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# Artificial Intelligence for Root Board Game

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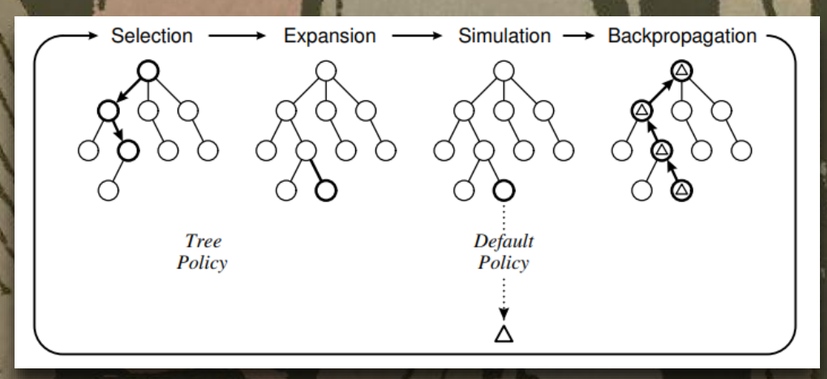
## Introduction

A **video game version of Root** was released in 2020, but there are multiple reports by its players that the **AIs make awful decisions** that no humans would ever make in a similar situation. i.e., their AIs are bad. Especially Eyrie Dynasties' AI.

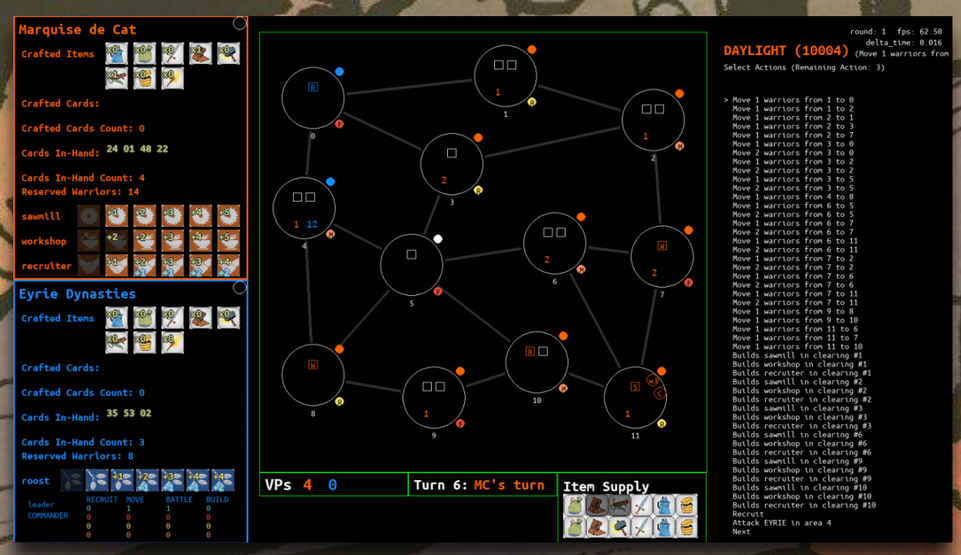
## Objectives

- To **create an artificial intelligence** (AI) that can play the board game "Root".
- To **find the best Monte Carlo Tree Search (MCTS)** algorithm **variant** for playing the board game "Root" for each faction.

