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GAME NIGHT EDITION

BLACK JACK

GROUP 20

TITLE:
SIMULATION OF BLACK JACK GAMES TO FIND THE MOST OPTIMAL STRATEGY

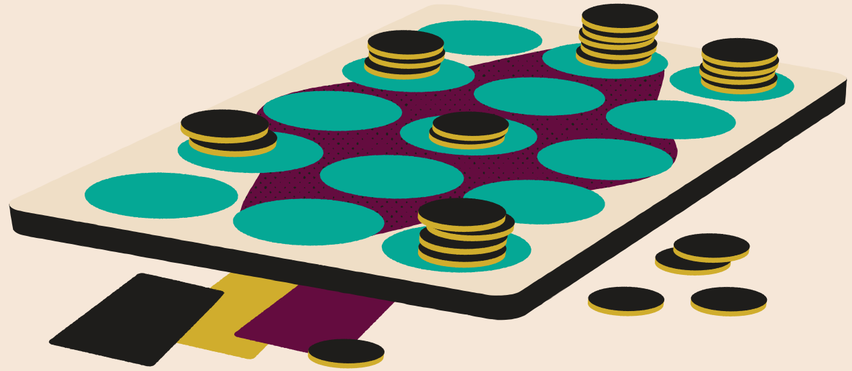
advisory: this is just a game simulation and does not depict real life.

MOTIVATION

WHICH PROCESSES WILL BE MODELLED AND WHY THIS TOPIC IS IMPORTANT?

MOTIVATION

- Explore **different** blackjack **strategies** and **‘best practices’**
- Crucial to find **the optimal strategy** to increase probability of winning



BACKGROUND

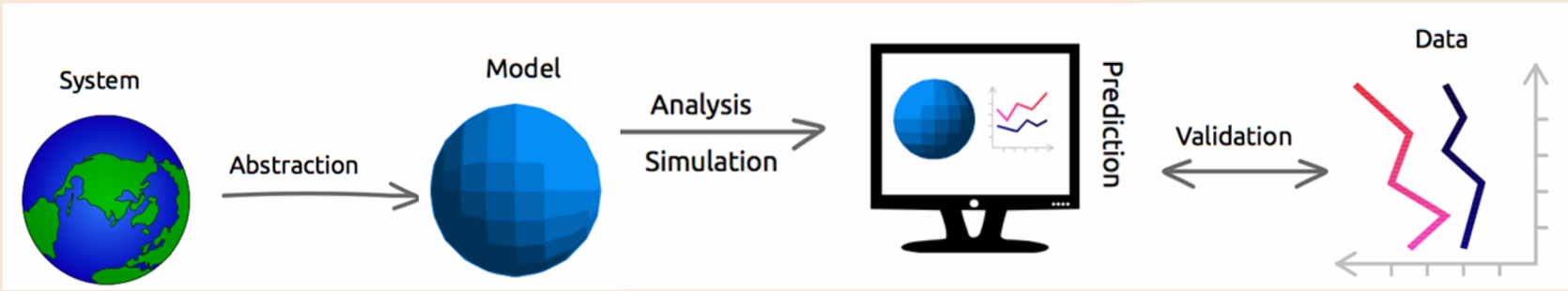
What are the existing modelling strategies concerning this topic?

CONTENTS

How do we plan to conduct the modelling and simulation tasks?

