ΩmegaGo

Elastic, Highly Distributed Go AI Tournaments

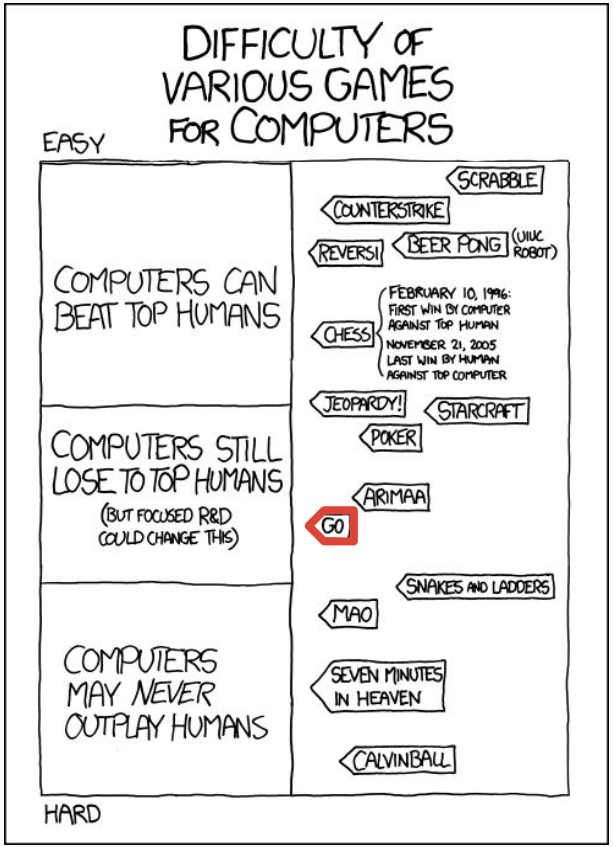
Joe Doyle and Rachel Kositsky
15-418 S16 Final Project

Go is like Chess, but harder

https://en.wikipedia.org/wiki/Go_(game)