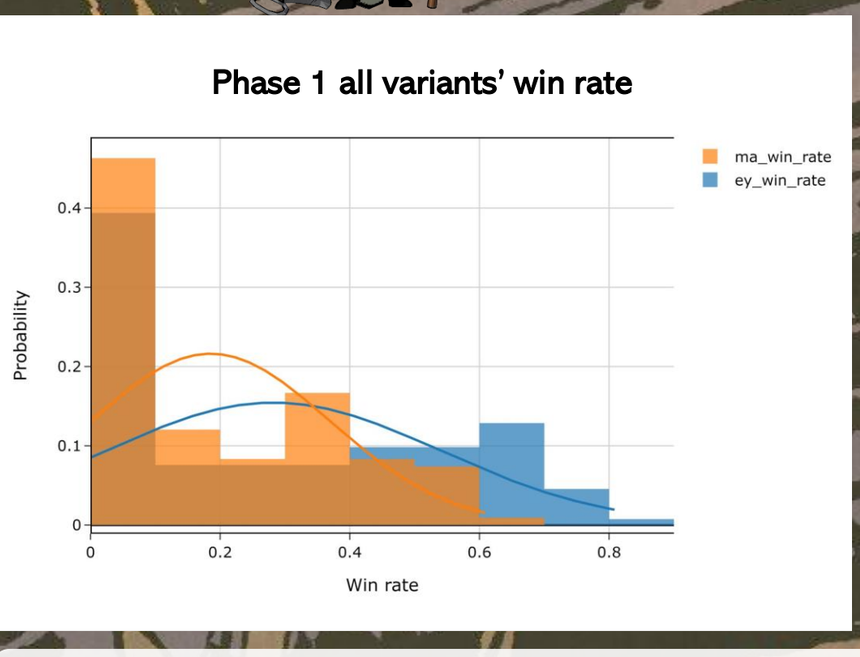



## Methods

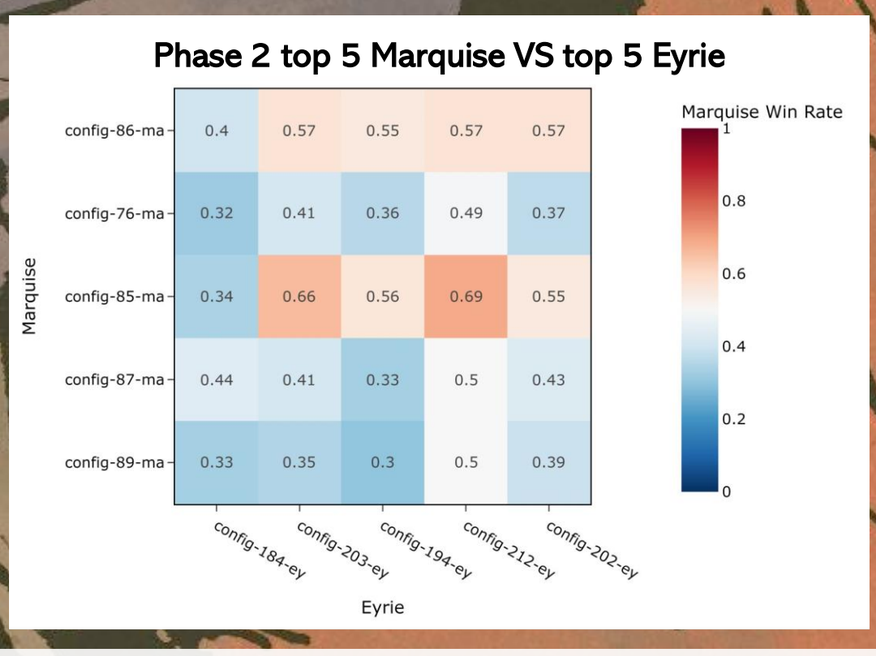
- **Create** a **minimal** version of **Root video game.**
- Implement the **Open-Loop MCTS algorithm.**
- Create **108 MCTS variants** for each faction
- and have them fight against the other faction with the *base* MCTS variant → total **216 battles x 100 rounds.**
- **Top 5** variants with **highest win rate** for each faction face a "Team-Round Robin" fight, i.e., they all fight each other.
- The variant from each faction with **highest average win rate** will be the **best variant for that faction**.




## Results




- Marquise faction is **easier to play** but has **less potential** to earn VPs
- Eyrie faction is **harder to play** but has **more potential** to earn VPs




The best MCTS variant for **Marquise de Cat** achieved **56.0%** average win rate with the following parameters:

- *reward-function*: **vp-difference**
- *expand-count*: **200 nodes**
- *rollout-count*: **1 rollout**
- *time-limit*: **no-limit**
- *action-count-limit*: **100 actions**
- *best-action-policy*: **max**

The best MCTS variant for **Eyrie Dynasties** achieved **63.4%** average win rate with the following parameters:

- *reward-function*: **vp-difference**
- *expand-count*: **200 nodes**
- *rollout-count*: **1 rollout**
- *time-limit*: **no-limit**
- *action-count-limit*: **20 actions**
- *best-action-policy*: **robust**

## Conclusion

- **Our AIs are intelligent!** Our AIs' average turns-to-win are 15.39 turns for Marquise and 13.68 turns for Eyrie. An average game of human versus human lasts 14 - 20 turns!
- We have created two intelligent AIs **using MCTS algorithm**!