

Playing Sueca with Autonomous Agents

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ABSTRACT

The strategic card game *Sueca* presents complex decision-making challenges due to its incomplete information and reliance on partner cooperation. Our approach will employ a multi-agent system (MAS) with agents capable of reactive, deliberative and hybrid reasoning, leveraging both immediate state decisions and decision-making strategies like the usage of the forward algorithm [Wikipedia 2024]. We anticipate demonstrating that our MAS can outperform baseline agents and provide insights into effective strategies for incomplete-information games. This contribution lies not just in competitive play, but in advancing the understanding of strategic decision-making in MASs.

1 INTRODUCTION

Sueca is a classic card game known for its strategic complexity and reliance on teamwork, which reflects challenges in real-world scenarios that require coordinated decision-making under uncertainty. Influenced by seminal work on game-playing agents and leveraging existing work like [Correia 2015], our project aims to craft a multi-agent system with sophisticated decision-making agents. The project tackles the challenge of building autonomous agents capable of adapting to dynamic game environments and cooperating effectively. The expected outcome is a system not merely capable of playing *Sueca* at a competitive level, but also one that provides valuable insights into multi-agent interactions in scenarios with incomplete information. These agents will serve as a model for investigating broader applications in complex systems where cooperation and adaptive strategies are crucial.

2 APPROACH

In this study, we adopt an approach that centers around the design and implementation of the multi-agent platform specifically tailored for the game of *Sueca*.

2.1 Environment

The environment is dynamic, in such a way that each agent's decisions impact all the other agents' decisions and outcomes. We can divide the environment and provide a definition as follows:

- **Game** - The game of *Sueca*, is chosen as the target environment, in a format which entails two teams, each with two players.
- **Rules** - The rules of *Sueca*, including card rankings, round mechanics and point calculations, will be implemented to create an accurate representation of the game environment.

2.2 Agents

In the environment there will be rational agents. Their actions will be guided by a utility function, defined according to the selected

strategy. The desired outcome for the agents is to win the game by accumulating more points than the opponent team. The utility functions used by each agent will prioritize achieving this specific outcome, through the use of different strategies.

The following section contains the agents' strategies we plan to implement:

- **Random Agent** - Each agent selects a card to play at random from its available hand. This strategy serves as a baseline to evaluate the performance of more sophisticated strategies.
- **MaximizePointsWon** - If it's the first turn, the agent plays a card randomly. Subsequently, the following strategic approach is adopted: if the agent's team is leading the round, it plays a card that maximizes the round's point total; otherwise, it plays the highest card that can win the round, if such a card exists.
- **MaximizeRoundsWon** - If it's the first turn, the agent plays a card randomly. Subsequently, the following strategic approach is adopted: if the agent's team is leading the round, it plays the lowest card that still ensures a win; if its team is behind, it plays the lowest card that can potentially win the round, preserving better cards for future rounds. This strategy aims to maintain a strong hand towards the game's end.
- **CooperativeAgent** - The agents track the suits that their partners have played to optimize team play. When it's the agent's turn to lead a round, it plays a card that complements its partner's strengths. In other scenarios, it behaves similarly to the MaximizePointsWon agent, aiming to secure the most points possible from each round.
- **DeckPredictor** - The agent uses a probabilistic approach by keeping track of the possible decks each agent has, using a round belief and playing the card that has the highest likelihood of success for that round.

3 EVALUATION

In order to validate this project's objectives, specifically how well every agent functions as a team, we will evaluate the agents' performance based on the number of points they collect after each game. To do so, first we will evaluate the agents' performance individually, by comparing the number of points each agent has collected. Then, we will evaluate their performance as a team, by comparing the number of points the team has collected. This way, we will be able to understand how well the agents are able to work together and how well they are able to adapt to different game distributions.

REFERENCES

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