
Isha Rani
Data & AI Leader
@isharanimicrosoftleader

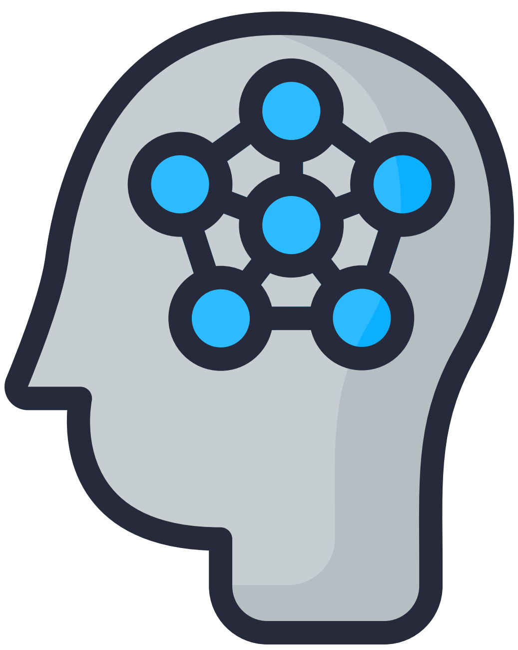
Save for later

Reinforcement Learning

> This document includes notes on Reinforcement Learning.

Introduction to Reinforcement Learning

Reinforcement Learning (RL) is like teaching a machine to make decisions by trying things out and seeing what works best. It's all about getting rewards for good choices. Unlike other types of learning where the machine is given all the answers, in RL, the machine figures out what to do through trial and error. It's like a self-taught system that learns by doing and getting feedback. RL is handy for machines that need to make lots of small decisions without human help. It's like learning from experience and aiming for the best results.

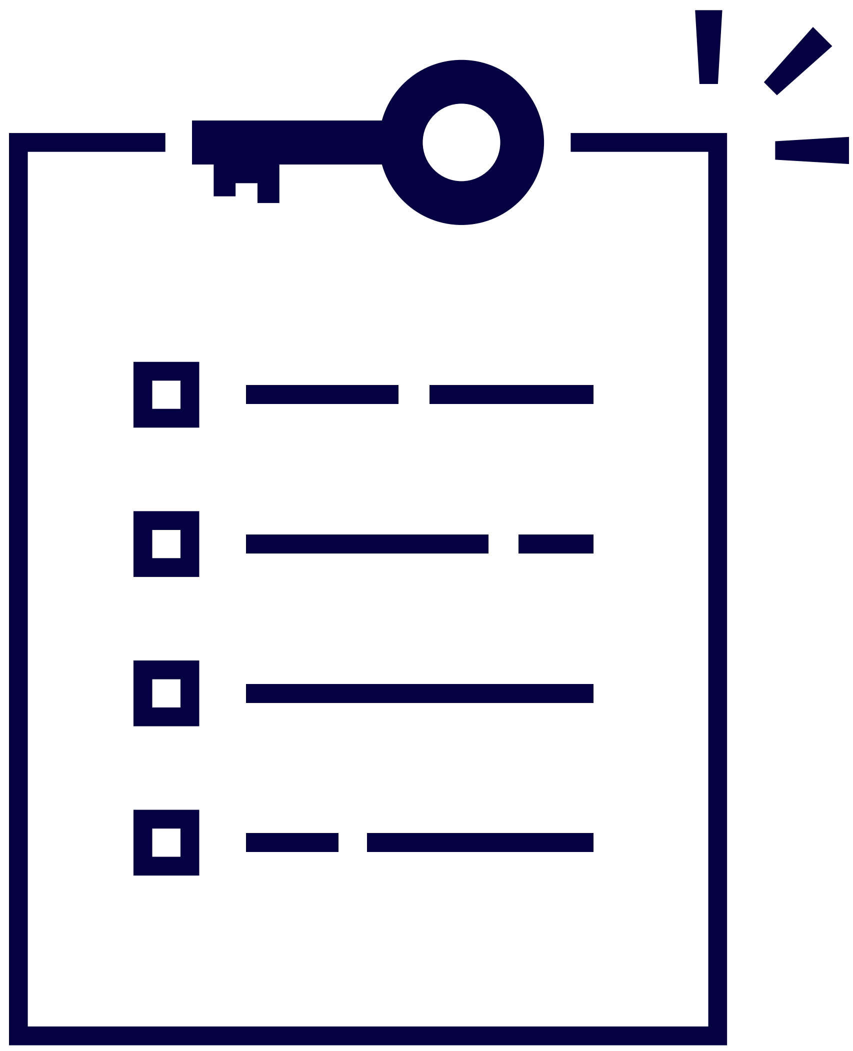


Isha Rani
Data & AI Leader
@isharanimicrosoftleader

Save for later

Main points in Reinforcement Learning :

- **Input :** This is where the model begins. It's like giving it a starting point.
- **Output :** There are lots of different answers to a problem. The model tries to find the best one.
- **Training :** The model learns by taking the input and giving an output. Then, the user says if it's good or bad, like giving it a gold star or a timeout.
- **Continual Learning :** The model doesn't stop learning. It keeps trying to get better.
- **Best Solution :** The one with the most gold stars wins. That's how the model decides which answer is the best.