CONTENTS

1. DEFINE GAME & HOUSE RULES
2. DEVELOP PLAYER MODELS
3. SIMULATE BLACKJACK ROUNDS
4. ANALYSE & COMPARE PERFORMANCE
5. DRAW CONCLUSIONS & NEXT STEPS



1. DEFINE GAME & HOUSE RULES

1

All of the players to place their bets

1

2

All of the players to be given two cards faced down

2

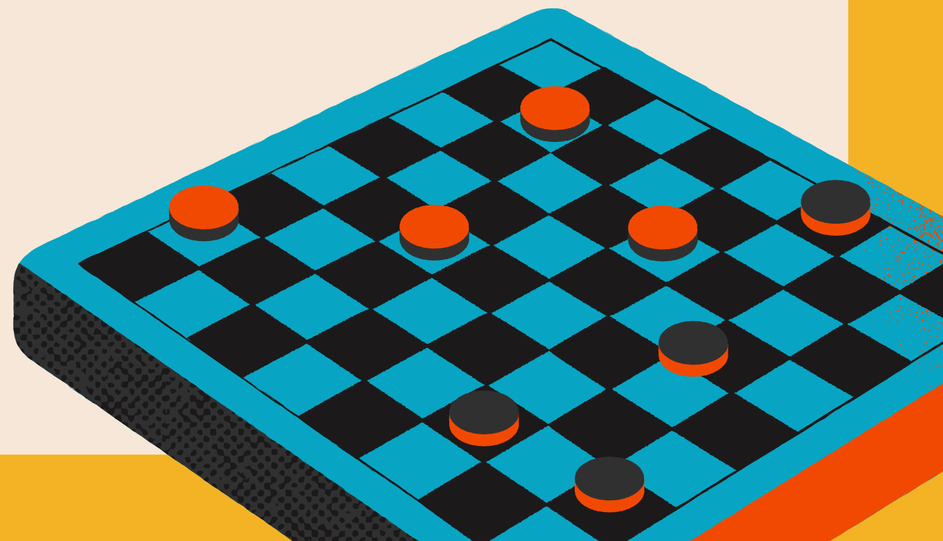
3

Have a higher hand value than the dealer without going over 21

3

2. DEVELOP PLAYER MODELS

6 Player (Strategy) Models



1

The average rational player

1

2

The overly conservative

2

3

The overly Aggressive

3

4

The Card Counter

4

5

The Betting God ‘赌神’

5

6

The Monte Carlo

9

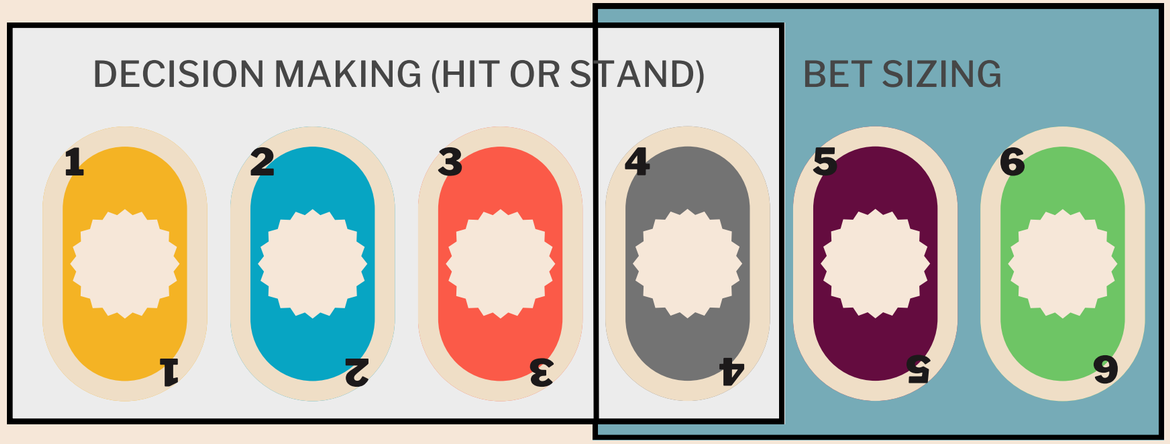
THE PLAYER MODELS

Player Profile	Strategy Type	Decision Making (hit or stand)	Bet Sizing
1. Average Rational Player	Basic Strategy	✅ Yes	❌ No
2. The Overly Conservative	Heuristic	✅ Yes	❌ No
3. The Overly Aggressive	Heuristic	✅ Yes	❌ No
4. The Card Counter	Basic Strategy + Adjustments from Count	✅ Yes	✅ Yes
5. The Betting God	Basic Strategy + Martingale Strategy	❌ No	✅ Yes (Doubles after loss)
6. The Monte Carlo	Monte Carlo (Decision-Making Focus)	✅ Yes	❌ No
(MISC) The Monte Carlo	*Monte Carlo (Bet Sizing Focus)*	❌ *No*	✅ *Yes*

