

# Team:

CSCI 154 Simulation

Project: Monte Carlo Blackjack

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# Motivation

- Blackjack -> Fun
- Competitive -> not lose
- Win some money
- Best strategy

# Rules of the game

Face cards = 10 points

Ace = 11 or 1 point

Win -> hand  $\leq 21$

Lose -> hand  $> 21$  or hand  $<$  dealer

# Problem Statement

## **The five policies that we simulated:**

- Policy 1: If your hand  $\geq 17$ , stick. Else hit.
- Policy 2: If your hand  $\geq 17$  and is hard, stick. Else hit unless your hand =21.
- Policy 3: Always stick.
- Policy 4: Hit once.
- Policy 5: If your hand  $>15$ , stick. Else hit.

## **All the policies were simulated 2 versions of the game**

- Infinite deck: On every run a card is drawn with equal probability.
- Single deck: One deck of cards is used. The deck is reshuffled after every game.

# Approach

- The game was simulated in python.
- Data visualization was done with matplotlib.
- Did different number of iterations for each policy.
- We removed the card after it is dealt for single deck.
- We did not remove the card after it is dealt so every card has  $1/52$  chance.

# Results

- We done the simulation for each policies and different versions of the game with 1000, 10000, and 100000 iterations.
- The data shows that the results are similar for each policy on different iterations and different version of the game.

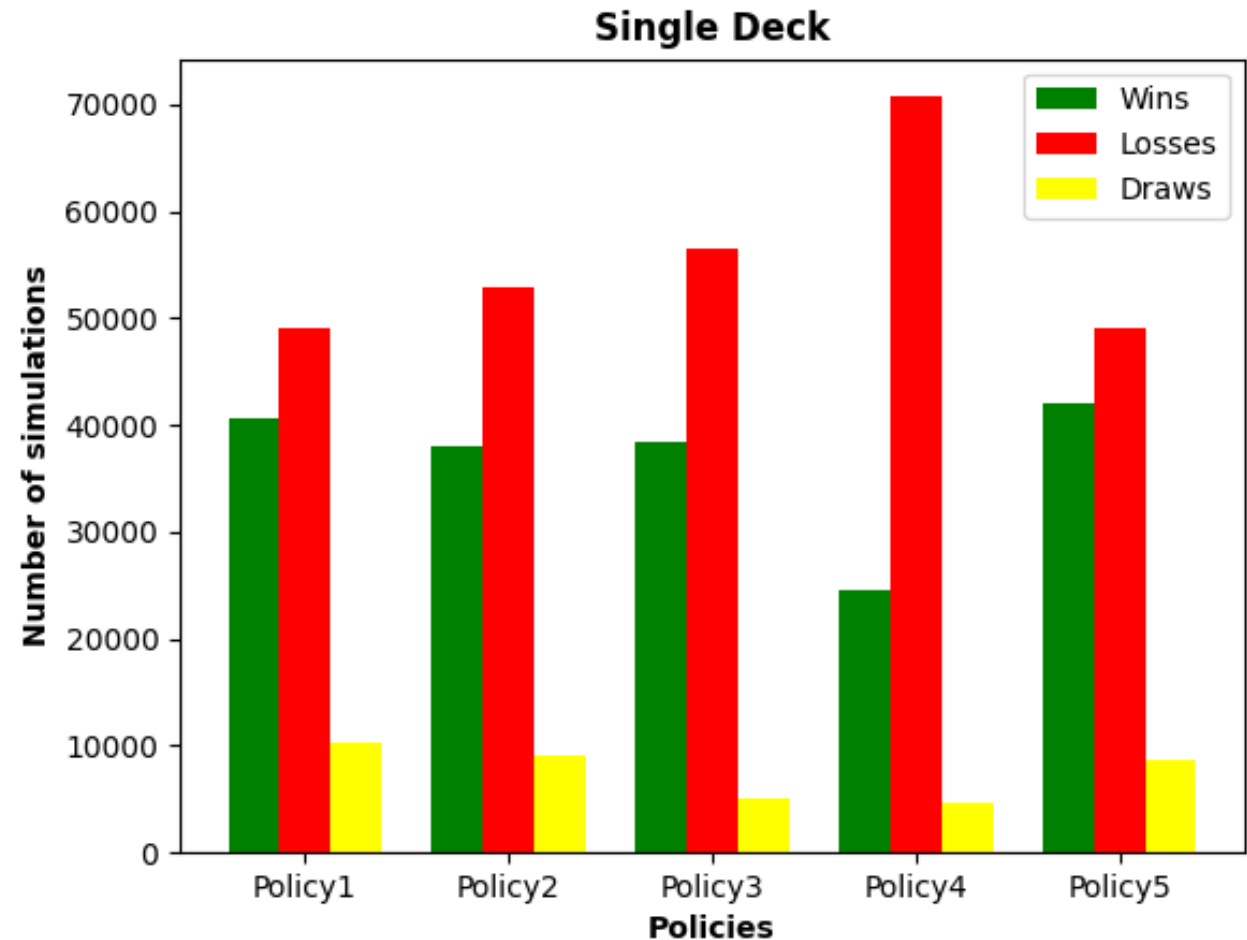
```
#single deck 100000
wins = [40678, 37953, 38477, 24559, 42102]
losses = [49073, 52921, 56534, 70755, 49116]
draws = [10249, 9126, 4989, 4686, 8782]
#infinite deck 100000
wins = [40689, 37903, 38041, 32958, 41849]
losses = [48784, 52649, 56683, 63882, 49235]
draws = [10527, 9448, 5276, 3660, 8916]
```

```
#1000 iterations infinite deck
losses = [487, 525, 567, 740, 495]
draws = [101, 98, 59, 57, 98]
wins = [412, 377, 374, 203, 407]
#1000single deck
losses = [517, 539, 573, 726, 465]
draws = [118, 81, 43, 44, 84]
wins = [365, 380, 384, 230, 451]
```

```
#10000 iterations infinite deck
losses = [4836, 5189, 5696, 7127, 4931]
draws = [1073, 982, 529, 470, 900]
wins = [4091, 3829, 3775, 2403, 4169]
#10000 single deck
losses = [4821, 5191, 5735, 7042, 4965]
draws = [1031, 915, 466, 420, 848]
wins = [4148, 3894, 3799, 2538, 4187]
```