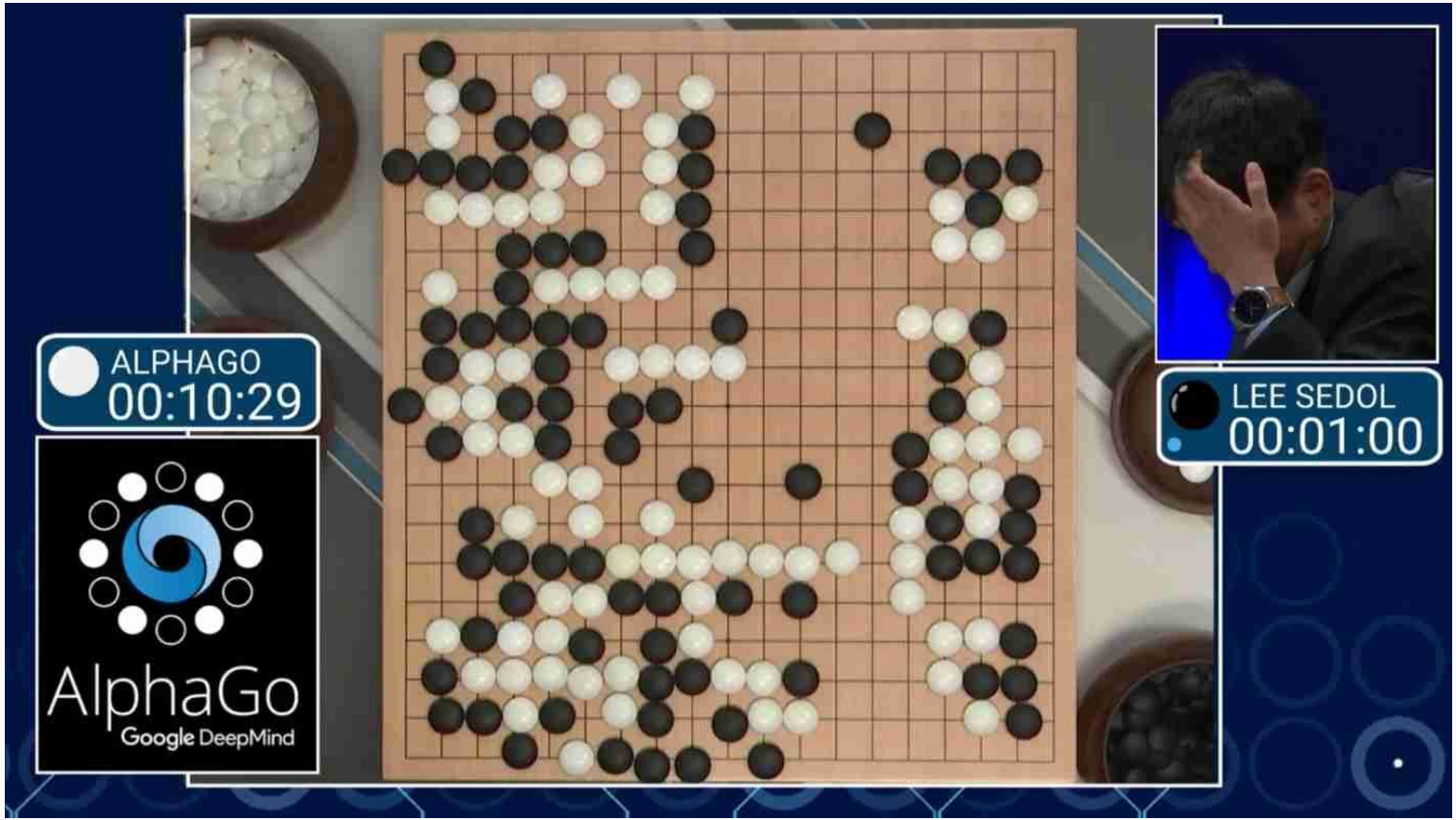
- Two players: **black** vs. **white**
- Players place stones on a **19×19** grid
- **Surround** territory and enemy stones to win
- Go: ~10^{360} possible games
- Chess: ~10^{124} possible games