Average Rational Player is the control of the simulation

3. SIMULATE BLACKJACK ROUNDS

For **each player profile**:
    For **each round in 300 games**:
    # Decision Making (hit or stand)
        if player **profile >= 1 and <= 3**:
            constant **bet amount at $100**
            simulate each of their strategies
    # Betting Strategy
        if player **profile == 4**:
            implement **high-low counting system**
            implement **scaling betting logic**
            simulate strategy 4
        if player **profile == 5**:
            implement **double bet after loss**
            implement **basic strategy for player 5's decision making** (hit or stand)
            simulate strategy 5
        if player **profile == 6**:
            implement **First- Visit Monte Carlo**
            constant **bet amount at $100**
            simulate strategy 6



4. ANALYSE & COMPARE PERFORMANCE

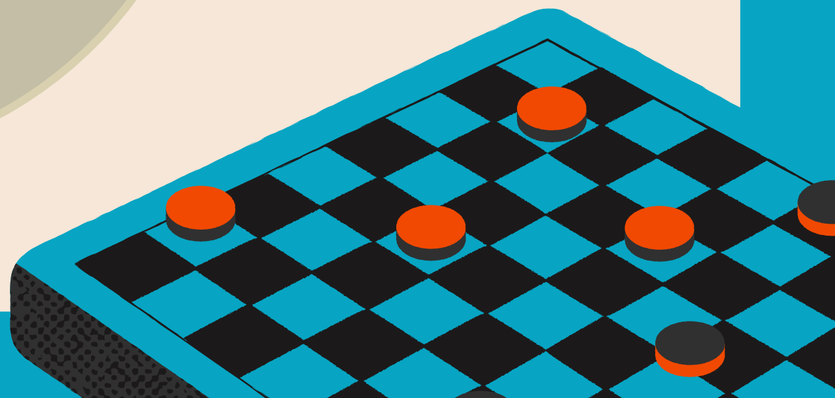
- Performance Metrics of each player strategy

Winning percentage against House

Average profit per round

Long-term return (total profit/loss after X rounds)

