Engineering Track: Final Project Proposal

B351 / Q351

Basic Information

Project Title

Adversarial Chess AI

Team Members

1. Name Zachery McCurtain
2. Name Ross Gander
3. Name Victoria Rios

Short Project Statement
The goal is to use some sort of artificial intelligence method to create an AI to play chess.

1 Problem Space

1. Describe the problem space. What are the objectives, challenges, and constraints? What are some of the variations found in the problem space?

   The problem space is creating an AI to play chess. The objective is to create an AI that performs reasonably well and is able to beat beginner/novice chess players, such as us. The challenges will be finding ways to evaluate the board state as good or bad.

2. What are some historical attempts to tackle the problem space? Include links and references where appropriate.

   One Historical attempt at this problem space has been minimax with alpha-beta pruning such as in the open-source chess engine Stockfish

   Another attempt being IBM's Deep Blue

   Another type of attempt being DeepMinds's AlphaZero using artificial neural networks, and trained by playing against itself

2 Algorithms

1. What solution are you proposing? How will this compare to historical approaches?
2. What algorithms will you implement? Include links and references where appropriate.

   Our plan is to start off with using a simple minimax algorithm and expand from there. First we will add alpha-beta pruning which has been used in the class as well already. Then we will implement a Monte Carlo Tree search to compare against our minimax algorithm. After that we will derive the heuristic using a genetic algorithm. Lastly, we will implement the standard chess openings rather than having minimax make these moves as minimax struggles heavily in the opening stages of the game. This is similar to the historical approaches as Stockfish and DeepBlue both used a variant of alpha-beta pruning.

3 Third-Party Libraries and Technologies

If you intend to use third-party tools or technologies, please explain the following for each technology:

1. What technology will you be using?

   Python, Numpy, python-chess, Enyclopedia of Chess Openings.

2. What will it be used for / how will it assist you in your project?

   Python will be the programming language that we use.
   Numpy will be used for data storage and just general numpy use.
   python-chess will be used for the creation of the chess game.
   Encyclopedia of Chess Openings will be used to have our Ai make moves based off of the standard chess openings.

3. How will you demonstrate your knowledge of the topic area despite off-loading work to the third-party technology?

   Numpy simply acts as a tool for the rest of the implementation. The algorithms will still need to be hand implemented by us.
   python-chess will accelerate the time it takes to create the game, and will let us focus on the algorithms being implemented rather than the creation of chess itself.
   Encyclopedia of chess openings will act as our data on chess openings since none of us are avid chess players.

List this for **all** non-standard libraries you will use. For example, the first item for many Python developers might be numpy, and the first item for many Javascript developers might be jquery. You may always opt to use more third-party tools later by presenting the proposal modification request form to your mentors at one of your check-ins.

4 Project Goals

In this section, please list the specific action items that you intend to complete by the end of the project. Include a range of reach (A-range), target (B-range), and safe (C-range) goals. Each set of goals should build on the previous set. This section will serve as a rubric used to assign a majority of your overall project grade, so be as specific as possible. You may use a bulleted format. This section should be no longer than 1 page single-spaced.

4.1 C-range Goals

Create the game of chess and implement a simple minimax with alpha-beta pruning.

4.2 B-range Goals

Monte Carlo tree search and improved heuristic.

4.3 A-range Goals

Heuristic made using genetic algorithm.

4.4 A+-range Goals

Opening moves read from third-party file.

Timeline

Please delineate the major milestones of your project (no milestone should take more than a week to accomplish). The milestones should have accompanying descriptions of everything they entail.

First Milestone: the game of chess completed allowing a game of chess to be played.
Second Milestone: Basic minimax algorithm with alpha-beta pruning and simple heuristic.
Third Milestone: Improved heuristic.
Fourth Milestone: Monte Carlo Tree Search.
Fifth Milestone: Genetic Algorithm for heuristic
Sixth Milestone: Opening moves taking from third party file.
Seventh Milestone: Final Paper Draft
Eighth Milestone: Final Paper and source code
Ninth Milestone: Poster for virtual symposium
Tenth Milestone: Group Reflection.

Then, for each milestone, specify when you will have it completed (specific date). Additionally, make it clear which milestones you will have completed by each check-in date.

Project Proposal completed by Nov 3rd. Project Proposal Meeting.
First and Second Milestone completed Nov 9th. First Check-in Meeting.
Third and Fourth Milestone completed Nov 16th. Second Check-in Meeting.
Fifth Milestone completed Nov 30th.
Sixth Milestone completed Nov 30th if time allows.
Seventh Milestone completed Dec 3rd. Paper Draft Meeting on Dec 7th.
Eighth Milestone Completed Dec 10th. Virtual Symposium on Dec 13th.
Ninth Milestone completed Dec 17.
Tenth Milestone completed Dec 17.

Acknowledgement

Instructor Mentor 1 _____ Signature _____

Instructor Mentor 2 _____ Signature _____

Team Member 1 _____ Signature _____

Team Member 2 _____ Signature _____

Team Member 3 _____ Signature _____