Report: Implementation of a Poker Agent

Introduction

In this report, I detail the process of implementing and evaluating different methods to develop a poker agent. I implemented and assessed three distinct methods for their performance and effectiveness in a simulated environment. I compare and discuss these methods based on their configurations, performance, and results.

Methods Tried

1. **First Method**:
    - **Description**: This method evaluates hand strength solely based on the player's hole cards. It considers the sum of card values, the presence of pairs, and whether the cards share the same suit.

      Code: https://codeshare.io/zl7ewr

2. **Second Method**:
    - **Description**: This method builds on the first by incorporating community cards into the hand strength evaluation.

      Code: https://codeshare.io/NKmYx9

3. **Third Method (Selected)**:
    - **Description**: This method enhances the second method with more sophisticated decision-making logic and random elements to simulate human unpredictability.

      Code: https://codeshare.io/XLBYxz

Configurations (Hyperparameters) Used

1. **First Method**:
    - **Hand Evaluation Based on Hole Cards**:
        - **Card Ranks**: Numerical values assigned to cards (e.g., 2-14 for 2-Ace).
        - **Pair Bonus**: Additional strength if the hole cards form a pair (+0.2).
        - **Suit Bonus**: Additional strength if the hole cards are of the same suit (+0.1).
2. **Second Method**:
    - **Hand Evaluation Including Community Cards**:
        - **Card Ranks**: Same as the first method.
        - **Community Cards Integration**: Strength adjustment based on the presence of community cards matching hole cards.
        - **Pair Bonus and Suit Bonus**: Same as the first method.
3. **Third Method**:

- **Enhanced Hand Evaluation**:
  - **Card Ranks**: Same as the previous methods.
  - **Community Cards Integration**: Advanced strength evaluation incorporating community cards.
  - **Pair Bonus and Suit Bonus**: Same as the previous methods.
- **Strategic Decision-Making Logic**:
  - **Action Selection**:
    - **Preflop**: High hand strength leads to aggressive actions (e.g., betting or raising), moderate strength to conservative actions (e.g., calling), and low strength to folding.
    - **Postflop (Flop, Turn, River)**: Hand strength thresholds determine the aggressiveness of actions. Random elements introduce variability.
  - **Opponent Actions Consideration**: Historical opponent actions influence decision-making to simulate human behavior.
- **Random Elements**:
  - **Action Variability**: Randomly chosen actions to prevent predictability and simulate human-like play.

Comparison of Methods

Feature	First Method	Second Method	Third Method
Hand Evaluation	Player's hole cards only	Player's hole cards + community cards	Player's hole cards + community cards with strategic adjustments
Consideration of Community Cards	**No**	**Yes**	**Yes**
Consideration of Opponent Actions	**No**	**Partial**	**Yes, more robust**
Randomness in Decision Making	**No**	**Partial**	**Yes**
Complexity	**Low**	**Medium**	**High**
Performance	**Low**	**Modest**	**Medium**
Advantages	Simplicity and speed	More comprehensive hand evaluation	Robust hand evaluation and strategic decision-making logic
Disadvantages	Does not consider the table context	Limited consideration of opponent actions	Increased complexity and need for fine-tuning

Discussion and Conclusion

The first method is the simplest, evaluating hand strength based only on the player's hole cards. Although quick and easy to calculate, its performance is limited as it does not account for community cards or opponent actions.
The second method improves performance by incorporating community cards into the hand strength evaluation. This provides a more complete view of hand strength, though it still has limitations in considering opponent actions and game dynamics.
The third method, which I ultimately selected, combines community card evaluation with more robust and random decision-making logic. This approach balances complexity and performance, offering a strong foundation for future enhancements. The strategic decision-making logic and inclusion of randomness allow the poker agent to better simulate unpredictable human behavior, resulting in superior performance.

Selected Method

The method I chose for the final implementation of the poker agent is the third method. Its combination of robust hand evaluation, inclusion of community cards, and strategic and random decision-making logic proved to be the most effective and adaptable in the simulation environment.