# CS221 Project Proposal
# AI Agent for Chinese Chess

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**Abstract**

As a Chinese Chess Lover from childhood, I have great passion for building an AI agent for Chinese chess. I have been destroyed by my father in this game, and now with what I have learned and going to learn from CS 221, I am going to challenge him with my AI-powered chess agent!

The simulator is already built with web interface and web server by *Julia*. Also a greedy player is implemented as the baseline. The next step is to implement several AI agent with different strateties: minimax game tree, alpha-beta pruning, Temporal Difference learning, reinforcement learning for evaluation function, and also potential training in neural network.

*Keywords:* AI, Game, Chinese Chess

## 1. Introduction

Chinese chess (Xiang Qi) is one of the most popular board games worldwide. Having a long history, the modern form of Chinese chess was popular during the Southern Song Dynasty (11271279 A.D.).

Chinese chess is a two-player, zero-sum game with complete information. Chinese-chess expert knowledge started to be developed some 800 years ago. Nowadays, the world has many excellent human players. Yet, already now, the strength of the best Chinese-chess programs can be compared to that of human players notwithstanding the fact that the game is considered rather complex. The state-space complexity of Western chess and Chinese chess was estimated by Allis (1994). The game-tree complexity of Chinese chess is based on a branching factor of 38 and an average game length of 95 plies (Hsu, 1990). Detailed game rules can be found at https://en.wikipedia.org/wiki/Xiangqi#Rules

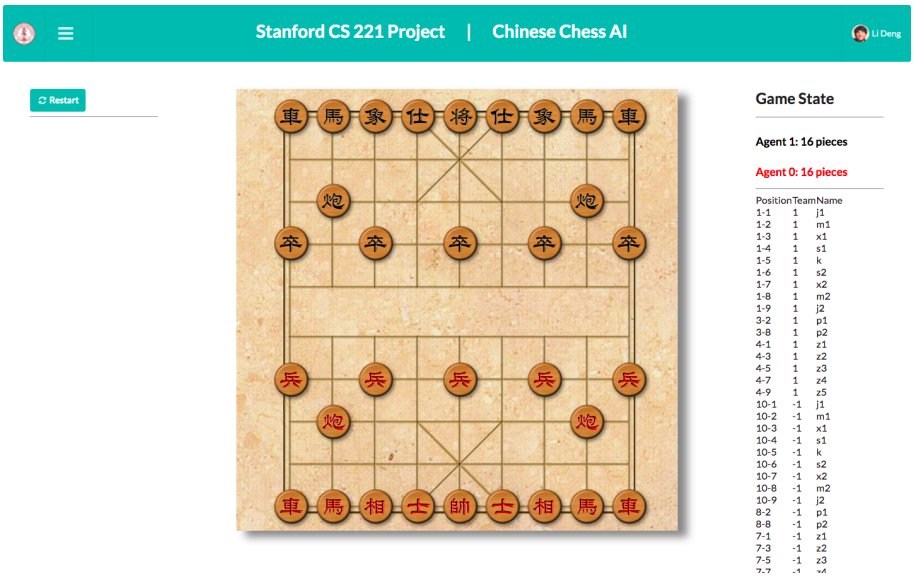
Table 1: State-space complexity and game-tree complexity (log)

| Game | Space Complexity | Game Tree Complexity | Branching Factor |
|---|---|---|---|
| Chess | 50 | 123 | 35 |
| Chinese chess | **48** | **150** | 38 |
| Go | 160 | 400 | 250 |

So we can see that the complexity of Chinese Chess is between Chess and Go. It is challenging enough to be a course project, but not too complex to analyze.

## 2. Simulator

The simulator is built with with a web interface by *Angular2* and a web server with *node* powered by *Julia*. Compared to GUI interface by Python, web interface has more flexible and powerful representation. *Julia* is a new programming language, and is famous for its high performance. AI strategies are going to be implemented in *Julia*. *Node* takes output computing result from *Julia*, and *Angular2* takes the data about chess piece move and renders on web. Also *Angular2* sends updated game state to *Node* , and then to *Julia* to compute. So this is the work-flow of the game simulator.



## 3. Base Line and Oracle

Greedy strategy is used as the baseline: i.e, as long as there is one opponent piece available to be captured, then capture it. By playing with this greedy strategy, and it winning rate against me is around 10%.

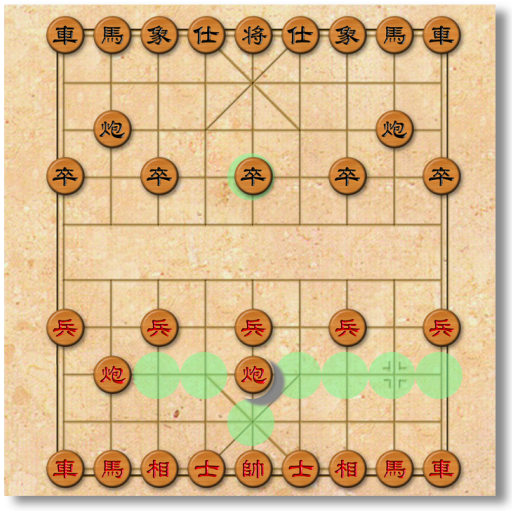
In the papers about Chinese Chess, the benchmark is the top chess player in the world. Due to the lack of such top human player for my game, currently I am using the top level on QQ game online platform. And its winning rate against me is around 95%.

## 4. Strategies

- Game Tree: Minimax, alpha-beta pruning
- Reinforcement learning with evaluation function
- Temporal Difference Learning
- Neural network

## 5. Github Repo

The project is hosted on Github:
https://github.com/dengl11/ChineseChessAI



Green spots mean the legal moves of selected piece.