



BLACKJACK

Carlos Mercado, Edgar Renteria, Jordan Nicholls,
Maria Guimaraes-Diniz-Tomaz

MOTIVATION

- ◆ Blackjack is a very popular game
- ◆ Monte Carlo Concept simulation provides a powerful tool to optimize strategies
- ◆ Powerful for understanding of the concept of probability
- ◆ The movie “21”.



Monte Carlo Methods

- Monte Carlo (MC) methods do not require complete information about the environment.
- Use of experience —sequences of states, actions and gains from interacting with the environment or from simulations
-



Background and Rules



GOAL: The goal of the game is to obtain cards whose sum of their numbers is as close to 21 as possible, but without exceeding this value.

DECK TYPES:

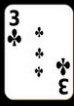
Finite deck of **52** playing cards (if card drawn cards total decreases)

Infinite deck (Deck never decreases)

CARD VALUES:



2



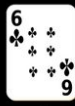
3



4



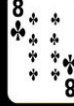
5



6



7



8



9



10



10



10



10



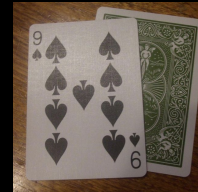
1/11

Banking game players: **PLAYER** and **DEALER**

PLAYER: start with a hand with two up cards.



DEALER: start with a hand with two cards (up/down).



KEYS:

- **HIT** (draw a card from the deck)
- **STICK** (stop drawing)
- **BUST** (If the sum of the values exceeds 21, the dealer wins regardless of their hand)
- **SOFT** (any hand with an ACE except Blackjack)
- **BLACKJACK** (If the first drawn two cards give a hand value of 21: win)



Policies



- Policy 1: if your hand ≥ 17 , stick. Else hit.
- Policy 2: if your hand ≥ 17 and is hard, stick. Else hit unless your hand = 21.
- Policy 3: Always stick
- Policy 4: Hand < 21 , Hit
- Policy 5: Hit until face card.

Blackjack Monte Carlo Implementation



1. Give the dealer two cards, and give the player two cards.
2. Add up both the dealer and the player cards.
 - a. Check for blackjacks for player and dealer
3. For given policy, add cards, or stay.
4. After staying, append cards to dealer hand until their hand sums to 17 or greater.
5. If dealer is over 21. Bust, dealer loses.
6. Winner is the person who has the greatest sum of cards at this point.

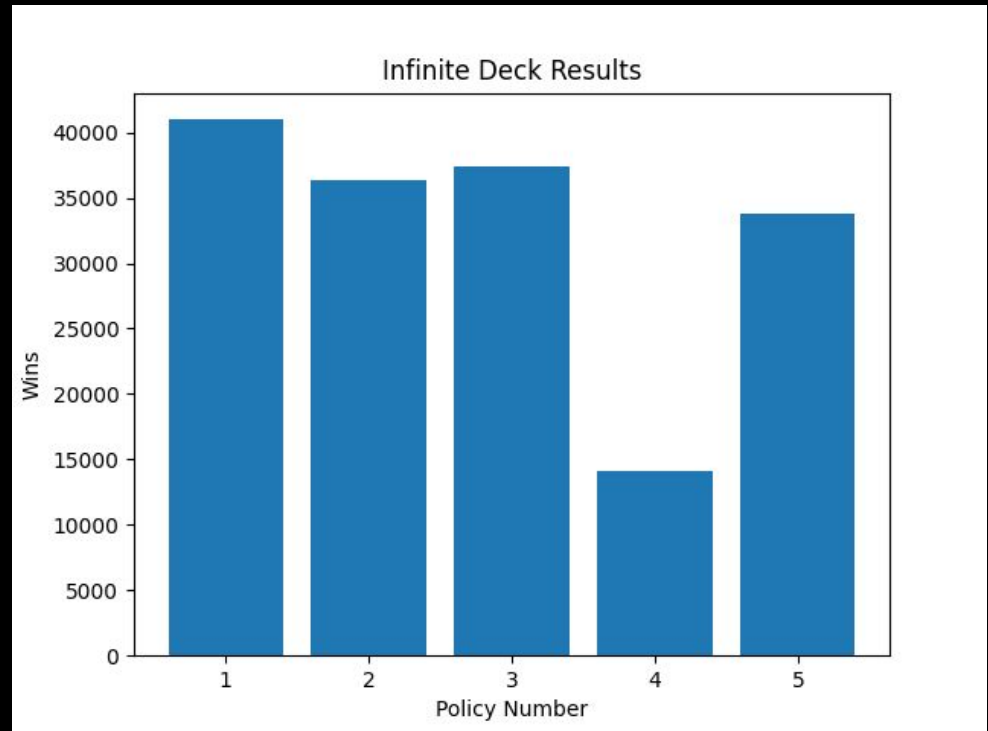
Repeat for multiple iterations.

