Chess AI

By: Michael Atkins, Greg Brinson, Muhammed Owais, and Taeesh Azal Assadi

VIRGINIA TECH

Problem Statement

We want to create a chess AI that will be powerful enough to not only be fun to play against, but also a good way to learn and improve your chess skills

Use-Case Scenarios

- Gaming and Entertainment
    - Chess playing AI and Chess Training apps
- Health and Cognitive Development
    - Cognitive Training and Therapeutic Purposes
- Social and Community Engagement
    - Online Communities, Chess Clubs and Events

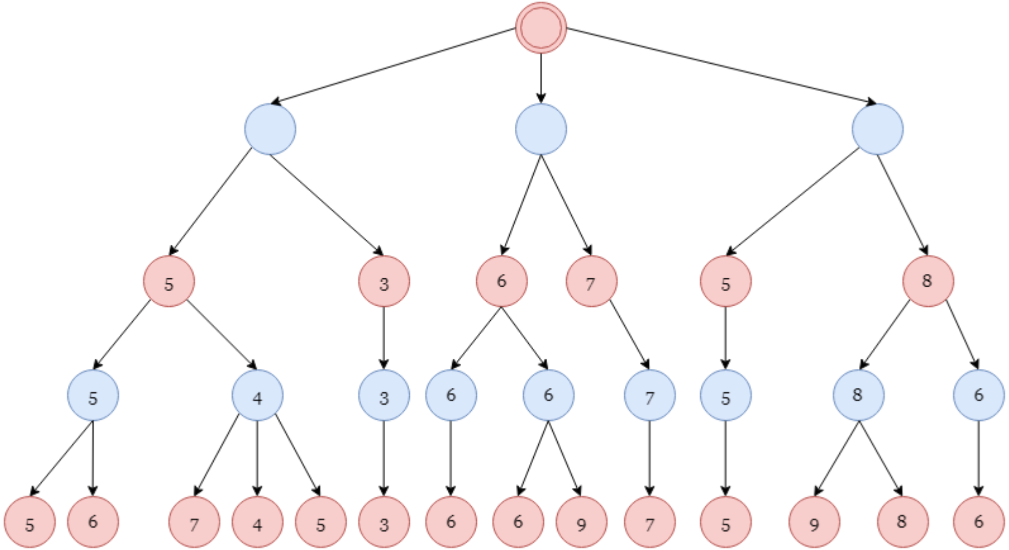
VIRGINIA TECH.

Requirements

- Accurate and powerful
- Fast and performant - people don’t like to wait

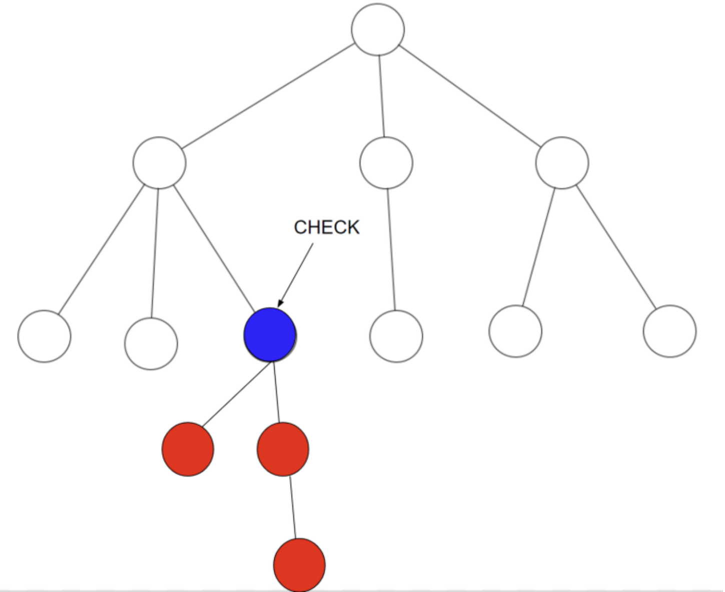
So how do we make it a good chess player?

