Deep Learning Carom Billiards

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Abstract:

Carom Billiards is a simple looking game on a billiards format but without the pockets. The goal of the game is to bounce off a player's "Q_ball" with two other balls within the same strike to get a score. The seeming simplicity of the game hides the complex game dynamics wherein reflection from the table boundaries and other balls play a key role. The objective of this project was inspired by the automation of Atari games by Google DeepMind's Deep Q-learning. A Neural Network was trained to play a simulation of carom billiards with the position of the balls as the "state", and, the angle and velocity of the q_ball as the "action" for a Q-learning approach.

Although the traditional method for Q-learning is to learn the probability distribution for the best action given a state, an alternate approach was used where state-action pairs were fed into the model as inputs and the quality associated with the action for the state was the target. This alternative could tackle the **action space for this problem, which is significantly higher than most Atari games** referenced above. Specifically, the action space includes each of the 360 angles for the q-ball and speeds ranging from 1 to 10; a total of **3600**. The Neural Network was able to learn the **non-linear** relationship between the collisions and rewards, with some surprising results.