Results/Discussion



From the results we can see that policy 1 (stay if hand ≥ 17 else hit), is the best approach of the 5 for infinite decks.

The worst approach is not surprisingly approach 4 (hit until 21).

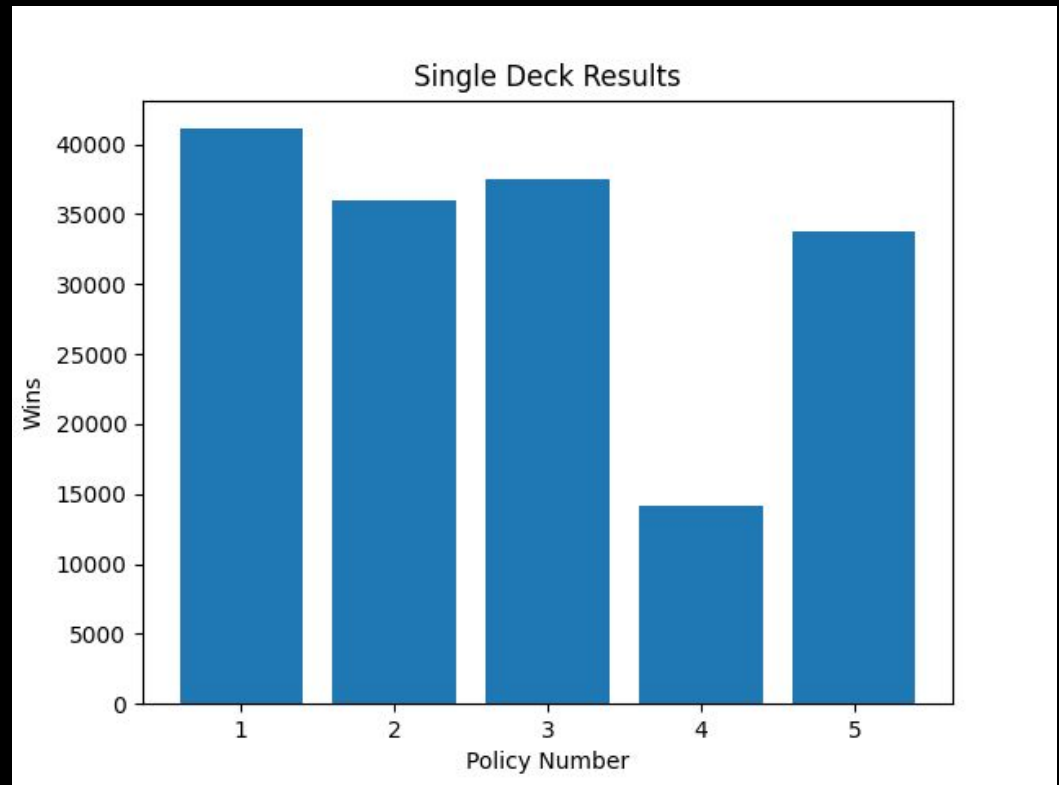


Results/Discussion



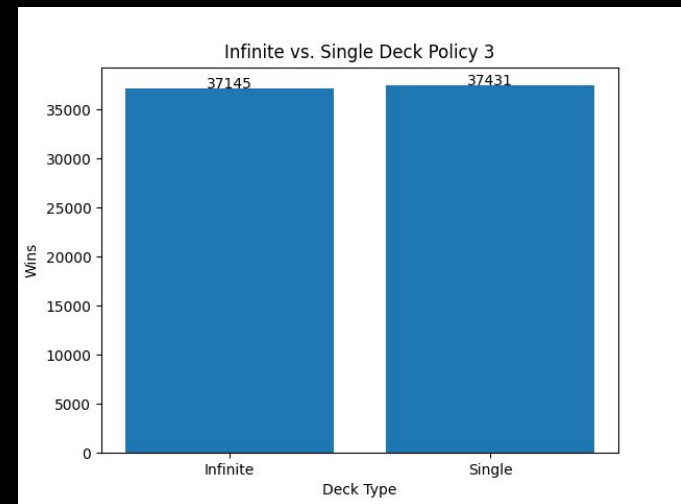