Computers *were* bad at Go



Adapted from https://xkcd.com/1002/

AlphaGo wins 4-1 against Lee Sedol

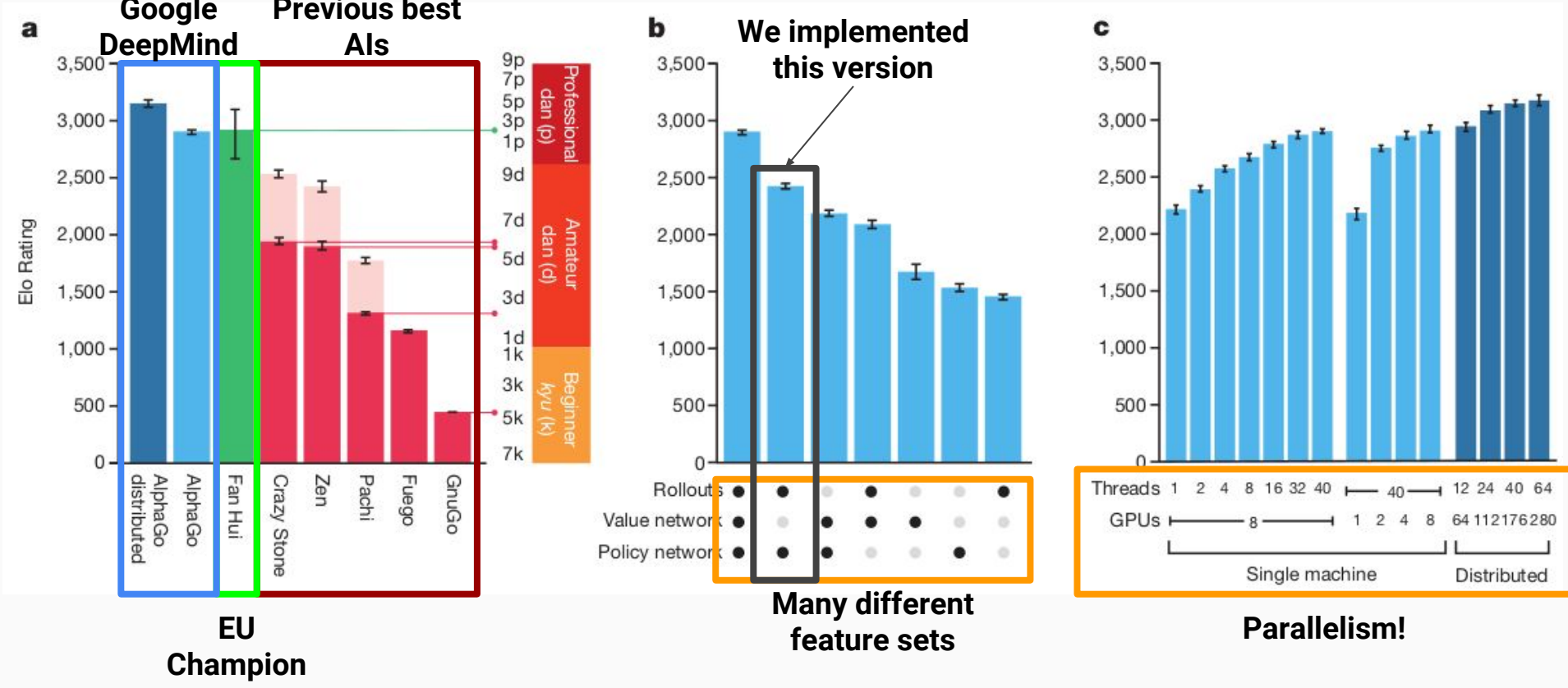


https://gogameguru.com/alphago-shows-true-strength-3rd-victory-lee-sedol/

New State of the Art: APV-MCTS

(taller bar = stronger AI)

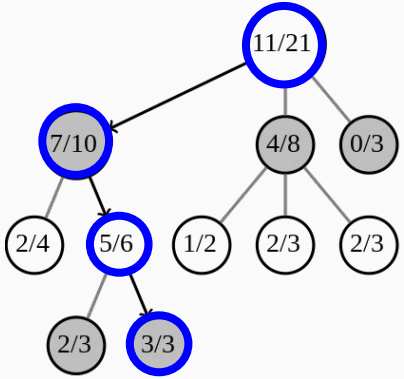
Silver, David, et al. "Mastering the game of Go with deep neural networks and tree search." Nature 529.7587 (2016): 484-489.



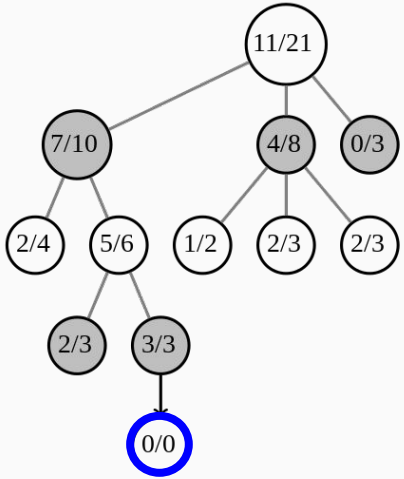
Lock-Free Monte Carlo Tree Search

- Pick **the best moves you know**
- Play **random moves until the game ends**
- Compute **win/loss**
- **Atomically** update each move's **win probability**