Isha Rani
Data & AI Leader
@isharanimicrosoftleader

Save for later

Types of Feedback in Reinforcement Learning

There are mainly two types of reinforcement

- **Positive Reinforcement :**
    - Occurs when a good thing happens because of a behavior, making that behavior happen more often.
    - It boosts behavior positively.

Advantages :

- Maximizes Performance
- Sustains Change for a Long Time
- Too much can lead to too many options, which can make results less effective.

- **Negative Reinforcement :**
    - Happens when a behavior strengthens because something bad stops or gets avoided.
    - It's like stopping something bad from happening.

Advantages :

- Increases Behavior
- Sets a Minimum Standard of Performance
- Provides Just Enough to Meet the Minimum

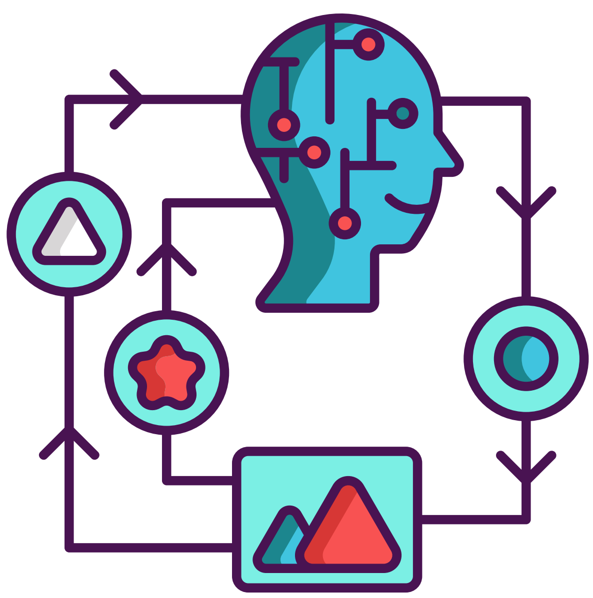

Isha Rani
Data & AI Leader
@isharanimicrosoftleader

Save for later

Elements of Reinforcement Learning

Reinforcement Learning elements are as follows :

- **Policy :**
  - -It's like a plan that the learning agent follows for a certain time.
  - - It tells the agent what actions to take depending on what it sees in the environment.
- **Reward Function :**
  - - This sets the goal for the learning process.
  - - It gives a score based on what's happening in the environment.
- **Value Function :**
  - - This tells us what's good in the long run.
  - - It calculates how much reward the agent can expect over time from a particular state.
- **Model of the Environment :**
  - - Models help with planning.
  - - They help the agent predict what will happen next in the environment.



Isha Rani
Data & AI Leader
@isharanimicrosoftleader

Save for later

Practical Applications of Reinforcement Learning

- It can be used in robotics for industrial automation.
- It can be used in machine learning and data processing.
- It can be used to create training systems that provide custom instruction and materials according to the requirement of students.

Other Applications of Reinforcement Learning

- **Robotics :** Pre-programmed robots work well in repetitive tasks like assembling cars.
- **Adaptive Controller :** Refinery controllers adjust settings while the refinery operates.

RL applies when :

- Environment is known but no clear solution.
- Only a simulation model is available.
- Interacting with the environment is the only way to learn.