5. DRAW CONCLUSIONS & NEXT STEPS



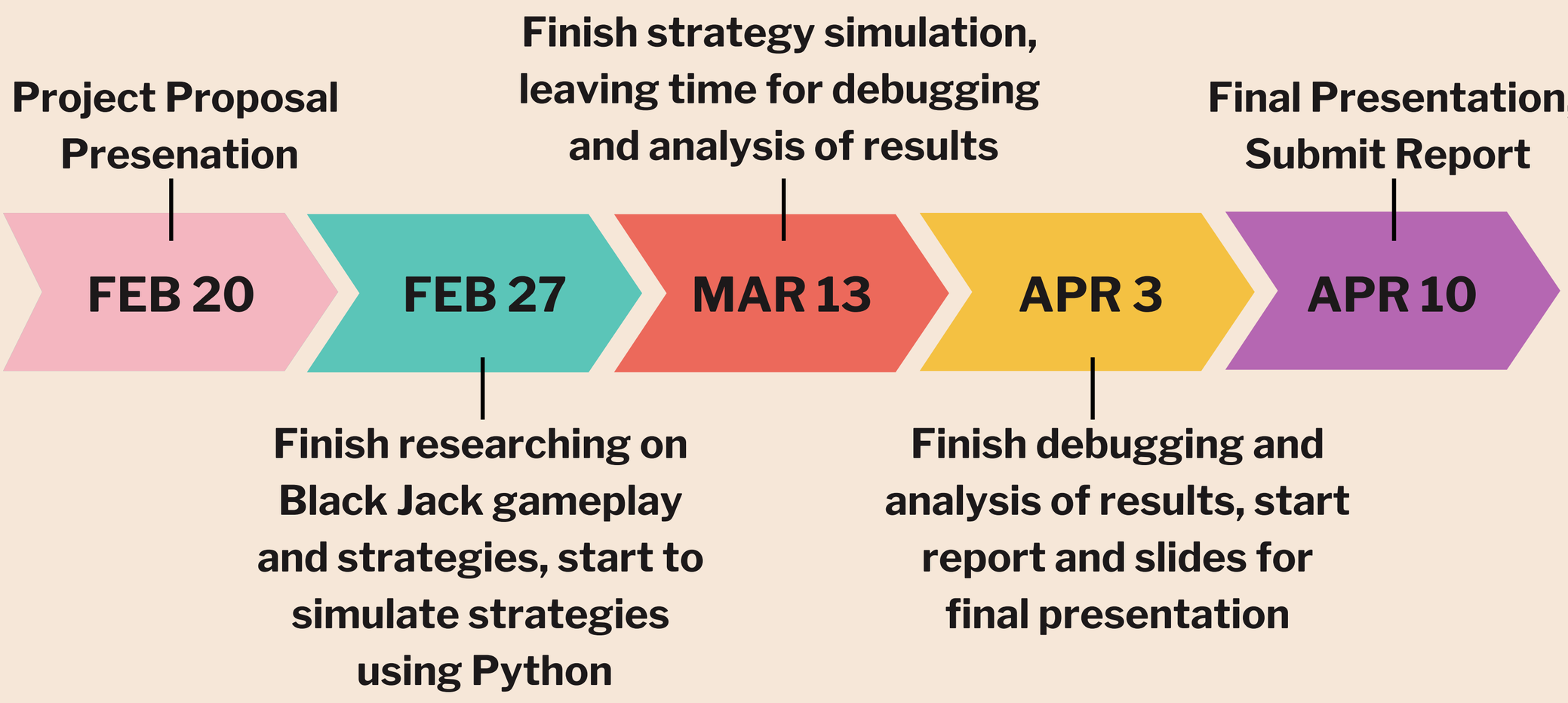
5. DRAW CONCLUSIONS & NEXT STEPS

Cheater!