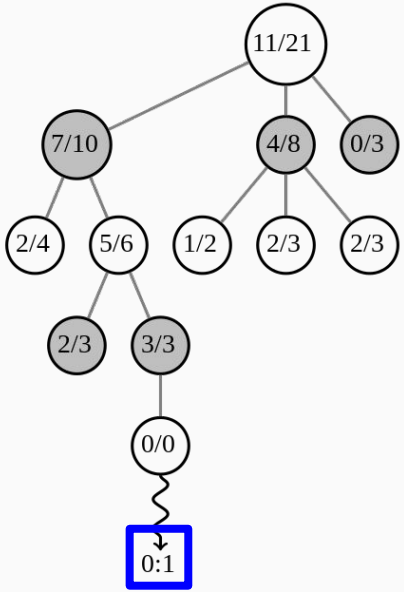
Selection



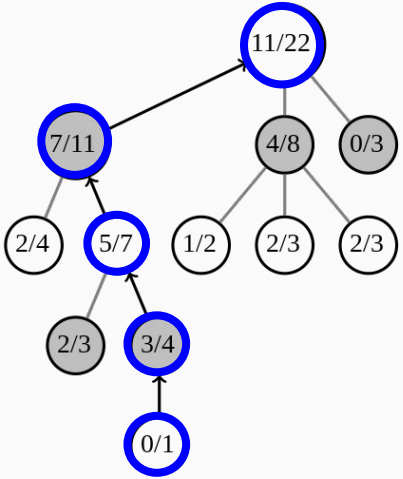
Expansion



Simulation



Backpropagation

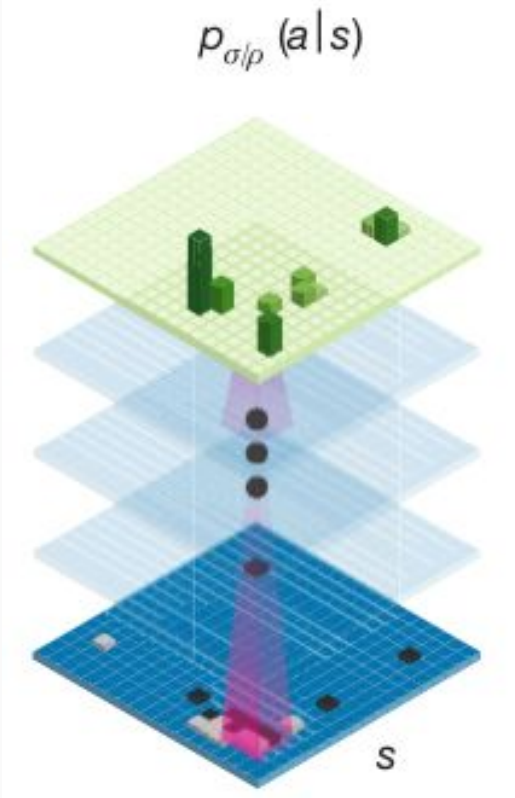


https://en.wikipedia.org/wiki/Monte_Carlo_tree_search

More threads ⇒ More data ⇒ Higher accuracy

Policy Neural Network: Structure

- Inputs: **19×19×46 image**
  - On/off attributes for each point
- Outputs: 19×19 grayscale image
  - **probability of playing** on each point
- *n* 3×3 inner convolutional layers
  - *n = 3, 4, 5, 6*
- **Asynchronous Policy MCTS:** Bias MCTS traversal
  - Policy provides **intuition**
  - MCTS provides **data**