Isha Rani
Data & AI Leader
@isharanimicrosoftleader

Save for later

Advantages of Reinforcement Learning

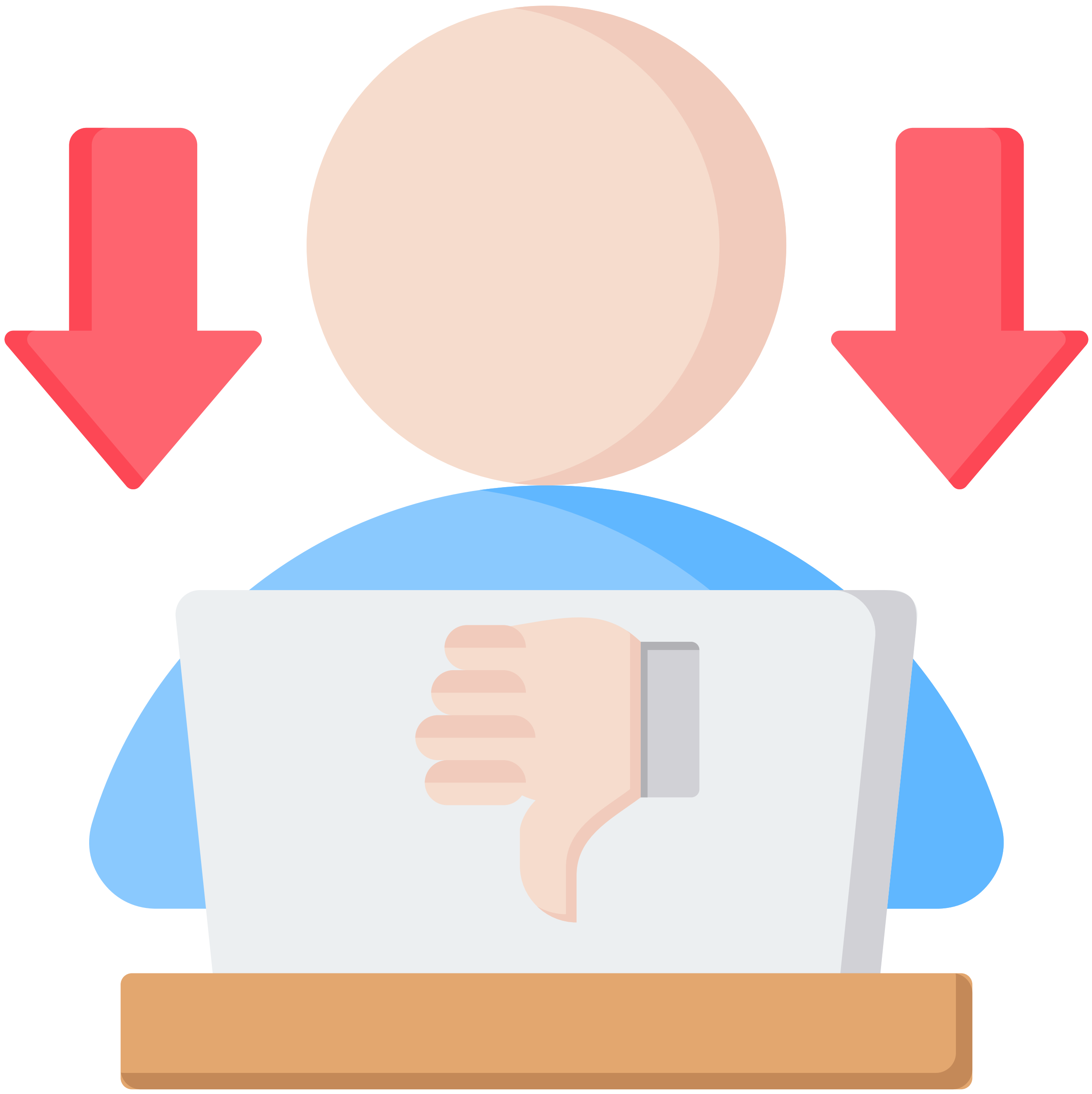
- Reinforcement learning tackles complex problems traditional methods can't handle.
- Models learn from mistakes made during training.
- Training data is gathered through direct interaction with the environment.
- It handles unpredictable environments, valuable for real-world applications.
- RL solves decision-making, control, and optimization problems.
- It's adaptable, working well with other techniques like deep learning to boost performance.


Isha Rani
Data & AI Leader
@isharanimicrosoftleader

Save for later

Disadvantages of Reinforcement Learning

- Reinforcement learning isn't the best choice for easy problems.
- It requires plenty of data and computing power.
- Success depends on a well-designed reward system.
- Debugging and understanding RL can be tricky since it's not always clear why the agent acts as it does.



Isha Rani
Data & AI Leader
@isharanimicrosoftleader

Save for later

Implementation Code

```
import gym
import numpy as np

# Define the Q-table and learning rate
q_table = np.zeros((state_size, action_size))
alpha = 0.8
gamma = 0.95

# Train the Q-Learning algorithm
for episode in range(num_episodes):
 state = env.reset()
 done = False
 while not done:
  # Choose an action
  action = np.argmax(
     q_table[state, :] + np.random.randn(1, action_size) * (1. /
(episode + 1)))

  # Take the action and observe the new state and reward
  next_state, reward, done, _ = env.step(action)

  # Update the Q-table
  q_table[state, action] = (1 - alpha) * q_table[state, action] + \
   alpha * (reward + gamma * np.max(q_table[next_state, :]))

  state = next_state

# Test the trained Q-Learning algorithm
state = env.reset()
done = False
while not done:
 # Choose an action
 action = np.argmax(q_table[state, :])

 # Take the action
 state, reward, done, _ = env.step(action)
 env.render()
```

Follow for more amazing content like this.