Task 3

Garvit Meena (B20ME033)

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1 Examining the model's components and providing technical updates on some of them:

There are several technically good suggestions for calculations like Hand Assessment procedures like Hand Strength and Hand Potential in the offered research paper titled "Opponent Modeling in Poker," although in betting strategy there are some areas to be handled in a more beneficial and effective way. In terms of Opponent Modeling, procedures such as weighing with enumeration, computing initial weights, and Re-weighting are described in this study. Now, let's talk about the technical aspects of these strategies and the faults that can be corrected using a variety of innovative ways.

Now, let's discuss about hand assessment methods. The following tactics are used to calculate hand strength. Enumeration methods can be used to compute the hand rank (HR) of a post-flop hand. The HR is calculated by comparing the hand to a random opponent's whole set of possible hands. Counting the number of times the hand wins, loses, or ties against this set yields the HR.

$$HR = \frac{wins + (ties/2)}{wins + ties + losses}$$

Consider player A's hole cards, which are T J, and the flop cards, which are 2 T K. Player A will win 899 times, tie 6 times, and lose 176 times out of 1081 possible opponent holdings, resulting in an HR of (899 + 6/2)/(899 + 6 + 176) = 0.834413.

The immediate hand rank/strength stated above is a measure of hand strength at the current moment in the hand, but it does not take future community cards into account.

The above-mentioned instantaneous hand rank/strength is a measure of hand strength at the current moment in the hand, but it ignores future communal cards.

When it comes to hand potential, the results of instantaneous hand strength and positive potential are combined to create effective hand strength (EHS). Positive potential suggests that you're more likely to start with a bad hand and work your way up to the best with future communal cards. Negative potential,

on the other hand, evaluates the chances of having a better hand but falling behind with subsequent cards.

$$EHS = HS + (1 - HS) * PositivePotential$$

By averaging the outcomes of all possible roll-out combinations, the Hand Strength is computed. In a 7-card game, potential can also be examined directly by first rolling out the remaining community cards and then enumerating all possible opponent holdings after all community cards have been rolled out.

Because the current method solely considers EHS (Effective Hand Strength) and Pot Odds, there are some flaws in the betting strategy. Pot odds are a numerical estimate of a player's return on investment that compares the investment required to stay in the hand vs the potential future winnings.

$$PotOdds = \frac{c}{p + c}$$

c is the amount to call, and p is the amount in the pot right now. The pot odds can be used to decide whether or not adding more chips to a pot is a good idea.

Now, here's a suggestion for a possible technological update: Assume that p is the size of the pot (money already in the pot) and b is the size of the bet we must place to stay in the game during a betting round.

Define d as:

$$d = EHS - (\frac{b}{b + p})$$

In this case, we might have naively utilised a deterministic boundary on d for Raise, Fold, and Call. However, in the case of Bluffing, such an approach might be exploited by the opponent, leaving us with no other option. As a result, it might be a viable method to betting strategy. However, there are some ways that can be used.

As we all know, Poker Modeling is a complex task that may be approached in two ways. One can play optimally, which is a more defensive approach as opposed to maximal play, which requires more aggression. This, in my opinion, is a superior approach since we can easily deceive our opponents and therefore this strategy can work as a go through technique against weak or average level players.

This approach, which is offered to determine starting weights, may now be used in opponent modelling. For starters, we can figure out how much each of the 1,081 potential opponent hands weighs. Assumes "reasonable" behaviour now appears to be susceptible to bluffing. Additionally, individual opponent history can be included to improve accuracy.

Where, (μ, representing the median hand) and variance (, for uncertainty) of the threshold needed for each player's observed action.

Figure 1: The above image describes the initial weighting process in simplified manner.

2 Conclusions and Future Work:

Although the changes to this modelling system were not comprehensive, it is instructive to see how significant improvements were gained with relatively few changes. Furthermore, identifying these features with an automated learning system rather than relying on the input of a human expert is considerably more fulfilling (and less effort!). While specialists' domain-specific knowledge is valuable, it is infamously difficult to integrate and retain in a high-performance game system.

The problem is far from solved, and we believe that a complete overhaul of the opponent modelling system is required. For example, the programme continues to underutilize the information provided by a showdown. Once the opponent's cards are known, the decisions made during the hand might reveal a lot. This can help us better understand how that player approaches the game and forecast future behaviour. While other components of poker algorithms may someday be perfected, this strategic aspect of the game will most likely remain a big difficulty for a long time.