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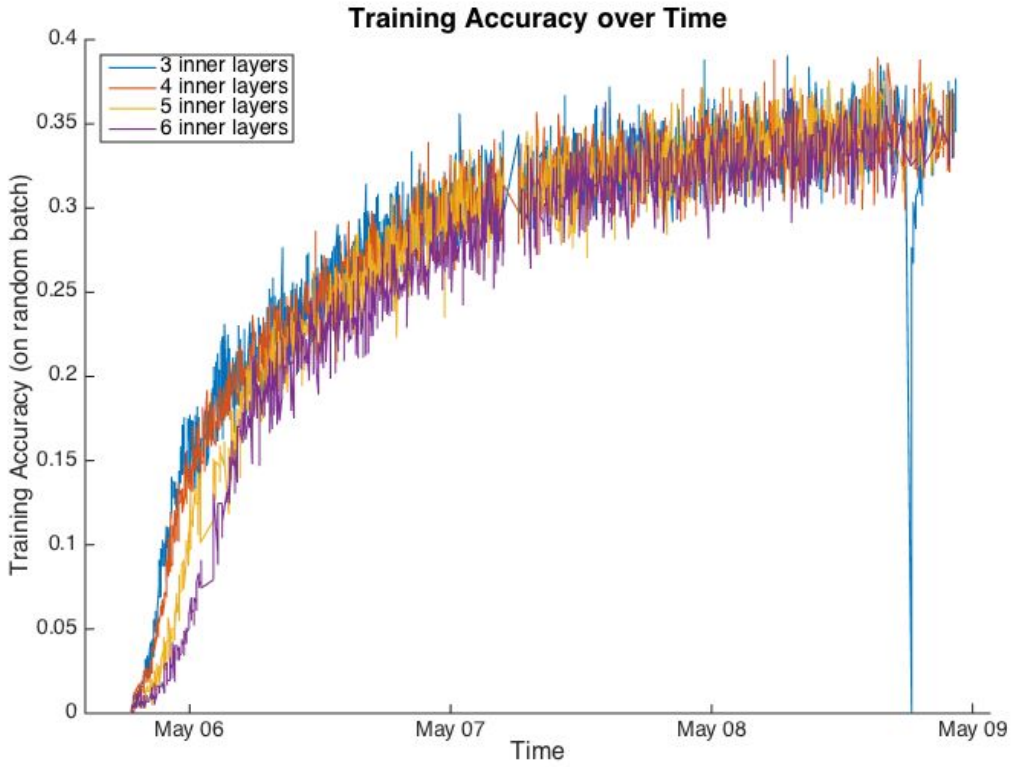
Policy Neural Network: Training



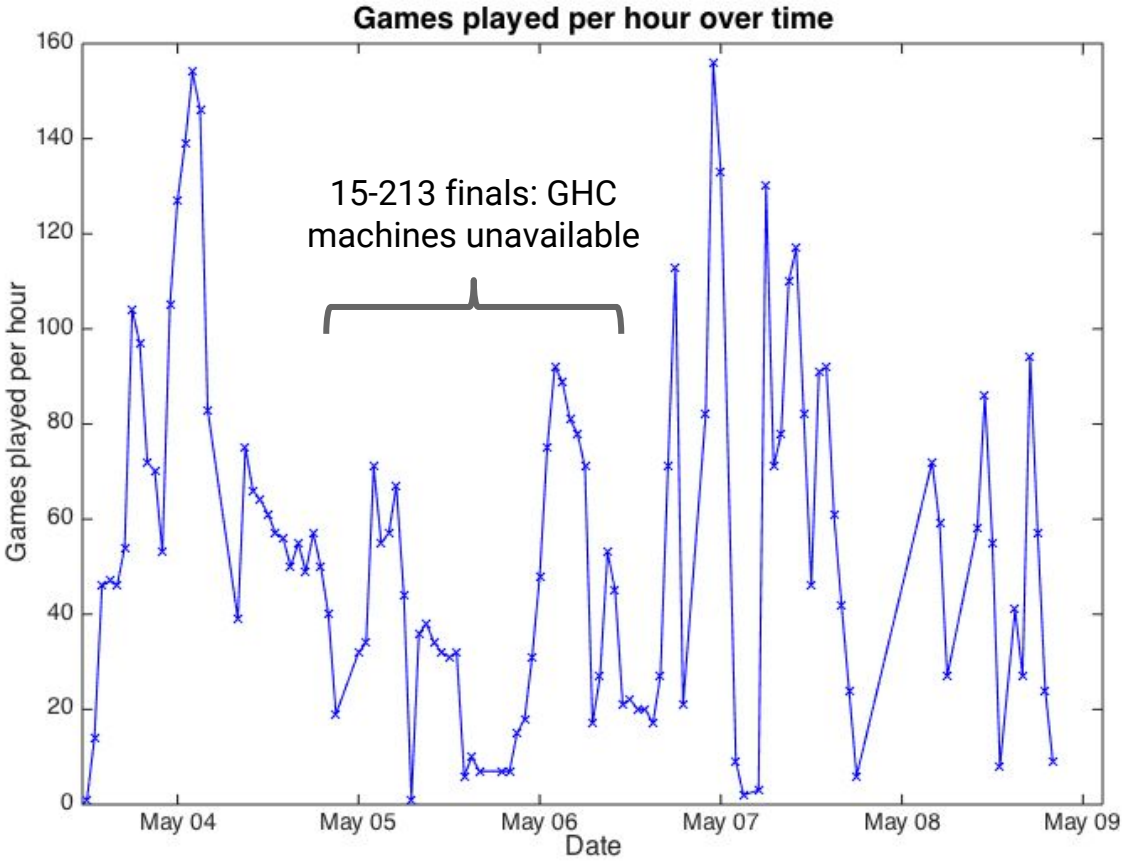
- Trained on `latedays`
- 70,000 skilled amateur games
- **Training Accuracy**: % of samples where the network guessed the move played
- AlphaGo: **57%** on this dataset

