UNO: A COMPREHENSIVE ANALYSIS OF REINFORCEMENT LEARNING BASED AGENT

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Over the past decades, there has been something quite common and rather foundational in the field of Artificial Intelligence (AI). It started with checkers and quickly gained popularity with chess and is now a multifaceted branch of AI – Game Playing. It can be imagined as giving toys to an infant to make them learn about the real world and gain problem solving abilities. In this paper, we propose to build and evaluate an intelligent game playing agent which learns to master the game of Uno.

The card game Uno is a relatively simple to understand yet an overwhelming environment to explore for a given decision-making agent. The rational agent is expected to perform better and win against its opponent despite the several sources of uncertainty involved throughout the course of the game. There are two main versions of the game: official and common. The official game rules prescribe a point value to each action and a player wins by being the first to reach a threshold. The common game is the popularized version where the first player to have no cards remaining is the winner. The objective of our paper is to train an agent that optimally plays the common version of Uno. Its performance is evaluated by running several simulations of the game against two other agents playing the game following a random and card-counting approach, respectively.

The challenges of training, evaluating, and analyzing the proposed decision-making agent are multiple and are bound to occur in an incremental manner. Therefore, these challenges can be thought of as checkpoints in the context of this paper. These checkpoints can be broadly categorised into three categories:

1. **Creating a game engine of Uno card game:** The exhaustive list of rules involving cards, deck, players, turns, and the overall gameplay are used to setup the required game environment in which the agents get to interact.
2. **Obtaining the game statistics from simulations:** The interaction between the two agents is be monitored and the statistics are to be used as data points for training the reinforcement learning based agent.
3. **Implementing the Reinforcement Learning techniques:** Searching for an optimal strategy in a finite environment dominated by uncertainty of events is a classical use for Reinforcement Learning. The game itself can be framed as a finite Markov Decision Process (MDP), having its own defined set of states, actions, and rewards.

The inherent stochasticity of Uno inspires the use of techniques such as Monte Carlo and Q-Learning with a discrete state-action matrix.

References:

1. '*Towards Learning How to Properly Play UNO with the iCub Robot*' by Pablo Barros, Stefan Wermter, Alessandra Sciutti published in 2019.
2. '*Reinforcement Learning on Spades*' by T Culhane.