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**CSCI 5512 Final Project Topic Proposal**

Problem Statement:

*What We Plan to Do:*

For our final project, we plan to create a system mimicking a game of poker with two players. One represents you, the player, and the other represents your opponent. The main goal is to build a “recommender agent” that advises you, the player, how to play against your opponent.

The game is standard poker where each player is dealt 5 cards from a shuffled deck and bets according to the perceived strength of their hand. One modification, however, is that the opponent player always bets first. So the opponent bets, then you bet, then both hands are laid down and a winner is determined based off standard poker rules. After this, the game ends. New games restart with both players having X amount of chips and a full deck of cards.

The opponent will be created to have a “propensity toward risk” parameter, which determines the likelihood of them betting a certain amount based on the strength of their given hand. To do this, we will need to come up with systems of measuring hand strength (which there is likely extensive research already done into, as we will look into in “Background References”) as well as a way of translating the “propensity toward risk” factor into actions based off the cards the opponent is dealt.

Once this is established, we will create a system for learning which samples a large amount of randomly generated games and the results--basically learning about the opponents actions to figure out an approximation of the strength of the opponent’s hand based off the amount of chips he is betting. With this information, we will program an agent that informs us, the other player, how to respond to the opponents move. There are three actions: fold, call, and raise. The agent will make recommendations as to which we should choose each game based off the opponent’s bet along with the strength of our own hand, using the learned information of the opponent’s typical behavior. Then we will analyze the results.

*Value of Doing it:*

This problem holds intellectual value as well as potentially practical value. The practical value is that it would be valuable in understanding how to win poker games based on characteristics of your opponent rather than just the cards displayed. Intellectually, however, this would help answer the question of how much a specific player and his skill at the game is relevant to winning poker, rather than simple chance of getting advantageous cards.

Background References:

* <http://webdocs.cs.ualberta.ca/~duane/publications/pdf/2000icai.pdf>
  + A look at ways to model a given opponent in a game of poker. This would be a useful reference to inform our understanding of how to create an opponent since it covers the complex ways to understand the “style” of a given player, something we need to come up with parameters for in order to inform our propensity of risk and other such factors.
* <https://www.researchgate.net/profile/Bjornar_Tessem/publication/229001385_A_case-based_learner_for_poker/links/546ca8ce0cf2b0bc8e539553.pdf>
  + This study also focuses on case-based reasoning to inform decisions in regards to poker, as opposed to basing decision making purely off facts and statistics. Likewise, it may help us come up with a way to model unique, complex players that will give us more interesting results to learn from and then teach our agent to suggest moves to counter.

Approximate Plan of Work:

(The following items could be split up between our team to varying extents)

* First, we will need to come up with the ways to measure A) strength of poker hands, and B) propensity to risk and how to translate that into bets based off the strength of a given hand.
* To start, we will also need to program a poker simulation using a deck of cards and two player and the rules defined above.
* After that, we will need to get our agent for the opponent to successfully play against us in the game. Once this is working, we will need to come up with a way to simulate a great number of games to generate a data set for us to sample from. Fortunately, since the opponent’s actions are never informed by ours, we only need to have this consist of the cards being dealt to the opponent, the strength of the hand being decided, and the opponent betting a certain amount based off that.
* From there, we come up with a learning algorithm that samples from this and figures out the approximate behavior of the opponent based off the bet amounts. This involves some machine learning most likely.
* After that, we program an agent that takes in the bet amounts of the opponent during a game, as well as our own hand, and uses the information to determine a course of action (call, raise, fold).
* Then we implement the agent in the game environment and play with it. To end, we need to come up with a way of assessing the results.
* Finally, we write the actual report including the code and results.