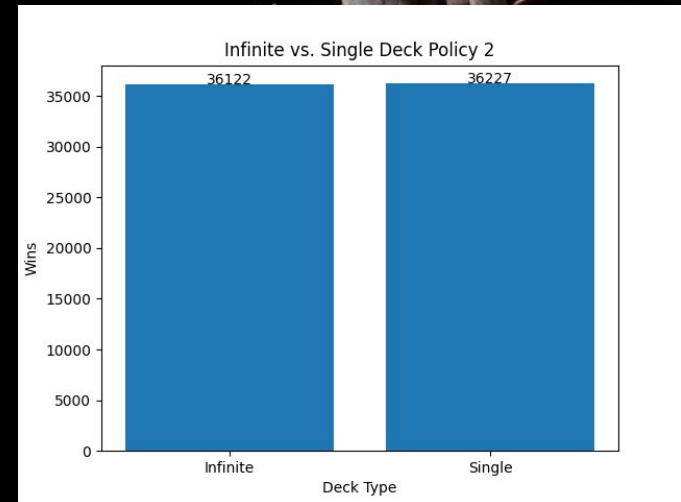
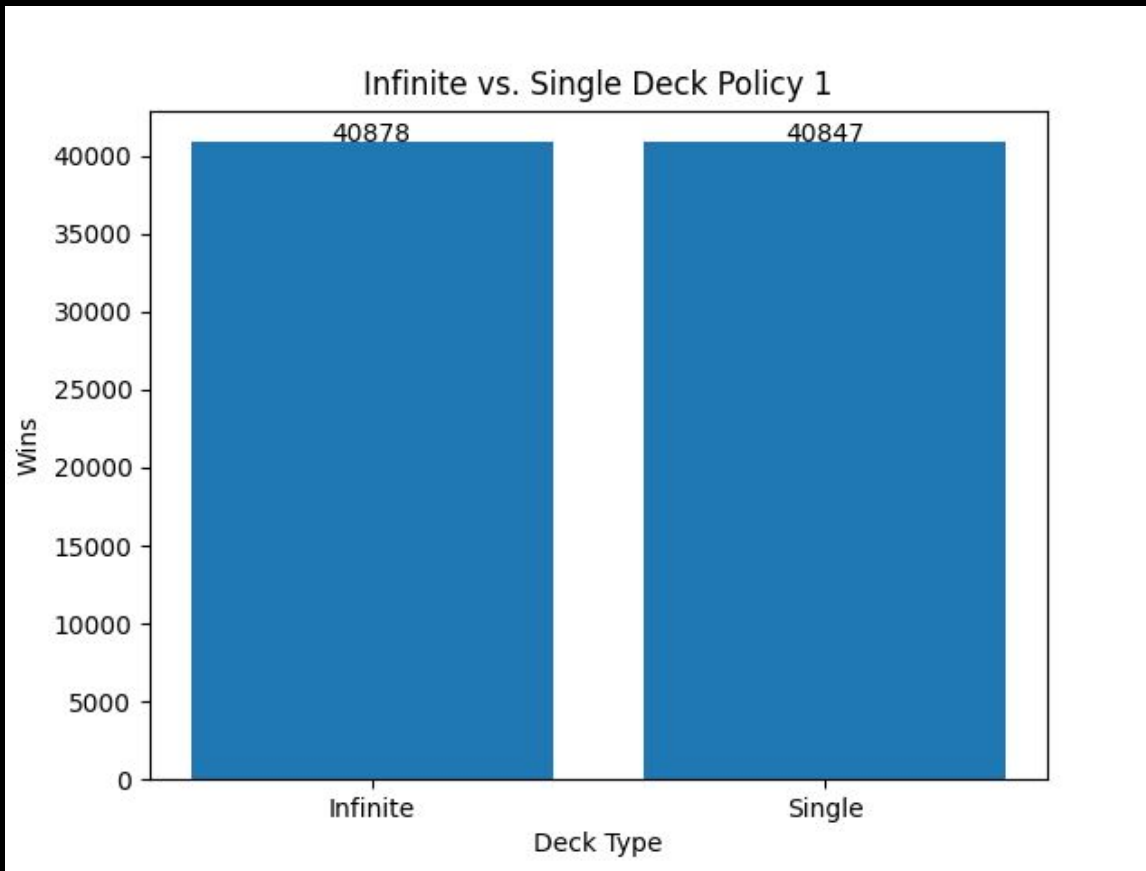
Just like the infinite deck approach, policy number one is the best of the five.

Worst approach is still policy 4.



Results/Discussion (Inf vs. Single Deck)

Very small differences in wins in the different deck approaches.



Results/Discussion (Inf vs. Single Deck)