PROJECT TIMELINE

WHAT IS THE TIME SCHEDULE TO MAKE PROGRESS

PROJECT TIMELINE



TEAMWORK

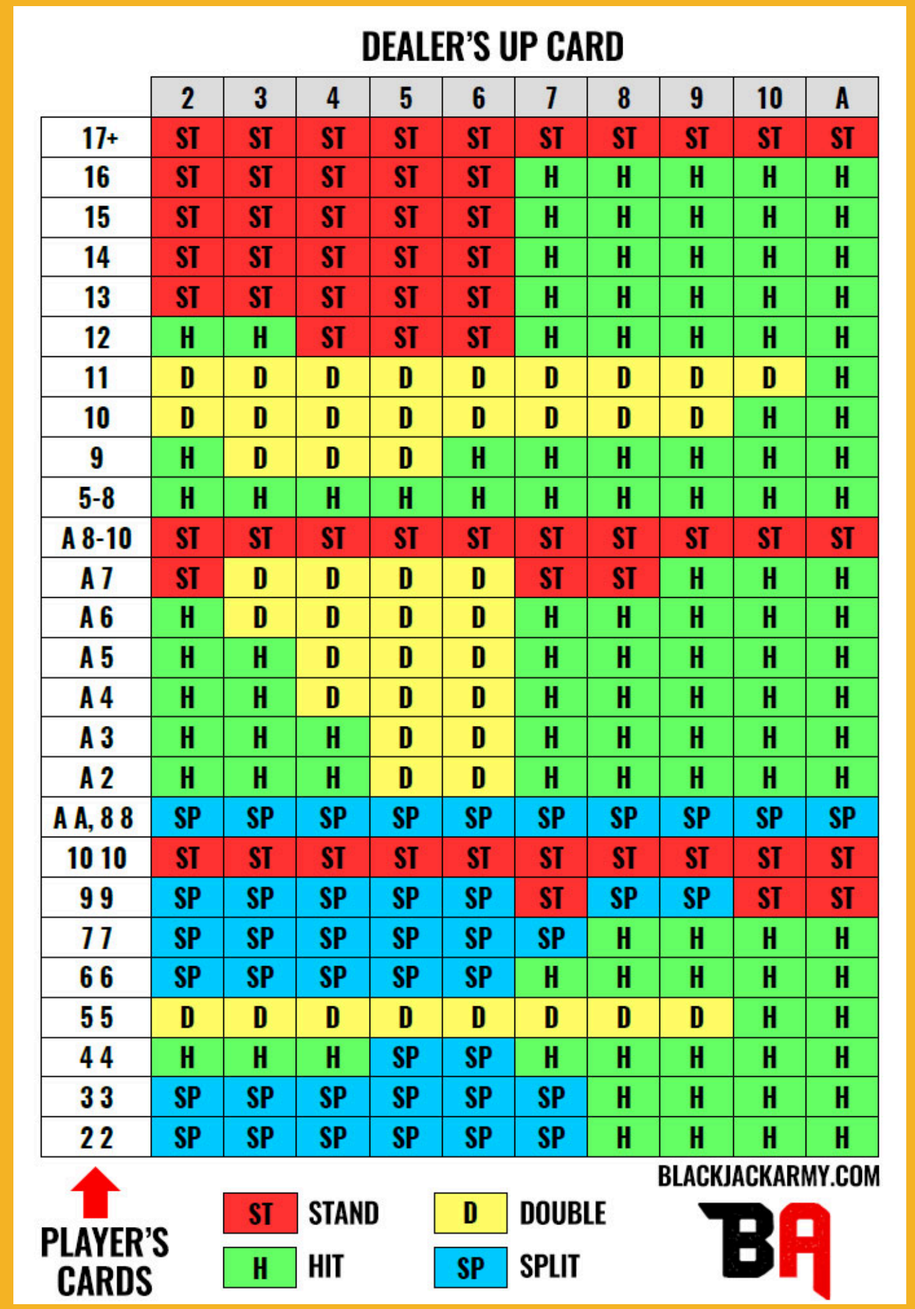
HOW EACH GROUP MEMBER CONTRIBUTE TO THE PROJECT

TEAMWORK

- Each member will be assigned **2 strategies** to research on and simulate
- Each member will then complete the report **and slides based on their respective strategies**
- The team will **work together** in terms of debugging, analysis of outcome, writing of report, as well as presentation rehearsals.

