An Attempt at Playing Heads-up No Limit Hold’em

Advisor: Dana Angluin
Benjamin Tong

Overview

No Limit Hold’em is the most common variant of the family of card games popularly known as poker, played across the world recreationally and even online. The game involves incomplete information, with each player knowing their own cards without knowing their opponents, and each player obtaining more communal information as the game progresses at the cost of potentially more chips, only to reveal the winner at the conclusion of each round. Although a single hand of no limit hold’em has an incredible amount of variance, there are professional players who are able to make a living by playing for EV, or expected value, in the long run; even when a professional loses a hand, they can still say they made the correct play if the play was positive expected value.

Due to the history and popularity of no limit hold’em, there have been many attempts to solve the game. Most recently, the Libratus Poker AI beat four professional players in heads up (one versus one) poker at a rate of 14.7 big blinds per 100 hands, which is a rate most professionals would not be able to make themselves against weaker players. The results were over 120,000 hands and the results were deemed statistically significant with p=0.5%. In this project, we seek to attempt to create a bot that can play heads up no limit hold’em and hold its own using machine learning techniques, similar to the Libratus bot.
Outline of Goals

As it is uncertain the difficulty of each step, we outline the intermediate steps we would like to achieve as we create a “smart” robot.

1. Create a framework in which hands in no limit hold’em can be simulated.
2. Create a bot that can play poker in which there is only preflop: all community cards are dealt after betting before the flop and the winner is decided.
3. Create a bot that can play poker in which there is only preflop and flop.
4. Create a bot that can play poker in which there is preflop, flop, and turn.
5. Create a bot that can play poker for all streets of betting.

Tools

We will be using the Python 3 language for this project due to the numerous modules available to it that assist in machine learning, possibly most importantly of which is scikit-learn, which contains functions for most of the common machine learning algorithms. Among these, we will likely try to utilize the different forms of regression to train the robot on parameters including things from the actual cards in the hand and on the table to the frequencies at which our opponent bets, folds, or raises at each street of action. We will focus on a reinforcement learning approach, as the Libratus bot did, for allowing our robot to learn the proper actions to take in any spot. To train the robot, we will train the robot by using random play, hand histories with humans, hand histories taken from the IRC database, and against previous iterations of the robot.
Deliverables

1. Learning algorithms for the robot
2. Learned knowledge by the robot
3. Analysis of robot play versus human play
4. Final report of findings

References

http://poker.cs.ualberta.ca/index.html (Includes useful links and references)

http://poker.cs.ualberta.ca/IRCdata/ (IRC poker data)

http://scikit-learn.org/stable/ (scikit-learn)

http://www.cs.cmu.edu/~sandholm/ (links to papers related to Libertus bot)