- Minimax



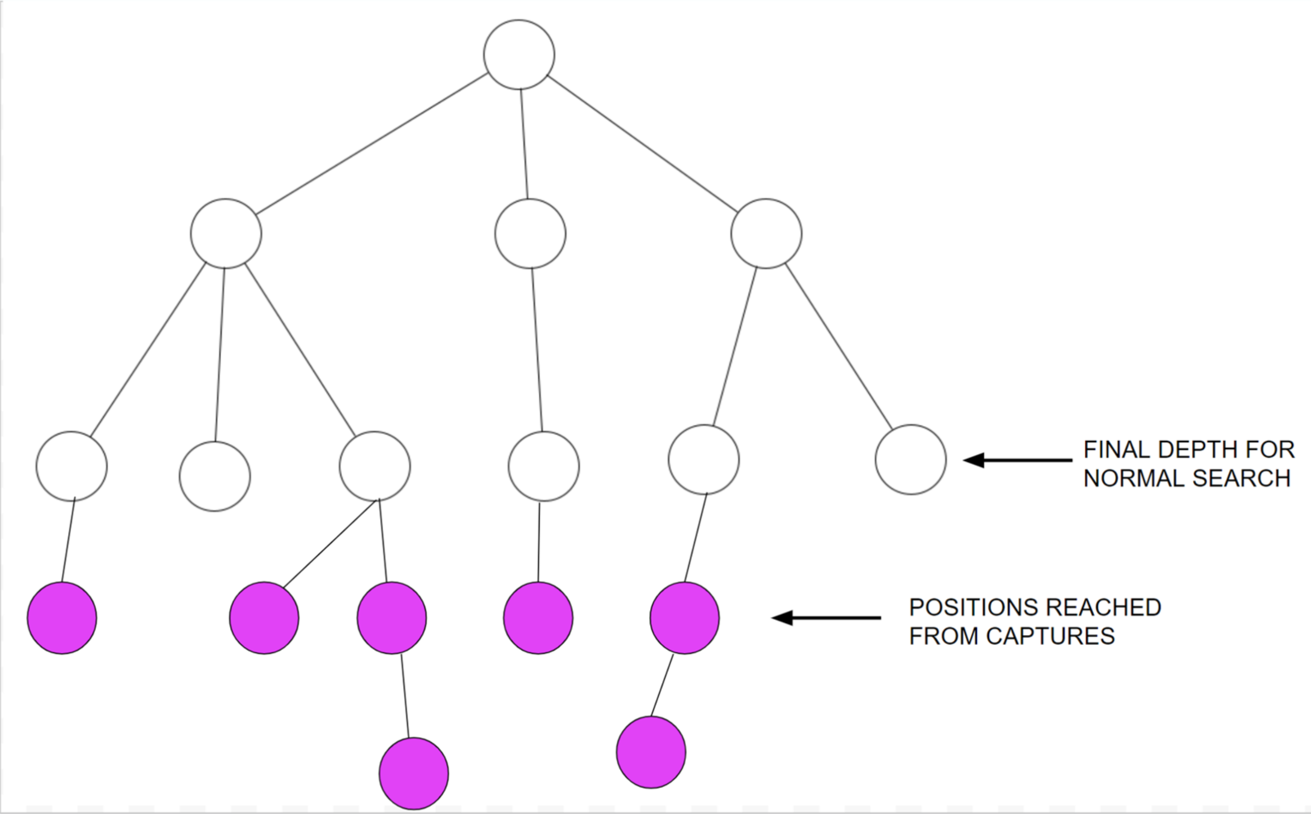
So how do we make it a good chess player?

- Search extensions
  - If we check the opponent, then extend the search depth of that branch



So how do we make it a good chess player?

- Quiescence S
  - Once we where we moves

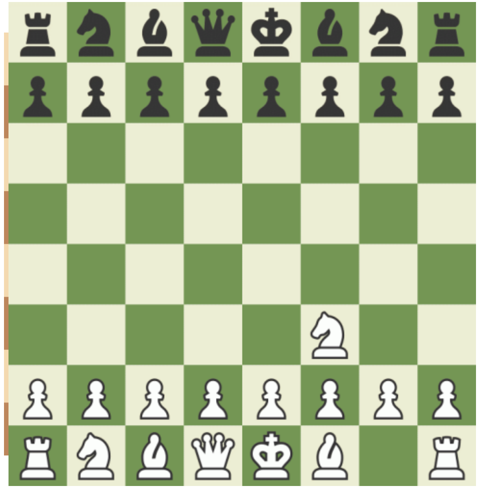

FINAL DEPTH FOR NORMAL SEARCH
POSITIONS REACHED FROM CAPTURES

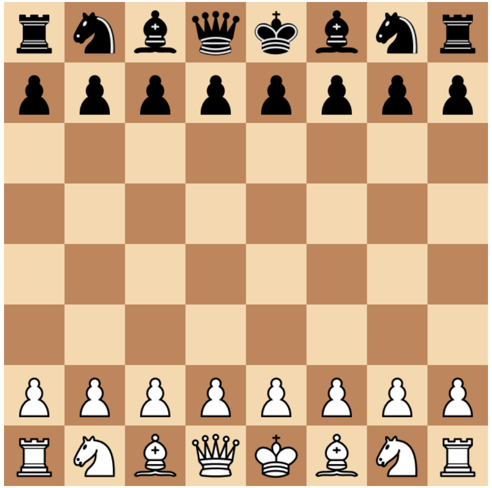
So how do we make it a good chess player?

