

# **MDP: Student Housing**

# What is Markov Decision Process?

A stochastic mathematical model for decision-making in uncertain environments.

## Key Components of MDP?

- States ( $S$ ): Different conditions within the environment.
- Actions ( $A$ ): Choices available to influence state transitions.
- Transition Probabilities  $P(s' | s, a)$ : Likelihood of moving to state  $s'$  from  $s$  after action  $a$ .
- Reward Function  $R(s, a, s')$ : Rewards or penalties received after transitions.

## Purpose

To strategize for the best outcomes in variable scenarios by optimizing rewards over time.

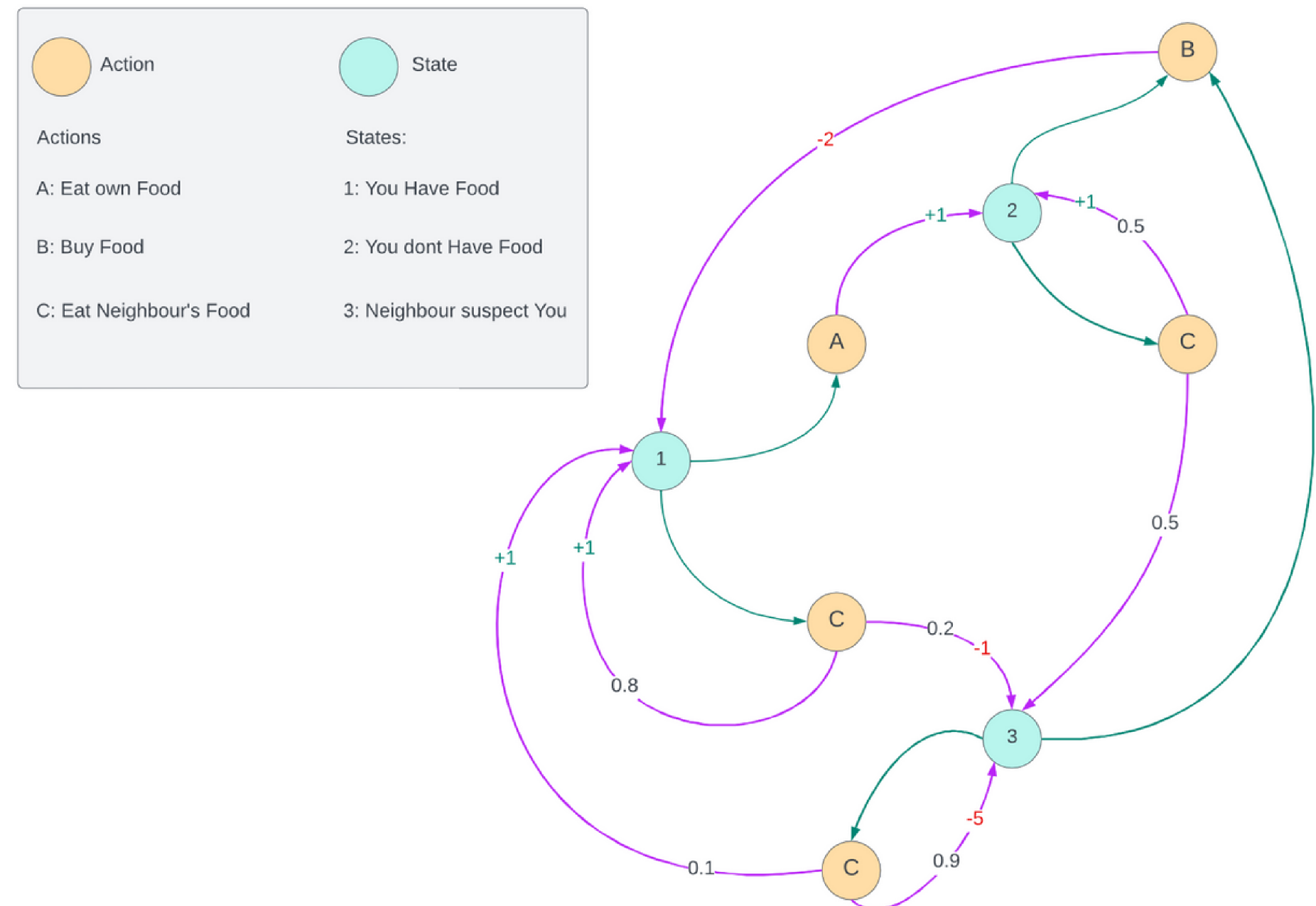
To find a policy ( $\pi$ ), mapping states to actions that maximize the expected cumulative reward, calculated as

$$E\left[\sum_{t=0}^{\infty} \gamma^t R(S_t, A_t, S_{t+1}, )\right]$$

# This model designs a scenario revolving around the management of food and interactions with a neighbour in Student Housing.

## States

- **You Have Food:** This state represents the scenario where the individual has food to consume.
- **You Don't Have Food:** This state represents case where the individual has run out of food.
- **Neighbour Suspects You:** This state represents case where neighbour suspect you stealing his food.



## Actions

- Eat Own Food: Consume available food.
- Buy Food: Buying food.
- Take Neighbour Food: Attempting to take food from the neighbor.

## Transitions

- From You Have Food:
  - Eat Own Food always result in "You Don't Have Food" with reward +1.
  - Take Neighbour Food has a 20% chance of resulting in "Neighbour Suspects You" with reward -1 and an 80% chance of resulting in "You Have Food" with reward +1.
- From You Don't Have Food:
  - Buy Food always results in "You Have Food" with reward -2.
  - Take Neighbour Food has a 50% chance of resulting in "Neighbour Suspects You" with reward -1 and a 50% chance of remaining in "You Have Food" with reward +1.
- From Neighbor Suspects You:
  - Buy Food transitions the individual back to "You Have Food" with reward -2.
  - Take Neighbour Food has a 90% chance of resulting in "Neighbour Suspects You" state with reward -5 and a 10% chance of resulting in "You Have Food" with reward +1.

# Conclusion

This MDP for Student Housing provides a clear model for predicting the best strategy in managing food resources and interactions with neighbors. The model defines possible states and actions, making it possible to evaluate the outcomes of various decisions under uncertainty and to strategize effectively for optimal results in a shared living environment.