APPENDIX

Basic strategy



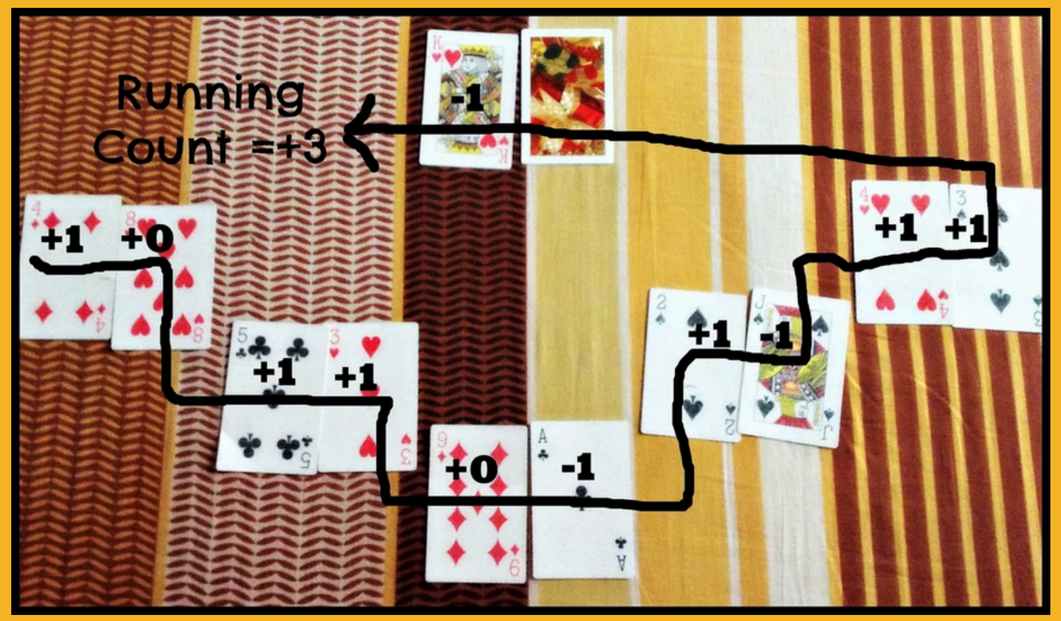
APPENDIX

Card Counting strategy

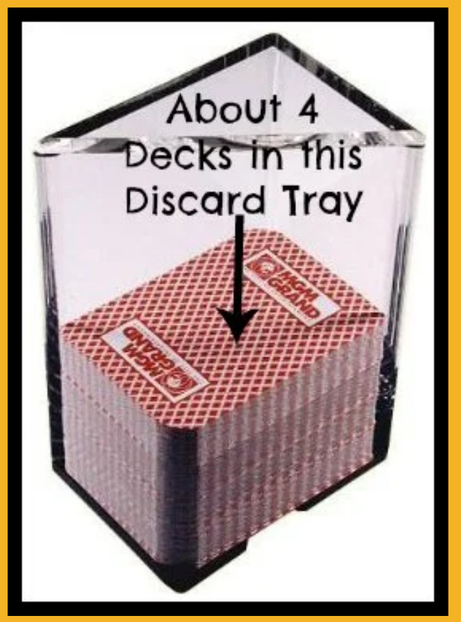
First, before you start play, you have to determine your betting unit. Your betting unit should be 1/1000 of your total bankroll.

Step 1:
The Hi-Lo Strategy

Step 2:
Keep tabs on Running Count



Step 3:
Find True Count



Step 4:
Adjust Betting Unit

Raise or lower your unit as your bankroll changes. By constantly adjusting your betting unit,you will never go broke,and your bankroll will increase faster in the long run.

APPENDIX

Monte Carlo Model Choice

In the context of Blackjack, while we can implement Every-visit MC, it is not needed, as it is not possible for the player to visit the same state twice in a single episode

Method	Updates State-Action Values	Efficiency	Bias Risk
First Visit Monte Carlo	Only the first time a state-action pair appears per episode	✅ More efficient	✅ Less biased
Every Visit Monte Carlo	Every time a state-action pair appears per episode	❌ Slower, higher memory use	❌ Can overvalue frequently visited states

Initialize:

$\pi \leftarrow$ policy to be evaluated

$V \leftarrow$ an arbitrary state-value function

$Returns(s) \leftarrow$ an empty list, for all $s \in \mathcal{S}$

Repeat forever:

Generate an episode using π

For each state s appearing in the episode:

$G \leftarrow$ return following the first occurrence of s

Append G to $Returns(s)$

$V(s) \leftarrow \text{average}(Returns(s))$

Pseudo code for the First-Visit Monte Carlo method

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THANK YOU FOR LISTENING!