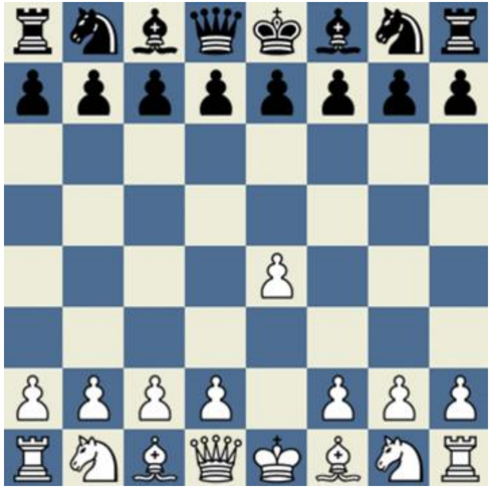
- Multi-heuristic game state evaluation
  - Material on board
  - King safety
  - Optimal piece locations
  - Castle rights

So how do we make it a good chess player?

- Opening book preparation
  - Randomly-weighted opening book knowledge

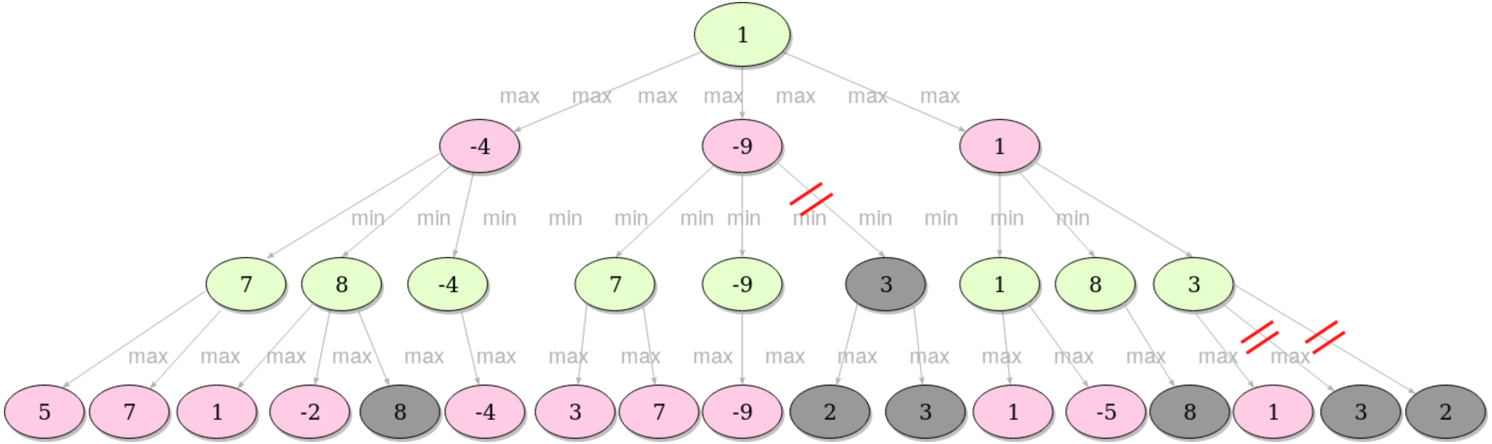






That's great...but how do we make it fast?

- Alpha-beta pruning



That’s great...but how do we make it fast?

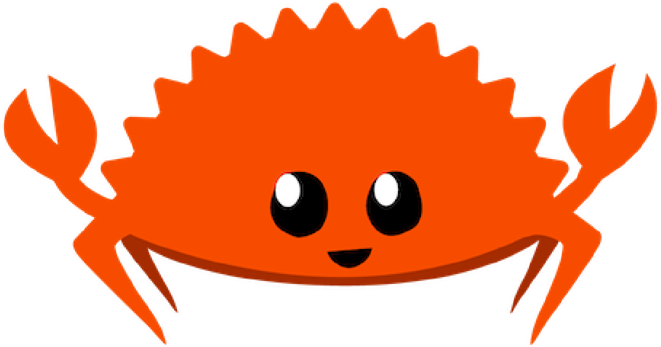
- Move ordering - we prefer:
  - Checks
  - Captures (the better the capture, the better it’s ordered)
  - Promotions
  - ‘Killer’ Moves
  - Early beta cutoff moves are better

That’s great...but how do we make it fast?

- Transposition tables
  - Two different sequences of chess moves can result in the same position - so cache the results of each position’s evaluation
  - Zobrist hashing
  - Iterative deepening requires we store the depth as well

That’s great...but how do we make it fast?

- Rust
  - ‘Blazingly fast’ language
  - WASM support



Results and Demo

- Rated ~1700 elo
  - This puts it in the 96th percentile of players globally according to chess.com
- Searches to depth of up to 11 ply with search extensions
  - A ‘ply’ is half a move

Lessons Learned & Future Improvements

- Lots and lots of chess programming resources on the web!
- Move timer
- Improvements to frontend