BLACKJACK

MONTE CARLO

BY: Universe 7

MOTIVATION

- To compare the effectiveness of 5 different Monte Carlo policies in the context of Blackjack.
- To gain insights on optimal strategies for playing under different game rules and constraints.
- To assess the impact of different game conditions, such as the infinite deck and single deck versions, with different policies.

PROBLEM STATEMENT

- ★ Evaluate five distinct policies of Blackjack.
- ★ Consider two game scenarios: infinite deck and single deck.
- ★ Analyze the impact of policy variations on strategy success rate.
- ★ Derive insights into optimal decision-making and gameplay approaches.

APPROACH

1.

Import required libraries and define functions to draw cards from infinite and single decks.

2.

Create functions to check if hand has an Ace, calculate hand values, and determine soft hand values.

3.

Define the three given policies and two additional policies for comparison.

4.

Create a function to generate a single deck and infinite deck that draws cards.

APPROACH

5.

Define a function to simulate Blackjack gameplay for a given policy and deck type.

6.

Implement a Monte Carlo function, which takes a policy, deck type, and number of simulations as input.

7.

Initialize the count of dealer wins, player wins, and draws for the Monte Carlo simulations.

8.

Run the Monte Carlo simulations for each policy and deck type, updating the count of wins and draws.

APPROACH

9.

Calculate the player winning probability for each policy and deck type.

10.

Print the player winning probability, dealer wins, player wins, and draws for each policy and deck type.

11.

Repeat over all policies and deck types, executing steps 8-10 for each combination.

12.

Analyze the results to understand the effectiveness of different policies under different game conditions.

TESTS

Policy Comparison

We tested five distinct Blackjack policies, ranging from simple to complex, to assess their performance in terms of winning probability and game outcomes.

Deck Type Variations

We evaluated each policy with a Infinite Deck and Single Deck types to analyze the impact of deck type on policy performance.

Simulations

We used the Monte Carlo method, running 100,000 simulations for each policy and deck type combination, to ensure accurate results.

Key Findings

Our analysis showed that complex policies tend to perform better

RESULTS

Policy 1: if your hand ≥ 17, stick. Else hit.

```
Infinite Deck - Policy 1: Player Winning Probability = 41.485%
Dealer wins: 48703, Player wins: 41485, Draws: 9812

Single Deck - Policy 1: Player Winning Probability = 41.458%
Dealer wins: 48811, Player wins: 41458, Draws: 9731
```

RESULTS

Policy 2: if your hand ≥ 17 and is hard, stick. Else hit unless your hand = 21.

```
Infinite Deck - Policy 2: Player Winning Probability = 34.738%
Dealer wins: 56677, Player wins: 34738, Draws: 8585

Single Deck - Policy 2: Player Winning Probability = 35.004000000000005%
Dealer wins: 56550, Player wins: 35004, Draws: 8446
```

RESULTS

Policy 3: Always Stick.

```
Infinite Deck - Policy 3: Player Winning Probability = 38.679%
Dealer wins: 56800, Player wins: 38679, Draws: 4521

Single Deck - Policy 3: Player Winning Probability = 38.896%
Dealer wins: 56622, Player wins: 38896, Draws: 4482
```

RESULTS

Policy 4: Basic Hand Chart

```
Infinite Deck - Policy 4: Player Winning Probability = 42.99%
Dealer wins: 48714, Player wins: 42990, Draws: 8296

Single Deck - Policy 4: Player Winning Probability = 43.38%
Dealer wins: 48321, Player wins: 43380, Draws: 8299
```

	Dealer Upcard									
Hard Total	2	3	4	5	6	7	8	9	10	A
5-7	H	H	H	H	H	H	H	H	H	H
8	H	H	H	H	H	H	H	H	H	H
9	H	H	H	H	H	H	H	H	H	H
10	H	H	H	H	H	H	H	H	H	H
11	H	H	H	H	H	H	H	H	H	H
12	S	S	S	S	S	H	H	H	H	H
13	S	S	S	S	S	H	H	H	H	H
14	S	S	S	S	S	H	H	H	H	H
15	S	S	S	S	S	H	H	H	H	H
16	S	S	S	S	S	H	H	H	H	H
17	S	S	S	S	S	S	S	S	S	S

