

Hearthstone AI: Comparing and Combining Effective Search Algorithms

Nickolas Ryan Rodriguez



MCNAIR SCHOLARS PROGRAM

Introduction

Hearthstone

- Introduced 2014
- Slight twist on the traditional style.
- Traditional style = play cards and manage resources
- Ends = 0 health or 40 turn-limit, typically
- 20 expansions = 3224 cards

Purpose

- Hidden information specialty
- Current implementations = slight improvements
- Proposals that lead to stronger results
- Outside perspective

Literature Review

- 10 Hearthstone centric journal articles
- MCTS or EA approaches
- MCTS = gameplaying AI agents
- EA = deckbuilding and game balancing AI agents
- New techniques were introduced to improve each implementation to increase better results

Monte Carlo Tree Search (MCTS)

- Decision-making tree
- Large search spaces utility
- Usually human maintained
- Computation problems

Evolutionary Algorithms (EA)

- Chromosomes, populations, and individuals
- Darwin's "Theory of Evolution"
- Optimizing solutions to problems
- Long runtimes and no predication capabilities.

Methodology

Results

- Current applications are strong, but have only slightly improved in each new experimentation
- Testing has been purely AI vs AI in specific simulator programs which may stunt growth and innovation
- All current challenges have been tackled separately rather than together, thus reducing areas of valuable data to gain
- An all-around human-like expert AI has not been formed yet

New Challenges

Arena Game Mode

- Unique set of cards allowed
- Deck building limitations removed
- Larger than normal search space

Battleground Game Mode

- No typical game mechanics
- Completely different set of challenges
- Combining different kinds of approaches

Combining Theory

MCTS gameplaying and EA deckbuilding

- High-level players = gameplaying and deckbuilding knowledge
- Current applications = In-the-box thinking
- Your only as strong as your tools

EA Randomizing in MCTS

- EA's random elements = mutation and recombination
- MCTS /= random factor
- Random card generation wins games

Discussion

Conclusion

- Hearthstone has provided a home for current and future AI applications by exposing new complex challenges as new expansions and updates roll through every year.
- MCTS and EA may be the most modern search algorithms to be use in the digital frontier, but I hope a stronger option can be reached that will revolutionize the effort towards a pure Artificial Intelligence agent.
- The proposals constructed in this research are only the steppingstones for future work that can possibly improve our understanding of AI research, as well as, the questions that continue to arise after every application.

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