Comparing AI Skill

Elastic distributed ***tournament*** system

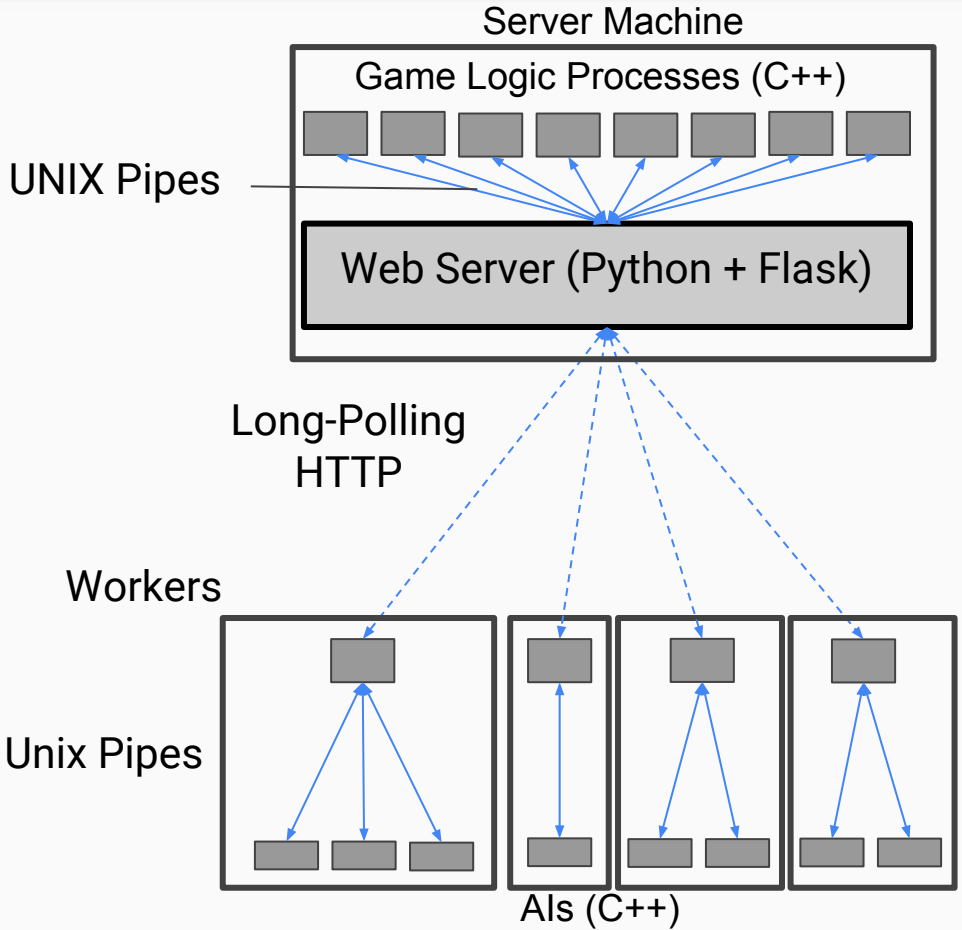
- Comparing AIs requires a lot of games
  - $O(n^2)$ comparisons for n AIs
- **“You can use whatever systems you can get your hands on”**
  - `ghc#.ghc.cmu.edu, unix#.andrew.cmu.edu`
- **Scale up and down** with available machines

