDC Agent

Game Setting

- Time limit: 10 seconds per ply
- Threefold repetition rule: A game is considered draw if the same position occurs three times.
- 60-ply rule: If no capture has occured in the last 60 ply (by both players), the game is automatically a draw

Part II: Report

Report Structure

Your report should include but not limited to:

- Implementation
  - How to compile and run your code in linux.
  - How did you design the evaluation function.
  - How did you design the move ordering.
- Experiments
  - Compare the results of using different evaluation function.
- Discussion
  - Game tree complexity of Chinese Dark Chess.
  - State space complexity of Chinese Dark Chess.

Submission

- Directory hierarchy:
  - student id // e.g. r09922026 (lowercase)
    - Makefile // make your code
    - src // a folder contains all your codes
    - report.pdf // your report
- Compress your folder into a zip file and submit to `https://www.csie.ntu.edu.tw/~tcg/2021/hw1.php`
- Due to server limitation, the file size is restricted to 2 MB.

Grading Policy

Grading Policy

$$Your\ Point = P \times (\frac{Your\ Score}{Boss\ Score} \times W_1 + Report\ Score \times W_2)$$

- P : 25
- *Your Score*: $\in [0, 26]$
- *Boss Score*: 21.475 (Sample Boards)
- W_1: 0.8
- *Report Score*: $\in [0, 1]$
- W_2: 0.2

Appendix

Sample Boards

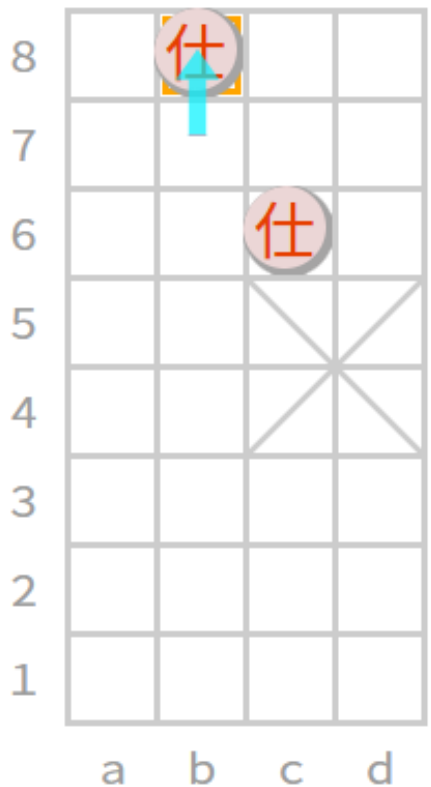
Information

- Average Score: Average score of testing CDC agents.
- Sample Boards Result: Boss CDC agent vs baseline.

The higher the serial of the board, the more difficult.

Average Score: 1.225

0



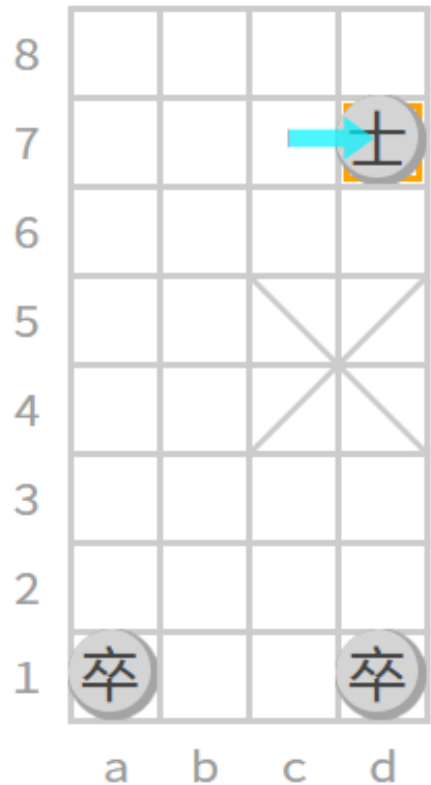
1.075 (W)

1.1875 (W)

Average Score: 1.0542

1

1.225 (W)



1.1125 (W)

Average Score: 0.8896

2

1.3 (W)

1.225 (W)