RESULTS

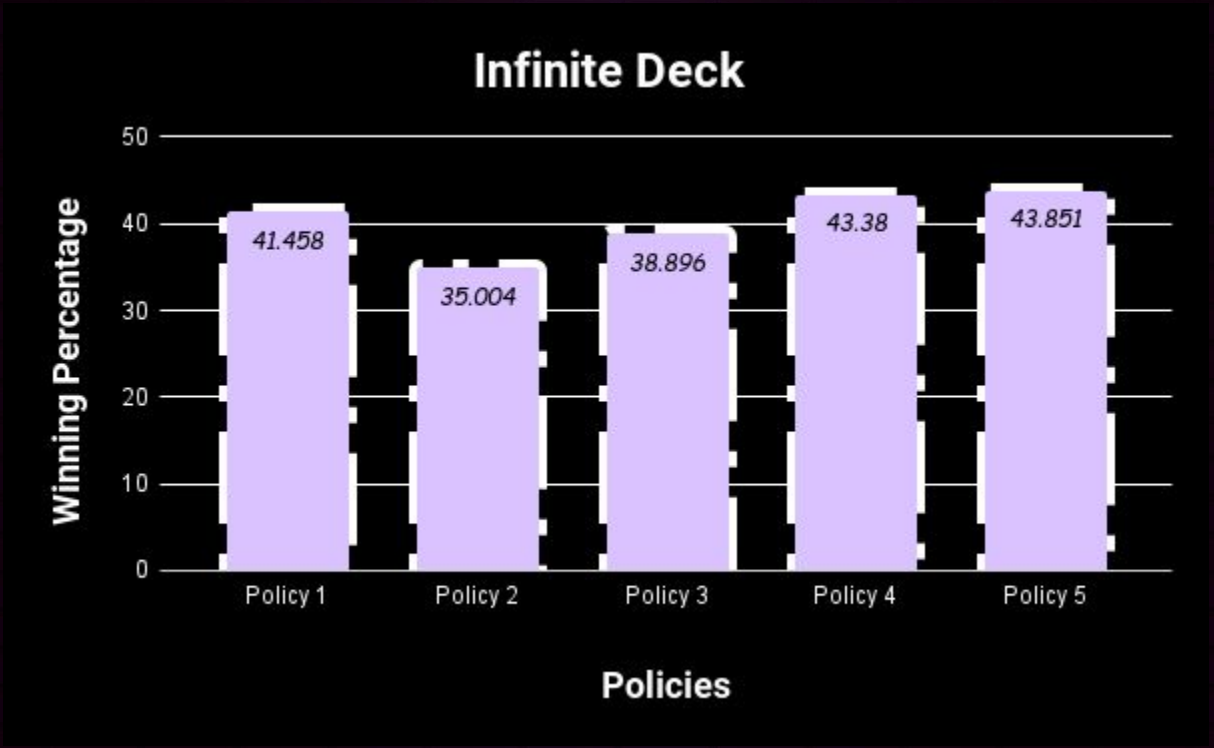
Policy 5: Basic Hand Chart (w/Soft Logic)

```
Infinite Deck - Policy 5: Player Winning Probability = 43.26%
Dealer wins: 48239, Player wins: 43260, Draws: 8501

Single Deck - Policy 5: Player Winning Probability = 43.851%
Dealer wins: 47914, Player wins: 43851, Draws: 8235
```

	Dealer Upcard									
Hard Total	2	3	4	5	6	7	8	9	10	A
5-7	H	H	H	H	H	H	H	H	H	H
8	H	H	H	H	H	H	H	H	H	H
9	H	H	H	H	H	H	H	H	H	H
10	H	H	H	H	H	H	H	H	H	H
11	H	H	H	H	H	H	H	H	H	H
12	S	S	S	S	S	H	H	H	H	H
13	S	S	S	S	S	H	H	H	H	H
14	S	S	S	S	S	H	H	H	H	H
15	S	S	S	S	S	H	H	H	H	H
16	S	S	S	S	S	H	H	H	H	H
17	S	S	S	S	S	S	S	S	S	S
Soft Total	2	3	4	5	6	7	8	9	10	A
A,2	H	H	H	H	H	H	H	H	H	H
A,3	H	H	H	H	H	H	H	H	H	H
A,4	H	H	H	H	H	H	H	H	H	H
A,5	H	H	H	H	H	H	H	H	H	H
A,6	H	H	H	H	H	H	H	H	H	H
A,7	S	S	S	S	S	S	S	H	H	H
A,8	S	S	S	S	S	S	S	S	S	S
A,9	S	S	S	S	S	S	S	S	S	S

Policy Comparisons



CONCLUSION

While our findings provide valuable insights, further experiments and optimization of policies could lead to even better results, enhancing the players' understanding of the game and their decision-making process.

THANKS!

FOR PLAYING