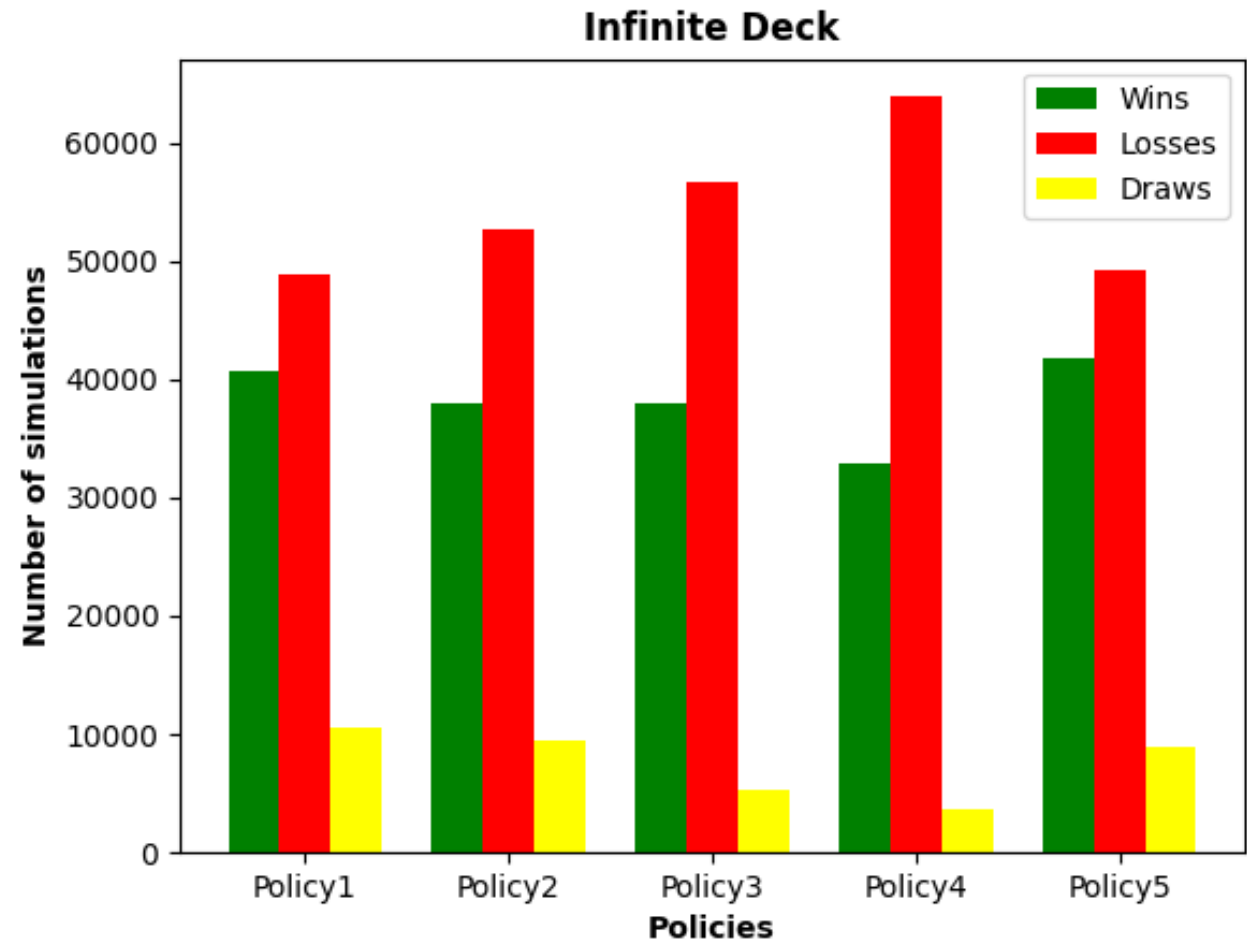
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# Conclusion

- The house will always have the upper hand.
- Single deck or infinite deck did not make much of difference.
- Policy 5 has higher chance of winning compared to other policies.
- If we to do something differently, we would spend more time on we want to code it.