Average Score: 0.8771

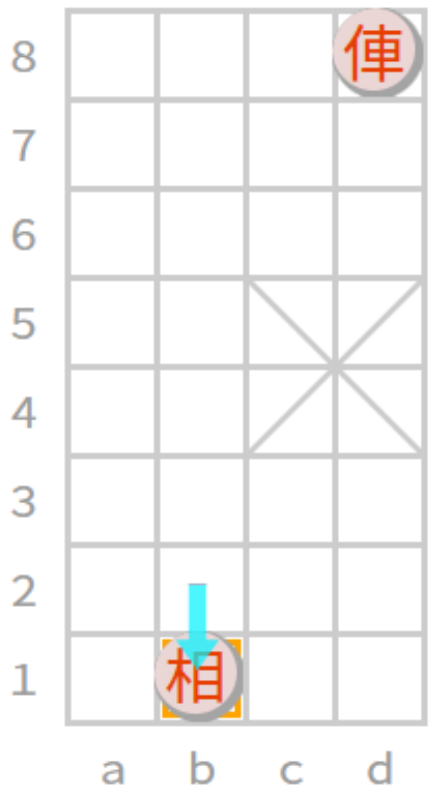
3

1.2625 (W)

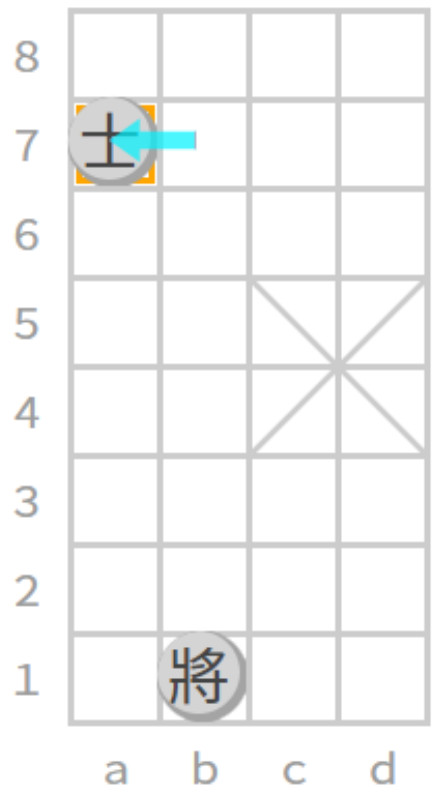
1.225 (W)

Average Score: 0.6625

4



1.075 (W)



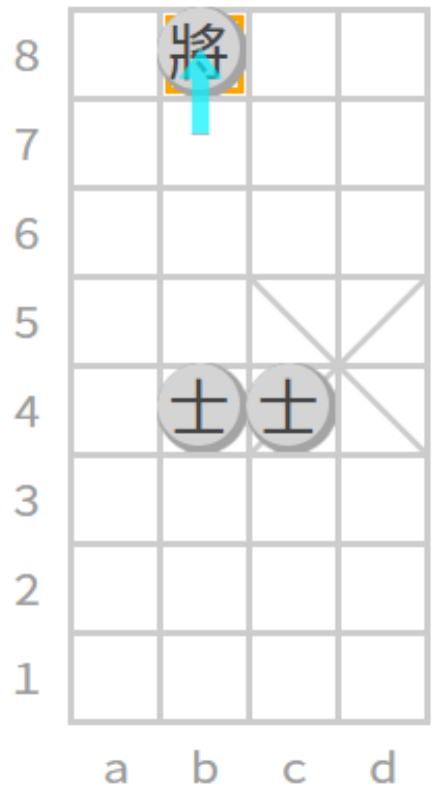
1.075 (W)

5

Average Score: 0.8646

5

1.225 (W)



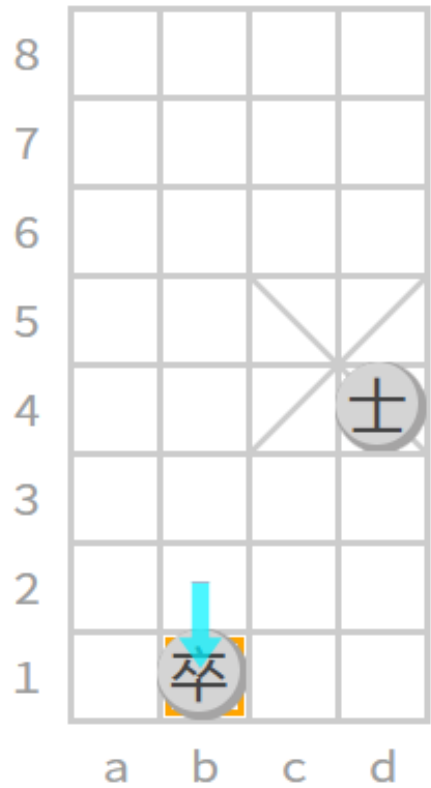
1.1125 (W)