Elastic distributed tournament system

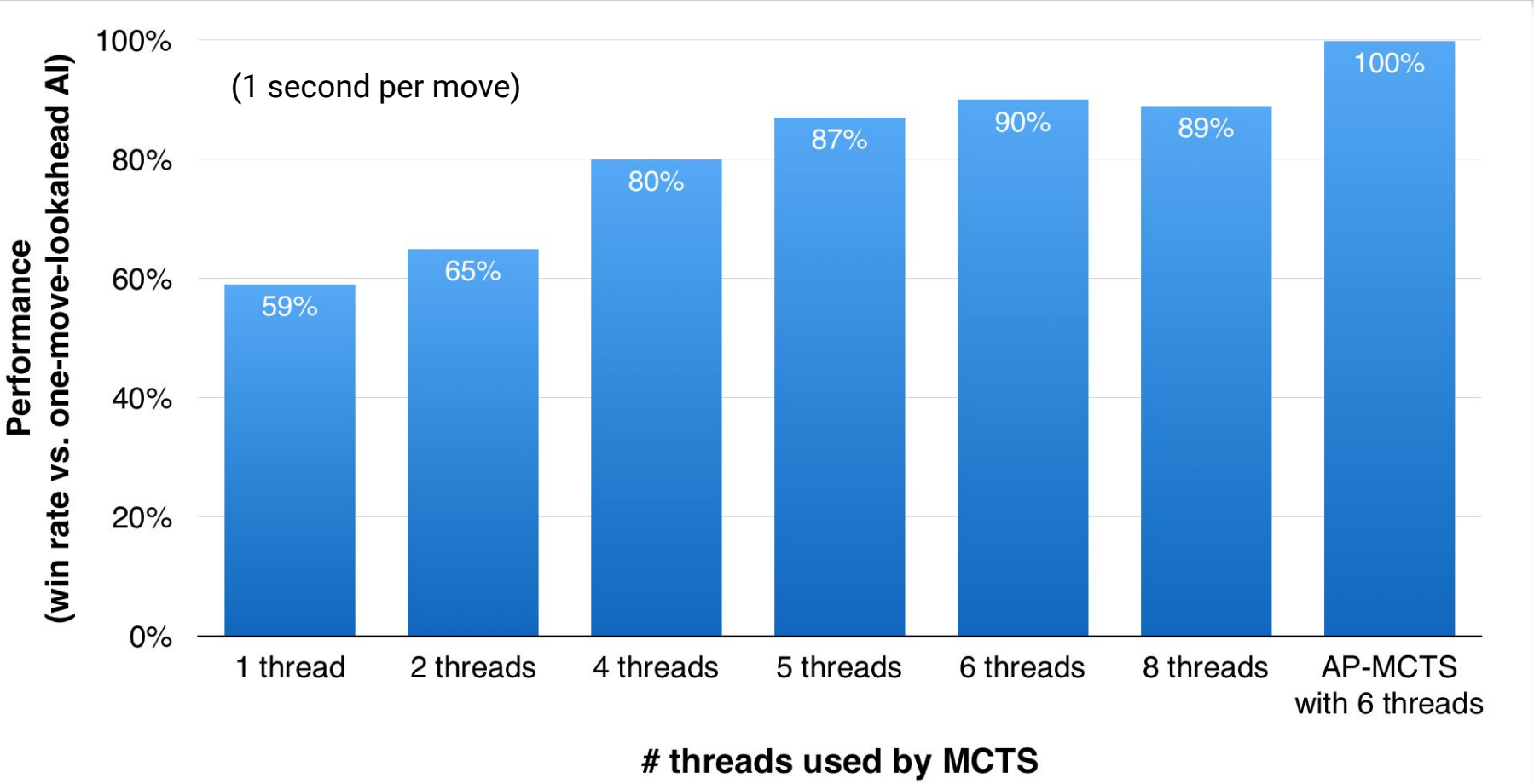


>5700
games played

Elastic ***distributed*** tournament system



MCTS improves with more threads



Demo

Questions?