Developing strategies for the bidding card game 'Diamonds' with GenAI

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1 Introduction

This is an essay that explores the developing startegies for the bidding card game 'Diamonds' with GenAI.

2 Problem Statement

The bidding card game 'Diamonds' is as follows. Each player gets a suit of cards other than the diamond suit. The diamond cards are then shuffled and put on auction one by one. All the players must bid with one of their own cards face down. The banker gives the diamond card to the highest bid, i.e. the bid with the most points. The points range as 1 = 1, 2 = 2, 3 = 3, 4 = 4, 5 = 5, 6 = 6, 7 = 7, 8 = 8, 9 = 9, T = 10, J = 11, Q = 12, K = 13, A = 14. The winning player gets the points of the diamond card to their column in the table. If there are multiple players that have the highest bid with the same card, the points from the diamond card are divided equally among them. The player with the highest points wins at the end of the game.

3 Teaching GenAI the game

The first step is to create a digital representation of the Diamonds game environment. This includes:

- **Game State:** Representing the current hand of each player, the remaining deck of diamonds, and the cumulative score.
- **Action Space:** Defining the available actions for each player, which is bidding a card from their hand.
- **Reward System:** Assigning rewards for winning diamond cards and penalties for losing valuable cards from their hand.

Next, we train a GenAI model, such as a Deep Q-Network (DQN), to play the game. DQNs excel at learning optimal actions in complex environments through trial and error. During training, the GenAI plays against itself or simulated opponents. It explores different bidding strategies, receives rewards based on its performance, and gradually learns to value different game states and make optimal bids.

4 Iterating upon strategy

- **Varied Opponents:** Train the GenAI against opponents with different bidding styles. This could include aggressive opponents who consistently bid high or conservative opponents who prioritize holding onto valuable cards. By encountering diverse strategies, the GenAI learns to adapt its bidding based on the opponent.
- **Incomplete Information:** In a real game, players don't have complete information about the remaining diamonds. To simulate this, during training, some diamond values can be hidden from the GenAI, forcing it to learn to estimate value and make decisions with partial information.

5 Analysis and Conclusion

By continuously making the GenAI play the game, it gets to know all the possibilities, and strategies to overcome all these possibilities. we can create a strategic AI opponent and gain strategic complexities of the game.