6

Average Score: 0.5292

6

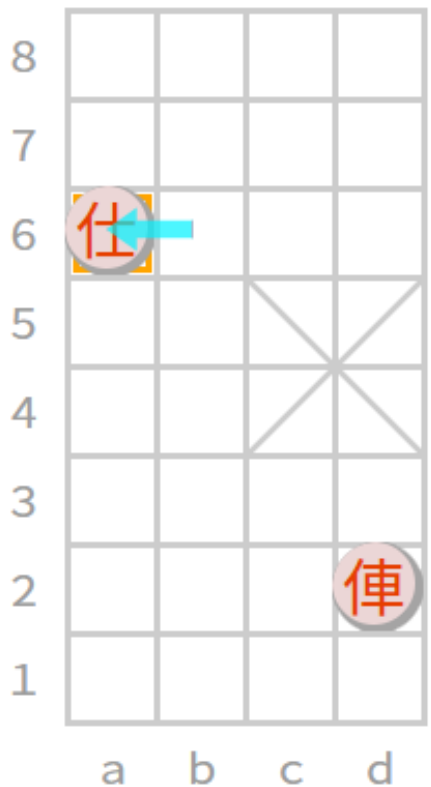
1.15 (W)



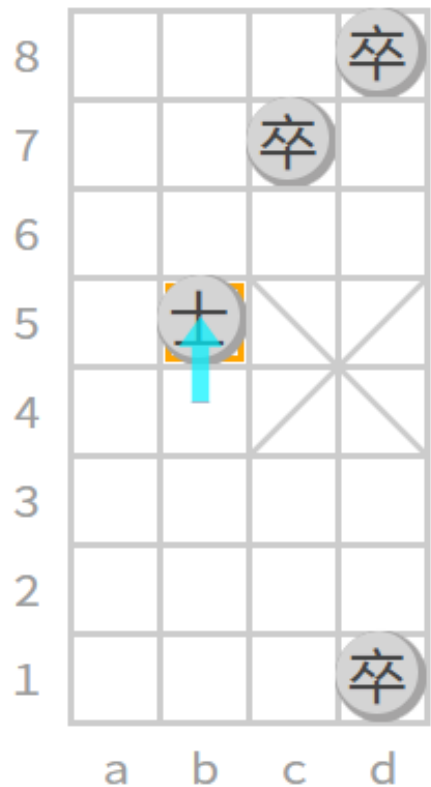
1.075 (W)

Average Score: 0.9854

7



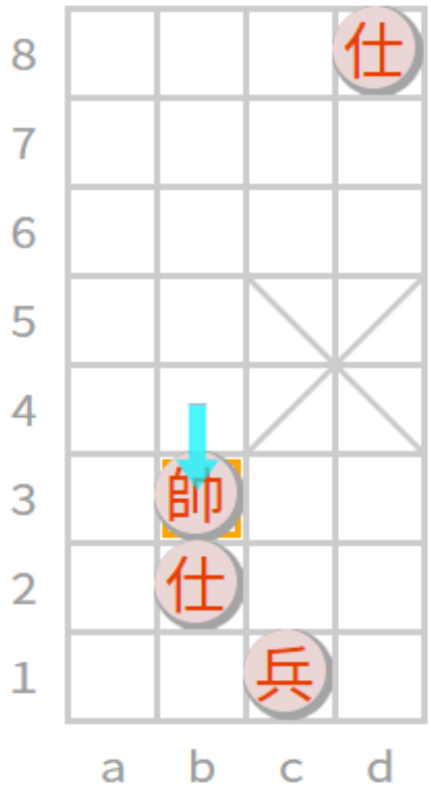
1.075 (W)



1.15 (W)

Average Score: 0.8771

8



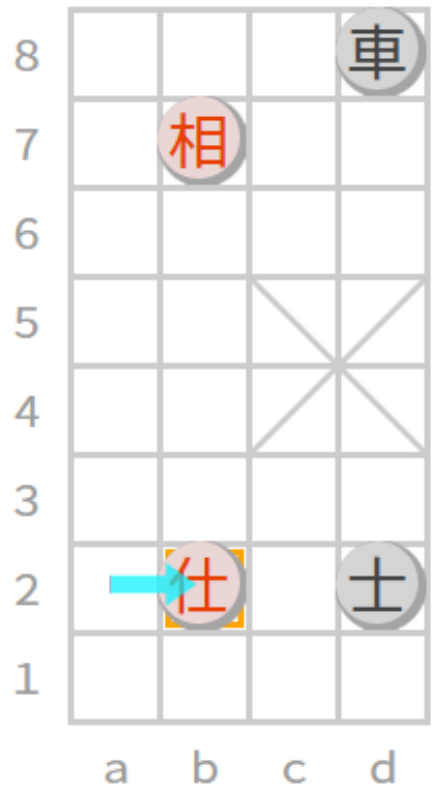
1.15 (W)

0.2375 (D)

Average Score: 0.4396

9

1.2625 (W)



0.2 (D)